Relevant variables of Class II malocclusion treatment

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Abstract

Results of orthodontic Class II malocclusion treatment can be influenced by inherent characteristics such as patient age, malocclusion severity and degree of compliance, or even by factors regarding the orthodontist's subjective preference such as the treatment protocol. Basically, Class II treatment protocols involve nonextraction or extraction of two or four premolars. However, a greater treatment success rate can be expected with the extraction protocol of two maxillary premolars, regardless of the skeletal pattern or the amount of maxillomandibular anteroposterior discrepancy. According to this review, it was concluded that Class II malocclusion treatment results are strongly influenced by the treatment protocol, while skeletal characteristics do not seem to exert significant influence.

Keywords: Malocclusion. Class II. Cephalometry. Tooth extraction.

INTRODUCTION

Success rate in Class II malocclusion treatment can be significantly influenced by factors such as treatment protocol[1,11], malocclusion severity[3,7], patient age[23] and degree of patient compliance[15]. Since malocclusion severity and age are inherent patient characteristics which are, therefore, defined ahead of time, these variables are beyond professional control. It has been shown that patient compliance is hard to predict by means of simple anamnestic methods of psychiatric or behavioral evaluation[2]. Although unpredictable, degree of compliance is one of the key variables affecting orthodontic treatment success[22], notably when the treatment plan involves the use of removable appliances[9], whose effectiveness relies considerably on patient compliance. In light of the treatment protocols currently available, Class II malocclusion can be treated with or without extractions. The extraction protocol consists basically in extracting either four or two premolars in the upper arch whereas nonextraction treatment can be performed using extraoral anchorage[9], functional orthopedic appliances[17], Class II elastics combined with fixed appliances[11] or, more recently, intraoral distalizing appliances[10] (Fig. 1). Recent studies, however, have shown that given the same age and degree of severity a Class II

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malocclusion treatment protocol with the extraction of two upper premolars provides superior efficiency than the protocols involving extraction of four premolars[5,8] or nonextraction[14]. Therefore, it is safe to assert that the choice of a treatment protocol to correct Class II malocclusion constitutes one of the few approaches – if not the only one – professionals can resort to in order to influence the success rate of treatments.

Although the treatment protocol involving the extraction of two upper premolars is more efficient than the Class II malocclusion protocol entailing four premolar extraction or no extractions, it is a known fact that the mechanism of malocclusion correction involves predominantly dentoalveolar changes, irrespective of the treatment protocol or the orthodontic appliance used[4]. Nevertheless, it has been speculated that patient skeletal features – such as facial pattern and jaw-to-jaw relationship – can impact orthodontic treatment success[8]. Thus, this review article aims to establish evidence regarding the impact of cephalometric features on the success rate of Class II malocclusion treatment.

LITERATURE REVIEW

Cephalometric features of Class II malocclusion

The concern with determining the craniofacial features of Class II malocclusions has long existed[12]. It underscores the need to learn about the dentoskeletal changes which characterize malocclusion, thus enabling the orthodontic treatment to target the correction of pre-existing dysplasias. Although a greater vertical development and transverse narrowing of the maxilla can be associated with the development of Class II malocclusion[28]. Hunter[13] points out that the dysplasias most often associated with Class II malocclusion occur on the sagittal plane and, according to Vargervik and Harvold[28], can be caused by: (1) anterior displacement of the maxilla or the maxillary alveolar process; (2) a small mandible or low-

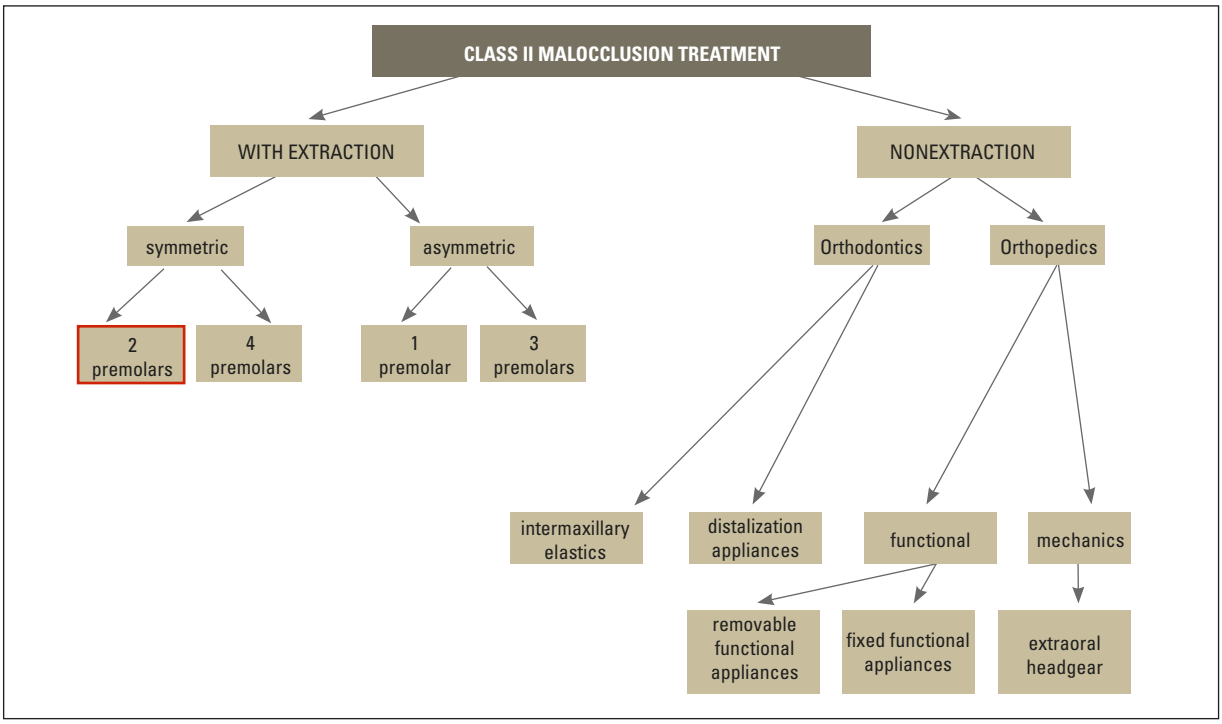

FIGURE 1 - Treatment protocols and clinical resources frequently employed to correct Class II malocclusion.

er teeth positioned in the posterior region of its base; (3) posterior position of the temporomandibular joint; and (4) any combination of these factors. Additionally, most cephalometric studies show that, among the sagittal alterations of Class II malocclusion, a smaller mandible positioned in the posterior region is found most often[13] (Fig. 2).

Impact of Class II malocclusion treatment extraction protocols

Basically, a Class II malocclusion treatment can be implemented without any extractions or with the extraction of either two or four premolars. Nevertheless, not all of these protocols yield the same treatment success rate.

Whenever the treatment of a complete Class II case, in the absence of crowding, is performed by extracting two upper premolars, the anterior segment of the upper arch is distalized to the extent of a premolar width (7 mm) so that cuspids can establish a Class I relationship while molars remain in Class II (Fig. 3). When the same malocclusion is treated with the extraction of four premolars and the posteroinferior segments can mesialize half the space left by the extraction (3.5 mm), the posterosuperior segments must be distalized by 3.5 mm while the anteroposterior segment must be distalized by 10.5 mm so that molars and cuspids can establish a Class I relationship, totaling 14 mm of upper arch distalization (Fig. 4). On the other hand, should this same malocclusion be treated without extractions, the postero and anterosuperior segments must be distalized by 7 mm each so that molars and cuspids establish a Class I relationship upon treatment completion, totaling 14 mm of upper arch distalization (Fig. 5). Therefore, it is possible to conclude that in comparison with the treatment protocol involving the extraction of two premolars the complete Class II treatment with four extractions or no extraction requires a greater amount of upper tooth distalization in addition to requiring greater patient compliance

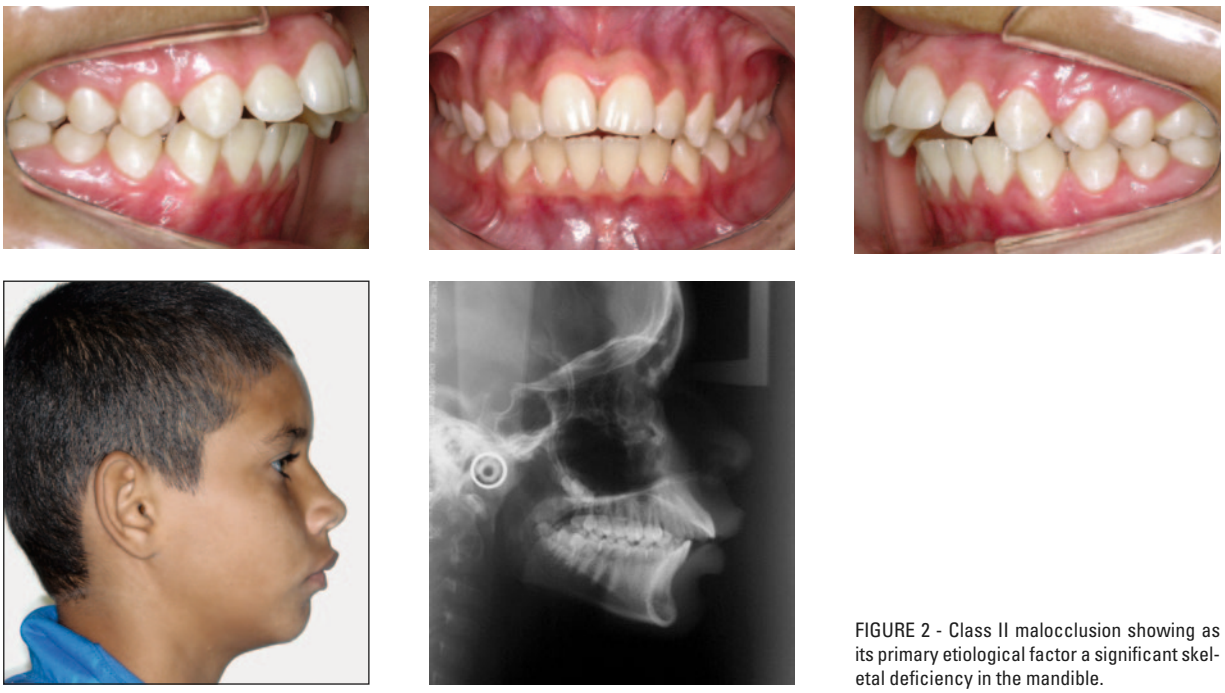

FIGURE 2 - Class II malocclusion showing as its primary etiological factor a significant skeletal deficiency in the mandible.

through the use of anchorage reinforcement appliances. Accordingly, a higher success rate in Class II treatment can be achieved with only two upper extractions. However, in spite of the fact that a Class II malocclusion treatment protocol with two upper extractions has proved more efficient[5,14,15] and more likely to provide a Class I cuspid relationship[6,15] by affording an adequate anterior guide and a reasonable posterior occlusal relationship, some authors still persist in the mistaken belief that finishing a treatment with a complete Class II molar relationship can be detrimental to a functional occlusion[21].

Impact of facial pattern on Class II malocclusion treatment

Although a handful of authors have strived to make a cephalometric characterization of Class II malocclusion, Keeling et al.[18] have demonstrated that there is a weak correlation between occlusal characteristics and the craniofacial morphology observed in head films. Therefore, if the same type of malocclusion can develop within a wide range of craniofacial morphologies, it was believed that these different facial patterns might influence in distinct ways the results of an orthodontic treatment.

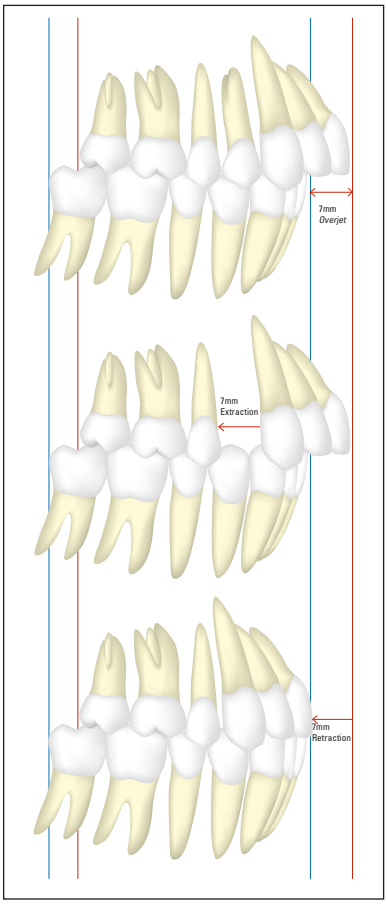

FIGURE 3 - Diagram showing the amount of movement required to correct a complete Class II malocclusion (7 mm overjet) treated with the extraction of two upper premolars.

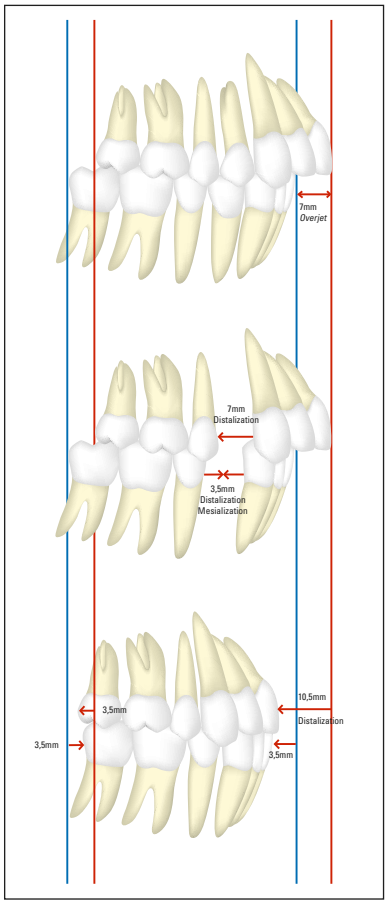

FIGURE 4 - Diagram showing the amount of movement required to correct a complete Class II malocclusion (7 mm overjet) with a 3.5 mm lower incisors protrusion or 3.5 mm crowding per quadrant, treated with the extraction of four premolars.

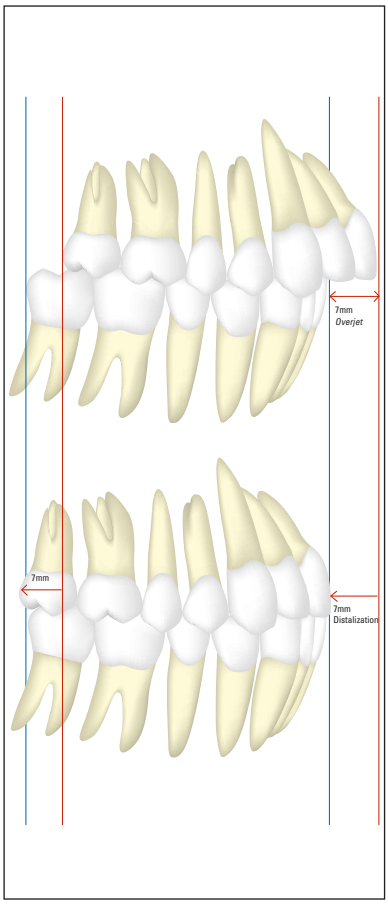

FIGURE 5 - Diagram showing the amount of movement required to correct a complete Class II malocclusion (7 mm overjet) treated with no extractions.

One of the first researchers to associate facial pattern with orthodontic treatment results was Charles Tweed[26,27], when he perceived that in order to attain a harmonious profile and pleasant facial aesthetics the position of the lower incisors at the end of treatment should vary according to the different facial patterns. Patients with a vertical pattern, for instance, should yield lower incisors which are more vertically positioned in relation to the bone base whereas patients with a more horizontal pattern should have their lower incisors positioned more buccally in relation to the mandibular plane[26,27]. In this manner, a relationship began to be established between facial pattern and an indication to have teeth extracted since the tendency towards more vertical lower incisors for patients presenting with a more vertical facial patterns would encourage professionals to extract lower incisors more often in this group. Therefore, extractions in the lower arch were aimed not just at correcting crowding but also cephalometric discrepancy by means of repositioning lower incisors in their bone base. However, lower incisor position was considered of such paramount importance that many extractions performed in the lower arch had the sole purpose of correcting cephalometric discrepancy[11,23,26,27].

In keeping with the concepts underlying Tweed's orthodontic mechanics cephalometric discrepancy continued to be viewed as a treatment goal to be achieved regardless of the malocclusion type. In 1953, Cecil Steiner[25] developed a diagnostic and planning method which took into account not just the influence of facial pattern but also the impact of anteroposterior discrepancy between bone bases on the final treatment result. Although facial pattern and discrepancy between bone bases did influence extraction diagnosis, Steiner was unable to forecast the potential difficulties aroused by lower arch extractions associated with Class II malocclusion correction. This limitation was due to the fact that his diagnostic method only took into consideration the complexities of lower arch treatment but not the difficulty in correcting anteroposterior discrepancy in both arches. Therefore, in Class II cases where the correction of cephalometric discrepancy required extractions, the repositioning of lower incisors towards the lingual region ultimately increased anteroposterior discrepancy between the lower segments of the arches, sometimes compromising treatment results[25]. As a matter of fact, subsequent studies have shed light on the difficulties that arise in trying to balance the Class II anteroposterior relationship when extractions are made in the lower arch[6,15]. As a result, extractions performed with the sole purpose of correcting cephalometric discrepancy have been questioned in Class II treatment, and even more so in the presence of an excellent dental alignment.

As well as a tool used in helping to correct cephalometric discrepancy, tooth extractions can also aid in controlling vertical dimension[20]. Assuming that lower incisors are more vertically positioned and that facial height control is more crucial for patients who have a vertical facial pattern, the indication to perform extractions in the lower arch of this patient group can be considered stronger than in patients whose facial pattern is either horizontal or balanced[26]. Regardless of the facial pattern, however, lower arch extractions should not be performed when treating Class II if the sole purpose is to correct cephalometric discrepancy or to control vertical dimension since the difficulty in correcting anteroposterior discrepancy between the arches is compounded in comparison with the treatment protocol involving the extraction of two upper premolars[5,6,15,16]. On the other hand, if the treatment protocol is conducted with no extractions the need to move upper molars towards distal not only undermines vertical dimension control[20], but it also makes it harder to accomplish the correction of anteroposterior discrepancy between the arches than would be the case if the treatment involving two upper extraction were put in place[14].

Therefore, Class II treatment with the extraction of two upper premolars both enables a greater vertical dimension control[20] – since it does not require upper molars to be moved distally – and favors the correction of anteroposterior discrepancy between the arches, compared with Class II treatment without extractions or with four extractions[8,14]. Thus, it could be conjectured that the occlusal results of Class II treatment involving two upper premolar extractions will tend to be less influenced by facial pattern since it would allow for a higher success rate even in vertical facial pattern cases. It should also be noted that studies of Class II treatment with vertical facial pattern have demonstrated that the use of headgear with cervically or occipitally oriented forces does not bring about significantly different changes in the vertical dimensions of the face.

Although Class II malocclusion treatment with the extraction of two upper premolars does yield a greater success rate[5,8,15], the belief that a vertical facial pattern has a negative bearing on the treatment results might indicate that the four-extraction protocol would be preferable in such cases. It was then speculated that the less-than-satisfactory results achieved with the Class II four-premolar extraction treatment might be more due to the deleterious influence of an unfavorable facial pattern than to a difficulty in correcting Class II molar relationship, as required by this treatment protocol. To investigate this hypothesis, Janson[16] assessed patients presenting with complete Class II malocclusion and treated with two and four molar extractions. The results of this study showed that, on average, patients treated with two extractions yield a more vertical facial pattern compared with patients treated with two upper extractions. Nevertheless, facial pattern did not show a significant correlation with occlusal results, which proved more satisfactory for the group subjected to the protocol comprising the extraction of two upper premolars. This study confirms the hypothesis that the quality of the occlusal results attained with Class II malocclusion treatment involving extractions is more influenced by the type of protocol used than by the patient's facial pattern. Thus, excellent occlusal results can be accomplished in treating Class II malocclusion of patients who present with discrepant facial patterns, provided that an extraction protocol is used which enhances the correction efficiency of the Class II anteroposterior relationship (Fig. 6).

It could therefore be assumed that if occlusal results are not significantly influenced by the patient's facial patters, this parameter should not be employed to justify any lower arch extraction since the four-premolar extraction protocol makes the correction of Class II anteroposterior relationship significantly harder[5,8,15], thereby decreasing this malocclusion's treatment success rate as it requires considerable patient compliance[3,7].

When Class II malocclusion is treated without extractions or with the extraction of the two upper premolars, the absence of extraction in the lower arch suggests that similar degrees of crowding and discrepancy may be present. However, the goal of tooth movement in the upper arch is substantially different in these two treatment protocols[14] since a nonextraction treatment involves moving the entire upper arch distally, which consequently entails less facial height control[29], unlike treatment with two upper extractions, which is likely to keep the upper molars in the same position, thus allowing for greater facial height control[29]. Therefore, patients with a Class II malocclusion who are treated with no extractions would be expected to display a more horizontal pattern than patients treated with two upper extractions. Although facial pattern does not seem to exert a significant impact on the occlusal results of the treatment[16], Simão[24] conducted a systematic study in 2006 to assess the effects of cephalometric features on the success rate of Class II treatment performed both without extractions and with the extraction of two premolars. The results showed that the cephalometric pattern of the patients did not exert significant in-

FIGURE 6 - Differences in facial pattern do not significantly influence the quality of treatment results, whereas a protocol involving the extraction of two upper premolars allows for improved occlusal results. Figure **6D** comprises a head film showing a skeletal Class II malocclusion with a vertical growth pattern and significant skeletal deficiency in the mandible. The head film in figure **6H** shows a Class II malocclusion with a balanced growth pattern and no mandibular deficiency. Despite a discrepancy in the facial pattern in both cases the extraction of two premolars made for excellent occlusal results.

fluence on the occlusal results accomplished with the two aforementioned treatment protocols. On the other hand, the type of treatment protocol used to correct Class II malocclusion was the only single factor which significantly influenced occlusal result quality. Patients who were treated with the extraction of two upper premolars showed better results than nonextraction patients. This conclusion supports Janson's et al.[14] study, which demonstrated that a more efficient Class II treatment was achieved with the extraction of two premolars than with a nonextraction protocol. In this manner, excellent occlusal results can be accomplished in treating the Class II malocclusion of patients who present with discrepant facial patterns, provided that a treatment protocol is used which enhances the correction efficiency of the Class II anteroposterior relationship (Fig. 6).

Cephalometric forecast of Class II malocclusion treatment results

The forecast of orthodontic treatment results based on cephalometric variables has not proved a very promising prognostic tool. When the cephalometric variables which define the facial pattern were used to predict Class II malocclusion treatment results, only 18% of treatment results variation could be explained by means of these cephalometric variables[19]. In a similar study, Zentner et al.[30] concluded that the cephalometric variables which define craniofacial morphology play a negligible part in forecasting orthodontic treatment success. Given their weak correlation, it can therefore be concluded that cephalometric pattern does not constitute a reliable parameter in predicting treatment results[19,30]. In fact, from the standpoint of occlusal relationships the treatment protocol can significantly influence Class II correction results while cephalometric pattern does not yield a significant association with result quality. Seen from this angle, the choice of a Class II treatment protocol should not be made under the influence of the patient's cephalometric pattern but rather based on the efficiency of the protocol in correcting the anteroposterior relationship between the arches.

CONCLUSION

The occlusal results of Class II malocclusion treatment are significantly influenced by the choice of treatment protocol. Although Class II treatment results can be affected by other variables – such as malocclusion severity, patient compliance and patient age – the facial pattern does not exert any significant influence. Therefore, the choice of a Class II malocclusion treatment protocol – mainly in terms of deciding whether or not tooth extractions are performed – should be based more on the severity of the occlusal relationship present in the malocclusion than on the patient's facial pattern.

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