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Maxillary first molar extraction in Class II malocclusion

Livas, Christos

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CHAPTER 1

GENERAL INTRODUCTION

1.1. NORMAL OCCLUSION AND MALOCCLUSION

Occlusion refers to the relationship of maxillary and mandibular teeth as they are brought into functional contact.¹ The current perception of normal occlusion has been strongly influenced by the work of Angle, Andrews and Roth. The original Angle's classification² was regulated by the articulation of the mesiobuccal cusp of the maxillary first molar in the buccal groove of the mandibular first molar and the arrangement of teeth in a smoothly curving line of occlusion. Decades later, based on the occlusion characteristics consistently observed in 120 study casts of non-orthodontic patients, Andrews³ described the 'six keys to normal occlusion'; Angle's occlusion of first molars, correct crown angulation and inclination, absence of rotations, tight proximal contacts and flat occlusal plane. Roth added further prerequisite features for normal occlusion regarding the coincidence of centric relationship and centric occlusion, the guidance during protrusion and lateral excursions of the mandible, and the even posterior contacts in centric occlusion.⁴

Malocclusion is defined as any appreciable deviation from the normal occlusion that may be perceived aesthetically unsatisfactory, thus implying imbalance in the relative size and position of teeth, facial bones and surrounding soft tissues.⁵ It represents neither a normal nor a healthy condition.⁶ The World Health Organization (WHO) included malocclusion under the heading of dental diseases and conditions that constitute worldwide major public health problems. The term used by WHO instead, Handicapping Dentofacial Anomaly, describes the dental condition that 'causes disfigurement or impedes function'. Such 'anomaly should be regarded as requiring treatment if the disfigurement or functional defect is or likely to be an obstacle to the patient's physical and emotional well-being'.⁷

1.2 DEFINITION OF ANGLE CLASS II MALOCCLUSION

According to Angle's occlusal classification of malocclusion,² the permanent maxillary first molar is presumed reference point. In normal occlusion, maxillary and mandibular molars should be so related that the mesiobuccal cusp of the maxillary molar occludes in the buccal groove of the antagonist. Deviating inter-arch relationships are identified as Class I, Class II division 1, Class II division 2 and Class III malocclusion. In Class II malocclusion, the mandibular first molar occludes distal to the normal position as defined above. Angle Class II is further categorized to Class II Division 1, characterized by labial inclination of maxillary incisors and increased overjet, and Class II Division 2, characterized by lingually inclined maxillary central incisors combined or not with labially tipped maxillary lateral incisors, reduced overjet, and partial or complete deep bite. Each of the divisions presents a subdivision, in which only one of the lateral halves is in distal occlusion, while the other half is in normal occlusion.

Therefore, Angle Class II subdivision malocclusions possess characteristics of both Class I and Class II malocclusions resulting in asymmetry between the right and the left sides of the dentition.

1.3 EPIDEMIOLOGY OF MALOCCLUSION

Class II malocclusion is a dentofacial deformity, commonly diagnosed in the general population. Differences in prevalence of malocclusion among countries may arise due to differences in racial and ethnic composition.⁸ According to the National Health and Nutrition Estimates Survey III data, an overjet of 5 mm or greater, indicative of Angle's Class II malocclusion appears in 23.0% of the children, 15.0% of youths, and 13.0% of the adults in the United States.⁶ Relatively higher prevalence rates of 21.3-24.0% have been observed in child and adolescent groups in northern European countries.⁹ A nationwide survey in the Netherlands reported a 28.0% prevalence of Class II malocclusion among 14-74 year-olds.¹⁰ Limited epidemiologic data regarding asymmetric Class II malocclusion is available. Class II subdivisions are estimated to account for up to 50% of all Class II malocclusions.¹¹

1.4 NEED FOR ORTHODONTIC TREATMENT OF CLASS II MALOCCLUSION – IMPACT ON THE ORAL HEALTH-RELATED QUALITY OF LIFE (OHRQOL)

Although not life-threatening, malocclusion is the third most prevalent oral pathology, after tooth decay and periodontal disease.¹² Research on the physical, psychological, and social consequences of malocclusion has been so far inconclusive. Certain types of malocclusion including Class II malocclusion with a large overjet and deep bite may contribute to development of temporomandibular disorder (TMD) in the long term.¹³⁻¹⁵ However, the evidence of the correlation between TMD and different types of malocclusion is generally weak, and this does not imply under any circumstances a cause-and-effect relationship.¹⁶ Malocclusion has been found to be associated with increased likelihood of dental trauma, especially in children with untreated Class II Division 1 malocclusions.¹⁷⁻¹⁹ A meta-analysis on the relationship between overjet size and dental trauma concluded that children with an overjet greater than 3 mm ran an almost two-fold risk of incisor injury compared to children with an overjet less than 3 mm.²⁰ The relationship between gingival inflammation and malocclusion remains also controversial. Patients with large overjets and deep overbites are more prone to experience periodontal disease associated with incisal contact. In extreme deep bite cases, direct trauma to gingival tissues from the incisal edges may induce palatal recession in the maxillary incisor region.²¹ Longitudinal research findings indicate a

significant but rather weak association between the type of speech disorder and dentofacial abnormality.^{22,23} There might be a tendency in Class II patients to pronounce differently sibilants such as /s/, /z/, /j/ and /ch/.²⁴⁻²⁶ Furthermore, an anterior open bite combined with a Class II occlusion may cause pronunciation disorders.²⁷ Negative effects of malocclusions on OHRQOL, predominantly in emotional and social well-being have been lately confirmed by studies with high level of quality.²⁸ Bullying has been significantly associated with Class II Division 1 incisor relationship, increased overbite, increased overjet and high need for orthodontic treatment need.²⁹ Patients with dentofacial deformities had a more negative oral health-related quality of life and a lower self-esteem compared with controls.³⁰ On the other hand, the self-concept of children with Class II malocclusion neither appeared low before treatment nor benefited from a brief period of early orthodontic treatment.³¹ Children that had received early treatment with a Twin-Block appliance reported higher self-concepts and more positive social experiences.³²

1.5 TREATMENT OPTIONS OF CLASS II MALOCCLUSION

Treatment decision making in Class II cases relies heavily on the patient's skeletal age, facial aesthetics, arch length discrepancy, and motivation. Growth modification with either functional appliances or headgear may be the standard treatment of choice in prepubertal patients with a favourable growth pattern. Nowadays, maxillary molar distalization mechanics or appliances supported by Temporary Anchorage Devices are widely used in the management of Class II malocclusion. Orthognathic surgery to alter the underlying jaw relationship may be reserved for individuals seeking treatment beyond the growth spurt. In crowded dentitions, orthodontic extractions of teeth in the maxillary arch alone or both maxillary and mandibular arches, may serve as treatment alternative. Without doubt, premolars are the teeth most frequently removed in such extraction protocols. However, less traditional Class II therapeutic approaches involving extraction of first or second molars have been also advocated by a number of authors.³³⁻³⁶

1.5.1 MAXILLARY FIRST MOLAR EXTRACTION TREATMENT: THE TECHNIQUE

The first permanent molar is often significantly compromised by caries or endodontic complications, or from developmental anomalies such as hypoplasia.³⁷ Depending on the eruption prognosis of maxillary third molars and the severity of malocclusion, removal of any compromised teeth in conjunction with orthodontic treatment may be considered in selected cases. Bilateral extraction of maxillary first permanent molars with Begg fixed appliances has been recently reintroduced in the treatment of Class II

Division 1 malocclusion.³⁸ Prior to molar extractions, bands with 6-mm single 0.018-in round buccal tubes and palatal sheaths are placed on the maxillary second molars. Premolars are not directly bonded with Begg brackets to facilitate sliding mechanics. Anchor bends on an individually made archwire constructed of 0.016-in premium plus pull-straightened Australian wire (Wilcock, Whittlesea, Australia) mesial of the molar tubes are utilized to prevent mesial tipping of the molars. Light horizontal elastics (5/16 inch) are prescribed for 24 hours a day, and replaced once per week. Anchor and v-bends between mandibular canines and molars are added to achieve bite opening. Anchorage required for canine retraction is reinforced by insertion of a transpalatal arch. At the time that Class I canine and premolar relationship is established, the premolars are bonded and Class II elastics are used instead of Class I elastics. After alignment of the maxillary premolars, the 0.016-inch starting wire is replaced by a 0.018-inch premium plus archwire (Wilcock, Whittlesea, Australia). During space closure and when indicated, torque auxiliaries may be inserted. In the final sessions, archwire adjustments are made for detailed finishing.

1.5.2 MAXILLARY FIRST MOLAR EXTRACTION TREATMENT OUTCOMES

A prospective longitudinal study of one hundred patients with Class II division 1 malocclusion consecutively treated with extraction of maxillary first molars and 1-stage full fixed appliances confirmed high treatment standards.³⁹ These authors demonstrated an 89.9% mean reduction of weighted PAR score and a minor effect on the soft tissue profile. In particular, the lower lip retruded 1.6 mm in relation to the aesthetic line, while the nasolabial angle became 2.1° more obtuse after treatment. Contrary to one of the prevailing orthodontic dogmas, a bite-closing effect of extracting the maxillary first molars was not observed. In other words, divergent patients did not seem to benefit more than deepbite patients when treated with this treatment modality. Nevertheless, the clinical relevance of this finding was deemed limited.

Analysis of overjet correction and space closure mechanisms on the same group of patients revealed a mean overjet reduction of 5.2 mm, on average accomplished by means of 1.7 mm skeletal and 3.5 mm dental changes.⁴⁰ Overjet reduction was mostly achieved by retrusion of the maxillary incisors and to a lesser extent by protrusion of the mandibular incisors and forward growth of the mandible. Interestingly, a pronounced mesialization of 9.9 mm of the maxillary second molars took place, whereas the maxillary premolars were distalized merely by 1.4 mm.

A recent comparative study on Class II treatment effects of extraction of maxillary first molars and Herbst appliance verified the predominantly dental contribution (65% dental and 35% skeletal changes) in the extraction group, while the Herbst group

exhibited mainly skeletal in origin effects (58% skeletal and 42% dental changes).⁴¹ There was a significant increase in the nasolabial angle by 2.33° in the extracted subjects compared to the Herbst controls. The soft tissue profile convexity decreased in both treatment groups, which was 0.78° more evident in the Herbst group, though not statistically significant. Overall, the authors concluded that both Class II treatment methods produced high standard outcomes.

1.5.3 UNILATERAL MAXILLARY FIRST MOLAR EXTRACTION IN CLASS II SUBDIVISION

Asymmetric mechanics in the affected side by means of various orthodontic accessories,⁴²⁻⁴⁴ as well as asymmetric extraction patterns^{45,46} and orthognathic surgery⁴⁷ may be each considered treatment of choice for Class II subdivision malocclusion. Modification of the aforementioned technique including unilateral extraction of a maxillary first molar on the Class II side has been suggested for treatment of asymmetric Class II malocclusion.⁴⁸ As far as we are aware, no clinical study has been carried out so far to provide insight into the treatment outcomes of this therapeutic modality.

1.5.4 MAXILLARY MOLAR ERUPTION AFTER EXTRACTION OF MAXILLARY POSTERIOR TEETH

Third molar inclination changes have been investigated in patients orthodontically treated or not with either second molar,⁴⁹⁻⁵³ first premolar extractions⁵⁴⁻⁵⁸ or unilateral extraction of the mandibular first molar.⁵⁹ Improved positions of maxillary third molars have been substantiated after orthodontic therapy with extraction of all first permanent molars.⁶⁰ Theoretically, the relative location of the extracted tooth to the maxillary third molar may determine the prognosis of third molar eruption.⁶¹ In this sense, molar extraction protocols may be proved more beneficial than premolar extractions. The effect on second and third molar inclination of either unilateral or bilateral extraction of maxillary first molars followed by orthodontic treatment remains to be determined.

1.5.5 ORTHODONTIC SPACE CLOSURE AND MAXILLARY SINUS INTERFERENCE

In almost half of the adults, the maxillary sinus penetrates the maxillary alveolar process, expanding between the periapical areas of the second premolar and second permanent molar.⁶² Experimental and clinical research has found modest apical root

resorption and variable tipping of teeth being intruded and bodily moved across the maxillary sinus floor.⁶³⁻⁶⁵ Given the amount and the location of space resulting from maxillary first molar extraction, tipping of the neighbouring teeth against the sinus walls may also be expected during closing mechanics.

1.5.6 OVERERUPTION OF THE UNOPPOSED MANDIBULAR SECOND MOLARS

Lack of antagonist contact has been identified to cause movement of the unopposed tooth in occlusal direction, i.e. overeruption.⁶⁶ The authors of a systematic review on the treatment need for posterior bounded edentulous spaces,⁶⁷ found an up to 2 mm overeruption for the most studies analyzed. According to the step-by-step description of the maxillary first molar extraction technique,³⁸ following appliance removal, segmental retention wires are bonded on mandibular first and second molars are to counteract overeruption of the second molars. These sectionals are maintained until occlusal contact of the maxillary third molars and antagonists occurs. But is this fixed retention adequate to inhibit vertical movement of the mandibular second molars?

1.6 AIMS OF THIS THESIS

The overall aim of this thesis was to evaluate posttreatment effects of unilateral and bilateral extraction of maxillary first molars in Class II malocclusion cases.

The specific aims of this research project were determined as follows:

1. To evaluate the stability of occlusal and soft tissue profile outcomes of Class II subdivision treatment with unilateral maxillary first molar extraction in the retention stage.
2. To investigate the influence of orthodontic treatment of Class II subdivision treatment with unilateral maxillary first molar extraction on the maxillary second and third molar inclination.
3. To assess the maxillary second and third molar inclination changes following bilateral maxillary first molar extraction in Class II Division 1 malocclusion subjects.
4. To investigate potential associations between maxillary sinus floor extension and inclination of maxillary second premolars and second molars in patients with Class II Division 1 malocclusion whose orthodontic treatment included bilateral maxillary first molar extraction.
5. To evaluate the effectiveness of fixed retention in preventing overeruption of mandibular second molars lacking antagonist contact in Class II Division 1 cases treated with bilateral extraction of maxillary first molars.

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