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ARTHROSCOPY
OF THE KNEE

H. R. Eikelaar
Casscells described arthroscopy as eminently suitable for the following purposes.

1. To diagnose lesions of the meniscus and cartilage, and to take a synovial biopsy specimen.
2. For a follow-up on patients after an earlier operation for osteochondritis dissecans or a synovectomy. After an interval of a few years the interior of the knee-joint can again be inspected without the need for any major operative intervention.
3. For assessment of cartilage changes at the undersurface of the patella and for the study of the relation between patella and patellar surface of the femoral condyles in various degrees of flexion of the knee-joint.

Arthroscopy was bound to give a correct diagnosis in 80% of cases. Casscells however, stressed that arthroscopy is not a method which obviates all other methods of investigation, but merely an aid which should be used in conjunction with other aids such as history, physical findings, radiological findings and particularly arthrograms.

In 1972 Jackson (Toronto, Canada) reported on 200 arthroscopic examinations in a carefully considered and elegant publication. He used the type 21 Watanabe arthroscope. Equipment and arthroscopic technique were discussed in detail. On the basis of his considerable research on the knee-joint, Jackson thought it justifiable to speak of the ‘problem knee’. In his view the value of arthroscopy is best indicated by three qualifying terms: ‘useful’, ‘very useful’ and ‘not useful’.

- He found arthroscopy ‘useful’ if:
  a. operative treatment could be avoided;
  b. a dubious preoperative diagnosis could be confirmed;
  c. a biopsy specimen could be taken;
  d. information of use in planning an operation was obtained.

- He deemed arthroscopy ‘very useful’ if:
  a. a totally different diagnosis could be established;
  b. it gave a correct diagnosis and prognosis which could not be established in any other way;
  c. treatment by means of the arthroscope was possible.

- Arthroscopy was described as ‘not useful’ if:
  a. it failed to supply additional information;
  b. misinterpretation led to errors in therapy;
  c. complications developed.

Arthroscopy was found to be ‘very useful’ in 20%, ‘useful’ in 55% and ‘not useful’ in 25% of 104 knee-joints examined arthroscopically and treated by operation. His study showed that the clinical diagnosis was the same as that made at arthroscopy and operation in only 68.5% of cases. The arthrographic diagnosis was confirmed at arthroscopy and operation in only 68.2% of cases.

Jackson reported that arthroscopy undoubtedly has its limitations. Not all intra-articular parts can be seen, specifically not the popliteal fossa and posteromedial and posterolateral meniscal attachments. It is difficult to view the anterior horns, retropatellar adipose body, ruptures of the collateral ligaments and of the posterior cruciate ligament. Changes in these structures can be observed with the aid of tilted X-rays and arthrography.

Jackson found hardly any contraindications to arthroscopy, but the examination is very difficult with an ankylosed knee. Serious complications were not observed; no infections developed in cases in which only arthroscopy was performed; thrombophlebitis occurred after arthroscopy in two cases, and pulmonary embolism developed in one case. There were occasional technical complications: a lamp broke in one case; a short circuit caused marked contractions of the quadriceps in another case. The patients involved were only temporarily inconvenienced.

Jackson formulated the following indications for arthroscopy.

1. Ill-defined pain as sole symptom in adolescents (usually female), in whom some local pathology can be (but usually is not) present.
2. Minimal or contradictory objective findings.
3. Persistance of complaints after earlier operation.
4. Knee lesions in professional athletes, for whom an early diagnosis is of economic importance.

5. Impossibility of taking a proper history, e.g. due to a language barrier.

6. Necessity of inspection of the interior of a knee-joint in order to make a prognosis.

7. Cases in which the sincerity of subjective complaints is doubtful, in which an exact diagnosis is of importance with a view to insurance or compensation.

- In other publications (1973, 1974) Jackson described the great value of arthroscopy in diagnosing abnormalities of the articular cartilage. Clinical examination revealed such abnormalities in only 13 out of 100 patients examined; arthroscopic examination disclosed such changes, in various degrees of severity, in 34 cases. Jackson's findings are the more interesting because they were illustrated with beautifully clear photographs.

- In 1973 O'Connor (Los Angeles, USA) reported on arthroscopy as diagnostic aid and therapeutic method in crystal-induced synovitis of the knee; in 1974 he described the use of the arthroscope in the management of acute lesions of ligaments of the knee. He too made use of the type 21 Watanabe arthroscope.

- In spite of the good results obtained with it, an instrument for endoscopy of body cavities with a light source which consists of a lamp mounted at the end of the instrument, has of necessity its limitations. Apart from the fact that difficulties can arise during examination, the effective light intensity is limited. Recent developments have made it possible to conduct light via glass fibres, thus increasing the light intensity. Ohnsorge (Cologne University Orthopaedic Clinic) in 1969 introduced an arthroscope in which the light was introduced into the cavity to be examined by means of glass fibres.

- In 1970 Wruhs (Vienna, Austria) reported on 19 arthroscopies with this instrument. With a specially adapted instrument he had also made photographs of the interior of the knee. He used air to enlarge the articular cavity of the knee.

- In many medical disciplines laparoscopy, bronchoscopy, gastroscopy, urethrosco py, cystoscopy, rhinoscopy, etc. have become indispensable diagnostic aids. In the past 80 years these instruments have shown numerous changes in diameter, light conduction and light intensity. The optical system, however, has remained virtually unchanged. Recently, however, Hopkins introduced a novel idea to improve optical performance (Ber ci and Kont 1969) by inverting the traditional optical system.

- It is now becoming increasingly understood that arthroscopy of the knee is an indispensable aid. At the international congress on the knee-joint held in Rotterdam in 1973, three papers were read on arthroscopy of the knee. Johnsson (USA) reported on his studies with the very slender Dyonic needle scope. Glinz and Henry described their investigations with an instrument which incorporated the Hopkins system and fibre glass illumination. Johnsson and Glinz examined a relatively small number of patients, but Henry presented a series of 300 cases. In the course of the period 1973-1974, publications on arthroscopy of the knee appeared in England (Gallannaugh et al. 1973; Edgar and Lowy 1973), Sweden (Alm 1974), and Switzerland (Henche 1973, 1974). Alm and Henche used an instrument with the Hopkins system and fibre glass illumination, but they examined a relatively small number of patients.

- Having initially used a type 21 Watanabe arthroscope, we have in Groningen made use since 1969 of an arthroscope with a traditional optical system and fibre glass illumination, and of an instrument with the Hopkins system and fibre glass illumination.
CHAPTER III.

THE ANATOMY OF THE KNEE-JOINT

The anatomy of the knee-joint (Von Lang und Wachsmuth 1972; Spalteholz 1953) will be discussed so far as it is important for arthroscopic interpretation.

The knee-joint is formed by the femur, tibia and patella. The two femoral condyles move over the two tibial condyles, and the patella follows these movements along a slide path. The soft tissues in and about the knee-joint ensure stabilization of the joint and restrain its movements. The distal end of the femur consists of the two femoral condyles. The articular surface of each condyle is spiral-shaped in sagittal section, the curvature of the condyle increasing from its anterior to its posterior aspect. The length of the radius of curvature always decreases in posterior direction. The two femoral condyles are not the same size throughout. In sagittal direction the lateral condyle is 1–2 cm shorter than the medial condyle. The latter is of nearly constant width in transverse section, but the lateral condyle slightly narrows down in posterior direction. The two condyles have a transverse curvature as well, the curvature of the medial condyle being slightly more marked. The lateral femoral condyle slightly protrudes in front of the medial condyle, which shows a somewhat more marked lateral curvature.

Fig. 1: Evolutes of the femoral condyles
The lines connecting the points indicate the evolutes.
Note the different lengths of the spiral radii.
(calculated by Dr. A. Hennig, Munich)
(von Lang und Wachsmuth)
The two condyles are separated by the intercondylar fossa. Both condyles are covered by a layer of cartilage of nearly constant thickness throughout, but thickest near the sagittal axis and slightly thinning laterally and medially.

The tibial plateau can be divided into a medial and a lateral half. These halves are separated by the intercondylar area in which the intercondylar eminence is found. The two tibial condyles are oval-shaped, with the longer axis in the sagittal plane.

The medial condyle is slightly longer than the lateral; it has a slightly concave shape, whereas the lateral condyle is a horizontal plane or shows a slight convexity. The cartilage covering the tibial condyles is 1-5 mm thick; it is thickest at the centre and becomes thinner towards the periphery.
The menisci are localized between the articular surfaces of the two femoral and two tibial condyles. They are semilunar in shape, and consist chiefly of fibrocartilaginous tissue and elastic fibres, most of which extend longitudinally. The lateral meniscus curves more markedly than the medial one. Due to this more marked curvature the anterior and the posterior horn of the lateral meniscus are closer together than those of the medial meniscus. The meniscus is wedge-shaped in transverse section. The part of the medial meniscus which articulates with the femoral condyle is concave, whereas the part which articulates with the tibial condyle is convex. The base of the medial meniscus, which connects with the joint capsule, has a thickness of 16-17 mm in the posterior horn area and tapers down towards the anterior horn to about 8-9 mm. The meniscus narrows down towards the articular cavity and ends in a sharp edge. The case of the lateral meniscus partly connects with the joint capsule. At the base, this meniscus is 11-13 mm thick throughout and encircles the intercondylar eminence like a ring. The lateral meniscus, too, narrows down towards the articular cavity.

It is mainly the lateral meniscus which may show abnormal shapes. Occasionally it may be a completely closed ring, but more often it is discoid, the halfmoon being more or less closed. These abnormalities are fairly rare in the medial meniscus, but are occasionally encountered. The outer one-third of the meniscus is vascularized from the capsule, while the inner two-thirds are nourished osmotically from the synovial fluid.

Medial meniscus

The anterior horn has fan-shaped connections with the medial aspect of the intercondylar fossa and the anterior aspect of the medial tibial condyle. The posterior horn becomes a transverse fibrous membrane which inserts on the tibia behind the medial intercondylar eminence, between the insertion of the posterior horn of the lateral meniscus and that of the posterior cruciate ligament. The anterior horns of the two menisci are usually connected by the transverse ligament of the knee. The infrapatellar synovial fold, otherwise known as mucosal ligament, extends from the intercondylar fossa to the alar fold, an adipose fold between the distal end of the patella and the proximal margins of the menisci. This can be regarded as a rudimentary septum of the knee. This structure comprises a branch of the middle genicular artery.

Lateral meniscus

The attachments of the anterior and posterior horn of the lateral meniscus lie close together. The posterior horn attaches by two slips to the medial and lateral tubercles of the intercondylar eminence. The anterior horn arises in the intercondylar fossa, immediately in front of the attachment of the posterior horn. Anteriorly and posteriorly the lateral meniscus is about 1 cm away from the margin of the lateral tibial condyle. The posterior horn of the lateral meniscus connects with the medial intercondylar fossa of the femur through Humphrey's ligament. This ligament attaches in front of the insertion of the posterior cruciate ligament. The convex posterior margin of the lateral meniscus also has a fibrous connection with the medial intercondylar fossa of the femur. This attaches behind the insertion of the posterior cruciate ligament (Wrisberg ligament).
Fig. 3a: Tibial condyles, menisci and cruciate ligaments from above. (von Lang und Wachsmuth).

Fig. 3b: Articular cavity of knee-joint with soft tissues. Patella in transverse section. (von Lang und Wachsmuth)
A slender, round tendon of the popliteal muscle extends past the lateral aspect of the lateral femoral epicondyle immediately distal to the attachment of the intra-articular collateral ligament, precisely behind the mid-portion of the lateral meniscus. The popliteal muscle originates from the popliteal fossa of the tibia.

The insertion of the popliteal muscle is a complex one. As already mentioned, the superficial part of the popliteal muscle inserts on the posterior convex curvature of the lateral meniscus. In a small number of cases the superficial fibres also continue in the tendon of the popliteal muscle. In the majority of cases, therefore, this part of the meniscus has no connection with the lateral femoral condyle. The deeper fibres of the popliteal muscle extend in the capsule to the lateral femoral condyle and there attach beneath the lateral ligament. Via the arcuate ligament, too, the popliteal muscle connects with the lateral meniscus. On the lateral side of the capsule of the knee-joint, the tendon of the popliteal muscle is firmly attached, and reinforced by the lateral bundle of the arcuate popliteal ligament. According to Last (1948, 1950) the popliteal muscle is enveloped in a pouch of which the lateral wall is made up of the fibrous capsule, while the medial wall is formed by the synovial membrane. Last therefore maintained that the tendon does not lie free in the articular cavity. During arthroscopy, however, the tendon of the popliteal muscle can be clearly seen to extend free through the articular cavity.

The mobility of the posterior horn of the lateral meniscus, therefore, depends on Humphrey’s ligament, Wrisberg’s ligament and the popliteal muscle.

The cruciate ligaments

The two cruciate ligaments extend from the tibial intercondylar area to the femoral intercondylar fossa. In their course they decussate lateromedially as well as anteroposteriorly. The anterior cruciate ligament arises from the anterior tibial intercondylar fossa and inserts on the inside of the lateral femoral condyle in the femoral intercondylar fossa. The posterior cruciate ligament arises from the posterior tibial intercondylar fossa and extends to the inside wall of the medial femoral condyle in the femoral intercondylar fossa.
The patella

- The patella is localized on the anterior side of the knee-joint at the level of the centre of the two femoral condyles. All fibres of the rectus femoris and the vastus intermedius muscle, and most of the fibres of the vastus medialis and the vastus lateralis muscle, continue in a tendon. The superficial fibres of this tendon extend through grooves over the anterior aspect of the patella, while the fibres of the stronger deep layer attach to the base of the patella. Distal to the patella the two layers of fibres form the patellar ligament which is about 5-6 cm long, 2-3 cm wide and 0.2 cm thick.

- This ligament encompasses the apex of the patella and radiates elastic fibres into the tibial tuberosities. The proximal one-third of the patellar ligament is separated from the articular cavity by the synovial membrane; the distal part is separated from the cavity by the tibia and the infrapatellar fatty body.

- The patella has a triangular shape and, in adults, is 4.5 cm in length as well as in width; its maximum thickness is about 2 - 2.5 cm. The anterior surface of the patella is slightly convex and shows longitudinal grooves as well as 5-7 large nutrient foramina. The large tendon of the quadriceps femoris muscle inserts on the proximal base. The fibres of the patellar ligament arise from the distal apex. The posterior surface of the patella has two oblique asymmetrical sides. The larger lateral side is slightly concave, and the smaller medial side is slightly convex. The patella can show numerous variations: the lateral as well as the medial articular surface can be very small, or
the medial articular surface can be divided into a proximal, middle, distal and medial surface, while
the lateral articular surface can be divided into a proximal, middle and distal surface. The patella can
consist of several bone fragments.

– Ficat (1970) made a very intensive study of the possible abnormalities in the shape of the
patella.

– During knee movements, the undersurface of the patella slides over the femoral patellar surface
as far as the beginning of the femoral intercondylar fossa. The patella can slide up and down over a
distance of some 6 cm. The femoral patellar surface is a groove which anteriorly connects the two
femoral condyles. There is never any contact with the tibia.

– The weight-bearing surfaces of the femoral condyles are separated from the femoral patellar
surface by a rounded edge. In the normal knee-joint there is congruence between the femoral
patellar surface and the shape of the articular surface on the underside of the patella. The slope of
the lateral portion of the femoral patellar surface is broader and steeper, and protrudes more than
the medial portion. Articulation is better on the lateral than on the medial side. The lateral force
exerted on the patella by the quadriceps femoris muscle therefore exceeds the medial force.

– In the extended knee-joint, the direction of traction in the patella is from proximomedial to
distolateral. In the maximally flexed knee, however, the direction of traction is from proximolateral to
distomedial. As the knee is extended and flexed, the patella is guided in the groove of the patellar
surface.

The joint capsule

– The joint is enclosed by an articular capsule. Its outer part consists of a fibrous membrane, while
its inner intra-articular part consists of synovial membrane. On the anterior side, the capsule
attaches about 2 cm above the femoral cartilage surface. The distance between the capsule
insertion and the cartilage surface on the posterior side is about 1 cm. In the region of the
intercondylar fossa the capsule turns in as far as the origin of the two cruciate ligaments. On the
tibia the reversal fold of the capsule is about 0.5 cm beneath the cartilage surface. At the
intercondylar eminence the capsule slightly turns into the joint on the anterior side. On the posterior
side of the joint the capsule follows the cartilage margin to a point just before the insertion of the
cruciate ligaments, which means that these insertions are localized extracapsularly. On the lateral
side the capsule extends almost as far as the articulation between tibia and fibular head. On the
medial side the reversal fold of the capsule is localized slightly higher. The two menisci are
connected with the capsule everywhere except at the site of the tendon of the popliteal muscle.

– Around the articular cavity there are a number of bursae which communicate with the articular
cavity. A few of these bursae can be examined with the arthroscope, and a knowledge of their
anatomy is therefore of importance.

The bursae

1. During flexion and extension of the knee-joint, the muscle fibres and the tendon of the
quadriceps femoris muscle are displaced in relation to the anterior distal part of the femur. Between
this tendon segment and the femur one usually finds the suprapatellar bursa, the proximal reversal
fold of which is very loosely connected with adjacent structures and rolls up and down with
movements of flexion or extension. This bursa, which has a very ample communication with the
articular cavity, is partly lined by synovial tissue. Only very rarely does this bursa not communicate
with the articular cavity. In some cases the bursa may extend above the proximal margin of the
patella over a distance of some 8 cm.

– The tripartite tendinous portion of the quadriceps femoris muscle, in which the patella is
embedded, continues into the knee-joint capsule. The synovial membrane is nearly everywhere
laced with subsynovial adipose tissue in which blood vessels, nerves and strands of connective
tissue are contained. At the patellar margin on either side of the two femoral condyles we find flat
fatty folds, with synovial tissue at the margins. These fatty folds are known as the adipose body of the knee.

- The fatty folds found between the distal end of the patella and the proximal margins of the menisci, are known as alar folds. These folds are pliable in response to movements of the knee-joint.

- The base of the adipose body is localized almost at the level of the tibial tuberosity and, as the adipose body increases in volume, extends via the anterior margins of the menisci and the interarticular space. The infrapatellar synovial fold has already been mentioned.

2. Another synovial bursa which communicates with the articular cavity is the subtendinous bursa of the medial head of the gastrocnemius muscle, localized between the medial femoral condyle and the gastrocnemius muscle. This bursa communicates with the articular cavity in some 50% of cases.

3. Between the medial head of the gastrocnemius muscle and the tendon of the semimembranous muscle lies the bursa of the semimembranous muscle, which can be fairly large and communicates with the articular cavity in 10-67% of cases. In the majority of cases, however, this bursa communicates with the bursa of the gastrocnemius muscle.

4. The tibiomembranous bursa is localized at the insertion of the semimembranous muscle on the tibia. This bursa often communicates with the lower part of the articular cavity.

5. Anatomy textbooks mention the anterior bursa of the popliteal muscle, which always communicates with the articular cavity. The lateral meniscus does not connect with the capsule where this crosses the tendon of the popliteal muscle. Even when the meniscus lies on the tibial plateau, there is at this site a communication between the meniscotibial and the femoromeniscal space. The popliteal muscle bursa can continue distal to the tibiofibular joint. In addition, a small bursa is localized between the dorsal aspect of the popliteal muscle and the lateral ligament. This bursa is called posterior bursa of the popliteal muscle, and usually communicates with the articular cavity.

Intra-articular compartments

- Both the lateral and the medial compartment of the knee-joint can be further divided into two subcompartments separated by the menisci, namely: the meniscotibial and the femoromeniscal space. At abduction and adduction, the menisci are slightly lifted off the tibial plateau. The division into a meniscotibial and a femoromeniscal space has functional significance also. Flexion in the knee takes place in the femoromeniscal space, whereas rotations take place in the meniscotibial space.
Fig. 5: Displacements of the menisci during movements in the knee-joint.

- a. Extension; final rotation $5^\circ$
- b. Maximum flexion (impression surfaces of femoral condyles: hatched areas)
- c. $90^\circ$ Flexion and $10^\circ$ endorotation
- d. $90^\circ$ Flexion and $42^\circ$ exorotation (von Lang und Wachsmuth)

Collateral ligaments

- Two other structures, although not intra-articular, are of importance because the movements of the knee-joint are dependent not only on the shape of the epiphyses but also on its ligaments.

- The collateral fibular ligament (lateral ligament) is a round, sharply defined, pencil-thick band which extends from the lateral femoral epicondyle to the head of the fibula. It is connected with the joint capsule only by loose tissue, is tensed at extension of the knee-joint and exorotation of the lower leg, and relaxed at flexion of the knee-joint and endorotation of the underleg.

- The collateral tibial ligament (medial ligament), on the other hand, is firmly connected with the fibrous membrane of the capsule and therefore also with the medial meniscus. It can be divided into a superficial and a deep part. The superficial part of the medial ligament extends from a point just behind the medial femoral epicondyle to the medial condyle of the tibia behind the insertion of the pes anserinus, 5–8 cm below the intra-articular space. The anterior part of these fibres takes a vertical course, while the posterior part extends obliquely. The oblique part of this superficial band continues into the deep part of the medial ligament, and so connects with the medial meniscus. For the deep part of the medial ligament extends from the medial femoral condyle to the medial aspect of the tibia, where it inserts immediately below the articular surface. This part of the ligament is firmly connected with the joint capsule, and therefore with the medial meniscus.

The anterior aspect of the knee-joint.

- Of all joints the knee-joint, or at least most of it, lies most immediately beneath the skin. The skin over the anterior part of the knee is innervated from the lumbar plexus (segments L3 and L4). The anterior cutaneous branches of the femoral nerve continue into the distal infrapatellar branch of the saphenous nerve which, in 70% of cases, extends through the sartorius muscle. The branches are
localized medially, the more important branches lying between the medial femoral condyle and the tibial tuberosity. The innervation on the lateral side is substantially less extensive, and this is of importance in selecting a site for insertion of the arthroscope.

Owing to its excentric position, the joint’s anterior and medial and lateral aspects are covered by skin rather than by muscles. This is also due to the fact that the extensor apparatus fans out in the joint capsule. This anatomy makes it readily possible to inspect the joint and palpate it. Deeper structures such as the cruciate ligaments, the menisci and the posterior side of the joint, however, can be examined only with technical aids.

Partly because of its anatomy the knee-joint, and particularly the patella, is readily injured in accidents. The normal features of the knee-joint depend on sex, muscular development and age. The anatomical constellation simplifies intra-articular inspection on the anterior side: the larger blood vessels and nerves, and most of the muscles and tendons are localized on the posterior side. Only the great saphenous vein and the subcutaneous saphenous nerve are localized on the medial side of the anterior aspect.

The knee-joint also differs from other joints in the human body in that its movements have no skeletal limitations: stabilization of the knee and limitation of its movements are ensured by the soft tissues in and around the knee-joint. Possible movement in the knee-joint are flexion, extension and rotation on the longitudinal axis of the leg. These rotatory movements are always possible, except when the knee-joint is in full extension or flexion. The knee can be extended until the weight-bearing lines of leg and thigh are in line. As a rule, however, the longitudinal axis of the femur lies about 6° behind the weight-bearing line. Hyperextension of the knee-joint is generally impossible. From the extended position, the knee can be flexed about 160°. Flexion of the knee is not a hinging movement, but a complex movement involving rolling and sliding.

The rolling movement is a result of the incongruence of the two articular surfaces and the relatively large insertion of the muscles on the interarticular space. The ligaments prevent flexion from being purely a hinging movement. Studies by Lengenhager (Brantigam and Voskell 1941, 1943) have shown that the anterior cruciate ligament assists in controlling extension and endorotation. It was also found that the anterior cruciate ligament can be severed with causing a so-called drawer phenomenon. Lengenhager demonstrated that an anterior drawer phenomenon is caused by a lesion of the medial ligament. The posterior cruciate ligament is maximally tensed in knee flexion, and in that case limits not only flexion but also endorotation. A marked posterior drawer phenomenon occurs when the posterior cruciate ligament is severed.

The medial ligament relaxes when the knee is in marked flexion. As described earlier, the medial ligament consists of a superficial and a deep part. The deep part controls abduction of the knee-joint. The superficial part, which is fan-shaped, controls in particular the anterior displacement of the tibia. Exorotation is also limited by this ligament. A lesion of the medial ligament therefore causes instability of the knee: there is increased abduction, a positive anterior drawer phenomenon, and increased exorotation. The increased abduction, however, can be prevented by marked contraction of the sartorius, the semitendinosus and the gracilis muscle.

The lateral ligament is relaxed in knee flexion without rotation. The two menisci ensure exact adaptation of the articular surfaces of femur and tibia. Without menisci, however, it is still possible to flex, extend and rotate the knee-joint.

Many functions have been attributed to the menisci:

1. The wedge shape of the menisci deepens the articular cavity, and the asymmetry of the condylar curvatures is neutralized by changes in the position of the menisci.
2. The menisci can support the femoral condyles.
3. The menisci ensure limitation of extension.
4. The menisci function as shock absorber because their elasticity ensures some resilience to jolts.
5. The menisci can prevent incarceration of the capsule.
6. The menisci enhance the stability of the knee-joint.
7. The menisci improve the sliding function of the knee-joint (Kingma).
Apart from flexion and extension, the knee-joint is also capable of rotatory movements. With the knee flexed, lateral movements are possible to a limited extent. With the knee in extension the ligaments are so tensed that lateral movement is no longer possible. The menisci move anteriorly in extension, and posteriorly in flexion of the knee, the lateral meniscus moving a longer distance than the medial meniscus. Flexion and extension take place in the femoromeniscal space of the joint. Exorotation of the tibia occurs during the final 15-20° extension of the knee. This rotatory movement takes place in the meniscotibial space of the joint. The meniscus is not displaced in relation to the femoral condyles but follows their movements (Kingma). The meniscus is slightly deformed in this rotation.

At extension of the knee-joint the meniscus becomes longer and narrower. The mobility of the lateral meniscus exceeds that of the medial meniscus, due to the type of insertion. The insertion points of the lateral meniscus are closer together than those of the medial meniscus. Moreover, the connection of the lateral meniscus with the joint capsule is partly interrupted by the tendon of the popliteal muscle. Due to its attachment to the arcuate ligament on the posterior horn of the lateral meniscus, the popliteal muscle pulls the posterior segment of the lateral meniscus back.

Together with the ligaments of Wrisberg and Humphrey, this muscle also regulates the movements of the lateral meniscus and prevents it from sliding too far beyond the posterior margin of the tibia (Last 1948).

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Corpus femoris
Ligamentum collaterale fibulare
Epicondylus lateralis
Tendo m. poplitei
Bursa m. poplitei
Capitulum fibulae

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tendo m. quadriceps femoris
Bursa suprapatellaris
Cavum articulare
Patella
Bursa praepatellaris subcutanea
Meniscus lateralis
Ligamentum patellae
Bursa infrapatellaris profunda
Tuberositas tibiae
Corpus tibiae

Fig. 6: The right knee-joint with its bursae. Lateral view (Spalteholz).
CHAPTER IV.

EQUIPMENT

Instruments, photography, sterilization

- An endoscopic instrument in general, and an endoscope for inspection of the knee-joint in particular, must meet very strict requirements in view of the special anatomical situation. The following features of an endoscopic instrument are important.

1. Direction of view and angle of view
   - The term direction of view refers to the angle between the direction in which the investigator looks and the longitudinal axis of the endoscope. This is expressed in degrees of angle. The angle of view is the angle between the lines drawn from two points localized in the same plane (perpendicular to the optical axis) and the second nodal point of the lens (Weber 1967).

2. Depth of focus
   - The term depth of focus indicates the range within which all objects are seen in sufficiently sharp focus (Weber 1967).

3. Relative aperture
   - The relative aperture is the ratio between the effective aperture and focal length. Generally speaking, loss of light is very high in scopes of small diameter.

4. Instrument diameter
   - The total diameter of the scope plays an important role, and largely determines the total diameter of the instrument. Optical possibilities have been expanded by making use of thin glass fibres. Light conduction via glass fibres can be arranged in two different ways:
     a. with glass fibres incorporated in the shaft;
     b. with glass fibres incorporated in or arranged directly around the optical system.

5. Resolving power
   - This is the ability of an optical system to form distinguishable images of details lying very close together. The resolving power can be increased by bringing the scope closer to the object. With an endoscope, this is dependent on the quality of the optical system.

6. Illumination
   - Fibre glass illumination has unmistakable advantages over illumination with a lamp. It determines the diameter of the instrument. A lamp system is vulnerable: the lamp can fuse and there may be some failure in the wiring system.

7. Possibility of making photographs
   - Photographic aspects will be discussed on page 28.

- Numerous instruments have been used for arthroscopy in the past, but all proved to be in need of improvement.

The type 21 Watanabe arthroscope

- Three different instruments have been tested in our clinic. In 1969 we started with the type 21 Watanabe arthroscope, which Watanabe had especially designed and constructed for endoscopy of the knee. The instrument consists of an optical system of several lenses, contained in an inflexible tube with a diameter of 4.9 mm and a length of 16.5 cm. The angle of view is 100°. The depth of focus is from 1 mm to nearly 0. The light source is a Wolfram lamp mounted at the end of the instrument beside the lens, without obstructing view. Lamp holder and scope can both be introduced into a shaft with a diameter of 5.9 mm. Leaving sufficient room in the shaft for irrigation fluid, which can wash the scope lamp. In addition to a scope with a direction of view of 0° there is one with a direction of view of 90°. We have not used the latter, which will therefore be left undiscussed.

- The optical system of the type 21 Watanabe arthroscope with a direction of view of 0° gives a
magnification of 10 × at a distance of 1 mm and 2 × at a distance of 1 cm; a true-sized image is obtained at a distance of 2 cm.

- Photographs can be made through the arthroscope. During arthroscopic examination a 6 V lamp supplies light. Photography is made possible by a synchronized contact on the camera, connected with the transformer, by which the 6 V lamp can be given 15 V overvoltage. This amount of light is sufficient to obtain colour slides.

- These slides can be obtained with the aid of a 35 mm halfminiature mirror reflex camera no. 2 Olympus Pen F, with a special attachment for the eyepiece of the instrument. The film we used was Kodak Ektachrome type B (125 ASA). The shutter time was 1/30 second.

- Although the optical system of the Watanabe arthroscope is excellent, a number of limitations came to the fore. When we started using this instrument we observed gas bubbles at the end of the scope, caused by the heat from the lamp. The gas bubbles formed because irrigation during examination was insufficient. The wiring system of the illumination was vulnerable. We had occasional failures due to oxidation of contact points or fusion in the lamp. The diameter of the instrument limited intra-articular movements, and on one occasion our manipulations caused the lamp to break off within the joint (cf. illus. 140).

- Apart from the technical imperfections of the instrument, there were other limitations. It was impossible accurately to examine the popliteal fossa, nor were the posteromedial and posterolateral connections of the menisci visible. In a large number of cases the posterior horn of the medial meniscus could not be examined, although the posterior horn of the lateral meniscus was clearly visible. With an intact anterior cruciate ligament, the posterior cruciate ligament could never be examined. The anterior horns of both menisci and the retropatellar fatty body were not clearly visible in many cases.

- The optical system of the type 21 Watanabe arthroscope misted up after a certain period of use. This was probably due to the method of sterilization. It is also possible that water vapour had entered the optical system. In any case, we had to return the optical system to the manufacturer for repair on many occasions, and often it was several months before the repaired instrument was available again. It was therefore not only the limitations of the instrument but also the recurrent necessity of time-consuming repairs that made us look for another instrument.

- As successor to the type 21 Watanabe arthroscope we selected an instrument evolved by the firm of R. Wolf, Knittlingen, FRG, and described by Ohnsorge and Wruhs (1969, 1970). Watanabe recently introduced his type 22 arthroscope, which makes use of cold light by means of glass fibres (annual meeting AAOS, held in Las Vegas, USA, in 1973).

**The Wolf arthroscope**

- The optical system of the Wolf arthroscope (Merle et al. 1974; personal communications Wolf Cy) consists of a Lumina cold light optical system with a diameter of 3 mm, which is surrounded by glass fibres. System and fibres are accommodated in a single tube. There is one system with a direction of view of 0°, and another with a direction of view of 70°. The angle of view is 60°. The shaft, which has a system of taps for introducing fluid or gas into the joint, has a length of 94 mm and a diameter of 4 mm. The equipment also includes a sharp and a blunt trocar, a length of flexible fibre glass tubing and a light projector.

- The light source is the light projector 4000 (R. Wolf, Knittlingen, FRG), which provides an illumination of 80,000 - 100,000 lux. Light conduction from projector to instrument takes place via the flexible fibre glass tubing.

- Wruhs filled the joint with air before inserting the instrument. We prefer to inspect the joint under constant irrigation with physiological saline, and consequently had to make some minor modifications on the shaft of the instrument.

- The Wolf arthroscope has some considerable advantages:
1) it differs from the type 21 Watanabe arthroscope in that no heat develops at the end of the optical system;
2) the amount of light introduced into the joint through the instrument is substantially larger than that provided by a Wolfram lamp (moreover, we were no longer bothered by failures at inconvenient moments);
3) the relatively small diameter of the instrument permits more extensive manipulations.

- The Wolf arthroscope revealed more of the menisci than the type 21 Watanabe instrument, but in actual use we nevertheless encountered some serious disadvantages. Of course the efficiency of an arthroscope is not solely determined by its suitability as an aid in diagnosing meniscal lesions. One of the requirements to be met by an effective and manageable arthroscope is that it can be used to examine abnormalities of the articular cartilage.

- Owing to the relatively small angle of view (60°), orientation within the knee-joint was exceedingly difficult, and necessitated excessive manipulations with the instrument. Due to these manipulations the highly movable corpora libera in the knee-joint were often overlooked because they had been moved out of the field of vision. And interpretation of abnormalities of articular cartilage was greatly impeded by the small angle of view.

- It was not possible to obtain adequate photographic documentation with this instrument. Wruhs (1970) used a specially designed scope for photography of the interior of the knee-joint. We tried to make photographs through the scope used in examination but, like Wruhs, we found it difficult to obtain good photographs.

- In collaboration with Messrs Martens, Huiser and Hersevoort of the Medical Photography Department of the University of Groningen, we tried to find a satisfactory solution of the photographic problem by means of experimental arrangements.

- We used the endoscopic half-miniature mirror reflex camera no. 2 Olympus Pen F, to which the 70 mm Riwo lens (Wolf) was attached by means of a special attachment device. To introduce the maximum amount of light into the joint, we used the no. 5004 electronic flashgun (Wolf). Moreover, we used films of different sensitivity with shutter times from 1 to 1/30 second.

- With the available equipment, however, we did no succeed in obtaining adequate photographic documentation of the findings in the interior of the knee-joint. There was insufficient overview, and the prints obtained were too dark and blurred.

- Yet it is logical that one attempt to record a visual observation in a photograph, which provides a lasting document.

- The making of a diagnosis during arthroscopic examination is based on what the investigator observes and on his interpretation of what he observes. His experience plays an important role in this respect. For several reasons it is of importance to record the visual observations. Especially with a view to instruction and information of colleagues, who take part in interpreting the findings, it is of great importance to obtain a record which can be reproduced as desired at any given time. When observations are recorded on colour slides, subsequent study of even tiny details is possible. A good colour slide, therefore, is indubitably more valuable than even the most detailed description.

- In view of the limitations of the type 21 Watanabe arthroscope and the limitations encountered in actual practice when attempting to obtain photographs with the Wolf arthroscope, we looked around again. From the numerous available optical systems with fibre glass illumination, we selected a scope with a Hopkins optical system, manufactured by the firm of Storz in Tuttingen, FRG. The instrument of course had to be suitable for arthroscopy of the knee-joint and had to meet certain very strict requirements in terms of angle of view, direction of view, relative aperture, diameter, depth of focus, resolving power, illumination and photographic possibilities.

The Storz-Hopkins arthroscope

- The Hopkins optical system of the Storz-Hopkins arthroscope (personal communications Storz
Cy 1970-1974; Berci et al. 1973) consists of a number of glass rods with polished ends, separated from each other by a small air-filled space which serves as lens. The excellent image quality ensured by this system contributes much to accurate diagnosis.

- Traditionally, the optical system of a telescope consists of a number of glass lenses, separated by air-filled spaces.

![Diagram of traditional optical system](image1)

Fig. 1: A. Traditional optical system  
B. Hopkins optical system

- The Hopkins optical system, designed for bronchoscopy in children, was adapted to arthroscopic requirements. The optical system is inflexible and has a diameter of 4 mm. The shaft with its system of taps has a diameter of 5 mm. Two different instruments were used: one with a direction of view of 0° and the other with a direction of view of 30° (foroblque). The angle of view is about 100°. (in air).

![Diagram of Hopkins optical system](image2)

Fig. 2: Relationship between object distance and field of view (size of object) for Hopkins-Storz foroblque telescope.

- The graph shows the size of the object which can be observed at various distances from the lens. The depth of focus ranges from 1 mm to nearly infinity. At a distance of 5 cm from the lens end, two points which are 0.4 mm apart can still be separately observed.
- We prefer the instrument with a direction of view of 30°, because anything in line with the longitudinal axis of the instrument can still be observed.

![Diagram](image)

**Fig. 3: Storz-Hopkins scope - for oblique**

A. field of vision  
B. direction of view

- A very large area can be surveyed by rotating the instrument on its own axis, without any need for extreme manipulation. Use is made also of an optical biopsy forceps (Carlens type); its telescope has a direction of view of 0° and a diameter of 2.7 mm.

- An external light source is used, the light being introduced into the scope via a length of flexible fibre glass tubing. The light source for fibre glass illumination was manufactured by the American Cystoscope Makers Inc., New York. The light strength is adjustable, and this is of importance in particular in examining cartilage. In the case of over-illumination, small defects can be overlooked due to the whiteness of the cartilage.

**Photography with the Storz-Hopkins arthroscope**

- One of the factors determining the high degree of accuracy in radiological diagnosis is the availability of radiographs. The advantages of a radiograph are:
  1) it can be studied as long and as often as desired;
  2) comparison with subsequent findings is possible.

- By adding a few radiographs to a patient's case history, a great contribution can be made to a correct diagnosis.

- If photographs are to be made of the interior of the knee-joint during arthroscopic examination, the following requirements must be met:
  1) the investigator should be in full technical command of his instrument and able to manipulate it properly;
  2) the examination should be fairly brief, and not prolonged unreasonably;
  3) any increased risk for the patient should be avoided;
  4) this particular form of documentation should be simple.

- We make use of two light sources:

  1. For visual observation, the ACMI light projector, connected with the scope by a length of flexible fibre glass tubing. The light required for examination shines through flash tube and scope, and constantly illuminates the interior of the knee-joint.
2. For photography, the Storz flashgun. The flash tube is attached to the scope and powered by an aggregate with an adjustable output of maximally 500 W/sec. The direct attachment of the flash tube to the scope minimizes the loss of light (unlike the situation in the Wolf system, in which the flash is conducted through the flexible fibre glass tubing.

- Photographic exposures are made with a 35 mm half-miniature (18 × 24 mm) mirror reflex camera no. 2 Olympus Pen F, fitted with a RIWO lens (Wolf) with a focal distance of 70 mm and adjustable frame. This combination is mounted on the scope by means of a special fitting-ring. Image selection and focusing are done through the camera viewer. Camera and flashgun are connected by a synchronized cable which activates the flash during exposures. The shutter time is 1/30 second. The light yield of the flashgun is adjusted according to the object to be photographed (over-exposure can otherwise easily occur in photographing the ivory-coloured cartilage). The best photographs are obtained through a scope with a direction of view of 30°. The flash is produced in the longitudinal axis of the scope; this ensures diffuse illumination of sufficient intensity of the area to be photographed, and visibility of all cartilage details.

- For colour slides we use AGFAchrome Professional reversal film, daylight type, sensitivity 50 ASA. A new film is used for each patient.

Sterilization

- Only the scopes of the type 21 Watanabe, Wolf and Storz-Hopkins arthroscopes were sterilized in ethylene oxide. Shaft and obturators were autoclaved, because this is quicker than gas sterilization. This form of sterilization was chosen in order to prevent damage, although the Storz-Hopkins scope can be sterilized in the autoclave if necessary. Gas sterilization is sufficient to destroy all bacteria and spores.

- The instruments were packed in perforated aluminium boxes. After sterilization in ethylene oxide, the instruments were vented during a 24-hour period in order to prevent a possible irritant effect of the ethylene oxide on tissues.

- After ethylene oxide sterilization of the Watanabe and the Wolf arthroscope, we encountered difficulties in that the optical system misted up. This was probably caused by condensation of water vapour in the air-filled spaces contained in the optical system. With the Storz-Hopkins arthroscope these complications did not occur.

- The camera with film was not sterilized in ethylene oxide. Before using it to photograph the interior of the knee-joint, we wrapped the camera in sterile towels.
CHAPTER V.

TECHNIQUE OF ARTHROSCOPY

- This chapter discusses the technique of arthroscopy of the knee with the aid of the Storz arthroscope with Hopkins optical system, with a diameter of 4 mm, a direction of view of 30° and a shaft diameter of 5 mm. With this instrument, arthroscopy is a simple procedure which ensures an optimal view of the interior of the knee-joint without any untoward effect on the joint. The instrument itself and its sterilization have been discussed in detail in chapter IV.

Anaesthesia
- All patients are examined under general anaesthesia. We prefer general anaesthesia in order to achieve adequate muscle relaxation, which makes it possible to apply varus and valgus stress during the examination without inconveniencing the patient. The same conditions could be created in an examination under lumbar anaesthesia, but we have not used this method. Local anaesthesia is sufficient for a simple examination such as inspection of the synovial membrane in the suprapatellar space. In such cases only the skin at the site of insertion of the instrument is anaesthetized, and the knee-joint is filled with about 50 ml physiological saline which contains some 10 ml 2% lidocaine. (person communic R.W. Jackson, S.W. Casscells, R.L.O'Connor). We have never examined a knee-joint under local anaesthesia because we have not wanted to confine our examination to the synovial membrane.

1. Pre-arthroscopic examination
- The patient is supine throughout the examination. Since certain symptoms cannot be provoked during a clinical physical examination, the knee-joint should be examined immediately after anaesthetizing the patient, when pain and muscle defence have been abolished. Features to be studied are:

1) mobility, particularly the presence of limitation of extension as a result of incarceration;
2) lateral, rotatory and anteroposterior mobility (drawer phenomenon);
3) lateral mobility of the patella;
4) the typical symptoms indicating meniscal lesion

2. Application of a tourniquet
- A pneumatic tourniquet is applied to the thigh, usually before sterile draping, but not inflated. We take this precaution to ensure that, if haemorrhage occurs during arthroscopic examination, the tourniquet can be inflated and the knee-joint examined under ischaemia. In no case has it been necessary to inflate the tourniquet. Even in the case of haemarthrosis the interior of the knee-joint can be inspected, thanks to a wellfunctioning system of irrigation.

3. Sterile draping
- The leg is painted with iodine from halfway the thigh down to the ankle, and sterile draping is done in the conventional way. The lower leg is wrapped in a sterile tricot bandage, taking care to keep the bulk of the draped lower leg as small as possible because the investigator's face comes very close to the leg during the examination.

- A linen-wrapped sheet of plastic is placed beneath the leg to prevent the table from being drenched with fluid from the intra-articular space as a result of irrigation. To avoid infections, the investigator wears a sterile mask

4. Arthroscopic examination
- The knee-joint is punctured on the lateral side at the level of the upper pole of the patella (needle: 19 Gauge). The point of the needle must be aimed at the patellofemoral joint to ascertain an intra-articular position. Such fluid as may be encountered in the knee is drained off for examination. Through the needle, the knee-joint is then filled with 75-100 ml physiological saline at room temperature. It should be ascertained that the fluid is indeed introduced intra-articularly rather than into the subsynovial space (this would reduce rather than enlarge the intra-articular space). The needle remains in situ during the examination, and the irrigation fluid can drain from the knee-joint through a length of tubing attached to the needle.
An adequate system of irrigation is indispensable. The irrigation fluid of choice is a physiological saline solution at a temperature of about 25°C. A solution which is too warm causes hyperaemia of the synovial membrane, which may distort its features. When the solution is too cold, the synovial membrane becomes pale. This pallor is also observed when the intra-articular pressure in the knee is raised too high. In that case the small vessels in the synovial villi are no longer visible, and this can easily lead to misinterpretations.

The purpose of irrigation is to enlarge the intra-articular space and wash out minor haemorrhages. To ensure an adequate flow of the physiological saline in the knee, the flask with the solution must usually be suspended about 1.5 m above the knee. In some cases a balloon must be attached to introduce the fluid into the knee-joint under some slight positive pressure. Without adequate irrigation, minor haemorrhages can cause considerable confusion. Given adequate irrigation, it is unnecessary to inflate the tourniquet.

The site of choice for insertion of the arthroscope is the anterior aspect of the joint, immediately medial or lateral to the patellar ligament. We always use the lateral approach, via which not only the medial but also the lateral compartment of the joint can be inspected without difficulty.

The knee-joint is flexed about 60°, and the thumb is used to palpate the anterior aspect of the tibial margin and the lateral aspect of the patellar ligament. The thumb is firmly pressed into the angle formed by the lateral tibial margin and the lateral aspect of the patellar ligament, taking care to avoid upward or downward displacement of the overlying skin. Immediately above the nail of the thumb, a transverse skin incision of about 6 mm is made. This procedure was chosen to ensure that the instrument can be introduced above the anterior attachment of the meniscus.

With a slight rotating movement, the shaft with sharp trocar is introduced through the incision; the shaft should virtually parallel the tibial plateau and the trocar point should be aimed between the two condyles. The sharp trocar is then replaced by a blunt one, whereupon the knee-joint is slowly extended and the instrument carefully passed into the suprapatellar recess between the patella and the groove of the femoral condyles. When the tip of the shaft is lying in the suprapatellar recess, the arthroscope is inserted. Next, the fibre glass tubing is connected with the arthroscope and the irrigation system with the shaft.

The suprapatellar space can be inspected by lightly moving the arthroscope up and down and rotating it on its axis. The patellofemoral joint is examined by carefully retracting the instrument until the patella becomes visible in the upper part of the field of vision. The direction of view of 30° makes it possible to examine the entire undersurface of the patella and the patellar surface of both femoral condyles. During this examination the patella can be manually moved down, laterally or medially. Mild forms of chondropathy are readily visible because cartilage shreds float in the physiological saline solution and are slightly moved to and from as a result of the constant irrigation.

There is always a risk of errors in estimating the true size of certain changes, but this risk is particularly grave with cartilage shreds. The distance between object and lens determines the precision of the estimate, and this is why it is necessary constantly to move the instrument up and down.

The suprapatellar space and femoropatellar joint should be examined with the knee-joint in extension. The knee cannot be flexed when the instrument lies between patella and femoral condyles. Once the instrument is sufficiently far retracted, the knee-joint can be flexed, and a good impression can be gained of the congruence of the femoropatellar joint. After examination of the femoropatellar joint, the instrument is moved past the medial femoral condyle to the medial compartment of the joint. With the knee extended, the anterior horn of the medial as well as that of the lateral meniscus is clearly visible.

The leg is then moved over the edge of the table, with the dangling leg in 20-90° flexion. The course of the internal margin of the meniscus can now be identified. The cartilage of the medial femoral condyle, the tibial plateau and anterior horn, the mid-portion of the meniscus and part of the posterior horn are clearly visible. For a better view of the posterior horn of the medial meniscus, valgus stress must be applied while at the same time the knee-joint is kept in 20° flexion.
It is always possible to observe the attachment of the medial posterior horn and the course of the internal margin of the posterior horn. In younger individuals, a larger part of the posterior horn of the medial meniscus is usually visible than in older patients.

The posterolateral part of the attachment of the posterior horn cannot be seen with the techniques so far developed. This means that any abnormalities in this area cannot be observed, and this is unfortunate because lesions at this site are quite common. However, the course of the internal edge of the internal meniscal margin and the secondary changes in the articular cartilage of the medial femoral condyle warrant certain conclusions with regard to pathological changes in this area.

In view of the great importance of meniscal lesions in the overall context of the pathology of the knee-joint, and the errors which can be made in the diagnosis and treatment of these lesions, we were disappointed to find that it was long impossible to inspect the meniscus in its totality; not even arthroscopy made this possible.

In this context we have evolved a concept which is as simple as it is useful. With the aid of a needle (19 gauge) inserted into the intra-articular space under direct visual control, it is possible by simple manipulations slightly to lift the meniscus, thus bringing changes of the tibial part of the meniscus into view. The same needle can be used to manipulate the posterior horn in order to bring any possible pathology into view.

We chose this method because the needle can be manipulated under constant visual control, so that injuries to the meniscus and the articular cartilage can be avoided.

The posterior compartment of the intercondylar fossa can be inspected by introducing the instrument into this region past the attachment of the posterior horn of the meniscus. The arthroscope is retracted, and the anterior cruciate ligament can then be readily seen in the intracondylar space. However, the anterior cruciate ligament should not be confused with the mucous ligament (synovial fold) just in front of it. So far, however, we have not succeeded in obtaining a good view of the posterior cruciate ligament while the anterior cruciate ligament is intact. The above-mentioned structures in the articular compartment can hardly be seen, if at all, in cases of marked hypertrophic synovitis. To our surprise, we have never been inconvenienced by Hoffa's body in these examinations.

The lateral approach used for inspection of the medial compartment of the knee-joint, can also be used to examine the lateral compartment. The end of the arthroscope is introduced into the anterior part of the intracondylar space. The foot is then placed on the table and the knee flexed 30-60°. With mild pressure on the medial part of the joint, varus stress is applied which causes the joint to open on the lateral side. The end of the arthroscope can then be introduced into the lateral compartment.

A good impression can then be obtained of the cartilage of the femoral condyle and the tibial plateau, as well as of the entire lateral meniscus and the intra-articular part of the tendon of the popliteal muscle.

Although we have opted for the lateral approach, the posterior horn of the lateral meniscus is generally viewed more readily and better than that of the medial meniscus. In no case have we found it necessary, using the Storz-Hopkins 30° arthroscope, to use the medial approach in order to obtain a better view into the lateral compartment of the knee-joint.

We must emphasize the necessity of avoiding overinterpretation of findings. The arthroscope should be lightly moved over very small distances to enable the investigator to make a proper estimate of the true distance from and the true size of the objects observed. All arthroscopically visible parts of the interior of the knee-joint can be photographed.

Although arthroscopy is mainly a diagnostic aid, its possibilities give it therapeutic importance also.

1. The arthroscope can be used to take a synovial biopsy specimen, either blindly or under direct visual control.
2. Small corpora libera or foreign bodies can be removed via the arthroscope.
3. Cartilage debris can be washed out of the joint.

- After completion of the inspection the knee-joint is again irrigated and emptied. For this purpose the knee is extended and the tip of the shaft is introduced into the suprapatellar recess, whereupon the scope is removed from the shaft. After irrigation the shaft is slowly retracted while the suprapatellar recess is being compressed in order to ensure optimal removal of fluid from the knee. The incision is then closed with a single suture. The arthroscopy is often followed by an arthrotomy.

- A patient submitted only to arthroscopy is allowed to stand and walk after about 24 hours. The suture is removed after one week. Patients submitted exclusively to arthroscopy experience hardly any inconvenience as a result. In a number of cases subjective symptoms were considerably reduced even though only arthroscopy had been carried out.
CHAPTER VI.

NORMAL ARTHROSCOPIC FEATURES

This chapter discusses the arthroscopic features observed in the normal knee-joint, of which the following parts can be directly observed (but of course not without instrument manipulation).

1. The suprapatellar recess
2. The entire undersurface of the patella
3. The patellar surface of both femoral condyles
4. The cartilage surface of both femoral condyles (except for the extreme posterior parts)
5. The cartilage on the tibial plateau, including the part concealed beneath the menisci
6. The femoromeniscal as well as the tibiomeniscal surface of the menisci
7. Both menisci, and attachments of anterior and posterior horn
8. The posterior intercondylar fossa
9. The anterior cruciate ligament
10. The mucous ligament (synovial fold)

All these parts of the knee-joint can be viewed with the 30° Storz-Hopkins arthroscope, diameter 4 mm, introduced anterolaterally. The manner in which the various structures can be viewed has already been discussed in chapter V.

A number of structures, however, cannot be observed; this applies in particular to the posterolateral part of both menisci and the posterior cruciate ligament.

The synovial membrane of the suprapatellar recess present a reddish-pink appearance; particularly at the apex, the membrane has few villi. A round opening is usually visible at this apex, which gives access to the quadriceps bursa. The size of this opening between the quadriceps bursa and the intra-articular space can vary considerably. The synovial surface shows an undulating aspect. Villi are less numerous in children than in adults. They may be abnormally numerous in rheumatoid arthritis and haemophilia. The villi can be irregular, enlarged, truncated or oedematously swollen. An elevation is often found at the interface between suprapatellar recess and the cartilage of the femoral condyles. On the lateral walls of the recess, villi are often seen to move to and fro as a result of the constant flow of physiological saline required for effective arthroscopic inspection.

Almost the entire undersurface of the patella can be seen with the 30° arthroscope. The cartilage of the patella is often found encircled by a crown of villi, and adipose tissue originating from Hoffa's body is frequently found at the lower pole. Medial facet, mid-portion and lateral facet can all be adequately inspected, and this is of importance in particular in locating cartilaginous abnormalities on the undersurface of the patella.

The cartilage of the patellar surface of both femoral condyles is likewise visible in its entirety, though in a fragmentary fashion. When the arthroscope is retracted until its end is localized immediately above the intracondylar space, the knee-joint can be lightly flexed and congruence or dyscongruence of the femoropatellar joint can then be viewed. The cartilaginous surface of the femoral condyles is white and glossy. For observation of the total surface of the cartilage of the femoral condyles, the knee-joint must be flexed and extended while the instrument is being lightly moved to and fro.

When the arthroscope is passed into the intra-articular space via the anterior aspect of the femoral condyle, the attachment of the medial meniscus to the capsule becomes visible fairly quickly. This attachment often presents a striated appearance. The view on the attachment of the anterior horn is obstructed by the insertion of the anterior cruciate ligament and adipose tissue. With the knee-joint extended to slightly flexed, however, a large part of the anterior horn can be observed. The tip of the instrument can be used to push the adipose tissue away, and the 30° direction of view makes it possible to inspect that part of the anterior horn that is not concealed behind the insertion of the anterior cruciate ligament. The internal margin of the meniscus takes a rounded course and is knife-sharp in young individuals, but slightly ragged in older patients. The course of the internal
margin of the medial meniscus can generally be followed without difficulty while the knee is being extended and flexed, the region being inspected with the knee in valgus position.

However, one blind spot remains: the posterolateral part of the meniscus cannot be seen, the view on this area being obstructed by the femoral condyles. The internal margin of the middle segment of the medial meniscus is often slightly undulant; this is normal, and probably due to its physiological mobility. The attachment of the posterior horn can be seen between the anterior cruciate ligament and the internal margin of the medial femoral condyle. It is also possible to guide the arthroscope over the posterior horn of the meniscus in order to gain an impression of the posterior intercondylar fossa.

The anterior cruciate ligament is fully visible when the knee-joint is flexed 60-90°. The lower portion presents the appearance of a thick white tendon covered by a thin transparent membrane in which blood vessels are observed. Behind the anterior cruciate ligament lies the posterior cruciate ligament. In this area, immediately behind the anterior cruciate ligament, a reddish mass of tissue is often observed. In no case, however, have we identified this mass as posterior cruciate ligament. In front of the anterior cruciate ligament a thinner fibrous strand is visible: the mucous ligament (synovial fold). Its structure is clearly different from that of the anterior cruciate ligament.

When inspecting the lateral meniscus, one begins with the posterior horn and follows its internal margin (taking a U-shaped course via the middle segment) to the anterior horn. With the arthroscope we used, the anterior horn of the lateral meniscus can be fully inspected even via the lateral approach. It is often possible to view posterior and anterior horn at the same time. The posterior horn of the lateral meniscus and its attachment are often better and more extensively visible than those of the medial meniscus. When the end of the arthroscope is moved laterally via the internal margin of the middle segment, with the knee in slight flexion and subjected to varus stress, the intra-articular part of the tendon of the popliteal muscle is often visible.

In the case of a discoid lateral meniscus it is often impossible to identify the course of its internal margin. Differentiation between tibial plateau cartilage and a discoid lateral meniscus can be achieved by exerting pressure on the lateral intra-articular space: in the case of discoid meniscus, the cartilage surface is observed to move to and fro.

Abnormalities in the area of the posterolateral connections of both menisci can often be deduced from the abnormal course of the internal margin of the middle segment and the posterior horn of these menisci. If necessary, a small needle can be inserted under direct visual control, its point being introduced into the area of the posterior horn of these menisci. Pathological changes, if any, can be made visible by manipulation. Or the needle can be inserted beneath the menisci to lift them slightly, making it possible to inspect the meniscotibial areas. It is not possible, however, to visualize the meniscotibial parts of the anterior horn in this manner. Like the articular cartilage, the menisci present a smooth, glossy, white surface.
CHAPTER VII.

RESULTS OF ARTHROSCOPIC EXAMINATION IN 267 PATIENTS*

Introduction

- Of the arthroscopies of the knee so far performed in 378 patients, 267 performed during the period 1969 through 1974 are analysed in this chapter. This selection was made because the follow-up after arthroscopy had to be more than six months. The patients in question had been referred to our clinic by the family doctor, in many cases also by general surgeons, orthopaedic surgeons, neurosurgeons or rheumatologists. A small number of patients had been referred by medical officers of the Joint Medical Service and the Board of Appeal, exclusively in connection with diagnostic, therapeutic and prognostic problems.

- The motivation of the study was the fact that in examinations of the knee-joint there is often a marked discrepancy between the diagnosis based on physical examination and the findings at arthrotomy. Affections of the knee-joint encountered in orthopaedic practice are for the most part conditions which come under the heading of internal derangement, and meniscal lesions are most prominent in this category. Knee symptoms are very often caused by a combination of pathological changes. The clinical diagnosis usually focuses on the principal abnormality, additional changes having been overlooked or considered to be of too subordinate importance to be mentioned.

- The purpose of the study was to establish which intra-articular structures of the knee-joint can be seen with the aid of the arthroscope, and which significance can be attached to arthroscopy of the knee as a diagnostic aid in comparison with more conventional methods such as physical examination, laboratory studies and radiological examination, including arthrography. To ensure optimal results it was necessary also to analyse the equipment, technique of arthroscopy, interpretation of arthroscopic findings and such complications as might occur after arthroscopy.

- For a complete diagnosis in patients with knee symptoms, it is of importance to obtain a clear image of the following intra-articular structures:

1) synovial membrane
2) cartilage on the undersurface of the patella and the patellar surface of both condyles
3) cartilage of the medial and the lateral compartment of the knee-joint
4) medial and lateral meniscus
5) cruciate ligaments
6) tendon of the popliteal muscle.

- We started performing arthroscopy in 1969, our only guideline during the first two years being Watanabe’s Atlas of Arthroscopy (1969). Our experience in the practice of arthroscopy was substantially increased during a period of practical work with Prof. Dr. Robert W. Jackson in the Toronto General Hospital, Canada. (1971)

The investigation

- The series studied included 211 males (79%) and 56 females (21%) aged 2-72 years (mean age 28). We examined 137 right and 130 left knees. Four chronological groups can be distinguished for an objective comparison of various results. The groups differed in arthroscopic equipment used.

- In group I (25 patients), the results obtained with the type 21 Watanabe arthroscope were compared with the findings of physical examination and arthrotomy.

- In group II, 28 patients were examined with the type 21 Watanabe arthroscope, but with an improved irrigation system and using different manipulation.

- In group III, 26 patients were examined with the Wolf arthroscope.

- In group IV, 188 patients were examined with the Storz arthroscope and the results of

* No absolute value should be attached to the percentage often given to indicate frequency; the total numbers considered are often too small to justify this.
arthrography, arthroscopy and arthrotomy were compared in several cases. Dual manipulation was first applied in this group.

Group I
- Our active experience with arthroscopy was initially very limited, and we therefore expected difficulties in the interpretation of arthroscopic features. This is why we first selected 25 patients in whom an exploratory arthrotomy was justifiable. Arthroscopy was carried out prior to arthrotomy. We used the Watanabe technique and his type 21 arthroscope. The arthroscopic features were compared with the features observed at arthrotomy.

- The number of patients in this group (25) was not an arbitrary number. Robert W. Jackson (personal communication) maintains that the arthroscopist can have acquired a certain skill and experience only after a minimum of 25 independently performed arthroscopies. The group consisted of 19 males and 6 females aged 17-72 (mean age 29.5); 15 right and 10 left knees were examined. The instrument was introduced only anterolaterally in 20 cases, while in 5 cases it was introduced anteromedially as well as anterolaterally. A comparison between the principal clinical diagnostic findings and the arthrotomy findings is presented in table 1. No arthrography was done in these cases.

<table>
<thead>
<tr>
<th>conditions</th>
<th>clinical diagnosis</th>
<th>arthrotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>patellar chondropathy</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>lesion of medial meniscus</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>lesion of medial meniscus + cruciate ligament</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>lesion of lateral meniscus</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>cystic lateral meniscus</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>osteochondritis dissecans without corpus liberum</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>knee symptoms of obscure origin</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Number of patients: 25

- The table seems to suggest that a correct diagnosis was made in 20 cases, while 5 cases (10:2) were misdiagnosed (20%). However, table 1 is 'misleading'; further analysis of the lateral and medial meniscal lesions is required.

<table>
<thead>
<tr>
<th>clinical diagnosis</th>
<th>arthrotomy</th>
<th>lesion med meniscus</th>
<th>lesion lat meniscus</th>
<th>intact med meniscus</th>
<th>intact lat meniscus</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>lesion med. meniscus</td>
<td>12</td>
<td>2</td>
<td>3</td>
<td>17</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>lesion lat. meniscus</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>intact med. meniscus</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>intact lat. meniscus</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>total</td>
<td>12</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

37
Table 2 shows that a clinically diagnosed lesion of the medial meniscus was confirmed at arthrotomy in 12 cases. In 2 cases a clinically diagnosed medial meniscal lesion was found at arthrotomy to be a lateral meniscal lesion. In 1 case a clinical diagnosis of lateral meniscal lesion was not confirmed at arthrotomy. The clinical diagnosis 'meniscal lesion' was made in 18 cases and proved to be erroneous in 6 cases (an error score of 33.3%). (The diagonal in the table marks the correct diagnoses.)

<table>
<thead>
<tr>
<th>Table 3</th>
<th>arthroscopy</th>
<th>lesion med. meniscus</th>
<th>lesion lat. meniscus</th>
<th>intact med. meniscus</th>
<th>intact lat. meniscus</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>lesion med. meniscus</td>
<td>9</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>lesion lat. meniscus</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>intact med. meniscus</td>
<td>3</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>intact lat. meniscus</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>12</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that meniscal lesion was erroneously diagnosed at arthroscopy in 7 cases: error score of arthroscopy versus arthrotomy 43.7% (7/16 × 100). Comparison of table 2 with table 3 reveals a negative arthrotomy in 2 cases in which a medial meniscal lesion had been diagnosed both clinically and arthroscopically. In 2 other cases arthrotomy revealed a lesion of the lateral meniscus by arthroscopy and clinical examination had been overlooked. Clinical and arthroscopic examination together gave an erroneous diagnosis versus arthrotomy in 4 cases. The error score of clinical examination combined with arthroscopy versus arthrotomy was therefore 22.2%.

We chiefly focused on meniscal changes and lesions. We noticed however, that the synovial membrane could be readily inspected and that we were able to observe changes in cartilage, specifically on the undersurface of the patella, which we had not suspected. Table 4 presents a survey of additional findings concerning the articular cartilage of the femoropatellar joint and the medial and lateral compartments in these 25 patients.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>clinical</th>
<th>arthroscopic</th>
<th>arthrotomic</th>
</tr>
</thead>
<tbody>
<tr>
<td>chondropathic changes femoro-patellar joint</td>
<td>–</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>chondropathic changes medial/lateral articular compartment</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>lesion anterior cruciate ligament</td>
<td>2</td>
<td>–</td>
<td>2</td>
</tr>
</tbody>
</table>

The table clearly shows that, in 50% of cases, arthroscopy revealed cartilaginous changes in varying degrees of severity, which were confirmed at arthrotomy. Abnormalities of the anterior cruciate ligament, however, were not visible through the arthroscope. Cartilaginous changes of the femoropatellar joint were found in 6 of these 25 patients.
Table 5. Diagnosis at arthrotomy

<table>
<thead>
<tr>
<th>number of patients</th>
<th>principal diagnosis</th>
<th>additional diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>no meniscal lesion</td>
<td>patellar chondropathy</td>
</tr>
<tr>
<td>2</td>
<td>medial meniscal lesion</td>
<td>patellar chondropathy</td>
</tr>
<tr>
<td>1</td>
<td>medial meniscal and cruciate ligament</td>
<td>patellar chondropathy</td>
</tr>
<tr>
<td>1</td>
<td>lateral meniscal lesion</td>
<td>patellar chondropathy</td>
</tr>
</tbody>
</table>

Table 6. Diagnosis at arthrotomy

<table>
<thead>
<tr>
<th>number of patients</th>
<th>principal diagnosis</th>
<th>additional diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>medial meniscal lesion</td>
<td>chondropathy med./lat. articular compartment</td>
</tr>
<tr>
<td>2</td>
<td>lesion of medial meniscus + cruciate ligament</td>
<td>chondropathy med./lat. articular compartment</td>
</tr>
</tbody>
</table>

The patients in tables 5 and 6 are not always the same; only 2 patients showed a chondropathy of the patella as well as one of the medial/lateral compartment of the joint. In one of these patients the principal diagnosis was medial meniscal lesion; in the other patient the principal diagnosis was medial meniscal lesion with cruciate ligament lesion. A chondropathy of the patella was found in 4 of the 14 patients with a meniscal lesion. In 2 patients with a clinically diagnosed lesion of the medial meniscus, arthrotomy revealed that no meniscal lesion was present, and that the typical symptoms were caused by a chondropathy of the patella. Table 6 shows that in 4 of the 14 patients a meniscal lesion was associated with chondropathy of the medial or lateral compartment of the joint.

Complications

No significant complications were seen. No infections occurred. In one case it was impossible to inspect the knee-joint because the physiological saline solution had been subsynovially injected. In 6 cases arthrotomy disclosed scratches on the cartilage which had probably been caused by instrument manipulation.

Conclusion

This first group demonstrated that arthroscopy of the knee was practicable. The synovial membrane could be readily seen. Chondropathies could be more frequently diagnosed than by clinical examination. However, meniscal lesions and chondropathies of the two articular compartments were not more readily diagnosed than at physical examination. Lesions of the anterior cruciate ligaments could not be seen at all.

Although in this first group arthroscopy of the knee proved valuable in diagnosing chondropathies, it was less useful in diagnosing meniscal lesions. The causes of the limited usefulness were:
1) the technique of arthroscopy;
2) the equipment;
3) the interpretation of arthroscopic findings.

- The clarity of the arthroscopic features often left much to be desired, the view being often seriously obstructed by:

  a) minor haemorrhages;
  b) hypertrophic synovial tissue;
  c) the Hoffa body;
  d) small bubbles, probably produced by the heat from the lamp.

- The degree of view into the knee cavity was insufficient. The entire undersurface of the patella was insufficiently visible. Only the middle segments of the menisci were visible, and the anterior and posterior horns were virtually invisible as well as the tibial side. Nor was it possible adequately to inspect the anterior cruciate ligament and the articular cartilage of the two compartments of the joint; the view was often obstructed by hypertrophic synovial tissue.

- It was noticed that anterolateral introduction of the instrument often gave a better view than anteromedial insertion.

- Arthroscopy confronted us with a new aspect. The arthroscopic diagnosis 'chondropathy' was introduced, and the question arose as to how this diagnosis was to be classified as compared with the histological and arthrotomic diagnosis. The shreds of cartilage were clearly visible in the physiological saline solution. However, it was difficult to measure the cartilaginous changes. Arthroscopically gross changes proved to be only moderate at arthrotomy, and arthroscopically very slight cartilaginous changes were found to be very gross at arthrotomy.

- Although arthroscopy had proved to be feasible, several imperfections had to be faced. A degree of technical skill had been achieved, but several structures could not be sufficiently inspected, particularly the anterior and posterior horn and the tibial aspect of the menisci, the anterior cruciate ligament, and the cartilage of the medial and lateral compartments and of the patella. The irrigation system required modification, for a clear view is a primary requirement. Better irrigation with physiological saline might be achieved by introducing the saline into the joint under slight positive pressure with the aid of a small balloon, which had to be connected with the flask containing the physiological saline.

- Access to parts of the knee-joint which had so far been invisible might be gained by more pronounced instrument manipulation. Moreover, it was found necessary during inspection of the knee-joint to apply valgus stress, varus stress, rotation and flexion.

- The instrument was left unchanged, because we believed that better interpretation of findings would come with increasing experience. In view of our findings, we decided to improve the irrigation system and the technique of arthroscopy for our next group of 28 patients.

Group II

- The second group of patients in whom arthroscopy of the knee was carried out with the type 21 Watanabe arthroscope, included 23 males and 5 females aged 10-52 (mean age about 28). 14 right and 14 left knees were examined.

- The instrument was inserted only anterolaterally in 23 cases, and anteromedially as well as anterolaterally in 5 cases. In 23 cases arthroscopy was followed by arthrotomy. In 4 cases an arthrogram was made by request of the surgeon who had referred the patient to our clinic. These arthograms were made elsewhere.
It is apparent from Table 7 that the patients in this group had a wider variety of affections of the knee. The reason is obvious. Although meniscal changes continued to interest us, our experience with the first group of 25 patients had focused our attention on chondropathic changes, and on the problem of determining their degree of severity with accuracy. We had also become interested in corpora liberum which might be seen through the arthroscope, and in their dimensions.

It would be incorrect to deduce from this table a negative score for the clinical diagnoses versus the arthrotomic results.

Table 8

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesion Med. Meniscus</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Lesion Lat. Meniscus</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Intact Med. Meniscus</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Intact Lat. Meniscus</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 8 shows that physical examination yielded a diagnosis of meniscal lesion in 8 cases, that is 10 patients; for in 2 cases no meniscal lesion was diagnosed on the basis of physical examination but arthrotomy did reveal a medial meniscal lesion. Clinical physical examination yielded a diagnosis of medial meniscal lesion in 1 case, and of lateral meniscal lesion in 1 case; at arthrotomy, however, these lesions were not found. Arthrotomy confirmed the diagnosis of meniscal lesion in 6 of the 8 patients in whom this diagnosis had been made. As pointed out, arthrotomy revealed a meniscal lesion not diagnosed at physical examination in 2 cases.

<table>
<thead>
<tr>
<th>Arthroscopy</th>
<th>Lesion Med. Meniscus</th>
<th>Lesion Lat. Meniscus</th>
<th>Intact Med. Meniscus</th>
<th>Intact Lat. Meniscus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthrotomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesion Med. Meniscus</td>
<td>5</td>
<td></td>
<td>1</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Lesion Lat. Meniscus</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Intact Med. Meniscus</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Intact Lat. Meniscus</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 9 shows that an erroneous arthroscopic diagnosis was made in two cases (error score 20%). In 1 case arthrotomy disclosed an incarcerated Hoffa fragment which at arthroscopy had been interpreted as a lesion of the anterior horn of the medial meniscus (this was due to the fact that this anterior horn was not sufficiently visible at arthroscopy). In the other case a rupture in the posterior horn of the medial meniscus had been overlooked, because the course of this posterior horn was not sufficiently visible and interpretable. For 4 patients we had access to arthrograms which had been made elsewhere. Table 10 gives a comparative survey of clinical diagnosis, arthrography, arthroscopy and arthrotomy in these 4 patients.

Table 10

<table>
<thead>
<tr>
<th>Meniscal Lesion</th>
<th>Clinical Diagnosis</th>
<th>Arthrography</th>
<th>Arthroscopy</th>
<th>Arthrotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pat. 1 Medial</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Pat. 1 Lateral</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Pat. 2 Medial</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>b</td>
</tr>
<tr>
<td>Pat. 2 Lateral</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>b</td>
</tr>
<tr>
<td>Pat. 3 Medial</td>
<td>c</td>
<td>c</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>Pat. 3 Lateral</td>
<td>c</td>
<td>c</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>Pat. 4 Medial</td>
<td>d</td>
<td>d</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>Pat. 4 Lateral</td>
<td>d</td>
<td>d</td>
<td>d</td>
<td>d</td>
</tr>
</tbody>
</table>

Arthrotomy confirmed the clinical diagnosis in 3 cases. In 1 case the arthrographic expertise mentioned a lesion of both menisci, which at arthrotomy were found to be intact. In 1 case a lesion of the medial meniscus was suspected, but arthrotomy revealed a pinched Hoffa (patient 2). In 1 case arthrography was interpreted as indicative of a lesion of the lateral meniscus, but arthrotomy showed degeneration but no rupture of this meniscus (patient 4).
Of the 4 arthrographic diagnoses, 2 could be corrected on the basis of arthroscopic findings (patients 1 and 4). The arthrographic diagnosis of medial meniscal lesion was similarly made at arthroscopy, but turned out to be a pinched Hoffa at arthrotomy (patient 2). This means that the arthroscopic diagnosis was found erroneous at arthrotomy in 2 cases (patients 2 and 3). At arthrotomy, the arthrographic diagnosis was found correct in 1 case and erroneous in 3; in patient 1, both menisci were diagnosed as injured but found intact at arthrotomy, in patient 3, an arthrographically diagnosed lesion of the medial meniscus turned out to be a pinched Hoffa at arthrotomy; in patient 4, an arthrographically diagnosed lesion of the lateral meniscus was found at arthrotomy to be a degenerated but not ruptured meniscus.

It had already been noticed in group I that the arthroscope made it possible to gain a good impression of the cartilage of the femoropatellar joint and of the articular surfaces of both compartments of the joint.

In group II it was likewise possible to obtain a good view of the undersurface of the patella, but mainly of its central part. The cartilage of the articular surfaces of both compartments was found at arthrotomy to have been misinterpreted at arthroscopy.

In 2 cases a chondropathy of the medial femoral condyle and a corpus liberum were not correctly seen and interpreted because the view was obstructed by the Hoffa body. In 2 cases a chondropathy of the medial as well as the lateral compartment was misinterpreted owing to hypertrophy of synovial tissue, which obstructed the view.

Of the 28 patients in this group, 19 proved to show chondropathic changes.

Tables 11 through 14 indicate the localization of the chondropathy and whether the clinical diagnosis was or was not confirmed at arthroscopy and arthrotomy. Chondropathy of the articular compartments is defined as a chondropathy of both the femoral and the tibial part, the cartilage of the femoral side usually being more severely affected than that of the tibial side.

Table 11. Nine patients with patellar chondropathy

<table>
<thead>
<tr>
<th>principal diagnosis</th>
<th>at clinical examination</th>
<th>at arthroscopic/arthrotomic examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>none (previous meniscectomy)</td>
<td>3</td>
<td>3 (no arthrotomy in 1)</td>
</tr>
<tr>
<td>patellar chondropathy</td>
<td>–</td>
<td>4 (no arthrotomy in 1)</td>
</tr>
<tr>
<td>medial meniscal lesion</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>cystic lateral meniscus</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>
Table 12
Seven patients with patellar chondropathy and chondropathy of medial and lateral articular cartilage

<table>
<thead>
<tr>
<th>principal diagnosis</th>
<th>at clinical examination</th>
<th>at arthroscopic/arthrotomic examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>osteochondritis dissecans with corpus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>liberum</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>patellar chondropathy</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>corpus liberum (only)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>lateral meniscal lesion</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>rheumatoid arthritis</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 13
Two patients with chondropathy of the medial articular compartment

<table>
<thead>
<tr>
<th>principal diagnosis</th>
<th>at clinical examination</th>
<th>at arthroscopic/arthrotomic examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>patellar chondropathy</td>
<td>1</td>
<td>– (no arthrotomy)</td>
</tr>
<tr>
<td>osteochondritis dissecans without corpus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>liberum</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 14
Three patients in whom cartilage shreds were washed out

<table>
<thead>
<tr>
<th>principal diagnosis</th>
<th>at clinical examination</th>
<th>at arthroscopic/arthrotomic examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>medial meniscal lesion</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>none (previous meniscectomy)</td>
<td>1</td>
<td>1 (no arthrotomy)</td>
</tr>
<tr>
<td>lateral meniscal lesion</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>patellar chondropathy</td>
<td>–</td>
<td>1</td>
</tr>
</tbody>
</table>

In the 3 cases in which no diagnosis could be made, arthroscopy as well as arthrotomy revealed a chondropathy of the patella (arrow table 11). A clinically diagnosed patellar chondropathy was confirmed at arthrotomy, but this also revealed a chondropathy of both articular compartments (table 12). In 1 case there was a chondropathy, not of the patella but of the medial articular compartment (table 13).
- Of the 8 meniscal lesions found at arthrotomy (tables 8 and 9), 2 were found combined with a patellar chondropathy. All patients with a history of operation for meniscal lesion (3) were found also to have a chondropathy of the patella.

- Patients with a clinical diagnosis of osteochondritis dissecans (with or without corpus liberum) were examined arthroscopically in order to establish the extent to which the arthroscopically diagnosed chondropathic changes corresponded with those found at arthrotomy, and to establish whether the corpora libera could be adequately observed (tables 15 and 16).

<table>
<thead>
<tr>
<th>Table 15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>clinical examination</td>
</tr>
<tr>
<td>osteochondr. dissecans with corpus liberum</td>
</tr>
<tr>
<td>osteochondr. dissecans without corpus liberum</td>
</tr>
<tr>
<td>corpus liberum (only)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>arthroscopy</td>
</tr>
<tr>
<td>osteochondritis dissecans with corpus liberum</td>
</tr>
<tr>
<td>osteochondritis dissecans without corpus liberum</td>
</tr>
<tr>
<td>corpus liberum (only)</td>
</tr>
<tr>
<td>no corpus liberum</td>
</tr>
</tbody>
</table>

- Table 16 clearly shows that not all corpora libera were seen. In 2 cases a corpus liberum was overlooked with the arthroscope but found at arthrotomy. In 1 case this error was due to obstruction of the view by the Hoffa body. In the other case the physiological saline solution proved to have been injected subsynovially, thus reducing instead of enlarging the articular cavity.
Arthroscopy proved to be a valuable asset, although not for all the 28 patients examined, because a correct diagnosis could be made or a diagnosis corrected. In the 3 patients with a history of an operation on the meniscus, chondropathy of the patella was diagnosed. Arthroscopy revealed patellar chondropathy in 2, a medial meniscal lesion in 1, and a medial meniscal lesion with a patellar chondropathy in 1 of the 4 patients in whom clinical physical examination had failed to produce a diagnosis.

In 1 case a clinically diagnosed medial meniscal lesion proved to be a chondropathy of the patella. In another case a clinically diagnosed lateral meniscal lesion proved to be a patellar chondropathy. In yet another case a clinically diagnosed cyst of the lateral meniscus turned out to be a patellar chondropathy.

Arthroscopic results were found to have been insufficient in 4 cases: faulty interpretation ‘medial meniscal lesion’ in 1 case, overlooked medial meniscal lesion in 1 case, and overlooked corpus liberum in 2 cases.

Complications

A very positive finding was that no infections occurred in this group as a result of arthroscopic examination. Complications resulting from manipulations (the broken lamp and the damage to cartilage) were most likely due to still limited experience with arthroscopy. These complications did not occur in subsequent arthroscopic examinations.

Conclusion

Although the diagnostic results of arthroscopic examination in group II were substantially better than those in group I, the method did not yet entirely meet expectations. An important improvement was the modification of the irrigation system. The features of the interior of the knee-joint were more clearly defined, and the view into the articular cavity had improved. Apart from the experience gained in the first group of patients, meniscal abnormalities could be better interpreted because the instrument manipulations were extended, and the knee-joint itself was more freely moved during examination (flexion, extension, valgus stress and varus stress). The dimensions of certain lesions were more readily assessed because the instrument was lightly moved to and fro during examination.

An adequate impression was gained of the synovial membrane, femoropatellar joint, and the cartilage of both joint compartments. Nevertheless there were several limitations. Not all areas of the undersurface of the patella were fully and clearly visible, nor was the cartilage on the posterior aspect of the two femoral condyles. Invisible structures were:

- the anterior horns of both menisci;
- posteromedial and posterolateral attachments of both menisci;
- posterior cruciate ligament;
- popliteal fossa.

In only 21 of the 28 patients (65%) was the posterior horn of the medial meniscus visible. The anterior horn was never entirely visible, and in 5 cases (17.8%) the anterior cruciate ligament could not be seen.

It was found that the changes not visible at arthroscopy were localized precisely in the anterior and posterior horns of the meniscus. On the other hand, there were two new interesting observations:

1) chondropathy as an additional diagnosis in cases of meniscal lesion;
2) chondropathy which produces the symptoms of a meniscal lesion.

The fact that structures particularly in the anterior compartments were invisible or insufficiently visible could have been due to:

1) excessive hypertrophy of synovial tissue;
2) a large Hoffa body;
3) a too large diameter of the arthroscope.

Insufficient visibility of the posterior compartments could in our opinion be due to a too large diameter of the arthroscope, the variability of the anatomy of the knee-joint, and particularly the sometimes deep concavity of the tibial plateau. It seemed possible to overcome these difficulties by using a thinner instrument.

But there were several other reasons for our desire to find another instrument. In examinations of
the patients in group II the type 21 Watanabe arthroscope had shown a number of technical
imperfections which had had troublesome consequences.

1. During possibly somewhat incautious manipulation the Wolfram bulb had broken off, to remain
behind in the joint.
2. Light conduction had posed problems on several occasions.
3. Arthrotomy had shown that in a number of cases we had probably inflicted damage on cartilage
with the arthroscope.
4. In an inexplicable way (possibly as a result of sterilization) the optical system of the arthroscope
had misted up, and the instrument had had to be returned to the Japanese manufacturer for
repairs. The delay until the instrument was returned had been abnormally long.

– These complications, and the limitations of manipulation which impaired our view of the interior of
the knee-joint, motivated our search for an alternative instrument.

– The alternative would have to be a thinner instrument with fibre glass illumination, which would
free us from problems with the lamp. The smaller diameter of the instrument, we believed, would
enable us to see areas which could not be inspected with the type 21 Watanabe arthroscope. We
found such an instrument in the form of the Wolf arthroscope (Knittlingen, FRG), with a diameter of
3. mm, fibre glass illumination as described by Ohnsorge, and tested by Wruhs (cf. chapter IV).

– Wruhs filled the knee-joint with gas before inspecting the interior with the arthroscope; we
inspected the interior of the knee under constant irrigation with physiological saline. The shaft of the
instrument was modified to comply with our wishes in this respect.

**Group III**

– This group, examined with the Wolf arthroscope, comprised 26 patients: 19 males and 7 females
aged 2-52 (mean age 26.5). We examined 17 right and 9 left knees, inserting the instrument only
anterolaterally in 22 cases, and anteromedially as well as anterolaterally in 4 cases. In 18 cases
arthroscopy was followed by arthrotomy. The knee affections in this group were virtually the same
as those in group II. In 3 cases the surgeon who had referred the patient to our clinic, had obtained
an arthrogram.

### Table 17

<table>
<thead>
<tr>
<th>conditions</th>
<th>clinical diagnosis</th>
<th>arthroscopy/arthrotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>patellar chondropathy</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>chondropathy of patella and med.articular compartment</td>
<td>–</td>
<td>2 (no arthrotomy in 2)</td>
</tr>
<tr>
<td>medial meniscal lesion</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>lateral meniscal lesion</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>lesion lat.menisc. + cruciate lig.</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>cystic lateral meniscus</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>osteochondr.diss.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with corpus liberum</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>without corpus liberum</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>corpus liberum (only)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>rheumatoid arthritis</td>
<td>3</td>
<td>3 (no arthrotomy in 1)</td>
</tr>
<tr>
<td>haemophilia</td>
<td>1</td>
<td>1 (no arthrotomy)</td>
</tr>
<tr>
<td>no diagnosis</td>
<td>3</td>
<td>3 (no arthrotomy in 3)</td>
</tr>
<tr>
<td>no diagnosis (previous meniscectomy)</td>
<td>1</td>
<td>– (no arthrotomy)</td>
</tr>
</tbody>
</table>

| number of patients               | 26                 | 18 arthroscopy/arthrotomy |
|                                  |                    | 8 arthroscopy             |
In 7 cases we performed no arthrotomy because the degree of severity of the changes was insufficient to warrant an operation. The patient with haemophilia is a special case: radioactive gold was introduced into the joint via the arthroscope in this patient.

Table 17 presents a survey of the widely diverse conditions diagnosed first clinically and eventually at arthrotomy. A meniscal lesion was clinically diagnosed in 9 cases. It is on the basis of the clinical diagnosis that the cases will be discussed (tables 19, 19 and 20).

<table>
<thead>
<tr>
<th>Table 18</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>arthrotomy</strong></td>
</tr>
<tr>
<td>clinical diagnosis</td>
</tr>
<tr>
<td>lesion medial meniscus</td>
</tr>
<tr>
<td>lesion lateral meniscus</td>
</tr>
<tr>
<td>intact medial meniscus</td>
</tr>
<tr>
<td>intact lateral meniscus</td>
</tr>
<tr>
<td>total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 19</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>arthroscopy</strong></td>
</tr>
<tr>
<td>arthrotomy</td>
</tr>
<tr>
<td>lesion medial meniscus</td>
</tr>
<tr>
<td>lesion lateral meniscus</td>
</tr>
<tr>
<td>intact medial meniscus</td>
</tr>
<tr>
<td>intact lateral meniscus</td>
</tr>
<tr>
<td>total</td>
</tr>
</tbody>
</table>
Table 18 shows that the clinical diagnosis was erroneous in 3 out of 9 cases. In 1 case a clinically diagnosed medial meniscal lesion proved to be a lateral meniscal lesion; in one case a clinically diagnosed medial meniscal lesion was disproved at arthrotomy, and in 1 case a clinically diagnosed lateral meniscal lesion was disproved. Table 19 shows that the arthroscopic diagnosis was erroneous in 2 out of 7 cases. In 1 case lesion of the anterior horn of the medial meniscus was arthroscopically diagnosed, but arthrotomy revealed the anterior horn to be intact. Total rupture of the anterior cruciate ligament had been arthroscopically misinterpreted as rupture of the anterior horn of the meniscus. In the other case a rupture in the posterior horn of the lateral meniscus was overlooked at arthroscopy. In our opinion this was due to the very limited field of vision of the arthroscope, which impeded orientation in the interior of the joint.

The course of the internal edge of the posterior horn was always visible except in cases with marked hypertrophy of synovial tissue. Yet with this thinner instrument it was not possible to examine the entire posterior horn, and this caused the lesion in the second case to be overlooked. In assessing the cruciate ligaments there was marked uncertainty about interpretation of the features observed. In this group there were 2 cases with a clinical diagnosis of cyst of the lateral meniscus. In 1 case neither arthroscopy nor arthrotomy confirmed the cyst. In the other case both arthroscopy and arthrotomy revealed a small tear in this meniscus.

Table 20

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>meniscal lesion</th>
<th>clinical diagnosis</th>
<th>arthrogram</th>
<th>arthroscopy</th>
<th>arthrotomy</th>
<th>follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pos. neg.</td>
<td>pos. neg.</td>
<td>pos. neg.</td>
<td>pos. neg.</td>
<td>pos. neg.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>medial</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>none</td>
<td>symptom-free</td>
</tr>
<tr>
<td></td>
<td>lateral</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>medial</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>symptom-free</td>
</tr>
<tr>
<td></td>
<td>lateral</td>
<td>b</td>
<td>b</td>
<td></td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>medial</td>
<td>c</td>
<td>c</td>
<td>c</td>
<td>none</td>
<td>symptom-free</td>
</tr>
<tr>
<td></td>
<td>lateral</td>
<td>c</td>
<td>c</td>
<td></td>
<td>c</td>
<td></td>
</tr>
</tbody>
</table>

Arthrograms were available for 3 patients, in 2 of whom the diagnosis was not verified at arthrotomy. Arthrography was incorrect versus arthroscopy in 1 case. Table 20 shows that the arthographic expertise in 1 case mentioned a lesion of both menisci, which was not seen at arthroscopy. This patient (not operated on) was symptom-free at arthroscopic follow-up. In 1 case the arthroscopic diagnosis was incorrect: the arthrogram revealed no meniscal changes although arthroscopy had shown features suggestive of a rupture in the anterior horn of the medial meniscus. Arthrotomy in this case disclosed a total lesion of the anterior cruciate ligament. In a third patient both arthrography and arthroscopy failed to reveal any meniscal lesion; at follow-up this patient was symptom-free.

Assessment of chondropathies of the articular surfaces was found to pose considerably more difficulties. Although in this group there were no difficulties caused by the Hoffa body, chondropathic changes of the undersurface of the patella were misinterpreted in 2 cases. In 1 case the undersurface of the patella was considered intact at arthroscopy, but arthrotomy disclosed an unmistakable chondropathy. In another case a positive arthroscopic finding proved negative at arthrotomy. In 1 case a chondropathy of the medial femoral condyle was misinterpreted: negative arthroscopy, but unmistakable evidence of chondropathy at arthrotomy.
Table 21. Seven patients with patellar chondropathy

<table>
<thead>
<tr>
<th>clinical diagnosis</th>
<th>arthroscopic/arthrotomic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>lateral meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>medial meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>patellar chondropathy</td>
<td>2</td>
</tr>
<tr>
<td>none</td>
<td>1</td>
</tr>
<tr>
<td>none (previous meniscectomy)</td>
<td>1</td>
</tr>
<tr>
<td>rheumatoid arthritis</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>number of patients</th>
<th>verified</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6 (arthrotomy)</td>
</tr>
<tr>
<td></td>
<td>1 (only arthroscopy)</td>
</tr>
</tbody>
</table>

- Table 21 shows that a clinical diagnosis of patellar chondropathy was made in only 2 cases. In the other 5 cases a different diagnosis (or no diagnosis) was made. Arthroscopy/arthrotomy revealed a patellar chondropathy in 7 cases. The clinical diagnosis with an additional diagnosis of patellar chondropathy was verified by arthrotomy in 6 cases.

- Table 21 also shows that a clinically diagnosed lateral meniscal lesion proved at arthrotomy not to be a lesion but a patellar chondropathy, and that in the 2 cases in which no diagnosis was made arthroscopy revealed a patellar chondropathy.

Table 22

Seven patients with chondropathy of the patella and medial articular cartilage.

<table>
<thead>
<tr>
<th>clinical diagnosis</th>
<th>arthroscopic/arthrotomic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>osteochondritis dissecans</td>
<td></td>
</tr>
<tr>
<td>with corpus liberum</td>
<td>2</td>
</tr>
<tr>
<td>without corpus liberum</td>
<td>1</td>
</tr>
<tr>
<td>none</td>
<td>1</td>
</tr>
<tr>
<td>patellar chondropathy</td>
<td>1</td>
</tr>
<tr>
<td>rheumatoid arthritis</td>
<td>1</td>
</tr>
<tr>
<td>corpus liberum (only)</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>number of patients</th>
<th>verified</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>7 (arthrotomy)</td>
</tr>
</tbody>
</table>

- Table 22 shows in which clinical diagnoses several types of chondropathy (at several sites) can occur. An articular chondropathy existed in 14 of the 26 patients. The 7 patients in table 22 are not the same as the 7 patients in table 21. Table 22 is meant only to show whether or not the clinical diagnosis agreed with the arthroscopic or arthrotomic diagnosis, which revealed chondropathic changes as well. In 1 case no clinical diagnosis could be made, but arthroscopy and arthrotomy revealed a patellar chondropathy and chondropathy of the medial articular compartment. A patellar
chondropathy was found in 1 of the 8 cases in which arthrotomy revealed meniscal abnormalities (medial meniscal lesion in 4, lateral meniscal lesion in 3 and cystic lateral meniscus in 1 case) (cf. table 17). The patient whose symptoms had persisted after a meniscectomy, therefore, had a patellar chondropathy as well. In none of the patients with a meniscal lesion could chondropathic changes of both articular compartments be observed.

In this group, too, patients with clinically diagnosed osteochondritis dissecans (with or without corpus liberum) were arthroscopically examined in order to establish the extent to which the arthroscopically observed chondropathic changes correlated with those found at arthrotomy, and to establish whether corpora libera could be readily seen.

Table 23

<table>
<thead>
<tr>
<th>Clinical Diagnosis</th>
<th>Arthrotomy</th>
<th>Osteoch. Diss. with Corp. Lib.</th>
<th>Osteoch. Diss. without Corp. Lib.</th>
<th>Corp. Lib. (Only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteochondr. Diss. with Corp. Lib.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteochondr. Diss. without Corp. Lib.</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corpus Liberum (Only)</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arthroscopy</th>
<th>Arthrotomy</th>
<th>Osteoch. Diss. with Corp. Lib.</th>
<th>Osteoch. Diss. without Corp. Lib.</th>
<th>Corp. Lib. (Only)</th>
<th>No Corpus Liberum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteochondr. Diss. with Corp. Lib.</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteochondr. Diss. without Corp. Lib.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corpus Liberum Only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Corpus Liberum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Table 23 reviews the findings in 4 patients with osteochondritis dissecans with or without corpus liberum. Detection of corpora libera with the thin Wolf arthroscope was very disappointing: 3 of the 4 corpora libera found at arthrotomy were not seen arthroscopically.

During arthroscopic examination, no interference from the Hoffa body or the synovial membrane was experienced; nor were technical errors made in arthroscopy. The cause of the moderate results is probably to be found in the small angle of vision of the instrument, and the marked mobility of the
corpora libera. The latter move freely in the articular cavity, and during manipulation with the arthroscope had moved elsewhere before they could enter the field of vision. In one of these 4 patients the cartilage of the femoral condyle was assessed as intact during arthroscopy, but found to show marked chondropathy at arthrotomy.

- In these 26 patients the course of the internal margin of the posterior horn of the menisci was readily visible, and even the posterior intercondylar fossa could be inspected. Instrument manipulation was easier. Illumination was excellent, and in fact sometimes too bright. Substitution of the arthroscope lamp by a light source outside the instrument (with fibre glass tubing) proved a substantial improvement. It was even found possible to inspect the tibial aspect of the menisci. Nevertheless the instrument had some considerable limitations. Whereas the course of the internal margin of the posterior horns could be readily followed, the small diameter of the instrument made it impossible to see the posterolateral attachment of the menisci; nor could ruptures in the posterior horn be observed. The posterior cruciate ligament was not visible. Only part of the anterior horn could be seen. The small field of vision (consequence of the instrument's small diameter) was a serious handicap because it impeded orientation. This entailed a risk of overlooking certain areas of the undersurface of the patella and the articular cartilage in both compartments of the joint. The highly mobile corpora libera also escaped the view due to the small field of vision.

- In order to optimize the field of vision, cartilage was inspected from a relatively large distance, but this caused misinterpretation. Another serious handicap was that with this equipment it was impossible to obtain adequate photographic documentation. The photographs were too dark and ill-defined. An important advantage, however, was that only this arthroscope made it possible to inspect the interior of the knee in very young children.

Follow-up
- A follow-up on the 8 patients of group III who underwent no operation revealed the following.
  A. Three patients were free of symptoms; the arthroscopic diagnosis had been:
     a. meniscectomy + patellar chondropathy
     b. rheumatoid arthritis
     c. patellar chondropathy.
  B. Three patients had symptoms only at exertion; the arthroscopic diagnoses had been:
     a. patellar chondropathy with chondropathy of lateral and medial compartment in 2 cases
     b. no diagnosis in 1 case.
  C. One female patient continued to have the same symptoms (arthroscopic diagnosis: patellar chondropathy), and one patient with haemophilia remained unchanged.

Complications
- In none of the 26 cases were postarthroscopic complications observed, specifically no infection and no damage to cartilage as a result of instrument manipulation.

Conclusion
- In 6 of the 26 patients arthroscopy led to a diagnosis or correction of a clinical diagnosis. Patellar chondropathy was diagnosed in one patient with a history of meniscectomy, and in 2 of the 3 patients in whom no clinical diagnosis could be made. In 1 case in which a medial meniscal lesion was clinically diagnosed, arthrotomy and arthroscopy revealed no lesion. In 1 case in which no tear was suspected (cystic lateral meniscus), arthroscopy and arthrotomy both revealed a rupture. In 1 case arthroscopy made it possible to diagnose rheumatoid arthritis on the basis of a biopsy specimen. Arthroscopic results were incorrect in 5 cases: misinterpretation of a lesion of the anterior horn of the medial meniscus in 1 case; overlooked lesion of the posterior horn of the lateral meniscus in 1 case; overlooked corpora libera in 3 cases.

- The diagnostic value of arthroscopy with the Wolf arthroscope (diameter 3 mm) did not exceed that of arthroscopy with the Watanabe arthroscope (group II). After 79 arthroscopies we were familiar with the technique; the irrigation system was quite satisfactory; the image was clear and the fibre glass illumination was a great improvement (no more illumination problems). Yet our arthroscopic technique had to be improved, e.g. because with the slender instrument changes in the posterior horn were not entirely visible. At least some modifications were required: the instrument design should be such that all areas of the undersurface of the patella could be seen. Vision and interpretation of chondropathies of the patellar surface of the femoral condyles and the two compartments had to be improved, and the same applied to the internal margin of the posterior horn.
of both menisci and their attachments. The anterior cruciate ligament also had to be better visible. Apart from the fact that the instrument would have to have very high optical qualities (cf. chapter IV), it would have to fulfill the following requirements:

a. the largest possible angle of vision;

b. the smallest possible diameter;

c. possibility of photography through the instrument.

- The instrument had to be thinner than the type 21 Watanabe arthroscope, and preferably not much thicker than the Wolf arthroscope. Fibre glass illumination was a must. The direction of view had to be such that all areas of the undersurface of the patella as well as the anterior horns of the menisci could be seen. The angle of vision had to be optimal, and objects in line with the instrument axis would also have to be visible. A very large visual field could then be ensured by rotating the instrument on its axis.

- Since we aimed at optimal arthroscopic diagnosis, we sought a method to detect any possible pathology of the posterior horn of the meniscus. Owing to its position (largely concealed behind the femoral condyle) we could not hope to view the posterior horn through an inflexible arthroscope, however we might manipulate it. A different introduction of such an arthroscope would likewise fail to solve the problem, for the posterior horn itself must be manipulated, i.e. slightly raised in order to make invisible pathological changes visible. The only solution proved to be as simple as it was useful: dual manipulation, of which the literature so far has made no mention. A needle (19 gauge) is inserted into the posterior horn under direct vision; this makes it possible to manipulate the posterior horn and make observations on its undersurface. In order to avoid damage to the meniscus and the cartilage of the articular surfaces, the needle must always be inserted under direct vision.

- The instrument which optimally met our requirements proved to be the Storz arthroscope with Hopkins optical system and fibre glass illumination. The optical system is that of a paediatric bronchoscope; the diameter of the instrument is between that of the type 21 Watanabe and that of the Wolf arthroscope. The diameter of the arthroscope is 4 mm, and that of the shaft is 5 mm. The direction of view is 30° in relation to the instrument axis. The angle of vision in air is 100°. These two values made it possible to observe not only structures in line with the horizontal axis of the instrument, but also structures nearly 75° below the horizontal axis. A very large field of vision is ensured by rotating the instrument on its axis. Its diameter just permits a view of the course of the internal margin of the posterior horn. The attachment of the posterior horns of both menisci is readily seen. Even the posterior intercondylar fossa can be inspected. The direction of view ensures that all areas of the undersurface of the patella and the anterior horns of the menisci can be observed. The anterior cruciate ligament is readily visible. An important point is that good photographs can be made through the instrument. This Storz-Hopkins arthroscope was used in the next group of patients (group IV).

Group IV

- The Storz-Hopkins arthroscope was used to examine and analyse 188 knees. The patients were 150 males and 38 females aged 12-65 (mean age 28.5). We examined 91 right and 97 left knees, always introducing the instrument anterolaterally. In 105 cases the arthroscopic diagnosis was verified by arthrotomy. For correct evaluation of arthroscopy in relation to other methods of investigation, specifically arthrography, this series of 105 cases was divided into 3 groups.

Series A

1. 34 knees, arthrography (elsewhere), arthroscopy, arthrotomy.
2. 34 knees, arthrography (Thijn), arthroscopy, arthrotomy.
3. 37 knees, arthroscopy, arthrotomy.

- In the remaining 83 cases, no arthrotomy was performed. This series can also be divided into 3 groups.

Series B

4. 28 knees, arthrography (elsewhere), arthroscopy.
5. 17 knees, arthrography (Thijn), arthroscopy.
6. 38 knees, arthroscopy.

- The arthrography was intended mainly to detect a possible lesion of the meniscus.

A. 1. 34 knees, arthrography (elsewhere), arthroscopy, arthrotomy.
### Table 24

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Arthrotomy</th>
<th>No Menisc. Lesion</th>
<th>Lesion Both Menisci</th>
<th>Lesion Medial Meniscus</th>
<th>Lesion Lateral Meniscus</th>
<th>Chondropathy Patella</th>
<th>Ligament Lesion</th>
<th>None (Previous Meniscectomy)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Meniscal Lesion</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Lesion Both Menisci</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesion Medial Meniscus</td>
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<td>1</td>
<td>14</td>
<td>2</td>
<td></td>
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<td>18</td>
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<td></td>
<td>2</td>
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<td>Chondropathy Patella</td>
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<td></td>
<td>1</td>
</tr>
<tr>
<td>Ligament Lesion</td>
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<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>None (previous meniscectomy)</td>
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<tr>
<td>Total</td>
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<td>18</td>
<td>9</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

### Table 25

<table>
<thead>
<tr>
<th>Arthrogramy</th>
<th>Arthrotomy</th>
<th>No Meniscal Lesion</th>
<th>Lesion Med. Meniscus</th>
<th>Lesion Lat. Meniscus</th>
<th>Lesion Both Menisci</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Meniscal Lesion</td>
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<td>12</td>
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<td>12</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>15</td>
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<td>Lesion Lateral Meniscus</td>
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<td>1</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>7</td>
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<tr>
<td>Lesion Both Menisci</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
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<td>18</td>
<td>9</td>
<td>1</td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>
Table 26

<table>
<thead>
<tr>
<th>Arthroscopy</th>
<th>No Meniscal Lesion</th>
<th>Lesion Medial Meniscus</th>
<th>Lesion Lateral Meniscus</th>
<th>Lesion Both Menisci</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthroscopy</td>
<td>6</td>
<td>1</td>
<td>9</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Arthrotomy</td>
<td>1</td>
<td>17</td>
<td>9</td>
<td>1</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 26 shows that a lesion of the medial meniscus was arthroscopically misinterpreted in 1 case. This was a lesion of the anterior horn of the medial meniscus, assessed as positive at arthrography and arthrotomy but as negative at arthroscopy: an error score of arthroscopy for meniscal lesion of 3% (1 out of 34). Table 25 indicates that the results of arthrography were very poor.

Of the 34 arthograms, 13 were misinterpreted versus arthrotomy: a negative score of 38.2%. The distribution of these incorrect diagnoses was as follows.

Medial meniscal lesion:
- 1 case: positive arthrogram, but arthroscopy/arthrotomy negative;
- 1 case: positive arthrogram, but arthroscopy/arthrotomy showed lateral meniscal lesion;
- 1 case: positive arthrogram, but arthroscopy/arthrotomy showed lesion of both menisci;
- 5 cases: negative arthrogram, but arthroscopy/arthrotomy positive.

Lateral meniscal lesion:
- 1 case: positive arthrogram, but arthroscopy/arthrotomy negative;
- 1 case: positive arthrogram, but arthroscopy/arthrotomy showed medial meniscal lesion;
- 3 cases: negative arthrogram, but arthroscopy/arthrotomy positive.

- Most arthograms proved to have been made with air or contrast medium. The images were often ill-defined, and sometimes an excess of contrast medium had obviously been injected, which led to misinterpretation by the radiologist.

- Both arthroscopy and arthrotomy revealed abnormalities of cartilage and cruciate ligaments in 15 of these 34 patients (44%). The localization of the chondropathic changes is shown in table 27.

Table 27

<table>
<thead>
<tr>
<th>Condition</th>
<th>Arthroscopy</th>
<th>Arthrotomy</th>
<th>% of Patients with Chondropathic Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patellar Chondropathy</td>
<td>7</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Chondropathy Medial Compartment</td>
<td>10</td>
<td>10</td>
<td>29.4</td>
</tr>
<tr>
<td>Chondropathy Lateral Compartment</td>
<td>4</td>
<td>4</td>
<td>11.7</td>
</tr>
<tr>
<td>Loose Cartilage Shreds</td>
<td>1</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>Ligament Lesion (Total)</td>
<td>2</td>
<td>2</td>
<td>5.8</td>
</tr>
</tbody>
</table>
A patellar chondropathy was found in 7 of the 34 patients; 10 showed chondropathy of the medial articular compartment, and 4 chondropathy of the lateral compartment. All chondropathic changes found at arthroscopy were confirmed at arthrotomy. In 2 of these 34 patients, however, the anterior cruciate ligament was insufficiently assessable due to synovial hypertrophy. At arthrotomy the cruciate ligaments were found to be intact. Table 27 clearly demonstrates the large percentage of chondropathic changes observed.

<table>
<thead>
<tr>
<th>additional lesions</th>
<th>principal diagnosis at arthroscopy/arthrotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>patellar chondropathy</td>
<td>patellar lesion med. lesion lat. lesion both meniscus menisci ligament lesion total</td>
</tr>
<tr>
<td></td>
<td>chondrop. meniscus meniscus menisci menisci menisci</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

- Table 28 shows which chondropathic changes were observed in association with the principal diagnosis. The table shows that the 29 patients with a meniscal lesion (1 had been previously operated on) included 5 (17.2%) in whom a patellar chondropathy could be diagnosed as well. Of 20 patients with a medial meniscal lesion (1 previously operated on), 9 (45%) proved also to have a chondropathy of the medial compartment. Of 10 patients with a lateral meniscal lesion, 2 proved to have a chondropathy of the lateral articular compartment. The 13 patients in whom a discrepancy was found between arthrography on the one hand and arthroscopy/arthrotomy on the other, were examined 6-24 months after operation.

<table>
<thead>
<tr>
<th>good symptom-free symptoms unchanged not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
</tr>
</tbody>
</table>

- Table 29 shows that 11 of these 13 patients were subjectively free of symptoms. A follow-up was made also on the 15 patients in whom operation had revealed chondropathic changes in addition to the meniscal lesion (table 30). In 13 of these 15 patients in whom severe chondropathic changes had been shaved after total or partial meniscectomy, symptoms were absent after the intervention. However, the follow-up has been too short (6-24 months) to warrant definite conclusions from these results.
<table>
<thead>
<tr>
<th>Table 20</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Injury</strong></td>
</tr>
<tr>
<td>no lesion</td>
</tr>
<tr>
<td>lesion lat meniscus</td>
</tr>
<tr>
<td>lesion med meniscus</td>
</tr>
<tr>
<td>lesion both menisci</td>
</tr>
<tr>
<td>chondropathy</td>
</tr>
<tr>
<td>patella</td>
</tr>
<tr>
<td>ligament lesion</td>
</tr>
<tr>
<td>previous meniscectomy</td>
</tr>
<tr>
<td>total</td>
</tr>
</tbody>
</table>

- A. 34 knees, arthrography (Thijn), arthroscopy, arthrotomy.

- B. Table 31.

- C. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- D. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- E. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- F. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- G. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- H. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- I. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- J. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- K. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- L. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- M. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- N. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- O. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- P. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- Q. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- R. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- S. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- T. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- U. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- V. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- W. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- X. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- Y. Not available (1) previous meniscectomy, degeneration and medial meniscus.

- Z. Not available (1) previous meniscectomy, degeneration and medial meniscus.
Table 32

<table>
<thead>
<tr>
<th>Arthrography</th>
<th>Arthrotomy</th>
<th>No lesion meniscus</th>
<th>Lesion med. meniscus</th>
<th>Lesion lat. meniscus</th>
<th>Lesion both menisci</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No lesion meniscus</td>
<td>4</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Lesion medial meniscus</td>
<td>1</td>
<td>16</td>
<td></td>
<td>1</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Lesion lateral meniscus</td>
<td></td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Lesion both menisci</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>17</td>
<td>11</td>
<td>1</td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

Table 33

<table>
<thead>
<tr>
<th>Arthroscopy</th>
<th>Arthrotomy</th>
<th>No lesion meniscus</th>
<th>Lesion med. meniscus</th>
<th>Lesion lat. meniscus</th>
<th>Lesion both menisci</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No lesion meniscus</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Lesion medial meniscus</td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Lesion lateral meniscus</td>
<td></td>
<td></td>
<td>11</td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Lesion both menisci</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>17</td>
<td>11</td>
<td>1</td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

- Tables 32 and 33 would seem to warrant the following conclusions:
  1) there were no errors in diagnosis of meniscal lesion by arthroscopy versus arthrotomy;
  2) of the 34 arthograms, 5 were misinterpreted:
    a. medial meniscal lesion:
       1 positive arthrogram but negative arthroscopy/arthrotomy
       1 positive arthrogram but arthroscopy/arthrotomy showed lateral meniscal lesion.
    b. lateral meniscal lesion:
       1 negative arthrogram but positive arthroscopy/arthrotomy
    c. lesion of both menisci:
       2 positive arthograms: arthroscopy/arthrotomy showing only a lateral meniscal lesion in 1
       and only a medial meniscal lesion in 1 case.
The arthrograms were obtained by the double-contrast method, which proved to be a substantial improvement. The arthrographic features were clear and easily surveyed, in contrast to the features in the cases of series A.1. Despite the quality of the arthrograms, they had a negative score of 14.7% (5 out of 34) versus arthrotomy for meniscal lesions. Arthroscopy made it possible to establish why the arthrograms had been misinterpreted. Misinterpretation of medial meniscal lesions was found to be due to synovial hypertrophy and free-floating cartilage fragments in the joint. The lateral meniscus could not be properly assessed because the central segment of the discoid meniscus could not be seen on the arthrogram, and because a rupture immediately in front of the tendon of the popliteal muscle was confused with the features of an anatomically normal lateral meniscus.

The arthrographic diagnosis 'meniscal lesion' can comprise a wide variety of lesions; it need not be a direct indication for operative therapy because the type, extent and exact localization of a meniscal lesion cannot always be exactly determined from an arthrogram. It is evident that comparison between a two-dimensional arthrogram and a three-dimensional arthroscopy is hardly possible. We considered an arthrogram 'positive' when the radiologist's report mentioned 'meniscal lesion'. Differences in interpretation between arthrography and arthroscopy, however, always remained.
Table 34.
Comparative arthrographic and arthroscopic findings

<table>
<thead>
<tr>
<th>Arthrography</th>
<th>Arthroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. small fragment torn off middle segment medial meniscus</td>
<td>1. torn-off posterior horn</td>
</tr>
<tr>
<td>2. lesion central margin</td>
<td>2. torn-off middle segment and posterior horn; 2 corpora libera</td>
</tr>
<tr>
<td>3. dubious rupture in lateral meniscus</td>
<td>3. rupture in posterior horn lat.men.</td>
</tr>
<tr>
<td>4. rupture in posterior horn</td>
<td>4. minute 'rupture' in interface between posterior horn and wall; posterior horn not luxable; at arthrotomy small hook inserted into small rupture; posterior horn not luxable; meniscectomy; follow-up: increased symptoms</td>
</tr>
<tr>
<td>5. rupture in middle segment</td>
<td>5. bucket-handle lesion</td>
</tr>
<tr>
<td>6. lesion medial and lateral meniscus</td>
<td>6. small tear posterior horn medial meniscus; large tear posterior horn lateral meniscus; meniscus luxable; only lateral meniscectomy; follow-up after about a year; very good</td>
</tr>
<tr>
<td>7. lesion discoid lateral meniscus</td>
<td>7. lesion non-discoid lateral meniscus</td>
</tr>
<tr>
<td>8. lesion middle segment cystic lateral meniscus</td>
<td>8. fishmouth rupture posterior horn discoid lateral meniscus</td>
</tr>
<tr>
<td>9. lesion middle segment meniscus (no loose fragments)</td>
<td>9. bucket-handle lesion with turned-up fragment along outside femoral condyle</td>
</tr>
<tr>
<td>10. fishmouth rupture posterior horn lateral meniscus</td>
<td>10. rupture middle segment lateral meniscus with pendulent loose fragment</td>
</tr>
<tr>
<td>11. longitudinal rupture posterior horn lateral meniscus</td>
<td>11. fishmouth rupture posterior horn lateral meniscus</td>
</tr>
<tr>
<td>12. fishmouth rupture lateral meniscus</td>
<td>12. bucket-handle lesion lateral meniscus</td>
</tr>
<tr>
<td>13. fishmouth rupture medial meniscus without luxated fragment</td>
<td>13. bucket-handle lesion medial meniscus with intercondylar luxation fragment</td>
</tr>
<tr>
<td>14. fishmouth rupture posterior horn lateral meniscus</td>
<td>14. lesion posterior horn discoid lateral meniscus, with stacked fragments</td>
</tr>
</tbody>
</table>
Table 34 gives an impression of the relation between arthrogramic and arthroscopic interpretation for 14 positive arthrograms (diagnosis: 'meniscal lesion'). This comparative survey clearly demonstrates the discrepancy between arthrogramic and arthroscopic results. The arthroscopic diagnosis always corresponded exactly with the diagnosis made at arthrotomy. This means that an indication for operative therapy can be determined with the aid of arthroscopy. Apart from possible meniscal lesions, Thijn attempted to visualize changes in other structures (cartilage, cruciate ligaments) on the arthrogram. He mentions the presence or absence of such changes for 31 of the 34 arthrograms. Patellar chondropathy was arthrographically diagnosed in 7 cases, while arthroscopy and arthrotomy gave this diagnosis in 10 cases.

Table 35

<table>
<thead>
<tr>
<th>Arthroscopy</th>
<th>Patellar chondropathy pos</th>
<th>Patellar chondropathy neg</th>
<th>Chondrop med comp pos</th>
<th>Chondrop med comp neg</th>
<th>Chondrop lat comp pos</th>
<th>Chondrop lat comp neg</th>
<th>Lesion cruc ligam</th>
<th>No lesion cruc ligam</th>
<th>Corp lib pos</th>
<th>Corp lib neg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthrotomy</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Patellar chondropathy pos</td>
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<td>3</td>
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<td></td>
</tr>
<tr>
<td>Patellar chondropathy neg</td>
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<td>1</td>
<td></td>
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<td></td>
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<tr>
<td>Chondrop med comp pos</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Chondrop med comp neg</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Chondrop lat comp pos</td>
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<tr>
<td>Chondrop lat comp neg</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesion cruc ligament</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No lesion cruc ligament</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corp lib pos</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corp lib neg</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 35a

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patellar chondrop. pos.</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patellar chondrop. neg.</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chondrop. med. comp. pos.</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chondrop. med. comp. neg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chondrop. lat. comp. pos.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chondrop. lat. comp. neg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesion cruciate ligament</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No lesion cruciate ligament</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corpus liberum pos.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Corpus liberum neg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

- Table 35 shows that the arthrographic diagnosis 'patellar chondropathy' was arthroscopically and arthrotomically confirmed in 4 cases. If we add the cases in which arthrography nor arthroscopy and arthrotomy revealed patellar chondropathy, the arthrographic score reads 71% (22 out of 31). It is even more difficult to diagnose chondropathic changes in the medial articular compartment on the basis of the arthrogram. Table 35a shows that this was possible in only 20% of cases.

- The arthrogram revealed no abnormalities of the cruciate ligaments, nor were corpora libera visible.
Table 36

<table>
<thead>
<tr>
<th>number of patients</th>
<th>additional diagnosis</th>
<th>patellar lesion med</th>
<th>lesion lat</th>
<th>lesion both cruciate ligament lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>patellar chondrop.</td>
<td>3</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>chondrop.med.comp.</td>
<td>2</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>chondrop.lat.comp.</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>loose cartilage shreds</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>cruc.ligament lesion</td>
<td></td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

- Table 36 shows that chondropathic changes and lesions of the cruciate ligaments occurred mainly in association with a principal diagnosis of medial meniscal lesion. Of 30 patients with a meniscal lesion (1 previously operated on), 7 (23.3%) were found to have a patellar chondropathy. Of 19 patients with a medial meniscal lesion (1 previously operated on), 7 (36.8%) had a chondropathy of the medial articular compartment. Of 12 patients with a lateral meniscal lesion, 1 (8.3%) had a chondropathy of the lateral compartment.

Table 37

<table>
<thead>
<tr>
<th>number of patients</th>
<th>good</th>
<th>symptom-free</th>
<th>symptoms unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

- Table 37 reveals a high therapeutic success rate in spite of the discrepancy between arthrographic findings on the one hand, and those of arthroscopy and arthrotomy on the other.

Table 38

<table>
<thead>
<tr>
<th>number of patients</th>
<th>patients' subjective findings</th>
<th>type of lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>good</td>
<td>5 medial meniscal lesion and slight chondropathy of patella and med. femoral condyle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 medial meniscal lesion and cruciate ligament lesion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 severe patellar chondropathy (shaved)</td>
</tr>
<tr>
<td>4</td>
<td>satisfied</td>
<td>2 medial meniscal lesion and slight chondropathy of med. temporal condyle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 patellar chondropathy and slight chondropathy of med. temporal condyle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 lateral meniscal lesion and chondropathy of lat. femoral condyle with cruciate ligament lesion</td>
</tr>
<tr>
<td>2</td>
<td>unchanged</td>
<td>1 medial meniscal lesion and patellar chondropathy (not shaved)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 lateral meniscal lesion and slight patellar chondropathy</td>
</tr>
</tbody>
</table>
The data presented in table 38 were obtained in a follow-up on 15 patients with articular chondropathic changes in addition to meniscal lesions. The 5 patients in table 37 were summoned for a follow-up because there had been a discrepancy between arthographic and arthroscopic/arthrotomic findings. The table shows that 4 of these patients were well 6–48 months after operation. The patient whose symptoms remained unchanged had been treated for a lateral meniscal lesion with patellar chondropathy.

**Complications**
- None were observed.

**Conclusion**
- This series shows that arthroscopy nearly always made it possible to detect a meniscal lesion and that a correct operative indication could be determined. In only one instance was a chondropathy of the medial articular compartment misinterpreted at arthroscopy. Lesions of the cruciate ligaments and corpora libera could be observed and localized.
- By double-contrast arthrography, a meniscal lesion was demonstrable in 85.3% of cases. Interpretation of arthographic features, however, is exceedingly difficult and often is not borne out by arthroscopic findings. Chondropathic changes are not readily visible on the arthrogram, and lesions of the cruciate ligaments and non-osseous corpora libera are not visible at all on the arthrogram.

A.3. **37 knees (no arthrography), arthroscopy and arthrotomy**
- The group of 37 patients examined only by arthroscopy and at arthrotomy shows a quite different composition (table 39).

<table>
<thead>
<tr>
<th>lesion</th>
<th>clinical diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>patellar chondropathy</td>
<td>4 5</td>
</tr>
<tr>
<td>chondropathy patella +med. compartment</td>
<td>-- 1</td>
</tr>
<tr>
<td>medial meniscal lesion</td>
<td>7 9</td>
</tr>
<tr>
<td>lateral meniscal lesion</td>
<td>2 1</td>
</tr>
<tr>
<td>cruciate ligament lesion</td>
<td>3 1</td>
</tr>
<tr>
<td>lesion medial meniscus + cruciate ligament</td>
<td>-- 1</td>
</tr>
<tr>
<td>lesion lateral meniscus + cruciate ligament</td>
<td>-- 2</td>
</tr>
<tr>
<td>osteochondritis dissecans with corpus liberum</td>
<td>7 7</td>
</tr>
<tr>
<td>without corpus liberum</td>
<td>5 5</td>
</tr>
<tr>
<td>corpus liberum + chondropathy medial compartment</td>
<td>1 1</td>
</tr>
<tr>
<td>rheumatoid arthritis</td>
<td>1 1</td>
</tr>
<tr>
<td>synovial tumour</td>
<td>1 --</td>
</tr>
<tr>
<td>haematoma suprapatellar bursa</td>
<td>-- 1</td>
</tr>
<tr>
<td>no diagnosis</td>
<td>1 --</td>
</tr>
<tr>
<td>no diagnosis (previous meniscectomy)</td>
<td>5 --</td>
</tr>
<tr>
<td>synovial osteochondromatosis</td>
<td>-- 1</td>
</tr>
<tr>
<td>lateral posterior horn left in situ</td>
<td>-- 1</td>
</tr>
</tbody>
</table>

| total number of patients | 37 37 |
An arthrotomy was performed for meniscal lesions in 13 of these patients.

### Table 40

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthroscopy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesion Medial Meniscus</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Lesion Lateral Meniscus</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Intact Medial Meniscus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intact Lateral Meniscus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>3</td>
<td></td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>

### Table 41

<table>
<thead>
<tr>
<th>Clinical Diagnosis</th>
<th>Lesion Med. Meniscus</th>
<th>Lesion Lat. Meniscus</th>
<th>Intact Med. Meniscus</th>
<th>Intact Lat. Meniscus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthrotomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesion Medial Meniscus</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Lesion Lateral Meniscus</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Intact Medial Meniscus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Intact Lateral Meniscus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>3</td>
<td></td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>

In 5 of the 13 patients with a meniscal lesion (38.4%) the diagnosis could not be made on the basis of physical findings. The arthroscopic findings always corresponded with those at arthrotomy (tables 40 and 41). Patients in whom osteochondritis dissecans with or without corpus liberum had already been clinically diagnosed, were submitted to arthroscopy in order to assess the condition of the cartilage and to establish whether corpora libera could be observed (with a view to the choice of the arthrotomy incision).
It is apparent from table 42 that physical examination failed to reveal a corpus liberum in 4 cases, and that it indicated a corpus liberum in 1 case which was found absent at arthrotomy.

Table 43 shows that, of the 9 corpora libera, 1 was overlooked at arthroscopy. In this series arthroscopy disclosed a lesion of the cartilaginous wall in 4 cases; cruciate ligament lesions were confirmed at arthrotomy. In this series all chondropathic changes of patella and articular surfaces observed through the arthroscope, were confirmed at arthrotomy.
# Table 44

16 patients with patellar chondropathy in association with the following arthroscopic/arthrotomic diagnoses:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patellar chondropathy</td>
<td>6</td>
</tr>
<tr>
<td>Medial meniscal lesion</td>
<td>2</td>
</tr>
<tr>
<td>Lateral meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>1</td>
</tr>
<tr>
<td>Osteochondritis dissecans with corpus liberum</td>
<td>2</td>
</tr>
<tr>
<td>Osteochondritis dissecans without corpus liberum</td>
<td>2</td>
</tr>
<tr>
<td>Corpus liberum (only)</td>
<td>1</td>
</tr>
<tr>
<td>Synovial osteochondromatosis</td>
<td>1</td>
</tr>
</tbody>
</table>

12 patients with chondropathy medial compartment in association with the following arthroscopic/arthrotomic diagnoses:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patellar chondropathy</td>
<td>1</td>
</tr>
<tr>
<td>Medial meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>Osteochondritis dissecans with corpus liberum</td>
<td>3</td>
</tr>
<tr>
<td>Osteochondritis dissecans without corpus liberum</td>
<td>5</td>
</tr>
<tr>
<td>Corpus liberum (only)</td>
<td>1</td>
</tr>
<tr>
<td>Synovial osteochondromatosis</td>
<td>1</td>
</tr>
</tbody>
</table>

4 patients with chondropaty lateral articular compartment in association with the following arthroscopic/arthrotomic diagnosis:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>Lateral posterior horn left in situ</td>
<td>1</td>
</tr>
<tr>
<td>Osteochondritis dissecans with corpus liberum</td>
<td>2</td>
</tr>
</tbody>
</table>

4 patients with cruciate ligament lesion in association with the following arthroscopic/arthrotomic diagnosis:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>Lateral meniscal lesion</td>
<td>2</td>
</tr>
<tr>
<td>Cruciate ligament lesion</td>
<td>1</td>
</tr>
</tbody>
</table>

3 patients with detached cartilage fragments washed out in association with the following arthroscopic/arthrotomic diagnosis:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>Lateral meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>Cruciate ligament lesion</td>
<td>1</td>
</tr>
</tbody>
</table>
6 patients with chondropathy of the patella and medial articular compartment in association with the following arthroscopic/arthrotomic diagnosis:

- osteochondritis dissecans with corpus liberum: 3 cases
- medial meniscal lesion: 1 case
- patellar chondropathy: 1 case
- synovial osteochondromatosis: 1 case

2 patients with chondropathy of the patella and lateral articular compartment in association with the following arthroscopic/arthrotomic diagnosis:

- status after medial meniscectomy and cruciate ligament lesion: 1 case
- osteochondritis dissecans with corpus liberum: 1 case

13 patients with no chondropathic changes of the articular cartilage and an arthroscopic/arthrotomic diagnosis of:

- medial meniscal lesion: 7 cases
- lateral meniscal lesion: 1 case
- medial meniscal lesion in combination with cruciate ligament lesion: 1 case
- osteochondritis dissecans without corpus liberum: 1 case
- hematoma in suprapatellar bursa: 1 case

- Table 44 also shows the high rate of chondropathic changes in the 37 patients examined: 24 cases. A meniscal lesion was found in 13 of these 37 patients (table 40). Table 44 shows that 3 of these 13 patients had a patellar chondropathy as well. Of 10 patients with a medial meniscal lesion, 1 had a chondropathy of the medial articular compartment. Of 3 patients with a lateral meniscal lesion, 1 showed a chondropathy of the lateral articular compartment.

- Table 45 presents the findings at follow-up on 37 patients 6-24 months after operation.

### Table 45

<table>
<thead>
<tr>
<th>number of patients</th>
<th>patients' subjective findings</th>
<th>diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>good</td>
<td>3 osteochondritis dissecans with corpus liberum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 osteochondritis dissecans without corpus liberum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 medial meniscus lesion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 lateral meniscal lesion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 lesion of lateral meniscus and cruciate ligament</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 corpus liberum (only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 haematoma in suprapatellar bursa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 synovial osteochondromatosis</td>
</tr>
</tbody>
</table>
Complications

- None were observed.

Conclusions

- The results obtained in the 105 patients of series A. 1, A. 2 and A. 3 of group IV, in whom the arthroscopic changes were compared with the changes found at arthrotomy, would seem to warrant the following conclusions.

1. The diagnosis of meniscal lesions exclusively on the basis of physical examination leads to unacceptably poor results. The clinical diagnosis was found to have been correct in only 39 of the 70 cases (55.7%) in which an arthrotomy was performed for meniscal lesion.

2. On the basis of arthograms made elsewhere, a correct diagnosis could be made in 61.8% of cases. With the arthograms made by Thijn, the diagnostic success rate was 85.3%. The diagnostic success rate of arthroscopy proved to be 98.5%; only 1 of the 70 meniscal lesions was misdiagnosed.

3. Arthography has so far been unsatisfactory as an aid in diagnosing chondropathies. Non-osseous corpora libera and cruciate ligament lesions were not at all visible on the arthrogram. A chondropathy of the medial femoral condyle was arthroscopically misdiagnosed in 1 case.

4. Of 72 patients with a meniscal lesion (2 with previous operation), 15 (20.8%) were found also to have a patellar chondropathy. Of 49 patients with a medial meniscal lesion (2 with previous operation), 17 (34.6%) were found also to have a chondropathy of the medial articular compartment. Of 25 patients with a lateral meniscal lesion, 5 (20%) were found also to have a chondropathy of the lateral articular compartment. The total number of meniscal lesions was 74 (lateral and medial): 2 patients were found to have lesions of both the medial and the lateral meniscus.

- Series B comprised 83 patients in whom no arthrotomy was performed. The patients were divided into the following subgroups.
  B.4. 28 knees, arthography (elsewhere), arthroscopy.
  B.5. 17 knees, arthography (Thijn), arthroscopy.
  B.6. 38 knees, arthroscopy.

B.4. 28 knees, arthography (elsewhere), arthroscopy.
Table 46

<table>
<thead>
<tr>
<th>number of patients</th>
<th>clinical diagnosis</th>
<th>meniscal lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>arthrography</td>
</tr>
<tr>
<td></td>
<td></td>
<td>none</td>
</tr>
<tr>
<td>6</td>
<td>patellar chondropathy</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>none (previous meniscectomy)</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>ligament lesion</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>none</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>lateral meniscal lesion</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>cystic lateral meniscus</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 46 shows a high rate of failure of physical diagnosis (14 of 28 patients: 50%). An arthrogram of the knee had been made at the request of the referring surgeon in all cases. The radiological expertise mentioned a medial meniscal lesion in 5 cases, lateral meniscal lesion in 2 cases, discoid lateral meniscus without rupture in 1 case, and cystic lateral meniscus without rupture in 1 case. Arthroscopy, however, showed absence of any meniscal lesion in 7 cases; it confirmed the discoid lateral meniscus, but showed that the cystic lateral meniscus was degenerated rather than cystic. Arthroscopy showed that 7 of the 28 arthrograms (25%) had been misinterpreted. Chondropathic changes were not mentioned in the arthographic expertise.

Table 47

<table>
<thead>
<tr>
<th>number of patients</th>
<th>clinical diagnosis</th>
<th>arthroscopic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>none</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>none</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>none (previous meniscectomy)</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>patellar chondropathy</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>medial meniscal lesion</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>cystic lateral meniscus</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>cruciate ligament lesion</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 47 shows the large number of chondropathic changes in this group. Chondropathic changes were found in 6 of the 14 cases (42.8%) in which no clinical diagnosis could be made: patellar chondropathy in 2, chondropathy of the medial articular compartment in 2, and chondropathy of the patella and both compartments in 2 cases. In only 4 of the 6 cases in which patellar chondropathy was clinically diagnosed, was the diagnosis confirmed at arthroscopy. In 1 case a clinically diagnosed medial meniscal lesion proved at arthroscopy to be a chondropathy of the patella. In 2 cases a cruciate ligament lesion was clinically diagnosed: arthroscopy confirmed the diagnosis in 1 case, but revealed an intact ligament in the other.
In 2 of the 28 cases cartilaginous debris was washed out of the knee-joint at arthroscopy. The arthroscopic diagnoses were: chondropathy of the patella in 1 case, and chondropathy of the patella and both articular compartments in 1 case. It is to be noted that both patients were free of symptoms after irrigation of the joint.

### Table 48.
Follow-up

<table>
<thead>
<tr>
<th>patients’ subjective findings</th>
<th>arthroscopic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 good</td>
<td>4 no lesion</td>
</tr>
<tr>
<td></td>
<td>3 patellar chondropathy</td>
</tr>
<tr>
<td></td>
<td>1 chondropathy of patella and both articular compartments</td>
</tr>
<tr>
<td></td>
<td>1 discoid lateral meniscus</td>
</tr>
<tr>
<td>7 satisfied (symptoms upon exertion)</td>
<td>4 no lesions</td>
</tr>
<tr>
<td></td>
<td>3 patellar chondropathy</td>
</tr>
<tr>
<td></td>
<td>1 patellar chondropathy (previous meniscectomy)</td>
</tr>
<tr>
<td></td>
<td>1 chondropathy of medial compartment</td>
</tr>
<tr>
<td>5 unchanged</td>
<td>1 no lesions</td>
</tr>
<tr>
<td></td>
<td>2 chondropathy of patella and both articular compartments</td>
</tr>
<tr>
<td></td>
<td>1 patellar chondropathy</td>
</tr>
<tr>
<td></td>
<td>1 degeneration lateral articular compartment</td>
</tr>
<tr>
<td>7 not available</td>
<td>5 no lesions</td>
</tr>
<tr>
<td></td>
<td>1 chondropathy of patella and medial compartment</td>
</tr>
<tr>
<td></td>
<td>1 cruciate ligament lesion</td>
</tr>
</tbody>
</table>

Table 48 presents a survey of the findings obtained 6-24 months after arthroscopy. All patients examined only by arthroscopy were treated by the physiotherapist after this procedure.

Of these patients, 7 did not report for follow-up. Two patients (one with combined chondropathy of patella and medial articular compartment and one with a cruciate ligament lesion) were referred back to the surgeon who had originally referred them to us. Of the 5 patients in whom arthroscopy revealed no lesion, 2 proved to have psychological problems. A striking finding was that 16 of the 28 patients in this group became symptom-free after diagnostically arthroscopy and postarthroscopic physiotherapy. The rationale of the therapeutic effect after arthroscopy is still to be studied.

B.5. 17 knees, arthrography (Thijn), arthroscopy
<table>
<thead>
<tr>
<th>number of patients</th>
<th>clinical diagnosis</th>
<th>arthrography</th>
<th>arthroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>none</td>
<td>3 none</td>
<td>3 none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 medial meniscal lesion</td>
<td>2 chondrop. patella + both comp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 patellar chondropathy</td>
<td>1 cruciate ligament lesion</td>
</tr>
<tr>
<td>4</td>
<td>none</td>
<td>1 none</td>
<td>1 chondrop. medial compartment</td>
</tr>
<tr>
<td></td>
<td>(previous meniscectomy)</td>
<td>1 chondrop. med. compartment</td>
<td>1 chondrop. patella + both comp.</td>
</tr>
<tr>
<td></td>
<td>(med. 3)</td>
<td>1 chondrop. patella + both comp.</td>
<td>1 chondrop. patella + both comp. + cruciate ligament lesion</td>
</tr>
<tr>
<td></td>
<td>(lat. 1)</td>
<td>1 chondrop. patella + lat. comp.</td>
<td>1 chondrop. patella + both comp. without cruciate ligament lesion</td>
</tr>
<tr>
<td>2</td>
<td>medial meniscal lesion</td>
<td>1 medial meniscal lesion</td>
<td>1 chondrop. medial compartment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 none</td>
<td>1 none</td>
</tr>
<tr>
<td>2</td>
<td>lateral meniscal lesion</td>
<td>1 none</td>
<td>1 none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 patellar chondropathy</td>
<td>1 chondrop. patella + partial cruciate ligament lesion</td>
</tr>
<tr>
<td>2</td>
<td>ligament lesion</td>
<td>1 none</td>
<td>1 none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 medial meniscal lesion (dub)</td>
<td>1 chondrop. med. comp. + debns</td>
</tr>
<tr>
<td>1</td>
<td>patellar chondropathy</td>
<td>1 discoid lateral meniscus</td>
<td>1 none</td>
</tr>
</tbody>
</table>

**Table 50**

<table>
<thead>
<tr>
<th>clin. diagnosis</th>
<th>arthroscopy</th>
<th>no meniscal lesion</th>
<th>medial meniscal lesion</th>
<th>lateral meniscal lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>no meniscal lesion</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>medial meniscal lesion</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lateral meniscal lesion</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 51

<table>
<thead>
<tr>
<th>Arthrography</th>
<th>Arthroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No meniscal lesion</td>
<td></td>
</tr>
<tr>
<td>Medial meniscal lesion</td>
<td>12</td>
</tr>
<tr>
<td>Lateral meniscal lesion</td>
<td>4</td>
</tr>
<tr>
<td>Discoid lateral meniscus</td>
<td>1</td>
</tr>
</tbody>
</table>

- Table 51 shows that arthrographic expertise mentioned a medial meniscal lesion in 4 of the 17 cases. In 1 case the radiologist seriously doubted the diagnosis. In none of these cases did arthroscopy reveal a medial meniscal lesion. In only 3 cases was a definite statement about medial meniscal lesion made. The error score was therefore 17.6% (3 out of 17). In 1 case the arthrographic expertise mentioned a discoid lateral meniscus which at arthroscopy proved to be normal. Neither arthrography nor arthroscopy disclosed any rupture. Of the 3 faulty arthrograms, 2 concerned a lesion of the anterior horn. It is of importance to note that arthroscopy revealed the reason for arthrographic misinterpretation: synovial hypertrophy in 1 case, and loose shreds of cartilage in 2 cases.

- In addition to meniscal lesions, if any, Thijn mentioned in his arthrographic expertise whether there were changes of the undersurface of the patella or the articular cartilage.

- It is evident from table 49 that arthroscopy was more effective in detecting chondropathic changes than arthrography. Confining ourselves to the various compartments (femoropatellar, medial and lateral compartment), we can deduce the following from table 49.

Chondropathy of the patella:
3 cases: positive arthrography, positive arthroscopy.
1 case: positive arthrography, negative arthroscopy.
3 cases: negative arthrography, positive arthroscopy.

- Of the 7 arthrograms, 4 had been misinterpreted as demonstrated by the arthroscopic findings on patellar chondropathy.

Chondropathy of the medial femoral condyle:
3 cases: positive arthrography, positive arthroscopy.
2 cases: negative arthrography, positive arthroscopy.

- Of the 5 arthrograms, 2 had been misinterpreted as demonstrated by the arthroscopic findings on chondropathy of the medial femoral condyle.

Chondropathy of the lateral femoral condyle:
1 case: positive arthrography, positive arthroscopy.
1 case: negative arthrography, positive arthroscopy.

- Of the 2 arthrograms, 1 had been misinterpreted as demonstrated by the arthroscopic findings on chondropathy of the lateral femoral condyle.
Cruciate ligaments:
3 cases: negative arthrography, positive arthroscopy.
- Lesions of the cruciate ligaments were not visible on the arthrograms.

- In 3 of the 17 patients, cartilaginous debris was washed out of the joint. The debris was present in the following arthroscopic diagnoses:
  1) chondropathy of patella and medial femoral condyle, with degeneration of the meniscus;
  2) patellar chondropathy;
  3) chondropathy of the medial femoral condyle.

- That chondropathic changes of the patella, medial compartment, lateral compartment, and lesions of the cruciate ligaments occurred in combination with several other articular chondropathic changes is evident also from table 49. Of the 17 patients, 14 were followed up (6–24 months) after arthroscopy. All patients were given physiotherapy after arthroscopy.

- Follow-up 6–24 months after arthroscopy in 3 patients who showed a discrepancy between arthographic and arthroscopic diagnosis, revealed that 2 patients were free of symptoms, while the third had symptoms only upon marked exertion. Of the 3 patients in whom cartilaginous debris had been washed out of the joint, 2 were free of symptoms and 1 continued to have the same symptoms.

- The symptom-free patients were mostly those with an arthroscopic diagnosis of patellar chondropathy or patellar chondropathy with chondropathy of the medial compartment and marked degeneration of the medial meniscus. The patient whose symptoms persisted had an arthroscopic diagnosis of degeneration of the cartilage of the medial articular compartment.

<table>
<thead>
<tr>
<th>number of</th>
<th>patients' subjective findings</th>
<th>arthroscopic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>good</td>
<td>2 no lesions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 chondropathy medial femoral condyle (comp.)</td>
</tr>
<tr>
<td>8</td>
<td>symptom-free</td>
<td>2 no lesions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 chondropathy of patella and both compartments, cruciate ligament lesion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 chondropathy of patella and both compartments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 chondropathy medial femoral condyle (comp.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 cruciate ligament lesion</td>
</tr>
<tr>
<td>3</td>
<td>unchanged</td>
<td>1 no lesions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 chondropathy of patella and lateral compartment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 chondropathy of medial compartment</td>
</tr>
<tr>
<td>3</td>
<td>not available</td>
<td>2 no lesions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 chondropathy of patella and partial cruciate ligament lesion</td>
</tr>
</tbody>
</table>

Complications
- No complications were observed in group B.5 (specifically: no infection).
**Conclusion**

- In series A.1, A.2 and A.3 of group IV (105 patients in whom the arthroscopic diagnosis was compared with the arthrotomic diagnosis), it was found that arthroscopy always disclosed chondropathic changes, and meniscal lesions in 98.5% of cases. We initially assumed an arthroscopic diagnosis to be correct when it was confirmed by arthrotomy. In the group of 105 patients it was found, however, that the arthroscopically diagnosed intra-articular lesion was invariably present at arthrotomy. It seemed evident that the arthroscopic diagnosis was equivalent to the arthrotomic diagnosis. At this point we would go further and maintain that the arthroscopic diagnosis is superior to the arthrotomic diagnosis. As already pointed out in the introduction, the entire interior of the knee-joint can be inspected at arthrotomy only if the knee is very amply opened.

- In series A.1, arthrography (elsewhere) scored 61.8% for meniscal lesion, the corresponding score in series B.4 being 75%. In series A.2, arthrography (Thijn) scored 85.3% for meniscal lesion, the corresponding score in series B.5 being 82.4%. In the series B.4 and B.5, too, the large percentage of chondropathic changes stands out. In series B.4, symptoms in 1 case indicating a medial meniscal lesion proved to have been caused by a patellar chondropathy. In series B.4, 12 of the 28 patients showed chondropathic changes, versus 9 out of 17 patients in series B.5. Patellar chondropathy was (exclusively) clinically diagnosed in 36.6% of cases in series B.4. This clinical diagnosis was not made at all in series B.5. The positive arthrographic score for patellar chondropathy was 40% in series A.2 and 44.5% in series B.5. The positive arthrographic score for chondropathy of the medial femoral condyle was 20% in series A.2 and 60% in series B.5. The positive arthrographic score for chondropathy of the lateral femoral condyle was 0% in series A.2 and 50% in series B.5.

- Cruciate ligament lesions and shreds of cartilage were always visible at arthroscopy, but never at arthrography.

**B.6 38 knees, arthroscopy only**

- In this series of 38 patients, only arthroscopy was carried out, for reasons indicated by the referring physicians.

Table 53

<table>
<thead>
<tr>
<th>clinical diagnosis</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>11</td>
</tr>
<tr>
<td>none (previous meniscectomy)</td>
<td>8</td>
</tr>
<tr>
<td>patellar chondropathy</td>
<td>4</td>
</tr>
<tr>
<td>ligament lesion</td>
<td>6</td>
</tr>
<tr>
<td>medial meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>haemophilia</td>
<td>3</td>
</tr>
<tr>
<td>rheumatoid arthritis</td>
<td>2</td>
</tr>
<tr>
<td>synovitis villonodularis pigmentosa</td>
<td>1</td>
</tr>
<tr>
<td>osteochondritis dissecans (without corpus liberum)</td>
<td>1</td>
</tr>
<tr>
<td>foreign body</td>
<td>1</td>
</tr>
</tbody>
</table>

- Table 53 lists the clinical diagnoses. Again we find a strikingly large number of cases in which no clinical diagnosis could be made (19 out of 38). Most of the firstmentioned 11 patients in whom no clinical diagnosis could be made, were young women (about 18 years of age) with complaints involving the patella. A psychological component could not be measured in these cases. The total group of 19 patients without clinical diagnosis, including 8 with a history of meniscectomy, comprised 3 patients referred by the Joint Medical Service and the Board of Appeal with a request exclusively for diagnosis and prognosis.
Table 54

<table>
<thead>
<tr>
<th>clinical diagnosis</th>
<th>arthroscopic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>none</td>
</tr>
<tr>
<td>11 none</td>
<td>8</td>
</tr>
<tr>
<td>8 none</td>
<td>1</td>
</tr>
<tr>
<td>(previous menisc.)</td>
<td>1</td>
</tr>
<tr>
<td>4 patellar chondropathy</td>
<td>2</td>
</tr>
<tr>
<td>6 ligament lesion</td>
<td>3</td>
</tr>
<tr>
<td>1 med. meniscal lesion</td>
<td>1</td>
</tr>
<tr>
<td>30</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 54 shows that in 15 out of 30 cases no arthroscopic diagnosis could be made, and that the other 15 cases showed chondropathic changes in various localizations. The 8 patients with a diagnosis of haemophilia, rheumatoid arthritis, synovitis villonodularis pigmentosa, osteochondritis dissecans (without corpus liberum) and foreign body will be separately discussed at the end of this chapter. In 8 of the 11 patients in whom no clinical diagnosis could be made, arthroscopy likewise failed to supply a diagnosis. Again we find a strikingly large number of chondropathic changes of the patella (sometimes combined with chondropathic changes elsewhere in the joint). This applied to 1 of the 8 patients previously treated by meniscectomy.
Table 55

<table>
<thead>
<tr>
<th>number of patients</th>
<th>clinical diagnosis</th>
<th>arthroscopic diagnosis</th>
<th>follow-up findings</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>good</td>
<td>symptom-free</td>
</tr>
<tr>
<td>11</td>
<td>none</td>
<td>8</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
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<td>patellar chondropathy</td>
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<td>1</td>
<td></td>
</tr>
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<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
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<td>patellar chondropathy</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>lesion ant, cruc. lig.</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
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<td>1</td>
<td></td>
</tr>
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<td></td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>patellar chondropathy</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>5</td>
<td>10</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

*CA = court of appeal  
JMS = joint medial service

Table 55 shows that the arthroscopic diagnosis differed from the clinical diagnosis in 18 of these 30 patients. It is a remarkable fact that 9 of these 18 patients (50%) were free of symptoms after arthroscopy. Of the 12 patients in whom the arthroscopic diagnosis did not differ from the clinical diagnosis, 6 had become symptom-free. However, 3 of these 12 patients were not available for follow-up.

This series of 38 cases comprises 3 patients suffering from haemophilia. These young patients had recurrent haematomas in the knee-joints, and these joints were characterized by marked swelling and limitation of movement. The patients were admitted to our clinic for chemical synovectomy by introduction of radio-active gold into the knee (Driessen's thesis). In order to establish with absolute certainty that the radioactive gold would really be introduced intra-articularly, arthroscopy was first carried out. This made it possible to gain an impression of the condition of the cartilage in the knee-joint. Assessment of the articular cartilage was difficult owing to marked synovial hypertrophy; nor was it possible to observe the cruciate ligaments in these 3 patients. The cartilage of the femorapatellar joint and both articular compartments was only partly visible. The radiological pictures of these 3 youthful patients showed slight degenerative changes of the knee-joint. The arthroscopic observations can be described as follows.
In 1 patient, neither the medial nor the lateral meniscus could be observed owing to marked synovial hypertrophy. The menisci in the other 2 patients showed marked degeneration and pronounced fraying of the internal margins. In each of the 3 patients the undersurface of the patella showed severe degeneration of the cartilage. In 2 patients the cartilage of both articular compartments showed degenerative characteristics. In 1 patient, moreover, the cartilage of the femoral condyles had largely disappeared, and the bone showed numerous small cavities.

Conclusion: In these 3 young patients there was a marked discrepancy between arthroscopic features and radiological changes. A striking feature was the advanced degeneration of the cartilage in each of these patients. In haemophiliac, arthroscopy could be of diagnostic or even of therapeutic value for the following reasons:

1) more detailed information on the condition of the cartilage can be obtained (diagnostic);
2) it proved possible through the arthroscope to take a biopsy specimen from the synovial membrane (diagnostic);
3) radioactive gold can be intra-articularly injected with absolute certainty (therapeutic) (Driessen's thesis).

This group of 38 patients included 2 who were referred to us by the rheumatologist with the question whether a diagnosis of rheumatoid arthritis could be established arthroscopically. In these cases it was not possible arthroscopically to differentiate between rheumatoid arthritis and common synovitis. The synovial villi showed oedematous swelling and hyperaemia, and the synovial membrane showed marked hypertrophy. A finding of special significance was that articular cartilage in these 2 cases showed only slight degenerative changes, although the menisci were markedly degenerated. It was possible to obtain a synovial biopsy specimen through the arthroscope.

Finally, 3 other patients in this group were examined with the following diagnoses;
1) foreign body;
2) synovitis villonodularis pigmentosa;
3) osteochondritis dissecans without corpus liberum.

In the first case, a metal wire fragment could be removed from the joint by means of the arthroscope. This patient had earlier submitted to an operation for a ligament lesion, and a metal wire had been used for surgical repair. A metal fragment had broken off during the phase of postoperative recovery. Arthroscopy located this fragment beneath the posterior horn of the lateral meniscus. It was removed with the aid of the optical biopsy forceps.

The second patient had elsewhere been operated on for synovitis villonodularis pigmentosa. Arthroscopy did not permit of adequate evaluation of the synovial membrane. A biopsy was taken through the arthroscope and examined by the pathologist, who could not confirm the original diagnosis. Apart from slight chondropathic changes of the femoropatellar joint and both articular compartments, arthroscopy yielded no further information in this case.

The third patient was a 15-year-old boy who was admitted with a diagnosis of osteochondritis dissecans. Arthroscopy revealed intact cartilage on the femoral condyle. Follow-up revealed that the focus in the femoral condyle had disappeared spontaneously, and that the diagnosis had been erroneous.

In 3 of the 38 patients in this group, shreds of cartilage were washed out. The findings were as follows.

<table>
<thead>
<tr>
<th>Arthroscopic diagnosis</th>
<th>Patient's report at follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. patellar chondropathy</td>
<td>symptoms only upon exertion</td>
</tr>
<tr>
<td>2. patellar chondropathy</td>
<td>symptoms unchanged</td>
</tr>
<tr>
<td>3. patellar chondropathy</td>
<td>good, free of symptoms</td>
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CHAPTER VIII.

CASE REPORTS

- This chapter presents the course of treatment in 9 random cases in which arthroscopy was performed. One case, in which arthroscopy was likewise performed, was specifically included to illustrate a particular situation.

- The detailed 'exemplary' descriptions are presented:

1) to give an exact account of the preparations for arthroscopic examination, the examination as such, and the post-arthroscopic phase, if necessary;
2) to indicate the significance of the arthroscopy in the constellation of conventional investigations;
3) to facilitate a proper evaluation of the illustrations presented in the final part of this thesis (X-rays, reproductions of colour slides, and drawings). The figures given in brackets always refer to the corresponding illustration.

Patient 1, female aged 19, occupation: hairdresser.

Referred by: Family doctor in consultation with two orthopaedic surgeons with different views, an insurance company and the Board of Appeal.

History

- The patient reported having been bothered by the left knee for a few years. She reported medial slip of the patella a few times a week, causing her 'giving way', with subsequent swelling and pain. There were no symptoms of lock; mobility was always good and walking stairs posed no difficulty. With regard to these complaints she considered herself incapable of continuing work as a hairdresser.

- She had appealed to the Board of Appeal when the Joint Medical Service had pronounced her fit to work. She had (independently) consulted two orthopaedic surgeons, who had reached different conclusions: one surgeon reported in his expertise that no reliable observer had ever seen a patellar luxation, and that his examination had disclosed no abnormalities of the left knee; he believed that the complaints were imaginary and declared the patient fit to work. The other surgeon resolutely diagnosed 'habitual patellar luxation'. We were asked to settle the controversy.

Examination at admission

- The left knee was of normal shape and mobility; no tenderness, no crepitation at movement, no limitation of extension. Collateral and cruciate ligaments intact. No muscular atrophy. Slight axis deviation (about 10° valgus). Slight lateralization of the patella at extension of the knee. No abnormal lateral mobility of the patella.

Radiological examination

- Left and right knee: no abnormalities. Left and right patella in axial view: no abnormalities, specifically no sign of dysplasia. Radiological diagnosis: no abnormalities.

Pre-arthroscopic examination

- Marked lateral mobility of patella, but luxation impossible; no other abnormality.

Arthroscopic examination (Picture 13)


Arthroscopic diagnosis

- Chondropathy of the patella and the lateral aspect of the patellar surface of the femur condyle. These lesions can be explained by recurrent lateral subluxation of the patella.
Further course
– On the basis of our arthroscopic findings an operation was performed elsewhere, and confirmed our diagnosis of chondropathy. At present the patient is free of symptoms and has resumed work as a hairdresser.

Conclusion
– Exclusively on the basis of arthroscopic findings, a definite conclusion could be reached in a legal controversy. In our view the patient's complaints were justified and she was unfit to work as a hairdresser.

Patient 2, male aged 41, occupation: secondary school teacher.

Referred by: Family doctor in consultation with general surgeon who had operated on the patient.

History
– The patient reported having undergone an operation on the right knee because of pain and swelling, mostly upon exertion. The complaints had developed gradually. The right knee-joint had never had an abnormal shape; there had never been limitation of flexion or extension, but crepitation had been noticed during movement. The patient had submitted to operation because of these complaints: lateral meniscectomy.

– We saw the patient 6 months after this operation. He reported that his symptoms had not improved after the operation, but had in fact shown aggravation. The patient was very dissatisfied, reproached the surgeon for having removed the wrong meniscus, and threatened with litigation. Upon our request for information, the surgeon wrote that he had extirpated the lateral meniscus because the arthrogram had shown a rupture in this meniscus.

Examination at admission
– The right knee showed a healed lateral parapatellar cicatrix. Knee-joint swollen, containing a small amount of fluid; tenderness around the patella; crepitation at movement; no limitation of extension; normal mobility; intact collateral and cruciate ligaments. Quadriceps atrophy (1.5 cm). No axis deviation. No abnormal lateral mobility of the patella. No symptoms suggestive of meniscal lesion. Diagnosis: possibly chondropathy of the patella.

Radiological examination
– Left and right knee apparently normal. Left and right patellae apparently normal.

Pre-arthroscopic examination
– Intact ligaments, no symptoms suggestive of meniscal lesion, no abnormal lateral mobility of the patella.

Arthroscopic examination (Picture 15)

Arthroscopic diagnosis
– Marked patellar chondropathy.

Arthrotomy
– The operation confirmed the arthroscopic findings. Treatment: nettoyage of the patella.

Follow-up
– The patient was quite satisfied 2.5 years after operation.

Conclusion
– The fact that the patient was free of symptoms after nettoyage of the patella strongly suggests that the earlier diagnosis was incorrect, and that the lateral meniscectomy may have been without justification.
**Patient** 3, male aged 44, occupation: engineer.

**Referred by:** orthopaedic surgeon.

**History**
- The patient reported having been bothered since a few years by painful swelling of the right knee, mainly upon exertion. He complained of an uncertain feeling in the knee and increased pain when walking stairs. The knee has always shown normal mobility, without limitation of flexion or extension; crepitation was noticed during movement. The patient is uncertain about a previous trauma. He was treated elsewhere by an orthopaedic surgeon.

- The referring orthopaedic surgeon reported having treated the patient over a period of a few years for recurrent hydrops and an uncertain feeling in the right knee; he used ultra-short wave therapy, X-ray therapy, physiotherapy and intra-articular cortisone injections. X-rays and arthograms of the right knee-joint showed slight degenerative changes but no evidence of a meniscal lesion. The referring orthopaedic surgeon was unable to make a diagnosis and suggested a synovial biopsy, possibly followed by synovectomy; he also asked whether an arthroscopic diagnosis could be made.

**Examination at admission**
- The right knee-joint was swollen and contained fluid; the lateral aspect of the patella was tender, and movement was accompanied by crepitation; very slight painful limitation of extension, normal mobility, intact collateral and cruciate ligaments, quadriceps atrophy (2 cm). No axis deviation. Diagnosis: slight degenerative changes in the right knee-joint.

**Radiological examination**
- The right knee showed slight degenerative changes. Arthrography of the right knee (air arthrogram elsewhere): no evidence of a meniscal lesion. Diagnosis: slight degenerative changes in the right knee-joint.

**Laboratory data**
- All serum values were normal. ESR was 4 mm in the first hour. Rheumatic reactions were negative. Pharyngeal swab culture: no pathogenic micro-organisms.

**Pre-arthroscopic examination**
- Intact ligaments; no symptoms of a meniscal lesion; no abnormal lateral mobility of the patella.

**Arthroscopic examination (Pictures 25–31)**
- Suprapatellar recess: moderate synovitis; synovial villi showed marked hyperemia and oedematous swelling; villi not truncated or necrotic. Patella: marked chondropathy. Patellar surface of the femoral condyles: marked chondropathy. Medial articular compartment: chondropathy, large longitudinal rupture in cartilage of femoral condyle; intact meniscus which was in its normal position. Intercondylar space: intact anterior cruciate ligament. Lateral articular compartment: very slight chondropathy; intact meniscus in normal position.

- Three synovial biopsy specimens were obtained through the arthroscope. Results (Pathological Anatomical Laboratory, University of Groningen): microscopic examination showed that each of the three small tissue fragments consisted of synovial membrane with oedematous and polypous swelling of its entire surface, and covered with largely lymphocytic infiltrate in some parts. This was a relatively moderate common chronic synovitis. There was no histological evidence of rheumatoid arthritis or any other specific affection. Pathological anatomical diagnosis: chronic non-specific synovitis.

**Arthroscopic diagnosis**
1. Moderate synovitis.
2. Severe chondropathy of the patella and femur groove.
3. Chondropathy and large longitudinal rupture of the cartilage of the medial femoral condyle; both menisci intact.

**Conclusion**
- Clinical, X-ray, arthographic and laboratory findings did not lead to a correct diagnosis. Arthroscopy made it possible to diagnose a severe chondropathy of the femoropatellar joint and the medial femoral condyle. The patient was referred back to the orthopaedic surgeon, who could then give the proper operative treatment.
Patient 4, male aged 45. occupation: civil servant.

Referred by: family doctor.

History
- The patient reported a 6-week period of pain and stiffness in the left knee following an accident during volleyball. He located the pain on the lateral and posterior aspect of the left knee. The pain mainly occurred upon exertion. Patient said that he could not properly extend the left knee. In view of these complaints he was referred to the orthopaedic out-patient clinic.

Examination at admission
- The left knee was not swollen but contained a small amount of fluid. Tenderness of the lateral articular space. Coarse crepitation upon movement; painful limitation of extension (about 10°). Normal mobility; intact collateral and cruciate ligaments; quadriceps atrophy (3 cm); no axis deviation. Diagnosis: lesion of the lateral meniscus.

Radiological examination
- The left knee showed no X-ray changes. Arthrography of the left knee (Thijn): medial meniscus showing a disturbed contour of the anterior horn, consistent with rupture of the meniscus at this side. Contours of lateral and dorsal aspects of the medial meniscus intact; no signs of degeneration. Lateral meniscus seemed intact all round: no visible degenerative changes. Cartilage seemed normal. Arthrographic diagnosis: longitudinal rupture in the anterior horn of the medial meniscus; lateral meniscus intact.

Pre-arthroscopic examination
- Intact ligament, extension slightly limited, snapping sensation at movement, no abnormal lateral mobility of the patella.

Arthroscopic examination (Pictures 36–47)
- Suprapatellar recess: moderate synovitis. Patella: intact cartilage. Patellar surface of femoral condyles: intact cartilage. Medial articular compartment: intact meniscus, smooth intact internal margin with a normal course in anterior horn, middle segment and posterior horn. No ruptures. The anterior horn was covered with synovial tissue detached from the meniscus. Dual manipulation was applied in an effort to trace abnormalities of the posterior horn: its internal margin had a normal course and could not be luxated with a needle. Nor were changes found on the tibial side of the meniscus. The cartilage was intact. Intercondylar space: intact cruciate ligament. Lateral articular compartment: discoid lateral meniscus; anterior and posterior horn intact. Very broad middle segment, frayed and with transverse ruptures so that the middle segment can be reversed with the needle, causing incarceration. Very mild chondropathy.

Arthroscopic diagnosis
1. Moderate synovitis.
2. Intact medial meniscus, with synovial membrane growing over the anterior horn.
3. Lesion discoid lateral meniscus.

Operation
- Lateral incision. Partial meniscectomy, removing only the movable middle segment of the lateral meniscus.

Follow-up
- Patient reported still having some vague symptoms upon exertion (ski-ing). No more symptoms in daily activities. Examination showed a knee of normal shape and function; no fluid, no limitation of extension, slight quadriceps atrophy (1 cm).

Conclusion
- Unlike radiological examination, arthroscopy revealed a lesion in a discoid lateral meniscus. The arthroscopic findings were confirmed. The medial meniscus was intact, the arthrographic changes being caused by overgrowth of synovial membrane on the anterior horn. At follow-up the patient was satisfied and free of symptoms.
Patient 5, female aged 27, occupation: lawyer.

Referred by: Family doctor in consultation with general surgeon.

History
- The patient reported a one-year history of trouble with the right knee, without apparent cause. She was in doubt about a traumatic injury. The knee was painful, especially when standing long or walking. Occasionally she reported having been unable to extend the right knee-joint properly. She localized the pain within the knee-joint. In view of these complaints she consulted a general surgeon in her home town. An arthrogram of the knee (elsewhere) showed: rupture of the lateral meniscus in the posterior horn, continuing in the anterior horn. Small medial meniscus, with the anterior horn far forward. Diagnosis: lesion of the lateral meniscus. The general surgeon was not convinced of the correctness of the diagnosis and referred the patient to us via the family doctor.

Examination at admission
- The right knee was of normal shape and mobility; no hydrops, intact ligaments, no tenderness, no limitation of extension, no signs of meniscal lesion. Crepitation of the knee at passive movement. When the patella was moved over the underlying structure, there was some slight friction. Quadriceps atrophy (1.5 cm). No axis deviation. Diagnosis: probably chondropathy of the patella.

Pre-arthroscopic examination
- Intact ligaments, symptoms of meniscal lesion cannot be induced, no abnormal lateral mobility of the patella.

Arthroscopic examination (Pictures 48-50)

Arthroscopic diagnosis
- Bucket-handle lesion of the medial meniscus with total medial luxation.

Operation
- Arthroscopic findings confirmed. Extirpation of luxated fragment of medial meniscus. Rim of about 3 mm left in situ.

Follow-up (18 months)
- The patient was satisfied. Locking symptoms no longer present, but some vague complaints at marked exertion.

Conclusion
- The general surgeon consulted had an arthrogram made, the radiologist reporting a rupture of the lateral meniscus. Physical examination at admission suggested a chondropathy of the patella. Arthroscopy disclosed a bucket-handle lesion of the medial meniscus, which was confirmed at arthrotomy.

Patient 6, male aged 20, occupation: windmill restorer.

Referred by: Family doctor.

History
- The patient reported having trouble with the right knee since a football match a few months earlier. Pain and swelling. The knee has always shown normal mobility since the accident; no limitation of extension. The patient had rested 14 days after the accident and had then resumed work, whereupon the knee had swollen again.

Examination at admission
- The right knee-joint was of normal shape and contained a small amount of fluid. Slight tenderness on the medial side of the joint normal mobility; no limitation of extension. Collateral and cruciate ligaments intact. Crepitation at movement. No quadriceps atrophy and no axis deviation. Diagnosis: posttraumatic synovitis as a result of distortion.
Laboratory findings
- All laboratory data were normal.

Radiological examination
- Arthrography of the right knee-joint (Thijn): at puncture, some 40 ml sanguinolent fluid was removed; unmistakable detachment of the posterior horn from the medial meniscus, the torn-off fragment lying against the eminence like a corpus liberum. The rupture probably continues as far as the middle segment of the medial meniscus. Diagnosis: lesion of the medial meniscus.

Pre-arthroscopic examination
- Intact ligaments: symptoms of meniscal lesion cannot be induced. No abnormal lateral mobility of the patella.

Arthroscopic examination (Pictures 74–78)
- Suprapatellar recess: synovitis. Patella: intact cartilage. Patellar surface of femoral condyles: intact cartilage. Medial articular compartment. Intact cartilage; internal margin of the medial meniscus can be followed over its entire length and has a normal course. Narrow meniscus largely overgrown with synovial tissue, which gives the upper surface an irregular aspect. Rupture not demonstrable even at dual manipulation. Highly hypertrophic synovial tissue against eminence and in intercondylar space. Intercondylar space: anterior cruciate ligament invisible due to marked synovial tissue hypertrophic. Lateral articular compartment: intact cartilage, intact meniscus in its normal position.

Arthroscopic diagnosis
- Synovitis. Arthroscopic and arthrographic diagnoses were clearly disparate. On the arthrogram the meniscus was irregular and appeared to be torn. Arthroscopy showed that this impression was due to the fact that the medial meniscus was covered with hypertrophic synovial tissue. The fragments against the eminence, arthrographically interpreted as detached meniscal fragments, were found at arthroscopy to be synovial tissue. Since the radiologist was quite positive, an arthrotomy was performed.

Arthrotomy
- Arthrotomy confirmed the arthroscopic findings: there was no meniscal lesion. A synovial biopsy specimen was taken before the knee was closed. Microscopic examination (Pathological Anatomical Laboratory, University of Groningen): synovial membrane slightly papillomatous at several sites on the surface, but otherwise showing marked diffuse thickening, with some local histiocytic reactions and slight fibrinoid necrosis. No other changes, specifically no distinct inflammatory cellular infiltrates. No indications of chronic rheumatic disease, tuberculosis or any neoplastic growth. Pathological diagnosis: chronic non-specific synovitis.

Follow-up
- One year after operation the patient was free of symptoms, played football without difficulty and had resumed work as a windmill restorer.

Conclusion
- The physical diagnosis was ‘posttraumatic synovitis due to distortion’. The arthrographic diagnosis was ‘lesion of the medial meniscus’. Arthroscopy as well as arthrotomy revealed marked synovitis. The medial meniscus was intact.

Patient 7, male aged 27, occupation: police constable.

Referred by: General surgeon.

History
- The patient had a one-year history of intermittent pain in the left knee-joint, associated with swelling. The patient localized the pain through the entire knee-joint. Symptoms occurred without demonstrable cause; the joint occasionally ‘jammed’, but there had never been distinct limitation of extension. There was sometimes uncertainty and ‘sagging’, but walking posed no problem. The symptoms had started after an accident while practising judo. The patient sought the advice of a general surgeon in his home town, who diagnosed a lesion of the anterior cruciate ligament and ordered an arthrogram, which showed no meniscal lesion.
Examination at admission

- The left knee was of normal shape and mobility; no hydrops, but slight lateral instability and slight positive drawer phenomenon. No tenderness; no symptoms of meniscal lesion; no quadriceps atrophy; no axis deviation. Diagnosis: ligament lesion.

Radiological examination


Pre-arthroscopic examination

- Slight lateral instability and slight positive drawer phenomenon. No symptoms of meniscal lesion; no abnormal lateral mobility of the patella.

Arthroscopic examination (Pictures 96–102)


Arthroscopic diagnosis

- Longitudinal rupture of tibial aspect of lateral meniscus.

Arthrotomy

- Arthroscopic findings confirmed. Lateral meniscus extirpated.

Follow-up (18 months)

- The patient was free of symptoms. The scar had healed. The knee-joint was restored to its normal function. The patient had resumed work on the police force and had taken up judo again.

Conclusion

- The general surgeon consulted had been unable to make a diagnosis. Arthograms failed to reveal any meniscal lesions. Arthroscopy led to a diagnosis of lateral meniscal lesion, which was confirmed at arthrotomy. After meniscectomy the patient was free of symptoms.

Patient 8, male aged 51, occupation: livestock farmer.

Referred by: Family doctor.

History

- The patient reported having developed acute pain in the right knee the previous day, when he stood up from a squatting position while milking. Violent pain on the inside of the knee, with limitation of extension. There was no past history of knee trouble.

Examination at admission

- The right knee-joint was swollen; hydrops and tenderness on the medial articular space; painful, resilient limitation of extension; intact collateral and cruciate ligaments; no axis deviation; no crepituation at movement. Diagnosis: medial meniscal lesion.

Radiological examination

- No X-ray abnormalities. Arthrography (Thijn): lesion of medial meniscus; intact lateral meniscus. Diagnosis: lesion of the medial meniscus.

Pre-arthroscopic examination

- Intact ligaments; resilient limitation of extension; audible snap at knee movement; no abnormal lateral mobility of patella.
Arthroscopic examination (Pictures 7G–73)
- The knee-joint contained a large amount of fluid (60 ml sanguinolent fluid removed at puncture). Arthroscope inserted in the usual way; marked accumulation of blood precluded inspection of any detail of the interior of the knee-joint. After 5 minutes’ irrigation of the knee-joint with a physiological saline solution, a clear view was obtained. Suprapatellar recess moderate synovitis. Patella: intact cartilage. Patellar surface of femoral condyles: intact cartilage. Medial articular compartment: chondropathy of medial femoral condyle; bucket-handle lesion of medial meniscus; no luxation of central fragment of meniscus, which had shifted over the rim which was still attached to the wall. Intercondylar space: intact anterior cruciate ligament. Lateral articular compartment intact cartilage; intact lateral meniscus of discoid shape.

Arthroscopic diagnosis
1. Synovitis
2. Chondropathy of medial femoral condyle.
4. Discoid lateral meniscus.

arthroscopy
- Arthroscopic findings confirmed. Partial meniscectomy, removing the torn-off fragment.

Follow-up
- Two months after the operation the patient was free of symptoms and had resumed work as a livestock farmer.

Conclusion
- This case history shows that an arthroscopic examination can be made after a recent trauma. Before inspecting the interior of the knee-joint, it must be irrigated for a few minutes with a physiological saline solution. Lesion of the medial meniscus was diagnosed clinically, arthrographically and arthroscopically. Arthroscopy led to an extension of the diagnosis: additional lesions were found.

Patient 9, male aged 30, occupation: carpenter.

Referred by: Family doctor in consultation with orthopaedic surgeon.

History
- The patient reported a one-year history of pain, crepitation and limitation of extension of the left knee-joint. The symptoms had developed gradually for no demonstrable reason. Past history: at age 13 (17 years earlier) the patient’s left knee had been operated on for osteochondritis dissecans.

Examination at admission
- The left knee was of normal shape and mobility, with a healed scar; no hydrops; crepitation at movement; no limitation of extension; intact lateral and cruciate ligaments; quadriceps atrophy (1.5 cm). Diagnosis: slight-to-moderate osteo-arthritis.

Radiological examination
- Slight-to-moderate degenerative changes in the left knee; no indications of a corpus liberum. Diagnosis: slight-to-moderate osteo arthritis.

Pre-arthroscopic examination
- No abnormal lateral mobility of the patella; induction of symptoms of meniscal lesion impossible; intact collateral and cruciate ligaments.

Arthroscopic examination (Pictures 94–95)
Arthroscopic diagnosis
1. Slight patellar chondropathy.
2. Chondromalacia of medial femoral condyle without defects.
3. Highly movable corpus liberum.

Arthrotomy
- Arthroscopic findings confirmed. Corpus liberum removed.

Follow-up (30 months)
- The patient was free of symptoms; there had been no recurrence of incarceration.

Conclusion
- Both physical and radiological examination failed to reveal a cause of the recurrent limitation of extension. Arthroscopic examination disclosed a corpus liberum.

Patient 10, male aged 26, occupation: draughtsman.

Referred by: General surgeon.

History
- The referring general surgeon reported that patient had sustained a serious injury of the left knee while playing football 3 years earlier. The accident had caused total rupture of the lateral ligament and total rupture of the anterior cruciate ligament. During an immediate operation the ruptured ligaments had been sutured with steel wire. In the course of postoperative management a steel wire fragment had broken off; it was lodged in the knee-joint, sometimes in the medial and sometimes in the lateral articular compartment.

Radiological examination
- The X-ray showed the wire fragment in the lateral articular compartment, in the area of the popliteal fossa. The general surgeon asked whether it would be possible to trace and remove this fragment by means of the arthroscope.

Arthroscopic examination (Pictures 133–139)
- At arthroscopy the wire fragment was traced without difficulty; it was localized beneath the posterior horn of the lateral meniscus and partly encapsulated in the wall. With the optical biopsy forceps the fragment was removed.

Conclusion
- Arthroscopy is not only of diagnostic but also of therapeutic value. Through the arthroscope it is possible to remove a corpus liberum, cartilage fragment or foreign body, even if this is localized on the tibial side of the meniscus.
CHAPTER IX.

SUMMARY AND CONCLUSIONS

This thesis presents a study of arthroscopy of the knee, i.e. a method of inspecting the interior of the knee-joint with the aid of a composite optical instrument.

Investigators have long been concerned with the idea of inspecting the interior of the living human body. In 1806, Philip Bozzini gave the first impetus to a series of developments which, so far as the knee-joint is concerned, attained its first goal in 1918 when Takagi (Tokyo, Japan), after many disappointments and failures, for the first time inspected the articular cavity of a human cadaver knee with the aid of a scope.

After the pioneer work of such investigators as Bircher, Switzerland (1921), Takagi’s pupil Watanabe was the first to introduce an effective method of arthroscopy and the necessary instruments. In 1965 the Watanabe method was adopted by Jackson (Toronto, Canada), who elaborated and publicized the method, and whose technique and approach has been our example.

Six years ago, on 19th November 1969, we performed the first arthroscopy of the knee in the Orthopaedic Department of the Surgical Clinic, University Hospital, Groningen. From 19th November 1969 to 1st September 1975 we performed 378 arthroscopies of the knee.

This thesis presents descriptions and a full analysis of the arthroscopies performed during the period from 19th November 1969 to 1st December 1974 (267 patients).

Our study had four objectives:
1. To establish whether (and, if so, to which extent) endoscopic examination of the knee-joint is feasible.
2. To determine which intra-articular parts of the knee-joint can be observed by means of an arthroscope.
3. To establish whether an adequate photographic documentation of the observations could be obtained.
4. To establish the value which could be attached to arthroscopy on the basis of our findings.

Adequate endoscopic examination of the knee-joint proved to be feasible.

The equipment proved to be an important factor, and was modified in the course of the investigations. We initially used the type 21 Watanabe arthroscope (53 arthroscopies). Although after overcoming preliminary difficulties it was found possible to obtain good images with this instrument, yet it proved to have its limitations. It had a number of technical imperfections, the most prominent of which were problems with illumination and the diameter of the instrument.

Next we used the Wolf arthroscope (26 arthroscopies), but again we encountered problems, mostly due to an insufficient angle of view and difficulties in photography. Once we had gained experience with these two instruments, we were able to formulate the requirements which a rigid arthroscope had to meet for optimal inspection of the interior of the knee-joint; these requirements concerned diameter, angle of view, direction of view, depth of focus and illumination. The diameter of the arthroscope should be 4-5 mm. The light source should be arranged outside the arthroscope, and the interior of the knee-joint should be illuminated with the aid of glass fibres arranged around the optical system. The angle of view should be about 100° (in air), and the optimal direction of view is about 30°. It should be possible to make good photographs. The depth of focus should range from 1 mm to nearly infinite. Moreover, the instrument should be of the simplest possible design so that:
1) arthroscopic examination becomes a simple procedure;
2) no complications occur during or after arthroscopic examination.

The firm of Storz (FRG) evolved an endoscope which met our requirements, and the subsequent arthroscopies (188) were performed with this instrument.
It was gradually found that the technique of examination, too, is important. An arthroscopy should be performed like an operation, that is to say in an operating theatre under aseptic precautions and under general anaesthesia. The general anaesthesia ensures adequate muscle relaxation so that varus and valgus stress can be applied to the knee during examination without giving the patient discomfort; it also serves to prevent unexpected movements on the part of the patient.

Proper irrigation with a physiological saline solution is important in order to ensure an unobscured image; even minute quantities of blood which could obscure the image should be washed away. The instrument is preferably inserted on the anterolateral side. To make the various structures visible, manipulations are necessary. The instrument is moved in the articular cavity; and the positions of the knee are changed. To these conventional manipulations we have added a third manipulation, the so-called 'dual manipulation' which takes the following course. An injection needle is introduced via the intra-articular space under direct visual control. The point of the needle is used to move the meniscus and this makes it possible to observe lesions of the menisci (e.g. of the posterior horns) and of the cartilage which cannot be made visible in any other way.

Using the technique outlined above, we found it possible with the aid of the Storz arthroscope to inspect the following structures in the interior of the knee-joint: 1) synovial membrane; 2) femoropatellar joint; 3) anterior cruciate ligament; 4) menisci; 5) cartilage of the mediolateral articular compartment. With an intact anterior cruciate ligament, it was nearly always impossible to examine the posterior cruciate ligament. The posterior attachment of the medial and the lateral meniscus and part of the posterior horns also remained invisible, although dual manipulation enabled us to see important parts of the posterior horn and to diagnose lesions, if any. The collateral ligaments are extra-articular structures and therefore invisible in patients with an intact capsule.

lt need not be pointed out that registration and interpretation of the features observed received the greatest care. This aspect of arthroscopy was the most difficult. For example, determination of the size of a lesion, a fragment of cartilage or a corpus liberum poses a problem which can be solved only on the basis of considerable experience and acquired technical skill.

If the proper instruments are used, the technique of arthroscopy can be learned without too much difficulty. Interpretation of the observations requires experience. The beginner-arthroscopist will have to perform at least 40-50 independent arthroscopies before he can be considered capable of forming correct conclusions.

What is the value of arthroscopy? It can make an important contribution to diagnosis. Confronted with a patient who complains about the knee, an accurate diagnosis must be made if proper therapy is to be instituted. This means that a history must be taken, a physical examination made, X-rays made and a few laboratory findings obtained. On the basis of these data an attempt must be made to establish the diagnosis. Experience has shown that a diagnosis on the basis of these data, the so-called clinical diagnosis, is uncertain in cases presenting knee symptoms.

The starting-point of our study was the diagnosis 'meniscal lesion'. We compared the clinical diagnoses with the findings obtained at the subsequent operation. The literature indicates a rate of failure of 5-30%. Our score for a correct clinical diagnosis of meniscal lesion was 62%: in a series of 109 patients diagnosed clinically as suffering from meniscal lesion, the operation did indeed reveal a meniscal lesion in 68 patients, i.e. 62% ± 4.85%.

Attempts are bound to be made to improve diagnostic reliability by supplementary examinations, e.g. arthrography, exploratory arthrotomy and arthroscopy.

In arthrography the technical procedure is important. Our experience indicates that technically imperfect arthrograms can hardly contribute to an improved diagnosis. The technically flawless double-contrast arthrograms supplied by Thijn did make a good contribution. Operation revealed a meniscal lesion in 25 out of 29 patients in whom a meniscal lesion had been diagnosed on the basis of double-contrast arthrograms obtained by Thijn; this is a score of 86% ± 6.34%.

In our view, exploratory arthrotomy is an obsolete procedure! An attempt should be made to establish the most detailed diagnosis possible in advance, whereupon a planned approach can be made.
- In arthroscopy there are several possibilities:
  1. The diagnosis is confirmed, but additional lesions are found. In the case of a meniscal lesion, for example, chondropathic changes are frequently found. This knowledge is of importance for evaluation of the patient, prognosis, and policy of aftercare (e.g. resumption of work).
  2. The diagnosis is not confirmed, in which case the surgeon can decide to refrain from operation. The patient is thus saved a superfluous operation.
  3. The diagnosis is changed, in which case the surgeon can decide to use a procedure different from the one originally planned.

- By means of arthroscopy we have succeeded in increasing diagnostic reliability to 98.5%. An arthroscopic examination was made with the Storz arthroscope in 188 patients. In 70 patients a meniscal lesion was found at operation; at arthroscopy a meniscal lesion had been observed in 69 of these patients: a score of 98.5% (=1.45%). It is to be noted that this high level of reliability was attained with the Storz arthroscope; our results with the Watanabe and the Wolf arthroscope were less good. Apart from the characteristics of the instrument, the increased experience of the arthroscopist and the dual manipulation play a role in this progress.

- Our arthroscopic examinations were not confined to the diagnosis of meniscal lesions; other structures were also inspected. In an early stage of the study we were already struck by the frequency of chondropathic changes, even in patients in whom these were not expected. The following is a summary of our observations on the various structures.

  **Cartilage**
  - Patellar chondropathy can be arthroscopically diagnosed. This was done in 67 of the 188 patients examined with the Storz arthroscope. It is to be noted that this diagnosis had been clinically made in only 12 of these patients. In other words: the clinical diagnosis of patellar chondropathy is highly unreliable.
  - A striking observation is that chondropathic lesions were so frequently found in knee-joints with a meniscal lesion. In the entire series of 267 patients, 99 were found to have a meniscal lesion at operation; 22 of these were found also to suffer from patellar chondropathy.
  - In a series of 47 patients examined with the Storz arthroscope and found at operation to have a medial meniscal lesion, 17 proved to show chondropathic changes in the medial articular compartment.
  - Interesting observations were made in patients who had elsewhere, a few years before, undergone meniscectomy and came to us with persistent symptoms. Arthroscopy was performed in 21 of these patients, and revealed patellar chondropathy in 15; 16 of the 21 patients had a chondropathy of the medial or the lateral articular compartment, or of both compartments. Of the 21 patients, 20 showed chondropathic changes.

  **Cartilage debris**
  - Cartilage debris was found at arthroscopy in 15 of the 188 patients examined with the Storz arthroscope. This debris was washed out.

  **Corpora libera**
  - Of the 9 corpora libera found at operation, 5 had been found at clinical and radiological examination. Arthroscopic examination (with the Storz arthroscope) had revealed 8 of the 9 corpora libera.

  **Cruciate ligaments**
  - Lesions of the anterior cruciate ligament were repeatedly observed; the posterior cruciate ligament was not readily visible unless the anterior ligament was absent.

  **Synovial membrane**
  - The synovial membrane was readily visible. Nearly all intra-articular changes were associated with changes of the synovial membrane: the synovial villi were oedematous, swollen and hyperaemic.
Only 2 patients with rheumatoid arthritis were examined. We were unable to establish a marked difference in synovial membranes between patients with rheumatoid arthritis and those with common synovitis. In view of the small number of patients and our limited experience in this context, conclusions cannot be justified. Further investigation in this direction is advisable.

The tendon of the popliteal muscle
- The tendon of the popliteal muscle was repeatedly visible by virtue of dual manipulation. We never observed lesions of the tendon proper.

Complications
- No complications occurred. A very positive experience was that no postoperative infections developed. In one case the lamp-bulb (of a Watanabe arthroscope) broke off. Arthroscopy is readily tolerated by the patient, who experiences no discomfort after the examination. A striking experience was that several patients showed unmistakable subjective improvement after a diagnostic arthroscopy (i.e. confined to inspection of the interior of the knee-joint).

Advantages and disadvantages of arthrography and arthroscopy
- Our findings clearly show that technically imperfect arthrograms can make no positive contribution to the diagnosis of meniscal lesions. Double-contrast arthrography of the knee-joint, however, can make an important contribution to this diagnosis.

- Arthrography and arthroscopy are complementary, not competitive methods. The strength of arthrography lies in its high score of success in diagnosing meniscal lesions; arthroscopy gives a high degree of certainty in diagnosing, not only meniscal lesions but also other changes and lesions.

- The advantage of arthrography is that it is a relatively simple procedure which can be carried out in any roentgen-room on out-patients, without general anaesthesia. Its disadvantage is that the results depend entirely on perfect technique.

- Arthroscopy makes it possible to see virtually all parts of the knee-joint, even better than at operation; this enables the arthroscopist to make the correct diagnosis with a high degree of certainty. Other advantages of arthroscopy are:

1) arthroscopy enables the investigator to make a multiple diagnosis;
2) arthroscopic findings enable the surgeon to plan an operation;
3) arthroscopy of the knee can be repeated, and can therefore be used to study the course of the disease, the effect of therapy and the natural history of a condition;
4) arthroscopic images can be photographically recorded; this is important for documentation, instruction and research;
5) a biopsy specimen can be taken through the arthroscope;
6) some minor therapeutic activities (washing away of cartilage debris, removal of small corpora libera and small foreign bodies) are possible.

- Disadvantages of arthroscopy are that the patient must be hospitalized, and that the examination must be made under general anaesthesia in an operating theatre under the conditions which normally prevail during an operation. Moreover, it is only in the hands of an experienced arthroscopist that the method can give good results.

Indications
- At the present state of arthroscopy, we find it impossible to establish mandatory indications for arthroscopy of the knee. In view of the fact that arthroscopy makes it possible to inspect virtually the entire interior of the knee-joint, there are sound arguments in favour of arthroscopic examination of any knee considered for operation.

- Arthroscopic findings enable the surgeon to plan his operation in detail. Site and size of the incision to be made can be exactly determined in advance. Obviously it is not practicable to have arthrotomy preceded by an arthroscopy; there are too many patients, too scanty means and too few experts to envisage this.
At this time, arthroscopy can be recommended under the following circumstances:

1) in cases in which the diagnosis remains uncertain despite clinical and radiological examination (including arthrography);
2) for patients with vague symptoms in whom a patellar chondropathy is suspected and in whom it is desirable to establish or eliminate this diagnosis with certainty; it should be pointed out that arthroscopy is an indispensable aid in diagnosing patellar chondropathy; the clinical diagnosis is unreliable and the radiological diagnosis is still being developed;
3) in cases in which a complete diagnosis is urgently required after a recent trauma;
4) in cases in which a complete objective diagnosis is required in view of litigation or insurance problems.

Contraindications

Contraindications to arthroscopy are:
1) a physical condition which precludes general anaesthesia and further investigation;
2) acute suppurative inflammation of the knee-joint;
3) acute inflammatory processes elsewhere in the organism;
4) a degree of limitation of movement of the knee-joint which precludes the necessary manipulations.

Focus on the future

Our study had posed a number of problems which it may be possible to solve in the future. How is arthroscopy likely to develop in actual practice? Should all orthopaedic surgeons learn the technique and apply it in practice? Should all residents in orthopaedic surgery be instructed in this technique, or should arthroscopy be left to experts in a few centres? Will arthroscopy be able to contribute to the necessary study of lesions of cartilage and synovial membrane? The question whether therapeutic interventions by means of arthroscopy will be possible, must remain moot.

Final conclusions

The conclusions of this are the following.

1. Endoscopic examination of the knee-joint is quite feasible.
2. Nearly all intra-articular structures of the knee-joint can be arthroscopically inspected.
3. Adequate photographic documentation of arthroscopic observations is possible.
4. Arthroscopy is a valuable asset, which has made it possible to improve the reliability of the diagnosis of knee symptoms to a very high degree.
5. Arthroscopy has amply extended and improved our understanding of the pathology of the knee-joint.
6. Arthroscopy opens perspectives for future investigations.
Samenvatting en conclusies:

In dit proefschrift worden onze onderzoekingen beschreven omtrent arthroscopisch onderzoek van de knie.
Bij deze onderzoeksmethode wordt met behulp van een samengesteld optisch instrument het inwendige van het kniegewricht geïnspecteerd.

Al zeer lang zijn onderzoekers is beslag genomen door de idee het inwendige van de levende mens te inspecteren. In 1806 maakte Philip Bozzini dit mogelijk. Hij gaf de eerste stoot tot een ontwikkeling, die, voor wat het kniegewricht betreft, na veel teleurstellingen en mislukkingen in 1918 voorlopig eindigde bij Takagi, Tokyo, Japan, die voor de eerste maal de gewrichtsholte van een menselijke kadaverknie met behulp van een kijker inspecteerde. Na het baanbrekende werk van o.a. Bircher, Zwitserland (1921) was het Watanabe, een leerling van Takagi, die de eerste bruikbare methode van arthroscopie evenals het instrumentarium introduceerde.

De methode van Watanabe werd in 1965 overgenomen door R.W. Jackson Toronto Canada, die de methode heeft uitgewerkt en bekendheid heeft gegeven en wiens benaderingswijze en techniek voor ons als voorbeeld heeft gediend.


Het doel van onze studie was vierledig:
1. Na te gaan of en zo ja in hoeverre een endoscopisch onderzoek van het kniegewricht mogelijk is.
2. Na te gaan welke intra-articulaire delen van het kniegewricht door middel van een arthroscoop kunnen worden waargenomen.
3. Na te gaan of een goede fotodocumentatie van de waargenomen beelden kon worden verkregen.
4. Na te gaan welke waarde op grond van onze bevindingen aan de arthroscopie kon worden gehecht.

Het bleek mogelijk te zijn een goed endoscopisch onderzoek van het kniegewricht uit te voeren. Een belangrijke factor bleek het instrumentarium te zijn. Lopende de onderzoekingen werd het instrumentarium gewijzigd.

Aanvankelijk maakten wij gebruik van de Watanabe no 21 arthroscoop (53 arthroscopieën). Hoewel het na het overwinnen van de aanloopmoeilijkheden gelukte goede beelden te krijgen, bleek toch dat dit instrument beperkingen had. Deze beperkingen lagen in een aantal technische tekortkomingen van het instrument, waarvan problemen met de verlichting en diameter van het instrument de belangrijkste waren.

Vervolgens hebben wij de arthroscoop van Wolf gebruikt (26 maal), maar ook hierbij stuitten wij op problemen, voornamelijk door de te kleine gezichtshoek en bij het fotograferen. Nadat wij met deze 2 instrumenten ervaring hadden opgedaan, konden wij formuleren waaraan een stijve arthroscoop voor het onderzoeken van het kniegewricht dient te voldoen, teneinde een optimale inspectie mogelijk te maken, met betrekking tot diameter, gezichtshoek, kijkrichting, dieptescherp en verlichting. De diameter van de arthroscoop moet 4 à 5 mm. bedragen. De lichtbron moet buiten de arthroscoop opgesteld zijn en het inwendige van het kniegewricht dient te worden verlicht door middel van fiberglasvezels die zich om het optische systeem bevinden. De gezichtshoek moet ± 100° (in lucht) bedragen, terwijl de gunstige kijkrichting ± 30° bedraagt. Het moet mogelijk zijn goede foto's te maken.De dieptescherpte moet van 1 mm. tot bijna oneindig bedragen. Tevens diende dit instrument een zo eenvoudig mogelijke constructie te hebben, opdat:

1. het arthroscopisch onderzoek een eenvoudige handeling worde.
2. geen complicaties tijdens of na het arthroscopisch onderzoek optreden.

De Fa. Storz (BRD) ontwikkelde een endoscoop die aan onze eisen voldeed en de volgende arthroscopieën zijn met dit instrument verricht (188). Aldoende bleek, dat ook de techniek van het
onderzoek een zaak van gewicht is. Een arthroscopie moet als een operatie worden uitgevoerd, dat wil dus zeggen, in een operatiekamer onder aseptische condities, onder narcose. De narcose dient om een goede spiervolting te waarborgen, opdat tijdens het onderzoek varus- en valgus kantelen aan de knie kan worden uitgevoerd, zonder dat dit de patient ongemak veroorzaakt en om te voorkomen, dat de patient onverhoedse bewegingen gaat maken.

Een goede irrigatie met een fysiologische zoutoplossing IS van belang, om een helder beeld te krijgen; zelfs kleine hoeveelheden bloed, die het beeld dreigen te verduisteren, moeten worden weggespoeld. Het instrument wordt bij voorkeur via de anterolaterale zijde ingebracht. Om de verschillende structuren te kunnen zien, moeten er manipulaties worden uitgevoerd. Het instrument wordt door de gewrichtsholte bewogen. De knie wordt in verschillende standen gebracht. Aan deze gebruikelijke manipulaties hebben wij nog een derde toegevoegd, de dubbelmanipulatie, die als volgt verloopt:

Er wordt van buitenaf via de gewrichtsspleet een injectienaald aangebracht. Met de punt van deze naald wordt de meniscus bewogen. Het is met deze dubbelmanipulatie mogelijk afwijkingen aan de menisci, (bijvoorbeeld aan de achterhoornen) en aan het kraakbeen waar te nemen, die op een andere wijze niet zichtbaar gemaakt kunnen worden.

Het gelukt om met behulp van de Storz-arthroscope bij toepassing van de geschikte techniek in het inwendige van het kniegewricht de volgende structuren te inspecteren: 1. synoviale membraan; 2. femoro-patellaire gewricht; 3. voorste kruisband; 4. menisci; 5. kraakbeen van mediale en laterale gewrichtscompartiment. Observatie van de achterste kruisband bij een intacte voorste kruisband is nagenoeg steeds onmogelijk gebleken. Ook de achterste aanhechting van de mediale en de laterale mensicus en een gedeelte van de achterhoornen bleven onzichtbaar, hoewel het met de dubbelmanipulatie altijd gelukt toch belangrijke delen van de achterhoorn te zien en eventuele afwijkingen daaraan vast te stellen. De zijbanden zijn extra-articulaire structuren; zij kunnen dus bij patienten met een intact gewrichtskapsel niet worden gezien.

Het spreekt vanzelf, dat aan het vastleggen en aan de interpretatie van de waargenomen beelden grote zorg is besteed. Dit onderdeel van de arthroscopie is het moeilijkst. Zo is b.v. het vaststellen van de grootte van een laesie, van een kraakbeenflard of van een corpus liberum een probleem dat slechts met veel ervaring en techniek kan worden opgelost. Het techniek van de arthroscopie valt, mits men gebruik maakt van het juiste instrumentarium vrij gemakkelijk te leren. De interpretatie van het waargenomene eist ervaring. De beginnende arthroscopist zal zeker 40 à 50 arthroscopieën zelfstandig moeten verrichten, alvorens hij in staat geacht moet worden juiste conclusies te trekken.

Wat is de waarde van de arthroscopie?

De arthroscopie kan een belangrijke bijdrage leveren tot de diagnostiek. De arts moet bij een patiënt met knieklachten een nauwkeurige diagnose stellen om de juiste behandeling te kunnen geven. Bij een patiënt met knieklachten zal hij anamnese opnemen, een lichamelijk onderzoek doen, röntgenfoto’s laten maken en enkele laboratoriumbepalingen doen. Hij zal trachten met behulp van deze gegevens de diagnose te stellen. De ervaring heeft geleerd, dat bij knieklachten de diagnose op grond van deze gegevens, de zogenaamde klinische diagnose, onzeker is. Bij ons onderzoek zijn wij uitgegaan van de diagnose meniscuslaesie. Wij hebben de uitkomsten van de klinische diagnostiek met de resultaten bij de daarop volgende operatie vergeleken. De literatuur vermeldt 5 - 30% missers. Wij zelf bereikten voor wat betreft de meniscus laesie een score van 62% goede uitkomsten van de klinische diagnostiek. Bij een serie van 109 patienten, waarbij op klinische gronden de diagnose meniscuslaesie werd gesteld, werd bij operatie 68 maal inderdaad een meniscuslaesie gevonden, dat is 62% ± 4.85%.

De arts zal trachten door uitbreiding van het onderzoek de betrouwbaarheid van de diagnostiek te verbeteren. In aanmerking komen arthografie, proef-arthrotomie, arthroscopie. Bij de arthografie is de technische uitvoering van groot belang. Volgens onze ervaringen leveren technisch niet volmaakte arthrogrammen geen bijdrage tot verbetering van de diagnostiek. De technisch fraaie dubbelcontrast arthrogrammen, vervaardigd door Thijn, leveren een grote bijdrage. Bij een serie van 29 patienten, waarbij op grond van de fraaie dubbelcontrast arthrogrammen van Thijn de diagnose meniscus-letsel werd gesteld, werd bij operatie 25 maal inderdaad een laesie van de meniscus gevonden, dat is een score van 86% ± 6.34%.

Proefarthrotomie komt naar onze mening niet meer in aanmerking, dat is verleden tijd! Men moet van te voren trachten, een zo gedetailleerd mogelijke diagnose te stellen en dan volgens een bepaald plan op zijn doel afgaan.
Er doen zich na arthroscopie verschillende mogelijkheden voor:

1. De diagnose wordt bevestigd, maar er zijn nog meer afwijkingen waar te nemen. Zo komen er bij een meniscuslaesie vaak kraakbeenafwijkingen voor. Deze kennis is van belang voor de evaluatie van de patiënt, de prognose, voor het beleid bij de nabehandeling, bijvoorbeeld bij de arbeidshervatting.


3. De diagnose wordt gewijzigd. De operateur kan nu besluiten de operatie anders uit te voeren dan hij aanvankelijk van plan was.

Het is ons gelukt met behulp van de arthroscopie de betrouwbaarheid van de diagnose op te voeren tot 98.5%. Er werd bij 188 patiënten een arthroscopie gedaan met de Storz-arthroscoop. Bij 70 patiënten werd bij operatie een meniscuslaesie geconstateerd: Tijdens arthroscopie werd bij deze 70 patiënten 69 maal een meniscusletsel waargenomen en 1 maal niet; een score van 98.5% (±1.45%). Hierbij dient te worden opgemerkt, dat deze hoge mate van betrouwbaarheid werd bereikt met de Storz-arthroscoop; met de Watanabe arthroscoop en de Wolf-arthroscoop waren de resultaten minder goed. Bij deze vooruitgang spelen naast de eigenschappen van het instrument de toegenomen ervaring van de operateur en de dubbelmani pulatie een rol. Het onderzoek met de arthroscoop heeft zich niet beperkt tot de diagnostiek van het meniscusletsel; ook andere structuren werden geïnspecteerd. Wij werden reeds in een vroeg stadium van de studie getroffen door het veelvuldig voorkomen van afwijkingen aan het gewrichtskraakbeen; ook bij patiënten, waarbij dit niet was verwacht. Hier volgt een samenvatting van onze waarnemingen aan de verschillende structuren:

Kraakbeen:
Het is mogelijk met de arthroscoop de diagnose chondropathia patellae te stellen. Bij de 188 patiënten onderzocht met de Storz-arthroscoop werd bij 67 een chondropathia patellae bevestigd. Vermeldenswaard is hierbij, dat op klinische gronden deze diagnose slechts bij 12 patiënten was gesteld. Met andere woorden, de klinische diagnose van chondropathia patellae is zeer onbetrouwbaar. Opmerkelijk is, dat er in de kniegewrichten met een meniscuslaesie zo vaak tevens kraakbeenlaesies aanwezig zijn. Uit de gehele serie van 267 patiënten waren er 99 die bij operatie een meniscus-laeisie bleken te hebben; 22 van hen bleken tevens een chondropathia patellae te hebben. Van een serie van 47 patiënten, onderzocht met de Storz arthroscoop, die bij operatie een mediale meniscuslaesie bleken te hebben, bleken er 17 kraakbeenafwijkingen in het mediale compartiment van het gewricht te hebben. Interessant zijn de waarnemingen bij patiënten, die elders een menissectomie hadden ondergaan en die nu bij ons kwamen wegens persisteren van de klachten. Er werd bij 21 van hen een arthroscopie gedaan; van de 21 bleken tevens een chondropathia patellae te hebben; 16 van de 21 patiënten hadden een chondropathie van het mediale of laterale gewrichtscompartiment of van beide. In totaal hadden 20 van de 21 patiënten kraakbeenafwijkingen.

Kraakbeen-debris:
Bij 15 van de 188 patiënten werd bij de arthroscopie kraakbeen-debris waargenomen. Dit débris werd uit het gewricht gespoeld.

Corpora libera:
Van de 9 bij operatie gevonden corpora libera waren bij klinisch en röntgenologisch onderzoek 5 vastgesteld. Bij arthroscopisch onderzoek werd (met de Storz-arthroscoop) 8 maal het corpus liberum opgespoord.

Kruisbanden:
Herhaalde malen konden afwijkingen aan de voorste kruisband worden waargenomen; de achterste kruisband kan niet goed worden waargenomen, tenzij de voorste ontbreekt.

Synoviaal membraan:
De synoviale membraan kon zeer goed worden geïnspecteerd. Bij bijna elke intra-articulaire afwijking waren tevens afwijkingen aan de synoviale membraan zichtbaar. De synoviale vlokken waren dan oedemateus, gezwollen en hyperaemisch. Er werden slechts 2 patiënten met een rheumaïdoïde arthritis onderzocht. Het was ons niet mogelijk tussen de synoviale membranen bij patiënten met rheumaïdoïde arthritis en die met banale synovitis een duidelijk verschil te zien. Gezien het geringe aantal patiënten en onze geringe ervaring op dit punt zijn conclusies niet gerechtvaardigd. Verder wetenschappelijk onderzoek in deze richting is zeer aanbevelenswaardig.

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De pees van de musculus popliteus:
De pees van de musculus popliteus kon herhaalde malen waargenomen dankzij de dubbel-manipulatie. Aan de pees zelf hebben wij nooit afwijkingen waargenomen.

Complicaties:
Er hebben zich geen complicaties voorgedaan. Als zeer positief hebben wij ervaren dat er zich geen post-operatieve infecties hebben voorgedaan. Eenmaal is een lampje afgebroken (Wata.tabne). De arthroscopie wordt door de patient goed verdragen. Hij heeft na de ingreep geen bezwaren door het onderzoek. Het is een bijzondere ervaring dat verschillende patienten na een diagnostische arthroscopie, dus ook als er behalve de inspectie geen handelingen in het kniegewricht waren verricht, toch duidelijk minder klachten hadden.

Voor- en nadelen van arthrografie en arthroscopie.
Uit ons onderzoek blijkt duidelijk, dat arthrogrammen, gemaakt met een onvoldoende techniek geen positieve bijdrage leveren tot het stellen van de diagnose meniscuslaesie.

De arthrografie van het kniegewricht met de dubbel-contrastmethode kan daarentegen een belangrijke bedrage leveren tot de diagnostiek. De arthrografie en de arthroscopie zijn geen concurrerende methoden; ze vullen elkaar aan. De kracht van de arthrografie is gelegen in een veelal juiste beoordeling van de menisci, terwijl men met de arthroscopie naast alle afwijkingen aan de menisci ook andere afwijkingen met grote zekerheid kan vaststellen.

Het voordeel van de arthrografie is, dat het een betrekkelijk eenvoudige methode is, die poliklinisch in elke röntgenkamer kan worden uitgevoerd, zonder narcose. Het nadeel is, dat de methode staat en valt met de techniek.

Bij arthroscopie is het mogelijk vrijwel alle delen van het kniegewricht te zien, zelfs beter dan bij operatie, waardoor de onderzoeker in staat is met grote zekerheid de juiste diagnose te stellen.

Verdere voordelen van de arthroscopie zijn:
1. De arthroscopie stelt de onderzoeker in staat een meervoudige diagnose te stellen.
2. Met de bij de arthroscopie verkregen kennis kan de operateur een plan voor de operatie maken.
3. Een arthroscopie van de knie kan herhaald worden. Het verloop van de ziekte en het effect van de therapie kan bestudeerd worden, evenals het natuurlijke verloop van een aandoening.
4. Voor documentatie en terwille van onderwijs en onderzoek is het van belang, dat de arthroscopisch beelden door middel van foto's goed kunnen worden vastgelegd.
5. Er kan een biopsie worden genomen.
6. Enkele therapeutische handelingen zoals uitspoelen van débris, verwijderen van kleinere corpora libera, en kleine corpora aliena zijn mogelijk.

De nadelen van de arthroscopie zijn, dat de patient in het ziekenhuis moet worden opgenomen en dat dit onderzoek in een operatiekamer onder dezelfde omstandigheden als bij een operatie onder narcose moet worden uitgevoerd. Bovendien kan de arthroscopie slechts in handen van de ervarenen goede resultaten opleveren.

Indicaties:
Het is ons niet mogelijk bij de huidige stand van de arthroscopie bindende indicaties voor het verrichten van een arthroscopisch onderzoek aan de knie te stellen. Omdat bij arthroscopie het inwendige van het kniegewricht nagenoeg volledig valt te inspecteren, zijn goede argumenten aan te voeren voor het verrichten van arthroscopie bij iedere te opereren knie.

De chirurg is na arthroscopie in staat een gedetailleerd plan voor de operatie op te maken, hij kan op grond van de waarneming die bij de arthroscopie gedaan zijn beslissen welke ingreep in de knie noodzakelijk is. Als gevolg hiervan kan hij de plaats en grootte van de incisie dus nauwkeurig van te voren bepalen. Het is duidelijk, dat het in de praktijk onmogelijk is aan elke arthrotomie een arthroscopie vooraf te doen gaan; daarvoor is het aantal patienten te groot, en zijn de middelen te schaars en is het aantal deskundigen te klein.

Thans willen wij de arthroscopie aanbevelen bij de volgende omstandigheden:
1. bij patienten, bij wie na lichamelijk en röntgenologisch onderzoek, waaronder arthrografie, de diagnose nog onzeker is.
2. bij patienten met vage klachten waarbij een chondropathia patellae vermoed wordt en bij wie het gewenst is deze diagnose met zekerheid vast te stellen of uit te sluiten. Hierbij dient te worden opgemerkt dat voor het stellen van de diagnose chondropathia patellae de arthroscopie onontbeerlijk is. De klinische diagnose is onbetrouwbaar. De röntgendiagnostiek is nog in ontwikkeling.

3. indien na een recent trauma de wens bestaat zo snel mogelijk tot een volledige diagnose te komen.

4. bij patienten, die terwille van een rechtsgeding of een verzekeringkwestie aandringen op een zo volledig en objectief mogelijke diagnose.

Contra-indicaties:
Contra-indicaties voor arthroscopie zijn:
1. de lichamelijke toestand van de patient laat geen narcose en geen verder onderzoek toe.
2. er is een acute, etterige ontsteking van het kniegewricht.
3. er zijn acute ontstekingsprocessen elders in het lichaam van de patient.
4. er is een dusdanige bewegingsbeperking van het kniegewricht, dat de nodige manipulaties niet kunnen worden uitgevoerd.

Toekomst:
Ons onderzoek heeft een aantal problemen opgeworpen, die in de toekomst misschien tot een oplossing gebracht kunnen worden. Hoe zal de arthroscopie zich in de praktijk verder ontwikkelen? Moeten alle orthopaedisch chirurgen deze techniek leren en in hun praktijk toepassen?

Moet aan alle assistenten in opleiding voor orthopaedisch chirurg deze techniek bijgebracht worden of dient arthroscope onderzoek uitsluitend in enkele centra door experts te worden beoefend?

Zal de arthroscopie een goede bijdrage kunnen leveren tot de zo noodzakelijke bestudering van afwijkingen van het kraakbeen en de synoviale membraan?
Het is vooral nog een open vraag of therapeutische ingrepen door middel van arthroscopie ingang zullen vinden.

Slotconclusies:

De conclusies van onze studie zijn:
1. Het endoscopisch onderzoek van het kniegewricht is zeer goed mogelijk.
2. Vrijwel alle intra-articulaire delen van het kniegewricht kunnen door middel van arthroscopisch onderzoek worden waargenomen.
3. Het is mogelijk een goede fotodocumentatie van de waargenomen beelden te verkrijgen.
4. De arthroscopie is een waardevolle aanwinst. Het is gelukt met behulp van arthroscopie de betrouwbaarheid van de diagnostiek bij patienten met knieklachten tot een zeer hoge graad op te voeren.
5. De arthroscopie heeft ons inzicht in de pathologie van het kniegewricht in ruime mate verbeterd.
6. De arthroscopie opent mogelijkheden voor toekomstige studies.
REFERENCES:

Casscells, S.W. Pers. communic.


1. Type 21 Watanabe arthroscope

Top to bottom:
- a) biopsy forceps (large)
- b) blunt trocar
- c) sharp trocar
- d) shaft with tap
- e) 0° scope, diameter 4.9 mm
- f) lamp mounting
- g) viewer extension (teaching attachment)

Note: the 90° scope with a diameter of 5.5 mm is not used and not shown.

2. The arthroscope ready for use. First the lamp mounting and then the scope is introduced into the shaft.

3. Transformer used with the type 21 Watanabe arthroscope

4. Endoscopic half-miniature camera type Olympus Pen F with synchronized shutter release and type 21 arthroscope.
5. Arthroscope manufactured by R. Wolf Cy, Knittlingen, Federal Republic of Germany.

Left to right:
- a) biopsy forceps
- b) shaft, diameter 4 mm, length 94 mm
- c) blunt trocar
- d) sharp trocar
- e) 0° scope, 3 mm diameter, with fibre glass tubing
- f) 70° scope, 3 mm diameter, with fibre glass tubing

6. Light projector (R. Wolf Cy, Knittlingen, Federal Republic of Germany.)


Top to bottom:
- a) biopsy forceps (small)
- b) biopsy forceps (large)
- c) shaft (diameter 5 mm)
- d) sharp trocar
- e) blunt trocar
- f) Hopkins optical system with fibre glass illumination (foroblique 30°), diameter 4 mm
- g) Hopkins optical system with fibre glass illumination (0°), diameter 4 mm
- h) fibre glass teaching attachment

8. Top to bottom:
- a) Hopkins optical system with fibre glass illumination (0°), diameter 4 mm
- b) Hopkins optical system with fibre glass illumination (0°), diameter 2.7 mm
- c) biopsy forceps for use with 0 2.7 mm optical system
- d) shaft
9. Frontal view of biopsy forceps with Ø 2.7 mm optical system and shaft

10. Optical biopsy forceps, optical system 2.7 mm

11. Arthroscope with Hopkins optical system diameter 4 mm and shaft, ready for use

12. a) Flash generator, maximum output 500 W/ second with four positions, 110/240 V AC (Storz)
   b) Light source for fibre glass illumination, adjustable light strength (American Cystoscope Makers Inc., New York)
13. Endoscopic half-miniature camera type Olympus Pen F with frontal attachment, RIWO lens (Wolf) and Hopkins optical system with electronic flashgun (Storz)

14. Arrangement for inspection, similar to that for an operation

15. The knee-joint punctured, and the intra-articular fluid is drained off, whereupon 75 - 100 ml physiological saline solution is introduced.

   a) demarcation of the patellar ligament
   b) anterior margin of lateral tibial surface
   c) site of insertion of arthroscope

16. a) The knee is flexed 60°
    b) The thumb is placed on the anterior margin of the lateral tibial surface, palpating the lateral margin of the patellar ligament as well.
    c) An incision of 6 mm is made immediately above the nail of the thumb
17. Shaft and sharp trocar are introduced through the incision, aiming at the intercondylar space.

18. The sharp trocar is replaced by a blunt one which, with the shaft, is introduced into the knee-joint. The knee is cautiously extended and the instrument is passed through the femoropatellar joint into the suprapatellar recess.

19. The scope is inserted

20. General view
21. Inspection of suprapatellar recess and femoropatellar joint with the knee extended.

22. Inspection of the medial intra-articular space: the leg is dangled over the edge of the table and the knee is flexed, thus applying valgus stress.

23. Inspection of the lateral intra-articular space: the foot is placed on the table and the knee is flexed; light pressure is applied to produce varus stress.
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139. Wire fragment removed
140. Broken-off lamp of Watanabe arthroscope
141. Debris of articular cartilage washed away out of the knee-joint.
1. suprapatellar recess
2. femoral condyle

Apex of suprapatellar recess
Adhesions in suprapatellar recess
Normal synovial membrane
(irrigation with physiological saline at 25° C)

1. patella
2. medial femoral condyle

Atrophic synovial membrane
(irrigation with physiological saline at 25° C)

Ordinary synovitis
(irrigation with physiological saline at 25° C)
1. patella
2. medial femoral condyle

Small corpus liberum in suprapatellar recess

Synovial membrane. Incipient rheumatoid arthritis (irrigation with physiological saline at 25° C)
Synovial osteochondromatosis

Synovial membrane in a patient with haemophilia A

1. in suprapatellar recess

1. in suprapatellar recess

8

9
Normal femoropatellar joint; intact cartilage

1. patella
2. lateral femoral condyle
3. medial femoral condyle

Normal femoropatellar joint and obstructed needle

1. patella
2. lateral femoral condyle
3. medial femoral condyle
4. needle
Intact cartilage of femoral groove

Case report: patient 1
slight cartilage defects undersurface patella

1. femoral groove
2. medial femoral condyle
3. lateral femoral condyle

1. patella
2. medial femoral condyle
3. lateral femoral condyle
45-year-old man
History: pain in left knee; no local pain at exertion
Physical findings: crepitation upon movement; no other changes
Arthroscopy: moderately severe patellar chondropathy

Case report: patient 2
Arthroscopy: severe patellar chondropathy

1. patella
2. femoral condyle

Normal anterior horn of medial meniscus (intact), left knee
Medial meniscus. Normal features; sharp, unchanged contours (arthrogram)
1. medial femoral condyle
2. anterior horn of medial meniscus

Normal middle segment of medial meniscus (intact), left knee

1. medial femoral condyle
2. middle segment of medial meniscus
Transition from middle segment to posterior horn of medial meniscus (normal), left knee

1. medial femoral condyle
2. transition middle segment to posterior horn

Innerborder middle segment and posterior horn of medial meniscus (normal), left knee; the slight convexity is normal

1. medial femoral condyle
2. posterior horn of medial meniscus

Course of internal margin of posterior horn of medial meniscus (normal), left knee

Attachment to posterior horn of medial meniscus (normal), left knee
1. medial femoral condyle
2. posterior horn of medial meniscus

Lateral meniscus (normal), left knee

1. medial femoral condyle
2. attachment to posterior horn of medial meniscus

Lateral meniscus (normal) (arthrogram)

1. lateral femoral condyle
2. medial femoral condyle
3. anterior cruciate ligament
4. lateral meniscus
Lateral meniscus. Course of internal margin posterior horn (normal), left knee

1. lateral femoral condyle
2. medial femoral condyle
3. lateral meniscus

Attachment of posterior horn of lateral meniscus (normal), left knee

Lateral meniscus. Normal features seen from posterior horn. Sharply defined central meniscal margin. Visible sulcus of popliteal muscle tendon. (arthrogram)

Undersurface of lateral meniscus
1. lateral femoral condyle
2. medial femoral condyle
3. attachment of lateral meniscus

Case report: patient 3
X-ray findings: slight osteoarthritis.
Arthrography: intact menisci, no other changes
Arthroscopy: patellar chondropathy, cartilage fracture in medial femoral condyle, synovitis, intact menisci, intact anterior cruciate ligament

25–31
Patellar chondropathy
1. patella
2. femoral condyle

Marked cartilage defects in patellar surface of femoral condyle
1. patella
2. medial femoral condyle
3. lateral femoral condyle

Cartilage fracture in medial femoral condyle, beginning at posterior horn of medial meniscus, right knee

Cartilage fracture in medial femoral condyle, right knee

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1. medial femoral condyle
2. cartilage fracture
3. medial meniscus

Cartilage fracture in medial femoral condyle

1. medial femoral condyle
2. cartilage fracture
3. medial meniscus
4. lateral meniscus
5. anterior cruciate ligament
Cartilage fracture in medial femoral condyle

Overall view of cartilage fracture in medial femoral condyle, right knee

1. medial femoral condyle
2. cartilage fracture
3. medial meniscus
4. lateral meniscus
5. anterior cruciate ligament

1. femoral groove
2. medial femoral condyle
3. cartilage fracture
4. medial meniscus
5. lateral meniscus
6. anterior cruciate ligament
History: complaints about right knee at age 19 during military service.
Diagnosis: osteochondritis dissecans of medial femoral condyle.
Treatment: operative. Tibial implant fixed in defect with two screws.
At the moment: recurrent locking.
Arthroscopy: intact femoropatellar joint, intact menisci, no corpora libera, marked chondropathy of medial femoral condyle; no cartilage on implant.
1. patella
2. medial femoral condyle

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1. medial femoral condyle
2. medial meniscus
3. anterior cruciate ligament

33

Medial femoral condyle with bone implant; implant not covered by cartilage; marked chondropathy of condylar cartilage

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1. cartilage shreds
2. medial femoral condyle
3. screw head
4. medial meniscus

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1. cartilage shreds
2. medial meniscus
3. screw head
Case report: patient 4
Clinical diagnosis: lesion of lateral meniscus, left knee. Arthrography: probably longitudinal rupture in anterior horn of medial meniscus; lateral meniscus intact. Arthroscopy: medial meniscus intact, lesion of dicoid lateral meniscus

1. medial femoral condyle
2. anterior horn of medial meniscus, partly covered by proliferating synovial membrane
Intact middle segment of medial meniscus

1. medial femoral condyle
2. middle segment of medial meniscus

Intact middle segment and posterior horn of medial meniscus

1. medial femoral condyle
2. transition from middle segment to posterior horn of medial meniscus

Intact middle segment and posterior horn of medial meniscus

No rupture visible even after needle manipulation
1. medial femoral condyle
2. transition from middle segment to posterior horn of medial meniscus

Attachment to posterior horn of medial meniscus

1. medial femoral condyle
2. needle

No rupture in undersurface of medial meniscus

1. medial femoral condyle
2. attachment posterior horn of medial meniscus

1. medial femoral condyle
2. anterior cruciate ligament
3. undersurface of medial meniscus
4. medial tibial surface
Lateral meniscus intact (arthrogram)

Transverse rupture in middle segment of lateral meniscus, left knee

Normal posterior horn of lateral meniscus, left knee
1. posterior horn of lateral meniscus
2. lateral femoral condyle

Detail of internal margin, middle segment of lateral meniscus. The fragment can revert and be incarcerated
1. lateral femoral condyle
2. lateral meniscus

Extirpated lateral meniscus fragment

**Case report: patient 5**
Arthrography: rupture of lateral meniscus, small medial meniscus, right knee.
Arthroscopy: bucket handle lesion of medial meniscus.
Lesion of medial meniscus; right knee

1. medial femoral condyle
2. rupture
3. medial meniscus
4. luxated meniscal fragment
5. lateral meniscus
History: complaints about ill-defined pain in right knee since football game at age 18 (sensation of 'something shifting'). Physical findings: normal shape and function, no hydrops, intact ligaments, no crepitation, no signs of meniscal lesion. Arthrography: lesion of medial meniscus. Arthroscopy: lesion of medial meniscus.
Rupture in medial meniscus, beginning at transition from middle segment to posterior horn

1. medial femoral condyle
2. rupture
3. medial meniscus

The meniscal fragment is centrally luxated with the aid of the needle

1. medial femoral condyle
2. rupture in medial meniscus

The rupture is brought to view with the aid of the needle
16-year-old boy. Left knee.
History: pain in left knee following an accident; recurrent signs of locking.

54–58

Normal course internal margin medial meniscus

Abnormaal course of internal margin from middle segment to posterior horn

1. rupture
2. medial femoral condyle
3. normal course internal margin medial meniscus

1. medial femoral condyle
2. rupture
3. abnormal course internal margin medial meniscus

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55
Medial meniscus: central strip of meniscal cartilage torn off. Torn-off fragment is not visible (arthrogram)

Posterior horn of medial meniscus, left knee

1. medial femoral condyle
2. abnormal course internal margin medial meniscus

Posterior horn of medial meniscus, left knee

1. medial femoral condyle
2. fibrillated internal margin of posterior horn of medial meniscus
30-year-old man. Left knee.

History: pain in left knee after football game; limitation of extension, hydrops.

Physical findings: hydrops, intact ligaments, slight limitation of extension, tenderness central intra-articular space.

Arthrography: lesion of medial meniscus; lateral meniscus unchanged.

Arthroscopy:

a) slight chondropathy of both femoral condyles;
b) bucket handle rupture of medial meniscus;
c) small rupture in anterior horn of medial meniscus;
d) degeneration of lateral meniscus with fishmouth rupture in middle segment

Exirpated medial meniscus with rupture in posterior horn, left knee
Torn-off fragment of anterior horn of medial meniscus

1. medial femoral condyle
2. medial meniscus
3. torn-off fragment of anterior horn

Longitudinal rupture in middle segment of medial meniscus

1. medial femoral condyle
2. rupture in medial meniscus

The fragment can be luxated with the aid of a needle
Extirpated medial meniscus; small movable fragment of anterior horn

Degeneration of lateral meniscus (Internal margin of middle segment)

1. lateral femoral condyle
2. degeneration of lateral meniscus
Degeneration of lateral meniscus with fishmouth rupture of internal margin at transition from posterior horn to middle segment

1. lateral femoral condyle
2. fishmouth rupture beginning at posterior horn

Fishmouth rupture in posterior horn of lateral meniscus

1. lateral femoral condyle
2. fishmouth rupture of lateral meniscus

15-year-old boy. Right knee.
History: locking of right knee following torsional injury.
Physical findings: changed knee contour and hydrops; 25° limitation of extension; central intra-articular space tender.
Clinical diagnosis: lesion of medial meniscus.
Arthrography: rupture of medial meniscus.
Arthroscopy: luxated medial meniscus
Luxated medial meniscus

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Luxated medial meniscus
1. medial femoral condyle
2. incarcerated posterior horn of medial meniscus
3. medial meniscus
4. lateral meniscus

1. medial femoral condyle
2. beginning of rupture
3. incarcerated meniscal fragment
4. lateral meniscus

Rupture in medial meniscus

Extirpated medial meniscus

1. medial femoral condyle
2. rupture
3. medial meniscus

1. rupture
2. site with which the meniscus was still connected
Case report: patient 8
Clinical diagnosis: lesion of medial meniscus.
Arthrography: lesion of medial meniscus.
Arthroscopy: vesicular swelling of synovial villi; lesion of medial meniscus (longitudinal rupture); chondropathy of medial femoral condyle; slightly discoid (intact) lateral meniscus.

70–73

Synovial membrane 3 days after accident, 2 days after arthrography

Lesion of medial meniscus: longitudinal rupture from middle segment to posterior horn
1. medial femoral condyle
2. vesicular swelling of synovial villi
3. anterior cruciate ligament

Lesion of medial meniscus

1. medial femoral condyle
2. beginning of rupture with slight luxation of meniscal fragment
3. lateral meniscus
4. anterior cruciate ligament

Lesion of medial meniscus

1. medial femoral condyle
2. fresh rupture
3. medial meniscus

1. medial femoral condyle
2. slight luxation of fragment of medial meniscus
3. lateral meniscus
4. anterior cruciate ligament
Case report: patient 6
Diagnosis: posttraumatic synovitis.
Arthrography: rupture of medial meniscus (middle segment and posterior horn), torn-off fragment as corpus liberum against eminence.
Arthroscopy:
a) synovitis;
b) normal intact medial meniscus with partial proliferation of synovial tissue;
c) large hypertrophic synovial tissue accumulations in intercondylar space and region of eminence;
d) intact lateral meniscus.
Exploratory arthrotomy: confirmation of arthroscopic findings in medial compartment of joint

74–78

Synovial tissue near eminence of intact medial meniscus, largely proliferated with synovial membrane
Hypertrophic synovial membrane
1. medial femoral condyle
2. middle segment and part of posterior horn
3. accumulation of synovial tissue
4. needle

1. medial femoral condyle
2. hypertrophic synovial tissue

Middle segment of medial meniscus

Needle manipulation in order to demonstrate a rupture

1. medial femoral condyle
2. course to posterior horn of medial meniscus

1. medial femoral condyle
2. no rupture demonstrable by needle manipulation; course of internal margin of posterior horn unchanged
3. needle point
Posterior horn of medial meniscus can be slightly luxated

1. medial femoral condyle
2. posterior horn of medial meniscus can be slightly luxated by needle manipulation
3. medial meniscus
4. needle

1. anterior cruciate ligament (normal)

Normal anterior cruciate ligament
29-year-old man. Right knee.
History: pain in right knee since football accident 6 months earlier.
Physical findings: slight hydrops, normal function, slight lateral instability, marked positive drawer phenomenon, tenderness of medial and lateral intra-articular space.
Diagnosis: lesion of anterior cruciate ligament.
Arthroscopy: totally ruptured anterior cruciate ligament, medial and lateral meniscus unchanged
Total rupture of anterior cruciate ligament

1. intercondylar space with absence of anterior cruciate ligament

1. torn-off anterior cruciate ligament

Partial rupture of anterior cruciate ligament

Partial rupture of anterior cruciate ligament
1. partial rupture of anterior cruciate ligament

Patellar synovial fold (mucous ligament)

1. femoral condyle
2. patellar synovial fold
3. cruciate ligament

1. femoral condyle
2. patellar synovial fold
26-year-old woman. Right knee.
History: Gives way when leaving a car, localized medial pain.
Physical findings: hydrops, mild limitation of extension, collateral ligaments intact, cruciate ligament untestable.
Diagnosis: distortion of right knee.
Arthrography: menisci unchanged.
Examination under anaesthesia: marked positive drawer phenomenon.
Arthroscopy: absence of anterior cruciate ligament; intact menisci, slight chondropathy

Congenital (?) absence of anterior cruciate ligament
1. synovial tissue
2. medial femoral condyle
3. lateral femoral condyle
4. absence of anterior cruciate ligament

Posterior cruciate ligament
1. posterior cruciate ligament
2. connection between posterior and anterior horn of lateral meniscus
Connection between posterior and anterior horn of lateral meniscus

1. lateral femoral condyle
2. connection between posterior and anterior horn of lateral meniscus
3. lateral meniscus

Connection between posterior horn of medial meniscus and posterior wall

1. medial femoral condyle
2. connection between posterior horn of medial meniscus and posterior wall
3. medial meniscus
4. lateral femoral condyle

To the popliteal fossa past the medial posterior horn

In the depth, the popliteal fossa
Case report: patient 9
X-ray left knee: slight to severe degenerative changes based on osteochondritis dissecans.
Arthroscopy: slight patellar chondropathy; chondromalacia of medial femoral condyle (highly movable corpus liberum).
Corpus liberum in intercondylar space

Corpus liberum (detail)

1. corpus liberum
2. medial femoral condyle
3. anterior cruciate ligament
4. medial meniscus

1. corpus liberum
2. medial femoral condyle
3. anterior cruciate ligament
4. medial meniscus

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Case report: patient 7

Arthrography (elsewhere): no changes.

Arthroscopy:

a) normal synovial membrane;
b) undersurface of patella covered with intact cartilage;
c) medial femoral condyle shows slight cartilage lesion of articular surface;
d) intact medial meniscus;
e) slight degeneration internal margin middle segment of lateral meniscus;
f) viewed from above, lateral meniscus is intact;
g) viewed from below, lateral meniscus shows longitudinal rupture.

Arthrotomy: confirmation of pathology of lateral meniscus

96–102

Slight degeneration internal margin middle segment of lateral meniscus

Intact posterior horn of lateral meniscus
1. lateral femoral condyle
2. slight degeneration internal margin of middle segment
3. lateral meniscus
4. anterior cruciate ligament

Lateral meniscus reversed with a needle, making rupture visible

1. lateral femoral condyle
2. intact posterior horn of lateral meniscus
3. anterior cruciate ligament

Rupture of undersurface of lateral meniscus

1. lateral femoral condyle
2. rupture undersurface lateral meniscus

1. lateral femoral condyle
2. rupture visible after reversing lateral meniscus with needle
3. lateral meniscus
4. needle
Exirpated meniscus. View from above normal; slight degeneration internal margin of middle segment

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Exirpated lateral meniscus. Fishmouth rupture undersurface

101

Exirpated lateral meniscus. Fishmouth rupture opened

102
Beginning of posterior horn of lateral meniscus with fishmouth rupture

Posterior horn of lateral meniscus with fishmouth rupture
Popliteal muscle tendon becomes visible

1. lateral femoral condyle
2. beginning of posterior horn of lateral meniscus
3. beginning of fishmouth rupture

1. lateral femoral condyle
2. fishmouth rupture
3. popliteal muscle tendon
4. lateral meniscus

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Needle point in fishmouth rupture in posterior horn of lateral meniscus
1. lateral femoral condyle
2. needle in fishmouth rupture
3. popliteal muscle tendon
4. lateral meniscus

Needle point in popliteal muscle tendon
1. lateral femoral condyle
2. needle point in popliteal muscle tendon
3. lateral meniscus
Lateral meniscus seems totally extirpated (left knee)

1. lateral femoral condyle
2. lateral meniscus totally extirpated
3. anterior cruciate ligament

Posterior horn of residual lateral meniscus (left knee)

1. posterior horn of residual meniscus
2. lateral femoral condyle
3. anterior cruciate ligament
21-year-old man. Left knee.
Clinical diagnosis: lesion of lateral meniscus.
Arthrogramy: lesion of lateral meniscus, extensive degeneration in central part.
Arthroscopy: lesion of lateral meniscus with luxation of fragment. (intercondylar)

109–111
Lesion of lateral meniscus (incarceration of fragment)

1. lateral femoral condyle
2. fragment of lateral meniscus incarcerated between condyles
3. rim of lateral meniscus
Lesion of lateral meniscus (incarceration of fragment)

36-year-old man. Right knee.
History: lame feeling in right knee, no locking, no swelling, no pain. Patient reported having been treated elsewhere with intra-articular cortisone injections. Physical findings: normal shape and function, no hydrops, slight swelling of lateral intra-articular space, slight crepitation at movement. Diagnosis: cyst of lateral meniscus. X-ray of right knee: calcification of lateral meniscus, slight degenerative changes. Arthrography: a) lateral meniscus shows peripheral swelling (meniscal ganglion); b) irregular central rupture; c) no distinct changes of articular cartilage.
Arthroscopy: intact femoropatellar joint, slight chondropathy of medial femoral condyle, cystic swelling of lateral meniscus, normal medial meniscus, marked degeneration internal margin middle segment, chondropathy of lateral tibial surface and ‘calcium squirts’; slight chondropathy of lateral femoral condyle

Chondropathy of lateral tibial surface with ‘calcium squirts’. Degeneration of lateral meniscus
Cyst of lateral meniscus

24-yars-old man. Left knee.
History: Meniscectomy at age 20. Now pain in left knee, particularly at exertion. Physical findings: healed surgical scar, normal shape and function, quadriceps atrophy, slight instability, crepitation at movement.
Arthroscopy: numerous adhesions in recess, atrophic synovial membrane, slight to moderate chondropathy of femoropatellar joint; marked chondropathy of medial femoral condyle; medial meniscus extirpated except for a residual zone of about 3 mm with a sharp edge; chondropathy of medial femoral condyle and changes in lateral compartment of joint

115–117
Features after extirpation of medial meniscus

1. medial femoral condyle
2. marked chondropathy of medial femoral condyle
3. rim of medial meniscus

Features after extirpation of medial meniscus

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36-year-old woman. Right knee.
History: fracture of lateral tibial head after accident (X-ray b 18 months after X-ray a); pain in right knee particularly at exertion; no locking. Physical findings: normal shape and function, lateral instability, quadriceps atrophy. Arthroscopy: intact lateral meniscus, marked chondropathy of lateral tibial surface.

118–120
Intact lateral meniscus and some artefacts

Normal posterior horn of lateral meniscus

1. lateral femoral condyle
2. anterior cruciate ligament
3. intact posterior horn
4. intact lateral meniscus
5. lateral meniscus

1. marked chondropathy of lateral tibial surface with depression
18-year-old man. Left knee. 
History: pain and swelling left knee after football injury. Physical findings: normal shape and function, very slight limitation of extension, intact ligaments, tenderness medial intra-articular space. Arthrography: normal lateral meniscus? Fibrous contour middle segment medial meniscus. About 18 months later hospitalization with same symptoms. Examination at admission: slight hydrops, normal function, intact ligaments, slight tenderness medial intra-articular space. Arthroscopy: intact, narrow medial meniscus; slight chondropathy of lateral femoral condyle; longitudinal rupture in lateral meniscus, beginning 1 cm in front of popliteal muscle tendon. Luxation of fragmented posterior horn, due to needle manipulation.

121–126

Arthrogram lateral meniscus (left knee)
Fragmented posterior horn of lateral meniscus

Degeneration of internal margin of middle segment, with small transverse rupture

1. lateral femoral condyle
2. lateral meniscus
3. fragmented posterior horn

1. lateral femoral condyle
2. lateral meniscus
3. degenerated internal margin of middle segment with small transverse rupture
1. lateral femoral condyle
2. lateral meniscus
3. longitudinal rupture

Longitudinal rupture in middle segment and posterior horn; no luxation

Longitudinal rupture in posterior horn, can be luxated with the aid of needle
1. lateral femoral condyle
2. longitudinal rupture
3. lateral meniscus

1. lateral femoral condyle
2. lateral meniscus
3. meniscal fragment which can be luxated

Extirpated lateral meniscus
21-year-old man. Left knee.
Arthograms have been lost.
Arthrographic findings: lateral meniscus ruptured in area of middle segment and posterior horn; fishmouth rupture configuration visible.
Arthroscopy: fishmouth rupture of middle segment

1. lateral femoral condyle
2. lateral meniscus
3. fibrillated internal margin of middle segment (general view)

127–132

Fibrillated internal margin of middle segment (general view)

Small transverse rupture and fishmouth rupture in middle segment

1. lateral femoral condyle
2. lateral meniscus
3. small transverse rupture and fishmouth rupture in middle segment

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Small transverse rupture and fishmouth rupture in middle segment

1. lateral femoral condyle
2. lateral meniscus
3. small transverse rupture and fishmouth rupture in middle segment

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Fishmouth rupture and small transverse rupture in middle segment (detail)

1. lateral femoral condyle
2. lateral meniscus

Extirpated lateral meniscus viewed from above

Extirpated lateral meniscus viewed from below
Case report: patient 10
X-ray 1a, 1b: broken-off steel wire in medial intra-articular space
X-ray 2a, 2b: a little later, fragment of wire has moved to lateral intra-articular space.
Arthroscopy: fragment localized beneath posterior horn of lateral meniscus. Removal of fragment with biopsy forceps under direct visual control

133–139
Attachment of posterior horn behind (irritated) synovial tissue

Wire fragment visible beneath posterior horn

General view of internal margin of lateral meniscus; wire fragment already visible beneath posterior horn

1. lateral femoral condyle
2. lateral meniscus
3. wire fragment
1. lateral femoral condyle
2. posterior horn
3. lateral meniscus

1. lateral femoral condyle
2. lateral meniscus
3. wire fragment
4. synovial membrane

Wirefragment beneath posterior horn

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Wirefragment beneath posterior horn

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1. lateral femoral condyle
2. lateral meniscus
3. wire fragment

1. lateral femoral condyle
2. lateral meniscus
3. wire fragment

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1. lateral femoral condyle
2. lateral meniscus
3. wire fragment

Lamp broken off after incautious manipulation with type 21 watanabe arthroscope; size compared with that of extirpated lateral meniscus.