Orthodontic treatment mechanics after the extraction of second premolars

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Abstract
This paper reviews the choice of second premolars as an extraction alternative, and discusses different options for treatment mechanics.

In many patients the normal full arch methods are appropriate, but in cases with mild anterior crowding there can be advantages to starting with sectional mechanics for the first six to eight months.

The technique of pre-alignment with sectional wires is popular with patients, because there are no appliances on the front teeth during the early months of treatment, and spontaneous improvement among the incisors is normally seen during this time.

The technique for using sectional mechanics is described, and the advantages explained, with recommendations for case selection.

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Keywords
Second Premolars, Treatment Mechanics, Preadjusted Appliance
The authors have developed a system of orthodontic treatment mechanics which they have found to be effective with the preadjusted edgewise appliance. The treatment method has been described in a series of books and published papers. Their recommended technique follows sound orthodontic principles and involves full arch mechanics, using the .022 slot and accurately manufactured tie-wing brackets. There is a requirement for precise bracket positioning, and repositioning where needed. During levelling and aligning, anchorage control is maintained with appropriate use of lacebacks and bendbacks. During the opening stages three basic arch forms are recommended – oval, square and tapered – but the case then progresses into an individualised arch form, based on the shape of the patient’s lower arch at the start of treatment. During the main part of the treatment, sliding mechanics are used, with light continuous forces and group movement on .019/.025 steel working wires with soldered hooks. Lighter wires of .014 steel or .016 heat activated nickel titanium (HANT) are recommended for the finishing and settling stages. These allow vertical settling of the occlusion and adjustment of arch form before the case goes into retention.

The extraction decision

The lower arch is a key focus in treatment planning. If crowding is present, opinions vary greatly among orthodontists concerning the ratio of extraction to non-extraction treatment. These variations are due to different views about the methods of creating space for tooth alignment, and it is beyond the scope of this paper to review the controversies about the extraction/non-extraction decision. Undoubtedly, there is reluctance from parents, patients and some referring dentists to accept the idea of premolar extractions. This may be due to parents or patients having previous bad experiences, or a fear of the process of removing the teeth. Reluctance from dentists may be due to them seeing disappointing results on patients returning to their offices after extraction treatment. These pressures are brought to every orthodontic practice. However, one of the orthodontist’s treatment goals is to manage the patient’s chief complaints, and some cases require extraction of premolar teeth to achieve this. Unfortunately, when there is insistence from a patient or a dentist that they do not want premolars extracted, it does not change an extraction case into a non-extraction case. If the crowding is greater than can be managed by appropriate interproximal enamel reduction and reasonable dental compensation, the authors maintain that extraction treatment is indicated.
DENTAL REASONS FOR SECOND PREMOLAR EXTRACTIONS
The possible dental reasons for considering second premolar extractions have been previously reviewed\(^2\). These include caries or large restorations, malformed\(^8\) or abnormally small teeth, agenesis of one or more second premolars, and severe local displacement. The authors have reported on a case with extraction of lower second premolars of abnormal size and shape to deal with mild anterior crowding\(^2\).

THE EXTRACTION OF SECOND PREMOLARS
The elective extraction of second premolars has been discussed in the literature for more than 50 years. In the 1940s and 1950s Nance, Dewel and Carey\(^9–11\) reviewed this as a useful option, and in the 1970s Logan\(^12\) and other leading orthodontists favoured this extraction choice. Nance\(^9\) suggested that second premolars could be a good option for borderline extraction cases with minimal crowding, where there was a need to avoid over-retraction of the incisors. This was based on the mathematical premise that when second premolars were extracted, there were eight teeth in front of the extraction sites, and hence greater resistance to incisor retraction, than the six teeth present after first premolar extractions (Fig. 1).

In a 2001 study\(^13\), it was reported that more upper incisor retraction was found in cases where the upper first premolars were extracted, compared with a second premolar extraction group, but a wide range of individual variation was noted. A study of 26 second premolar extraction cases\(^14\) found average incisor movement of 3.3 mm and 2.9 mm lingually in the maxilla and the mandible, respectively. The first molars moved mesially an average of 3.2 mm and 3.4 mm in the maxilla and the mandible, respectively. This may be considered as reciprocal space closure.

During treatment planning, it is logical to assume that there is less anchorage available after second premolar extractions than from first premolars, and this is the most common reason for choosing second premolars in borderline extraction cases. Orthodontic extraction of second premolars may be considered for treatment of two types of malocclusion:

- Patients with mild bimaxillary protrusion and little or no anterior crowding, where there is a need for only a small amount of retraction of upper and lower incisors. The authors have published a case\(^1\) where full arch mechanics and reciprocal anchorage were successfully used. Lower incisors were retracted from APo +9 mm to APo +4 mm after loss of second premolars.
- Cases with mild anterior crowding, and a need to preserve the face. Patients with mild or moderate anterior crowding, where there is a need to achieve good tooth alignment but preserve the face, with little or no change.

The authors have shown a case\(^2\) where normal full arch mechanics were used in the upper arch, and sectional mechanics (followed by full arch mechanics) in the lower, to achieve ideal tooth alignment. The profile was maintained and lower incisor position only changed from APo +4 mm to APo +3 mm during treatment.

Space obtained from premolar extractions is used for two main purposes: 1) With inter-arch mechanics, the space is used to allow incisor torque changes during correction of cases with a Class II or Class III incisor relationship. This helps to reach a normal overjet and overbite, and improved facial profile. This is achieved by varying the anchorage balance during sliding mechanics, normally with intermaxillary elastics or other methods of anchorage support. 2) With intra-arch mechanics premolar extraction space is used to manage crowding which is greater than can be treated by appropriate Interproximal Reduction (IPR) and reasonable dental compensation.

FULL ARCH MECHANICS
Full arch mechanics are normally appropriate in cases where there is no anterior crowding, as with the protrusive cases mentioned above. Brackets and tubes can be initially placed on all teeth, from first molar to first molar. Arches can quickly be levelled to rectangular steel wires, followed by space closure with en masse retraction, using active tie backs\(^1\). The second molars are often left without tubes and allowed to drift mesially in these cases.
For most cases the authors’ recommended treatment method is based on full arch mechanics. However, in a few second premolar extraction cases, where there is anterior crowding, sectional wires can be used to good effect. The technique of pre-alignment with sectional wires is popular with patients, because there are no appliances on the front teeth during the first six to eight months of treatment.

It is important to start space closure without delay, to avoid the risk of bone narrowing in the extraction site, which can occur within three to six months (Fig. 2). If narrowing occurs, mesial movement of the wide first molars is more difficult. Greater anchorage is achieved and undesirable retraction of the incisors may occur.

It is necessary to prevent tipping into the extraction sites (Fig. 3). Unwanted tipping will extend the length of treatment, because of the extra time required to parallel roots.

At the start of treatment, modified lacebacks and then sectional wires are placed from first premolars to first molars to begin closure of second premolar extraction sites (Figs. 4, 5, 6, 7). The six anterior teeth are not included in the set up, and this allows early use of heavier wires, which means that tooth movements can begin with minimal tipping.

**The Use of Sectional Mechanics**

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A male patient, aged 12.3 years, with a Class II skeletal and facial pattern. The posterior dental relationship was Class I bilaterally, with a slight anterior open bite and moderate anterior crowding. The panoramic radiograph confirmed a healthy dentition and the presence of unerupted third molars. The case shows sectional mechanics followed by full arch mechanics to treat a second premolar extraction case with anterior crowding. Cephalometrically, the patient’s upper incisors showed adequate torque, but they were slightly retrusive relative to True Vertical Line (TVL), and the upper lip was thin (Figs. 8, 9). The result was a very flat upper lip.

The ANB angle was 7 degrees and the Wits was 1 mm, indicating a steep occlusal plane, which resulted in a retrusive mandible. The lower incisors were flared anteriorly. The facial profile of this patient (Figs. 10, 11, 12) could not be improved significantly without surgical intervention, and this approach is often rejected in these cases. Therefore, the goal of treatment...
was to maintain the profile, while correcting the anterior dental crowding. The overbite and overjet were to be corrected by retracting the lower incisors 1 mm and by slightly deepening the curve of Spee. After the second premolars were extracted, first molars were banded with lingual buttons and first premolar brackets were bonded (Figs 19, 20, 21, 23, 24). Lacebacks were placed, and .020 round sectional wires (Fig. 22). 

The patient did not have brackets on the anterior teeth for the first 7 months of treatment. Care is needed, because the .020 round wires can sometimes rotate after placement, so that the ends become troublesome. For this reason, some orthodontists prefer to start with rectangular .0175/.025 or .019/.025 steel sectional wires and if necessary bend them a little to ensure they are passive.

At the second visit, lacebacks were gently tightened and sectional .019/.025 steel rectangular wires were placed (Figs 25, 26, 27). Normally lacebacks become a little loose during four weeks, and it is necessary to ‘take up the slack’, but not to over-tighten them to the level where there is blanching in the soft tissue, as this can cause unwanted side effects. Lingual buttons were added to the first premolars, and light elastic chains were placed lingually and palatally. These two sequences show the closure of upper and lower extraction sites using sectional wires, over a seven month period (Figs 28, 29, 30 and 31, 32, 33). Crowding was reduced in the upper and lower anterior segments, without the need for anterior brackets. Minimal tipping has occurred as the extraction sites closed, and tongue pressure has improved the alignment of the lower right lateral incisor. Light elastic chains are needed on the lingual and palatal sides of the teeth from time to time. They are used to assist rotation control, but are very effective and are not needed at every visit.
After eight months of treatment, the anterior teeth were bracketed with accurately manufactured milled brackets and full arch mechanics were started (Figs. 34 - 38). The normal .016 HANT wires were placed to begin leveling and aligning, with bend backs, and the case could be managed like a non-extraction treatment. Figure eight ligature wires are often used across the extraction sites at this stage, to maintain space closure. Leveling and aligning went ahead efficiently, and there were no issues with overbite control in this case. Separators were placed to help eruption of lower second molars.

Later in treatment conventional mechanics were used. An upper .019/.025 steel arch wire was placed with active tiebacks to complete space closure (Figs 39, 40, 41). Lower second molars were bonded using mini tubes, and a lower .019/.025 heat activated wire was selected to start second molar correction. In the final stages of treatment it was necessary to correct a tooth size discrepancy between upper and lower incisors. Unusually the uppers were oversized, compared with the lowers. Interproximal enamel reduction was needed distal to the upper central incisors and mesial to the upper lateral incisors. An upper .020 SS wire was placed with a light elastic chain to complete space closure and final overjet correction (Figs. 42 - 46). A lower .019/.025 stainless steel wire was placed to complete correction of the lower second molar rotations (Fig. 47). The final facial photos show a profile that has not been significantly changed (Figs. 48, 49, 50). Frontally, the patient has good symmetry and a pleasing smile (Figs. 51, 52, 53). Intra-oral photographs show a Class I occlusion with adequate overbite and overjet (Figs. 54, 55). The final panoramic radiograph shows good paralleling of roots (Fig. 56).
The final tracings (Figs. 57, 58) show adequate torque of the upper incisors, and more uprighting of the lower incisors. When mandibular growth is good, as is seen on the superimpositions (Fig. 59) the contact of the lower incisors with the upper incisors often causes additional lower incisor uprighting. This is clearly seen in many Class III cases, when lower incisor uprighting can be extreme. The upper incisors are still slightly retrusive relative to TVL, and the upper lip remains thin, with some flatness in the upper lip area. The occlusal plane angle is five degrees flatter than in the original tracing, however it is still relatively steep, creating some chin retrusion. Third molars were extracted, and supplemental upper third molars are evident on the panoramic radiograph.

The superimpositions (Figs. 59, 60) show that good mandibular growth occurred during the treatment period, and consequent lower incisor uprighting can be seen in the mandibular superimposition. The upper incisor position shows...
little change. The upper lip remains thin, resulting in some flatness of the profile in the area. The palatal superimposition shows the planned mesial movement of the upper molars was achieved, using sectional mechanics, which avoided unwanted retraction of the upper incisors.

Figure 59

Figure 60

REFERENCE LIST


