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Discogenic low back pain

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Summary

A neurosurgeon deals with chronic low back pain patients almost daily. Most of these patients still have complaints of low back pain despite many different previous therapies. Surgical treatment is only to be considered in few cases of chronic low back pain sufferers. From this large group of chronic low back pain patients we have tried to select a small group of patients who might benefit from spondylodesis. This thesis is about the selection and treatment of this patient group. Their assumed source of pain and the results of surgical treatment will also be discussed.

Chapter 1. This chapter is a general introduction to the classification of low back pain, the epidemiology of low back pain and the clinical anatomy of the lumbar spine. A general accepted classification of low back pain is not present, at the moment, mainly because we deal with a symptom (pain) without a definite diagnosis. In most cases of low back pain, the findings on physical examination, radiographs, and histopathological studies do not correlate. Therefore, a strict pathophysiological classification is not possible. Many people (70-80%) in Western society will experience a period of low back pain at least once in their life. Fortunately in only 1% of the cases the symptoms will last for more than one year. However, the social-economic consequences of this group of chronic low back pain patients are considerable, due to the direct medical costs and the losses from earning and productivity. The total costs for low back pain in The Netherlands were estimated at 1.7% of the gross national product. The anatomy of the lumbar spine and the motion segment as the functional unit of the spine are also discussed.

Chapter 2. In this chapter, the neuratomical mechanisms of low back pain are discussed in detail. The innervation of the different structures of the motion segment, de nociceptors and the pain pathways are subsequently described. Emphasis is laid on low back pain due to spinal degeneration. Degeneration of the lumbar spine is a sequence of biochemical, biomechanical, and physiological changes due to normal ageing. The degeneration process starts in the intervertebral disc and eventually affects all the structures of the spine. The degenerative changes of the different parts of the motion segment are discussed.

Chapter 3. In this chapter the innervation of discographically confirmed degenerated and “painful” human intervertebral disc was investigated. The innervation of intervertebral discs had previously been extensively described in fetal and adult animals as well as in humans. However, little was known about the innervation of severely degenerated human lumbar discs. The question was posed whether a disc that was removed for low back pain possesses an increased innervation compared with normal discs. The objective of this study was to determine the type and distribution patterns of nerve fibers present in degenerated human intervertebral discs. Therefore, the presence of nerve fibers was investigated using acetylcholinesterase enzyme histochemistry, as well as neurofilament and substance P immunocytochemistry. From 10 degenerated and 2 control discs, the anterior segments were excised and their nerve distribution studied by examining sequential sections. In all specimens, nerve fibers of different diameters were found in the

anterior longitudinal ligament and in the outer region of the disc. In 8 out of 10 degenerated discs, fibers were also found in the inner parts of the disc. Substance P-immunoreactive nerve fibers were sporadically observed in the anterior longitudinal ligament and the outer zone of the annulus fibrosus. These findings indicate a more extensive disc innervation in the severely degenerated human lumbar disc compared with normal discs. The nociceptive properties of at least some of these nerves are highly suggested by their substance P immunoreactivity, which provides further evidence for the existence of a morphologic substrate of discogenic pain.

Chapter 4. This chapter starts with a historical review of spinal fusion. The estimated number of spinal fusions performed in different countries are compared. Biomechanical considerations as well as different surgical techniques for interbody fusion and their complications are discussed. Special attention has been given to the minimal invasive anterior lumbar interbody fusion (mini-ALIF)-technique. In the last section of this chapter, bone grafting and the latest developments in the use of bone morphogenetic proteins and stemcells to improve bony union are discussed.

Chapter 5. This chapter is a prospective study that evaluates the outcome of lumbar interbody fusion in highly selected patients with severely disabling low back pain due to disc degeneration. Using strict in- and exclusion criteria, discography and external immobilisation, 157 patients with “discogenic” low back pain were selected for interbody fusion. An anterior or posterior interbody fusion was performed using tricortical iliac crest grafts. All the patients were operated in a 10-years time period. The postoperative regime consisted of immobilisation in a thoraco-lumbar plaster spica including the upper leg for three months. The clinical results were evaluated 1 and 3 years after the operation while the fusion results were obtained at least 1 year after the procedure by an independent radiologist. An overall clinically successful outcome was obtained in 67% of the patients after 1 and this percentage maintained unchanged at 3 years follow-up. A solid bony union was obtained in 60% of the patients. Patient satisfaction was statistically higher in those who showed bony union on radiographs. The best clinical results were seen in patients with a single level fusion and additional radiographic bony union. In all the patients, no major surgical complications were noted. This study shows that applying strict criteria results in a highly selected group of patients in which lumbar spinal fusion is successful in the majority of cases. Especially when one-level pathology is taken as one of the inclusion criteria, lumbar spinal fusion renders satisfying results.

Chapter 6. This chapter describes a retrospective analysis of the long-term clinical outcome and disability status after lumbar interbody fusion in highly selected patients. In the literature on lumbar spinal fusion in patients with chronic low back pain and benign segmental degeneration only early outcomes are given. The objective of this study was to evaluate for the first time the long-term outcome of lumbar interbody fusion for discogenic low back pain and to relate this to the 1-year and the 3-year clinical outcome. Out of 157 patients with disabling chronic low back pain treated by interbody fusion between 1980 and 1990, 75 patients were evaluated at minimally ten years after the procedure. The long-term outcomes were obtained by a postal questionnaire, which consisted of a Macnab classification, a Roland-Morris disability questionnaire and additional questions concerning other medical conditions, psychological state and current medication. The patients themselves completed the questionnaire. The long-term results were related to the initial fusion status, the number of levels fused, the type of surgical

approach, gender and the age of the patients. A successful clinical outcome of lumbar interbody fusion for disabling chronic low back pain was obtained in 71% after more than 10 years (mean 16.2, range 10-20 years) compared to 69% after 1 year and 71% after 3 years. The long-term Macnab classification correlated well with the Roland-Morris disability score. Patients with a one level fusion had a significant better long-term clinical success rate than patients with a multi-level fusion (86% versus 64%). Although patients with initial radiological fusion had a long-term clinical outcome superior to patients with initial radiological pseudarthrosis (77% versus 59%), this difference was not significant. There was no difference in long-term clinical outcome between types of surgical approach, gender and age of the patients. It is concluded that the early overall clinical outcome of lumbar interbody fusion for highly selected patients with “discogenic” low back pain was maintained over a long period of time. The better long-term results were obtained in patients with a one-level fusion.

Chapter 7. In this section a study is presented on the modification of the established film based roentgen stereophotogrammetric analysis (RSA) into a simple, widely applicable and fully digital technique for determining fusion after lumbar spinal arthrodesis. This novel digital roentgen stereophotogrammetric analysis (D-RSA) technique was validated using a standardized cylinder and a calibration box. Consequently, six 1.0-mm tantalum markers were inserted in anatomically appropriate positions of the L4, L5 and S1 lumbar vertebrae in soft-bones. The L4-L5 and L5-S1 levels were fixated with two types of hardware: stainless steel and titanium hardware (pedicle screws, spinal rods and straight slotted connectors, ISOLA System AcroMed®, Cleveland, Ohio, USA). Digital roentgen stereo pairs of the lateral lumbar spine in flexion and extension were obtained using a biplanar radiographic setup. The acquired digital images of flexion and extension were fully automatically analyzed to determine three-dimensional (3-D) lumbar vertebral motion across the different segments. The study shows that D-RSA is a valid method that fully automatically determines three-dimensional lumbar spinal motion in a highly accurate manner within minutes. With this technique it will be possible to assess an accurate follow-up of the stabilizing effects of lumbar spinal fusion.