Maxillary first molar extraction in Class II malocclusion

Livas, Christos

CHAPTER 7

SUMMARY AND GENERAL DISCUSSION

SUMMARY

In this thesis, we ran case series studies to investigate postorthodontic changes in patient groups treated with unilateral and bilateral extraction of maxillary first molars (M1s) and Begg appliances. In **Chapter 1**, a short introduction to basic orthodontic terms such as occlusion, malocclusion, and Class II Angle classification is provided. Class II malocclusion is commonly diagnosed in the general population, and represents a public health priority. Individuals with Class II malocclusion are seeking therapy on the grounds of physical, psychological, and social benefits. Treatment planning is driven by the patient's growth potential, dental crowding, aesthetics and appliance preferences. While extraction of premolars is commonplace in orthodontics, molars with questionable long-term prognosis may be chosen instead. A treatment approach combining bilateral M1 extraction and Begg fixed appliances has shown good treatment outcomes in Class II Division 1 malocclusion subjects. Modification of this technique with extraction of one M1 on the Class II side has also been described for treating Class II subdivision cases. The overall and specific aims of this thesis are presented.

Chapter 2 deals with a follow-up assessment of a Class II subdivision sample treated with unilateral M1 extraction in terms of occlusion, facial profile and midline aesthetics. Twenty Class II subdivision subjects consecutively treated by one orthodontist with the Begg technique and unilateral M1 extraction were selected from the records of a private practice. Inclusion in the study was based on the following criteria: white subjects, unilateral Class II molar relationship ≥1/2 premolar width, no tooth agenesis including third molars, fairly aligned mandibular arch, unilateral M1 extraction, and available records before treatment (T1), after treatment (T2), and 2.5 years in retention, on average. The control subjects were 15 untreated asymmetrical Class II adolescents closely matched by age, with complete T1-T3 documentation, retrieved from the archives of the Groningen Longitudinal Growth Study. PAR scoring and cephalometric analysis was carried out for both groups, while midline correction was evaluated on patient smile photographs. We observed significant changes in maxillary incisor retraction, mandibular incisor protraction, and lower lip protrusion, which promoted patients' facial profiles. The M1 extraction cases exhibited an average reduction of more than 20 PAR points, whereas the severity of malocclusion was slightly increased in untreated controls. At T2, facial and dental midlines were coincident in 45% of the treated subjects. Therefore, we concluded that asymmetrical M1 extraction in Class II subdivision patients may yield stable occlusal and aesthetic results from a long-term perspective.

A retrospective split-mouth study on the changes of maxillary second (M2) and third molar (M3) inclination following Class II subdivision treatment with unilateral M1 extraction and Begg appliances is presented in **Chapter 3**. Orthopantomograms of 21 Class II subdivision adolescents treated with the abovementioned protocol in one orthodontist-practice obtained at T1, T2, and T3 (at least 1.8 years after treatment) were traced. M2 and M3 axial inclination on the extraction and nonextraction sides was measured using the intertuberosity (ITP) and interorbital planes (IOP). According to the random effects regression analysis, time and extraction status were significant predictors for M2 angulation, whereas extraction was the only significant predictor for M3 angulation. On the basis of these results, it was concluded that unilateral maxillary M1 extraction led to a significant increase in M2 and M3 mesial inclination. There was a significant tilting of M2s over time irrespective of M1 extraction.

Chapter 4 desribes a cephalometric study aiming to investigate the changes in the inclination of M2s and M3s after orthodontic treatment of Class II Division 1 malocclusion with extraction of the M1s. The study group included 37 subjects meeting the following criteria: white origin, Class II Division 1 malocclusion, overjet ≥ 4mm, full complement of permanent teeth, treatment with extraction of the maxillary first molars and the Begg technique. Lateral cephalograms had been taken at T1, T2 and T3 (at least 3.7 years after treatment). Fifty-four untreated Class I and Class II subjects, followed up for a minimum of 3.6 years, were selected from the archives of the Nittedal Growth Material as controls. M2 and M3 inclination was defined relative to the palatal plane (PP) and functional occlusal plane (FOP). Mesial inclination of M2s and M3s in relation to PP was significantly increased in both groups. With reference to FOP, significant changes in M2 inclination were observed only in the extraction group, with the initially more distally tilted M2s reaching a mesial inclination at T2. M3 inclinations improved significantly in either group, but M3s became 4 times more upright in the extraction subjects. In light of these findings, we concluded that M1 extraction in Class II Division 1 patients results in significant uprighting of M2s and M3s and increases the chances for normal eruption of M3s.

The same sample of Class II adolescents was enrolled in the study described in **Chapter 5** to explore the possible association between the maxillary sinus extent and the inclinations of the maxillary second molars and second premolars before and after orthodontic treatment with bilateral M1 extractions. Maxillary posterior tooth inclination and lower maxillary sinus outline in relation to the palatal plane was determined on available lateral cephalograms at T1, T2 and T3 (on average 2.5 years after treatment). The results showed that second molar inclination achieved increasingly smaller angular values from T1 to T3. We found evidence for a negative correlation of maxillary sinus area and second molar inclination angle; the greater the sinus extent (area), the smaller the inclination angle. For premolars, inclination angles increased between T1-T2, but unlike molars, partially relapsed at T3. The maxillary sinus area was not associated with premolar inclination. To conclude, our study demonstrated a significant correlation between extension of the maxillary sinus floor and posttreatment second molar inclination. When a vertically extended maxillary sinus in patients undergoing M1 extractions is diagnosed, this possible association should be considered in space closure mechanics.

The potential of fixed sectional retainers in preventing overeruption of unopposed mandibular second molars was investigated in **Chapter 6**. Private practice records were screened for Class II Division 1 subjects who had received orthodontic treatment with M1 extraction and Begg fixed appliances and met the abovementioned criteria. 30 subjects with bonded buccal retention wires on the mandibular first and second molars lacking occlusion with antagonists at T1 and T2 were allocated to the study group. Twenty-five nonretention subjects with intra-arch occlusion in the posterior segments were assigned as controls. Analysis of panoramic radiographs was carried out to determine changes in the inclination of mandibular molars in relation to the mandibular plane and the resulting overeruption was expressed as movement of the second molar centroids between T1 and T2. No statistically significant changes occurred in either molar inclination or overeruption between retention and nonretention groups. This study concluded that fixed retention of nonoccluding mandibular second molar may be an effective means to inhibit tooth overeruption.

7.2 STRENGTHS AND LIMITATIONS

All studies examined unique patient samples with reference to the unconventional extraction decision and the extensive experience of the treating orthodontist in the Begg technique. Extraction of permanent first molars was found to be prescribed by US orthodontists in less than 0.5% of the extraction cases, whereas premolar extraction pattens accounted for 82%.[1] Because of the very low incidence of M1 extractions in orthodontic practice, it has not been earlier possible to conduct clinical trials with sufficient power to investigate aspects of this treatment modality. Previous research on the impact of maxillary first molar extraction on third molar position, angulation and/or eruption focused on different extraction protocols[2-5] and non-orthodontic patient groups,[3,5] in contrast to the studies presented here. Additionally, the inclusion of clinical records obtained at a minimum range follow-up of 1.8-3.7 years enabled us to evaluate the treatment effects from a longer-term perspective. Regarding Class II subdivision treatment, a single study assessing the occlusal stability of cases treated with asymmetrical premolar extractions 6.9 years on average after the end of treatment was found in the literature.[6] Therefore, our follow-up studies described in **Chapters 2 and 3** provided more insight into the maintenance of treatment outcome of asymmetric Class II malocclusion in the retention stage.

The methodological limitations of these studies are primarily related to the retrospective type of design, as retrospective data collection may induce selection and detection bias. To reduce selection bias, all patients meeting the inclusion criteria were enrolled.[7] 'Blinding (or masking) of outcome assessors may diminish the risk that knowledge of which intervention was received, rather than the intervention itself, affects outcome measurement'.[8] In the current studies, blinding of examiners or masking of records could not have been possible due to the obvious intervention of M1 extraction and its comparison with untreated subjects. Deliberate delay of treatment or nontreatment would have been inappropriate owing to ethical concerns of recruiting untreated participants in clinical trials.[9] To compensate for the lack of untreated Class II malocclusion subjects in **Chapters 2** and **4**, we selected historical controls closely matched by race, age, and if applicable by sex, and further increased the ratio of controls to cases in **Chapter 4**. The limited control over data collection did not allow outcome ascertainment on complete clinical records including dental casts in **Chapter 6**. Nevertheless, we struggled to apply robust radiographic analyses that integrated multiple reference planes (**Chapters 3 and 4**) and digitization points (**Chapter 6**) to strengthen measurement validity. One observer was engaged in all measurements, thus ensuring consistency of the results. On the other hand, this is a limitation of the studies because the extent of interobserver differences could not be assessed. However, it was attempted by the crafting of the computer-aided measurements to reduce observer error and increase objectivity. For example, the long axis of the molars in **Chapter 6** was computed automatically, based on the drawn outline of the whole tooth; therefore, significant interobserver differences in drawing the tooth outlines would be required for an appreciable change in the computed long axis, whereas large differences might be observed if the long axis was based on the manual identification of just two points. The impact of this design is evident by the lack of significant differences between repeated measurements. In addition to this, the involvement of more examiners, though theoretically ideal, might have caused interobserver differences due to observer variations in experience and training.[10] Despite the inherent technical discrepancies,[11,12] axial inclination of molars was determined on panoramic radiographs (**Chapter 3**) rather than lateral cephalograms (**Chapter 4**) due to superimposition of bilateral structures on cephalometric films. Finally, we need to recognize that all studies were not designed to test the involved questions in post hoc analyses. As a consequence, our studies may be, at best, used as indicators of potentially new information, and viewed as hypothesis-generating.

7.3 CLINICAL IMPLICATIONS

A decision to electively extract healthy premolar teeth for orthodontic purposes may not be justifiable in cases with compromised M1s. As a general rule, presence of extensive caries lesions, large fillings, endodontic or periodontal problems, or hypoplastic enamel should be taken into account when extraction treatment has been chosen. The first permanent molar has the shortest caries-free survival under the age of 8 years.[13] It also represents the most caries prone tooth in children older than 11 years.[14] First molars can suffer from developmental enamel hypomineralisation of unknown aetiology often involving permanent incisors. Lately published rates vary between 4.2-

21.4% depending on the child population and examination method.[15-17] In the Netherlands, an increase in the prevalence of molar incisor hypomineralisation was recorded between 1999 and 2003 with 12.7% of children having at least 2 defective molars.[18,19] Prognosis of endodontic treatment in multirooted teeth may be also problematic. Previous research showed that the most commonly extracted tooth due to endodontic complications was the M1.[20] In this scope, and of cource in the presence of healthy and well-formed M2s and M3s, M1 extraction may be a viable option.

Favourable and stable treatment outcomes in terms of occlusion, facial profile and midline aesthetics may be expected in management of Class II subdivision malocclusion with one M1 extraction (**Chapter 2**). Given the longer treatment duration of the premolar-extraction protocols (3 extractions, 3.5 years; 4 extractions; 4.0 years)[6] compared to the mean treatment time of 2.3 years in the M1 extraction group, the latter Class II subdivision treatment alternative appears more attractive. As soon as 6 months after treatment commences, a Class I canine and premolar relationship can be established.[21] Furthermore, patient cooperation is restricted to oral hygiene measures and once-per-week replacement of elastics, which may render this method suitable for patients with poor compliance. An additional benefit of orthodontic treatment with unilateral or bilateral M1 extraction may be the improved eruption status of M3s, even when unfavourably positioned before treatment (**Chapters 3 and 4**). Our studies also underpinned the interference of a vertically extended maxillary sinus in achieving proper tooth axial inclination during space closure (**Chapter 5**), and the capacity of multistranded retention wires to prevent overeruption of unopposed mandibular second molars (**Chapter 6**). Clinicians treating with M1 extractions should meticulously plan and apply mechanotherapy and retention to counteract unwanted posterior tooth movement.

7.4 FUTURE PERSPECTIVES

This PhD thesis generated research hypotheses that can be tested in new, specifically designed studies. The appliance of choice, the Begg light-wire appliance delivers only a single contact point between the bracket and the archwire, which reduces friction between the bracket and the archwire, and virtually eliminates the binding of the archwire in the bracket slot, as is seen in all horizontal slot brackets.[22] Given the low friction levels of as-received self-ligating brackets[23,24] and the popularity of these systems,[1] future research may focus on coupling maxillary first molar extraction(s) with self-ligating and conventional appliances in prospective randomized clinical trials.

Given the exceptional maxillary second molar protraction achieved by space closure mechanics[25] and the predisposing role of the distance of tooth movement in root resorption,[26] it would be interesting and methodologically challenging to investigate the

incidence of the associated molar root resorption. Nonetheless, the use of light elastic forces throughout the course of treatment may be expected to keep the extent of such potential complication limited.

The minimum length of the observation period in the treatment groups ranged between 1.8-3.7 years. In view of the late emergence of third molars, i.e. 17-21 years,[27] studies not covering this period might fail to accurately depict the rate of molar eruption. From a clinical perspective, more useful conclusions about the maxillary first molar extraction effects in the treatment of Class II malocclusion and outcome stability can be drawn if studies with longer follow-ups will be undertaken.

7.5 CONCLUSIONS

The studies of this thesis demonstrated:

1. Favourable occlusal and aesthetic outcomes on average 2.5 years posttreatment in Class II subdivision patients treated with unilateral M1 extraction.
2. A positive influence of ulilateral and bilateral M1 extraction on M2 and M3 inclination after treatment and in retention.
3. An association between maxillary sinus extension and mesial inclination of M2s in bilateral M1 extraction cases.
4. The effectiveness of multistranded retainers to inhibit overeruption of nonoccluding mandibular second molars.

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