Extraction of maxillary second molars in the treatment of Class II malocclusion

Efthimia K. Basdra, DDS, Dr.med.dent; Angelika Stellzig, DDS, Dr.med.dent; Gerda Komposch, DDS, PhD

In order to correct certain malocclusions, orthodontists very often decide to remove permanent teeth, especially the first premolars. Second molar extraction remains a controversial issue, although when done early[1,2] may be a viable alternative to premolar extraction.

There is no agreement in the literature on the indications for second molar extraction.[3,4] Less adverse facial profile change,[5-7] effectiveness of functional appliance therapy,[8] uneventful eruption of third molars,[9-11] and shorter treatment time[12] may be reasons for removing four second molars.

Many of the published articles are either case presentations or expressions of the author's personal views.[3,4,12] Statistical data refer to cases treated with the extraction of all four second molars.[13-16] To our knowledge, statistical data do not exist for cases treated solely with maxillary second molar extraction. The purposes of this study were to examine the results of maxillary second molar extraction cases, to evaluate the position and the anatomy of the erupted third molars, and to critically discuss the rationale for extracting maxillary second molars.

Maxillary second molar removal is indicated for the correction of Class II, Division 1, problems, provided there is excessive labial inclination of the maxillary incisors with no spacing, overbite is minimal, and the maxillary third molars are in good position and of proper shape.[17-19] This type of extraction is limited to nonskeletal Class II malocclusions having distinct counterclockwise growth characteristics[20] and well-

Abstract

The results of treatment following the extraction of maxillary second molars for Class II correction were evaluated. Records (cephalograms, orthopantomograms, and models) of 32 patients treated with maxillary second molar extraction were analyzed. Cephalograms taken before and after treatment were traced and 18 variables were compared. Changes in the axial inclination of the erupted third molars relative to the occlusal plane were measured on the orthopantomograms. The form and the position (eruption in occlusion, rotations) of the maxillary third molars were evaluated on the models. The average treatment time was 26 months. The results of this study show significant changes of the angles SNA, SNB, ANB, 1:SN, and the distances 1-NPog, and 1-APog, as well as significant effects on the soft tissue profile. In 19 cases examined 4 years postretention, all maxillary third molars had erupted into occlusion with a mesial contact point and acceptable mesiodistal axial inclination.

Key words

Maxillary second molars • Extractions • Class II treatment

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Table 1
Mean cephalometric values before and after treatment

Variables	Pretreatment mean	Posttreatment mean	SD	signif.
NSAr	125.30°	125.42°	0.44	NS
SArGo	143.34°	143.27°	0.97	<0.05
ArGoMe	122.11°	121.21°	0.47	NS
Sum	390.84°	390.34°	0.39	NS
SNA	80.79°	79.88°	0.27	<0.001
SNB	76.21°	76.44°	0.23	<0.05
ANB	4.57°	3.41°	0.73	<0.001
SNPog	78.02°	78.26°	0.24	NS
PPlGoMe	23.21°	22.01°	0.12	NS
SNGoMe	30.87°	30.41°	0.38	NS
SGo:NMe	67.56%	68.75%	0.44	<0.01
1 :SN	103.63°	99.69°	1.54	<0.01
1:NPog	8.81 mm	5.72 mm	0.38	<0.001
1:APog	7.32 mm	4.94 mm	0.48	<0.001
1:GoMe	96.90°	99.4°	4.76	NS
Interincisal angle	128.42°	130.33°	1.66	NS
Upper lip to E-line	-2.75 mm	-5.69 mm	0.48	<0.001
Lower lip to E-line	-1.83	-3.87	0.99	NS

formed mandibular arches with no crowding.[21,22] In some cases, maxillary second molar extraction, when combined with either extraoral appliances or Class II mechanics,[23] facilitates the distal movement of first molars for Class II correction.

The advantages of maxillary second molar extraction are that eruption pathways of the maxillary third molars are easier to predict than those in the mandible[24,25] and posterior movement of the maxillary first molars is easier.[23,24] With light headgear forces, a fully corrected Class I molar relationship can be achieved within 3 to 6 months.[24]

The disadvantage of maxillary second molar extraction is the enormous amount of space created,[26,27] usually in the front.[3,4] Driving the occlusion distally with headgear requires a great deal of patient motivation and cooperation.[8] After correction of the Class II relationship, treatment time can be prolonged until the maxillary third molars are in occlusion.[22,25]

Materials and methods

Records were obtained from the Department of Orthodontics, Heidelberg University, of subjects treated with maxillary second molar extraction. The sample consisted of 32 patients, 20 females and 12 males. The mean age at the beginning of treatment was 14 years 6 months (range 12 years to 22 years 8 months). In 28 cases, the maxillary second molars were extracted for correction of a Class II relationship. In four cases, only one molar was extracted (Class II, subdivision). Cephalograms taken in centric occlusion before and after treatment were traced and the following 18 variables were compared:

1. Saddle angle (NSAr)
2. Articular angle (SArGo)
3. Gonial angle (ArGoMe)
4. Sum (Sum of saddle, articular, and gonial angles)
5. SNA
6. SNB
7. ANB
8. SNPog
9. Palatal plane to mandibular plane (PPlGoMe)
10. SN to mandibular plane (SNGoMe)
11. Ratio of anterior to posterior face height (SGo:NMe)
12. Maxillary 1 to SN
13. Maxillary 1 to NPog
14. Maxillary 1 to APog
15. Mandibular 1 to mandibular plane (1:GoMe)
16. Interincisal angle
17. Upper lip to E-line
18. Lower lip to E-line

To evaluate the third molar anatomy and position, the patients were recalled and orthopantomograms and models were taken. The recall sample consisted of 19 patients with 34 maxillary third molars (four patients had only one second molar removed). The position (crossbite), size (mesiodistal), and form of the third molars were recorded on the postretention models.

The pretreatment and postretention axial inclinations of the third molars to the occlusal plane were compared on the orthopantomograms. To define the occlusal plane, a line from the mesial cusp of the first molar to the canine was recorded.[16]

The data obtained from the cephalograms representing changes during treatment were analyzed for statistical differences at the $P<0.05$, $P<0.01$, and $P<0.001$ levels of significance by means of Student's *t*-tests. Data from the orthopantomograms and models were evaluated on a percentage basis.

The average active treatment time was 2 years 2 months.

The periodontal status of the erupted third molars (pockets, mobility) was also evaluated for the recalled patients.

Results

Statistical analysis of the 18 cephalometric variables showed significant differences in nine measurements (Table1):

1. ArGoMe

2. SNA
3. SNB
4. ANB
5. SGo:NMe
6. 1:SN
7. 1:NPog
8. 1:APog
9. Upper lip to E-line

The following angles showed mean increases: NSAr, ArGoMe, SNB, SNPog, 1:GoMe, interincisal angle, the ratio SGo:NMe, and the distances upper lip to E-line and lower lip to E-line. The following measurements showed mean decrease changes: SArGo; the sum of saddle, articular and gonial angles; SNA; ANB; PPlGoMe; SNGoMe; 1 :SN; 1 to NPog; and 1 to APog.

All 34 reexamined maxillary third molars erupted into occlusion and had mesial contact points. The mesiodistal inclination of these third molars was favorable, in that the angle between the maxillary third molar and the occlusal plane increased[16] in all cases but one. Because of the large variability of the mesiodistal inclination on the orthopantomograms, no statistical analysis could be performed. Of the 34 maxillary third molars, six erupted into crossbite without disturbing the occlusion, and one was in true crossbite, which was due to the extreme buccal inclination of the mandibular second molars.

The size and shape of the third molars were acceptable in 30 subjects (88%), ranging from 8 mm to 10.5 mm mesiodistally.[26,27] Two molars had acceptable size (mesiodistally) but very poor triangular shape, while two others were very small (6.8 mm and 6.2 mm). None of the 34 examined third molars presented any signs of periodontal disease (pockets, mobility).

Discussion

The extraction of permanent teeth to correct crowding or a Class II malocclusion is a routine decision in orthodontic treatment. Every extraction approach involves a variety of considerations, such as the possibility of adverse changes in the facial profile, stability of the result, and eruption of the third molars.

In this study we examined second molar extractions in the maxillary arch, we evaluated changes in 18 cephalometric variables, and we noted the position of the erupted maxillary third molars as well as their size, form, and periodontal status.

Our results revealed significant changes in the cephalometric values SNA, SNB, ANB, SGo:NMe, I:SN and upper lip to E-line. The SNA angle decreased, as did the inclination of the maxillary incisors, as a result of the posterior movement that took place in the maxillary arch. The tips of the maxillary incisors moved distally in reference to NPog and APog lines with means of 3.1 mm and 2.4 mm, respectively. All these changes were statistically significant.

The upper lip was retracted in reference to E-line, and this change was significant. Although maxillary second molars are located far posteriorly in the arch, their extraction influences the soft tissue profile. Staggers[16] reported the same results in a comparison study of second molar versus premolar extraction.

The SNB angle slightly increased and contributed to some extent to correction of the Class II relationship. The posterior to anterior face height ratio increased contrary to bite opening mechanics (posterior movement of the maxillary dentition). Most likely the overbite would have increased even more without treatment, given the extreme horizontal direction of growth of our sample.

In the reexamined cases, all maxillary third molars had erupted. The same was observed by Smith[13] when the position of maxillary and mandibular third molars was evaluated after extraction of second molars. The third molars examined in our study all had mesial contact and acceptable axial inclination. We could not draw any optimal angulation of the long axis of the third molar because of the great variability in the mesiodistal inclination. Of the 34 molars examined, 31 were positioned satisfactorily in the arch without any need for further repositioning. Periodontal evaluation revealed good periodontal status with no pockets and no mobility. An increase in the angle between the maxillary third molar and the occlusal plane was observed. This suggests an improvement in the maxillary third-molar angulation[16] and is one of the advantages of this extraction approach. The failure of third molar eruption after premolar extractions is not a rare phenomenon.[7]

The form and size of the erupted third molars was acceptable in 88% of the cases. It is very important to evaluate the anatomy of the third molars prior to second molar extraction.[24] Malformed third molars are not good replacements for the second molars. It is easier to assess the form and size of the third molar in the later stages of tooth development. This is also the best time for second molar extraction. Chipman[25] reported that the optimal time for extraction is when the tips of the third molar crown are approximately at the same level with the vertical midline of the second molar. We observed the best results (good axial inclination, early erup-

Figure 1A-D
Ideal third molar position for second molar extraction. Note the slightly different left (A) and right (C) third molar positions on the same patient. Second molars were extracted simultaneously. Note early eruption of the right tooth (B) during treatment.

Figure 1

tion) when extractions were performed when the third molar crowns were positioned at the level of the root-crown junction of the second molars (Figure 1). Extractions performed earlier resulted in postponed third molar eruption, and evaluation of the third molar anatomy was not as accurate. Also, at this point, the third molars have descended so much that posterior movement of both first and second molars is not feasible.

The space created after the extraction of the maxillary second molars is considerably larger[26,27] and usually further away from the crowding[5] when compared with the space created after first premolar extraction. Bear in mind, however, that the entire space will not be taken by the first molars. The maxillary first molars move posteriorly far enough to correct the Class II relationship, while the rest of the space is used by the subsequent eruption of the maxillary third molars.[17,19]

A dental Class II relationship can usually be corrected with good headgear wear in 3 to 6 months,[22,24] although further headgear wear is advised until the premolars drift distally (Figures 2 and 3). Fixed appliances can then be used for exact tooth positioning. Until the first molars are Class I and have contact with the mandibular second molars, care should be taken to prevent overeruption of the mandibular second molars. This can be achieved with a mandibular removable appliance, fixed appliances[22] when the mandibular arch also needs treatment, or a fixed lingual arch with occlusal rests on the mandibular second molars.[17,19]

Patient cooperation and motivation are required for every extraction approach and especially here, where the need for headgear wear is absolute. As a relative "advantage" can be taken the posterior location of the extraction space. When a patient with second molar extractions wishes to interupt treatment, the extraction spaces will be closed, uncontrolled by the mesially drifting third molar.

The average active treatment time for our group was 2 years 2 months. Treatment time when compared with other extraction possibilities (four premolars) is not significantly different.[16] The treatment time mentioned above does not include the posttreatment observation time

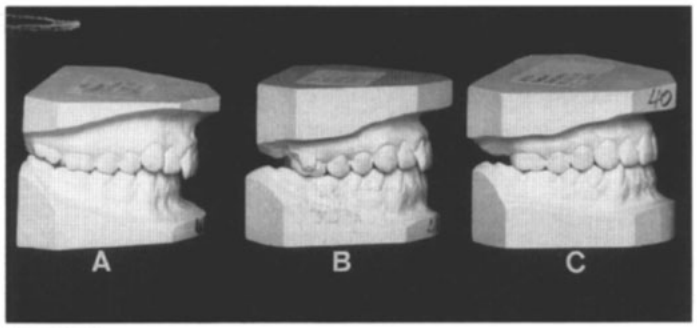

Figure 2

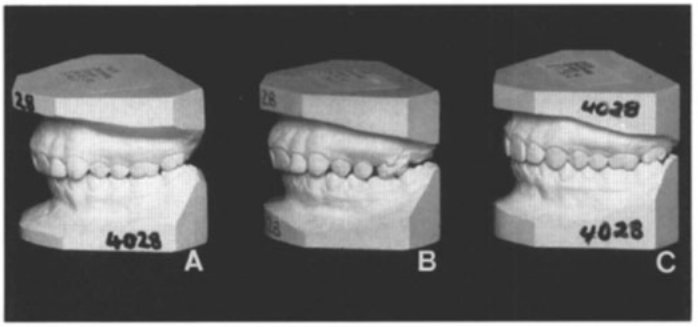

Figure 3

for the third molar eruption. The mandibular third molars should also be referred for extraction.[22]

Conclusions

In this study we examined and evaluated Class II cases treated by extracting maxillary second molars. Findings from this study can be summarized as follows:

1. Statistically significant changes were observed for the angles SNA, SNB, ANB, SArGo, and the ratio SGo:NMe.
2. The maxillary incisors were retracted with significant changes for 1:SN, 1-NPog, and 1-APog, and the distance upper lip to E-line was reduced significantly, affecting the soft tissue profile.
3. The duration of this treatment approach was 2 years and 2 months.
4. All reexamined third molars erupted with a mesial contact point, good mesiodistal axial inclination, and no signs of periodontal disease Their form and size were acceptable in 88% of the cases.

Maxillary second molar extraction is an alternative treatment choice for dentoalveolar compensation of Class II and subdivision cases. This treatment approach has its rigorous indications, and it is not a routine scheme. When the individual case meets the criteria, it is a very good and convenient approach for the dentoalveolar correction of certain Class II malocclusions.

Author Address

Dr. Efthimia K. Basdra
Department of Orthodontics
Heidelberg University
INF 400
Heidelberg 69120
Germany

E.K. Basdra is a research associate and lecturer in the Department of Orthodontics, Heidelberg University, Heidelberg, Germany.

A. Stellzig is a research associate and lecturer in the Department of Orthodontics, Heidelberg University, Heidelberg, Germany.

G. Komposch is professor and head of the Department of Orthodontics, Heidelberg University, Heidelberg, Germany.

Figure 2A-C
Case 1. Class II correction. (A) Pretreatment models. (B) Posterior movement of first molars and near correction of premolars and canine. (C) Posttreatment models.

Figure 3A-C
Case 2. (A) Occlusion at the start of treatment. (B) First molars in Class I relationship. (C) Class I occlusion at the end of active treatment.

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