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Morphological characteristics influencing the orthodontic extraction strategies: A comprehensive review

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Abstract
Extraction has now been accepted widely in various malocclusions including Angle's class II division1. However, the levels of scientific evidence in orthodontic treatment planning have been weak, and it is unlikely to systematically provide a rationale and consistent basis in decisions of extraction. Angle's class II division 1 malocclusions exhibit various morphological characteristics. Orthodontists should comprehensively consider the reciprocal impact of multiple factors when choosing different extraction strategies for various malocclusions. Molar relationship, lower anterior crowding, Bolton index, facial growth pattern, degree of spee and anterior overjet are the various factors that determine the extraction decisions. This article describes the various factors influencing the orthodontic extraction decisions and discusses the various extraction patterns used in different malocclusions.

Keywords: angle's class II division 1 malocclusion, morphologic characteristics, extraction treatment

1. Introduction
There are two reasons for extracting teeth in orthodontics: 1) to provide space to align crowded incisors without creating excessive protrusion and 2) to allow camouflage of moderate class II or class III jaw relationships when correction by growth modification is not possible. A patient who is both class II (or III) and crowded is a particular problem because the same space cannot be used for both purposes. The more extraction space is required for alignment, the less is available for differential movement in camouflage, and vice versa.

An important part of treatment planning is deciding which teeth to extract and how the extraction spaces are to be closed (i.e., by retraction of incisor teeth, mesial movement of posterior teeth, or some combination). These decisions determine the orthodontic mechanics [1].

A comprehensive extraction strategy should be based on considerations including but not limited to personal growth pattern, soft tissue profile, degree of crowding, molar relationship and mid-line.

2. Factors influencing the extraction decisions
Extraction decisions in Angles Class II division 1 malocclusion are mainly influenced by three variables [2]:

1. Lower anterior crowding
2. Anterior overjet
3. Facial growth pattern.

The other factors which influence extraction decisions are:

- Over jet and overbite
- Molar relationship
- Degree of spee
- Bolton index
- Protrusion of lower lip and lower anterior teeth.

2.1 Lower anterior crowding
Greater the crowding, less the degree of distal molar relationship because crowding of lower anterior teeth leads to forward movement of posterior teeth.

- First premolars are extracted to release severe crowding.
- Second premolars are extracted when crowding is not severe to correct Class II molar relationship.
- Extractions of only two maxillary premolars for cases presenting severe distal molar relationship over cusp to cusp, horizontal growth pattern, mild crowding of lower anterior teeth and large anterior overjet more than 7mm.
- Extra extraction of one lower incisor should also be considered if anterior Bolton index were significantly greater than normal.

Extractions of four first premolars for cases with:

a. Severe crowding of lower anterior teeth
b. Mild distal molar relationship
c. Vertical growth pattern
d. Significant lower lip prominence.

Extractions of two maxillary first premolars and two mandibular second premolars in:

a. Moderate crowding of lower anterior teeth
b. Moderate distal molar relationship less than cusp to cusp
c. Average growth pattern
d. Less lower lip prominence.

2.2 Anterior over jet
For some patients with significant overjet, extraction of upper premolars is often chosen as an alternative to orthognathic surgery.

In cases with great overjet and good or potentially good

mandibular arch, extractions can be limited to maxillary arch only. Incisor overjet acted as a main factor influencing the extraction choice of lower arch.

2.3 Growth Pattern

Extraction treatment was performed more likely in hyperdivergent facial type cases, whereas non-extraction treatment was more frequently carried out in mesiodivergent cases. Extraction of teeth contributed to 'closedown the bite'.

- Maxillary premolar extraction only was indicated in patients with horizontal growth pattern.
- Bimaxillary premolar extraction was suitable in patients with average or vertical growth pattern.

3. Teeth of choice for extraction

First premolars are most frequently extracted teeth in the maxillary arch to create space for relief of crowding and correction of superior protrusion. Cases requiring minimal anterior retraction can be considered for extraction of second premolars or second molars where the whole of the maxillary dental arch is distalised [3].

Indications of first premolar extraction in the upper arch only:

1. As an alternative to orthognathic surgery for non-growing class II patients with significant overjet.
2. In class II cases in which there has been a failure of attempted headgear or functional appliance treatment to achieve class I canine relationships.
3. A large overjet especially if the patient has full upper lips.
4. A relative mandibular deficiency.
5. Lower arch with minimal or no crowding.
6. Maximum anchorage required for orthodontic camouflage.

Based on the cephalometric outcome of cases treated with upper premolars only, Scott and Jernigan [4] suggested that 'maxillary first premolar extraction for orthodontic camouflage may be a viable treatment option, especially if the patient has full upper lips and only a relative mandibular deficiency'. As a result, extraction of only maxillary premolars with the goal of finishing with functional class II molars and class I canines is a viable functional compromise.

Orthodontic treatment involving the extractions of only two upper premolars is likely to result in a wide range of variation in the lip and upper incisor behaviour. The pre-existing soft tissue morphology is likely to be the greatest determinant of lip behaviour. In the light of these findings, one should perhaps accept that the upper lip curve and nasiolabial angle are more likely to be negatively affected during upper premolar extraction treatment in patients presenting with thin pre-treatment upper lips, increased pre-treatment nasiolabial angles, expected vertical mandibular growth direction, or of limited continued pubertal growth potential. In subjects with thick lips, and marginal mandibular deficiency, where dentoalveolar protrusion is limited to maxillary teeth, upper first premolar extraction is the only good option. Case selection is the key to optimum outcome for extraction treatment including only upper first premolars cases. Class II division 1 malocclusion in non-growing children or adults can be treated with the extraction of upper premolars only, or extraction of all first premolars or alternatively extraction of upper first premolars and lower premolars. The nature and severity of class II division I malocclusion and objectives of orthodontic treatment greatly influence extraction decision[3].

4. Lower arch extraction

In the lower arch, the teeth of choice for extraction are of either first or second premolars. The justification extraction of either first or second premolars is greatly influenced by the nature of malocclusion, the goals of occlusion and biomechanics being considered. Extractions of first premolars are indicated in crowding in the anterior segment, deep curve of spee due to supraeruption of anteriors and marked proclination of lower incisors. In such patients, molars may be in a half cusp to full cusp class II sagittal relationship.

Second premolar extraction in the mandibular arch is preferred over first premolars in full cusp class II molar relationship where no little space will be needed for correction of malocclusion in the anterior segment and majority of extraction space is utilized for mesial movement of the lower first molars. Second premolar extraction site is next to the first molar which offers greater and faster mesial movement of the lower first molar. However, the second premolar extraction in the lower arch accordingly limits the scope of correction of the anterior crowding and correction of severe proclination of the lower incisors [3].

Extraction of lower first or second premolar depends on the following factors

a. crowding of mandibular arch
b. Max/Mand plane angle
c. Anterior facial height/Posterior facial height.

Extraction of lower first premolar is done when crowding is severe, and more in anterior region. Extraction of lower second premolar is done when crowding is minimal, for anterior open bite cases or vertical growth pattern and to correct Class II molar relation. Extraction of lower second premolar helps in mesialization of lower first molar which helps in Class II molar correction and closes the bite due to wedge effect [2].

The various extraction patterns followed for orthodontic treatment are as under:

a. Upper and lower first bicuspids only.
b. Upper first bicuspids and lower second bicuspids.
c. Upper first bicuspids only.
d. Upper first bicuspids and one lower incisor.

a) and b) patterns used for cases having small overjet and vertical or average growth pattern. c) and d) patterns used in cases having great overjet and horizontal growth pattern [2].

5. Indications of different patterns of extraction [2]

1. **Upper and lower first premolar extraction is used in following cases**

- Severe crowding of lower anterior teeth
- Mild distal molar relation
- Vertical growth pattern
- Significant lower lip prominence.

2. **Upper first premolar and lower second premolar extraction is used in following cases**

- Moderate crowding of lower anterior teeth

- Moderate distal molar relation less than cusp to cusp
- Average growth pattern
- Less lower lip prominence.

3. Upper first premolar extraction only is used in following cases

- Severe distal molar relation
- Horizontal growth pattern
- Mild lower anterior crowding
- Large anterior overjet greater than 7mm.

4. Upper first premolars and extraction of one lower incisor is used in patients having above features and when anterior Bolton index is more.

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