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A new editorial direction for SIDO

Felice Festa
2013 SIDO President

Dear Colleagues,

as 2013 President of the Italian Society of Orthodontics (SIDO) and Editorial Director, I am very proud to announce SIDO new editorial initiatives designed to respond to the challenges of fast globalization and technological evolution.
Whilst Progress in Orthodontics has become online-only and open-access, I would like to welcome the birth of the "European Journal of Clinical Orthodontics" (EJCO) a clinically oriented journal with a fresh approach to daily clinical practice at the patient chair.

Enjoy the reading!

A new clinical journal in the era of Evidence-Based Practice

Raffaele Schiavoni
Editor-in-Chief

Evidence-Based Medicine (EBM) has since its inception been a procedure defined as the conscientious use of current best evidence in making decisions about the care of individual patients.[1]

The adjective 'evidence-based' has enjoyed widespread use in recent years and not always in ways that are entirely appropriate. In some cases the term has been confused with quality "Scientific Evidence", thus attracting a certain amount of unfounded criticism.

An explanatory paper recently set out to stress the essentially practical role of EBM rather than dwelling on its philosophical and methodological aspects, coining in the process the acronym EBP or "Evidence-Based Practice".[2]

In this system scientific evidence per se represents one component and one component only for the decision-making process in relation to the clinical situation the practitioner is presented with.

For a correct evidence-based approach the clinician must be aware of all the available scientific evidence and assess this in terms of its application to the specific problems of his or her individual patient.

An albeit brief discussion of EDP must in our view make clear the difference between "evidence of absence" and "absence of evidence".

In the former case the clinical studies point to the conclusion that there is a high probability of the absence of efficacy of the treatment employed so the practitioner should decide on an alternative approach in terms of patient care. In the latter case the research has succeeded neither in establishing the efficacy nor the ineffectiveness of the treatment. Such an occurrence should not however give rise to a paralysis of the decision-making process but should mean that that the clinician must base his or her strategy on acquired experience and training and on previous therapies that can be deemed to have produced positive results. After an appraisal of these two components the therapeutic decision should then be put into context in relation to the individual patient concerned.

A journal for the clinician should thus provide all the resources needed for engaging a reliable decision making process. It is therefore not a matter of excluding or of including particular types of publications but of assessing their educational objectives. The orthodontist may

also acquire information from a particular clinical case if the article's background reports the available scientific evidence and the reasons upon which the treatment decision is based, with a final discussion of how the evidence of the experience gave rise to the satisfaction of expectations or, if this is not the case, a suggestion of what might be the reason..

The information the orthodontist will find in the journal will have to be such as to permit him or her to decide whether or not to apply such information to the patient in question and hence answer some of those questions posted by Straus and Sackett in 1999[3], that is to say:

- *Is my patient so different from those in the study that result cannot be applied?*
- *Is the treatment feasible in my setting?*
- *What are my patient's likely benefits and harms from the therapy?*
- *How will my patient's values influence the decision ?*

This is the challenge we have before us... and we fervently hope not to disappoint!

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WHO'S WHO

In this section we introduce an influential orthodontist who has given a significant contribution to the specialty. An article by the author featuring his landmarks follows.

Domingo Martín

Domingo Martín started out as a biologist at the University of Southern California and went on to study Medicine and Dentistry at the University of Bilbao, where he graduated in 1983. It was here that he would meet his future wife Pilar, a colleague who led him towards his passion for orthodontics, which he went on to study at the University of Valencia under Professor Canut.

When studying there he read the articles of Ron Roth and realised that orthodontics is about more than just teeth!

He took Dr. Roth's two year functional course and then started lecturing with him and Dr. Williams, spreading The Roth Philosophy among the orthodontists. Doing so he became aware of the need for a multidisciplinary approach to our profession, placing great importance on teamwork.

Amongst the founders of the continuing education project called FACE, with his lectures he promotes the need not to relegate orthodontics to the realm of pure cosmetic profession.

*He practices in San Sebastian, in northern Spain, and in his own words "*it is a very successful practice, but it is not an overcrowded practice, as I really feel that quality and quantity rarely go together*".*

His working hours are from 9 a.m. to 3 p.m., giving him time to dedicate to his numerous interests that include classical music, cinema and a variety of sports.

Last but not least, Domingo and Pilar have created a "little" family of seven children with two more children recently adopted. Unfortunately none of them are orthodontists!

Goal Oriented Treatment

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Abstract

My treatment philosophy is characterized by clearly defined treatment goals. This helps with diagnosis and improves the quality and stability of the end result.
The objective is to establish an ideal occlusion with good facial esthetics and an orthopedic stable joint position. The philosophy can be summarized in four steps *(Fig.1)*. Step one: making sure that we have an orthopedic stable position. This is important for good diagnosis and a correct treatment plan. Step 2: placing the back teeth in the correct three-dimensional position to keep the mandible in this same position and place the occlusion in the correct vertical dimension. Step three: placing the front teeth correctly, once again three dimensionally for good function and esthetics. By following this sequence the fourth step is achieved, namely that of facial esthetics. The concluding situation thus represents the best possible combination of esthetics, function and orthopedically stable mandible position.

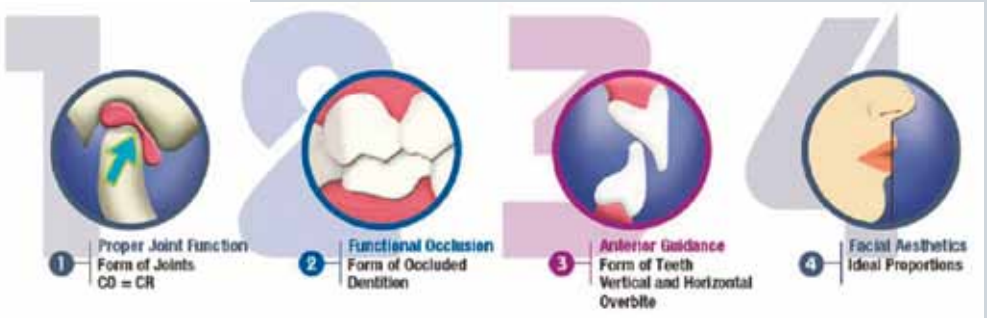


Figure 1

"The goal of this philosophy is to harmonize facial esthetics, dental esthetics, periodontal health, functional occlusion (orthopedic stable joint position), stability and airway"

Keywords
Functional Occlusion, Skeletal Anchorage, Vertical Control

INTRODUCTION

My vision of orthodontics is based on the complete orthodontic diagnosis and treatment system according to Dr. Ron Roth. His philosophy involves objective evaluation and diagnosis of jaw position and functional occlusion (rather overlooked in conventional orthodontic diagnosis) and execution of treatment based on the diagnostic information. It enables the orthodontist to improve diagnostic accuracy and the predictability of treatment.

Historically, focus has been placed on orthodontic mechanics and many different techniques have been developed such as edgewise, light wire, Begg and straight wire (SWA). Mechanics, though indispensable for treatment, is simply a means to an end. Sadly, the field of orthodontic diagnosis has seen very little progress over the years, since Angle's assumption that if the teeth are aligned into Class I, good function and esthetics would automatically follow. Morphological correction is undoubtedly important but there must also be thorough understanding of functional occlusion. Orthodontic treatment would serve no purpose if it provided only good alignment and interdigitation of teeth but with the condyles significantly displaced out of the fossae, something many orthodontists are not aware of.

Roth regards condylar displacement as a major contributor to unstable treatment results. The measuring of temporomandibular joint (TMJ) discrepancies turns orthodontics from mere tooth aligning technique" to "a treatment philosophy with emphasis on occlusal function".

My treatment goals are the following:

FACIAL ESTHETICS

This goal helps the orthodontist realize which tooth movements will harm the esthetics of the patient. It allows us to determine the position of the maxilla, mandible and chin, as well as the position and angulation of maxillary and mandibular teeth, and the orthodontic procedures that are required to achieve the desired results.

For example, it is in many cases important to prevent the mandible from rotating clockwise and, instead to rotate it counterclockwise. This moves the chin forward and shortens the lower face height, thus improving facial esthetics.

Facial esthetics must be also studied in the frontal plane. Facial asymmetry is closely related to TMJ status, occlusal function, tooth alignment and esthetics.

DENTAL ESTHETICS

Dental esthetics and facial esthetics are mutually complementary. The maxillary and mandibular dental midlines should match the facial midline as closely as possible. The occlusal plane should be parallel to the inter-pupillary line. The upper lip should be almost at the level of gingival margin on smiling with 2 to 3 mm of gingival exposure at full smile. Gingival form and attachment

Figure 2

level has a major impact to esthetics. There should be 3 to 4 mm of incisor exposure when the lips are at rest. The incisors should converge mesially to the midline and inclined labially.

The clinical crown length of anterior teeth is an important esthetic factor. The length and shape of premolars and molars also influence esthetics. The upper and lower teeth need to be arranged into a one-tooth-to-two-teeth relationship. As mentioned earlier, the mesial buccal cusp of the upper first molar should look most prominent in the arch *(Fig.2)*. This feature is incorporated into the Roth arch form, which consists of five curves, making the first molars more prominent than second molars. Other considerations include the leveling of the curve of Spee and the cant of the occlusal plane both sagittaly and transversely.

These criteria for dental esthetics focus our attention on the close relationship between esthetics and function.

FUNCTIONAL OCCLUSION

Many of the world's most respected dentists have described the importance of the joints in establishing a functional occlusion. Dawson[1], Lee[2], Okeson[3], and others have described the features of a functional occlusion. Roth attempted to bring the orthodontist into the same arena. His criteria for a functional occlusion are as follows:

1. Teeth in maximum intercuspation with the mandible in centric relation.
2. On closure into occlusion, the stress on the posterior teeth should be directed down the long axis of the posterior teeth so that the resultant stresses will be transmitted as tension to the periodontal ligament and lamina dura.
3. Posterior teeth should contact evenly and equally on closure into occlusion with light anterior contact when the joints are seated so as to protect the anterior teeth from lateral stress.
4. There should be adequate overbite and overjet to immediately disengage the posterior teeth in any excursive movement to protect the posterior teeth form lateral stresses. This anterior relationship should work in harmony with the movement pattern dictated by the TMJs so as not to produce lateral stresses on the anterior teeth.
5. Cusp height, fossa depth, ridge and groove direction, and cusp placement should be in harmony with the mandibular movements in all directions (border movements) to provide minimal interference of the teeth with the movement pattern of the mandible dictated by the TMJ.

According to Roth, any change in the temporomandibular joints has a direct effect on occlusal relationship of the lower and upper teeth. The joint status thus becomes imperative. The orthopedic stable joint position, is defined as "the most superior position anatomically of the condyles seated in the center of the discs against the eminentia and centered in the transverse plane".

I prefer the term "orthopedic stable joint position" instead of "centric relation" (CR) due to the confusion that exists today as what is the true definition of centric relation. The fact is I am trying to convince doctors to stop using the word centric relation. In the words of Okeson "an orthopedic stable joint position (**orthopedic stability**) exists when the stable intercuspal position of the teeth is in harmony with the musculo-skeletally stable position of the condyles in the fossa. When this position exists, functional forces can be applied to the teeth and joints without tissue injury"[4]. However, when there is a lack of harmony between the musculoskeletally stable position of the condyles and the intercuspal position of teeth, Okeson uses the term known as **orthopedic instability** and goes on to say "and when this condition exists there are opportunities for overloading and injury, such as tooth wear, periodontal changes and TMJ alterations"[5]. Instead of using centric relation we will refer to the orthopedic stable joint position *(Figs. 3,4)*.

Traditionally, diagnostic records designed to identify joint discrepancies have never been taken. White handheld models have played a central role in orthodontic diagnosis for more than a century, in addition to the cephalometric analyses available for over 60 years. Methods of examining joint status have however been available in general dentistry for more than 20 years and yet still few orthodontists take full advantage of the technology available.

Figure 3: Teeth together and condyles is placed

Figure 4: Condyles seated and open bite appears

PERIODONTAL TISSUES

A stable periodontal environment is crucial to creating a stable result. Goals for the orthodontist should be as follows:

1. Ensure adequate attachment of keratinized gingiva before moving teeth. Orthodontic movement in the presence of inadequate attachment may accelerate recession[6]. Results of animal experiments suggest a possible risk factor of gingival recession with time if the teeth are excessively flared buccaly or labially. We can, in fact, both improve or damage the periodontal status of a tooth with its buccolingual movement. Practicing orthodontists should have a clear picture of the normal periodontium and how the epithelial and connective tissue attachments as well as the bone height and thickness will change with tooth movement. A good prognosis is ensured only in the presence of proper relationship between the epithelial attachment, connective tissue, alveolar crest and cervical line.
2. Position teeth in the center of the bone. When teeth are moved through cortical bone, fenestrations and gingival recession may be an unintended consequence. Today, some orthodontists claim to have "nonextraction" practices. While most patients may be able to have teeth aligned without extractions, a significant number of the outcomes will result in teeth being positioned out of the bone. The issue is not "Can I treat without extractions" but "Can I reach my goals without extractions"? If I cannot achieve my goals, then extractions must be considered. This is an important issue in orthodontics.
3. Position teeth so that forces are directed appropriately without interferences to closure or excursions. While most clinicians agree that periodontal pockets do not form without bacterial inflammation, occlusal trauma in the presence of gingival disease accelerates attachment loss. Therefore, functional occlusal goals are important to periodontal health.
4. When possible, position teeth to level interproximal bone heights. When moderate bony pockets have developed, orthodontics may be attempted, it being understood that restorative procedures will be required after orthodontics is completed.
5. Create an easily maintainable environment. Proper interproximal contacts, relief of crowding, appropriate axial positioning of the teeth, and correction of vertical boney defects all serve to improve the maintainability of the dentition.

AIRWAY

With the advent of cone-beam imaging, we are now able to analyze airway volume on all of our patients. Airway obstruction can have a significant impact on the growth and development of the craniofacial complex in children and have serious health implications in adults who may suffer from sleep apnea. By critically analyzing the airway, we may be able to detect previously undiagnosed abnormalities; if this occurs, we should notify the patient's physician.

STABILITY

Traditional orthodontic research into stability has been directed at measuring how much unstable orthodontic cases have relapsed. Researchers have studied these failed cases and then drawn "conclusions that the answer to stability is to emulate what failed cases show us regarding arch form"[7]. Roth proposed that orthodontists should be examining the "common attributes" of cases that have "remained stable with healthy joints, healthy periodontium and no occlusal wear and attempting to emulate those attributes". Key features of stability included parallel roots, the occlusion allowing the joints to seat in centric relation, a mutually protected occlusion, and equal and even contact of centric cusps with forces directed down the long axis of the teeth.

The following case with open bite and tooth wear perfectly illustrates this treatment philosophy.

CASE SUMMARY

The patient *(Figs. 5, 6)* presented an open bite from second molar *(Figs. 7,8,9)* to second molar, mandibular deviation to the left, occlusal wear of anterior teeth along with TMJ and muscle symptoms.

The result was an increase of the open bite, as well as the centering of the jaw.

- *Age at initial examination*: 26 years and 6 months.
- *Sex*: Female.
- *Chief complaint*: "I can't bite".
- *Patient history*: treated with multibracket appliances in childhood.

PROBLEM LIST

- Vertical problem: open bite, posterior position of jaw, lip incompetence *(Fig. 10)*.
- Anteroposterior problem: mandibular retrusion, dental class II
- Midline problem.
- Tooth wear.

My treatment philosophy, as previously defined, starts from a stable condylar position. We therefore start with a splint. The reasons for splint therapy are many, i.e. signs of mandibular instability (orthopedic unstable joint position) occlusal wear, functional shifts, condylar images that clearly show a displaced condyle in the fossa, difficulty of jaw manipulation in taking CR bite due to muscle strain and of course muscle and TMJ symptoms. After splint wear there was seating of the condyle, an increase of the open

bite, disappearance of all muscle symptoms, as well as the centering of the jaw *(Figs. 11,12, 13)*. Once again following our treatment protocol, step number two would be to mount the case in this new jaw position and then go to the laboratory and carry out a diagnostic set-up. We first of all place the back teeth in a correct three dimensional position and we can now diagnose more thoroughly and see if the problem can be corrected orthodontically. In this case we saw that intruding the back teeth approximately 2.5mm would help us achieve auto rotation of the mandible and thus correct the open bite and the Class II.

Figures 5, 6: Initial facial photographs

Figures 7, 8, 9: Initial intraoral photographs

3-D CHECK

- Vertical problem: corrected with intrusion of molars and transverse correction of second molars, which were vestibulized.
- Antero-posterior problem: it was solved together with the vertical correction.
- Transverse problem: the midline shift was functional, so it was centered with the stabilization of condyles, after splint therapy.

TREATMENT PLAN

- Vertical control: intrusion of posterior teeth.
- Lingualization of second molars, bringing them into the arch.
- Dental aligning.
- Gingival margins leveling.
- Reconstruction of teeth sizes for achieving occlusal function.

MECHANICS

- Intrusion of upper molars with skeletal anchorage "KLS Anchorplates" (vestibular plates between first and second molars) and a transpalatal bar (TPB) to control the torque of first molars *(Figs. 14, 15, 16)*.

Figure 10: Initial lateral cephalogram

Figures 11, 12, 13: Changes after splint-therapy: here we see the increase of the open bite and the overjet, as well as the centering of the midline



Figures 14, 15, 16: The transpalatal bar with hooks to control the upper second molars and the coil springs ligated to the skeletal anchorage to intrude the first and second molars

Figure 17: Final records – lateral cephalogram

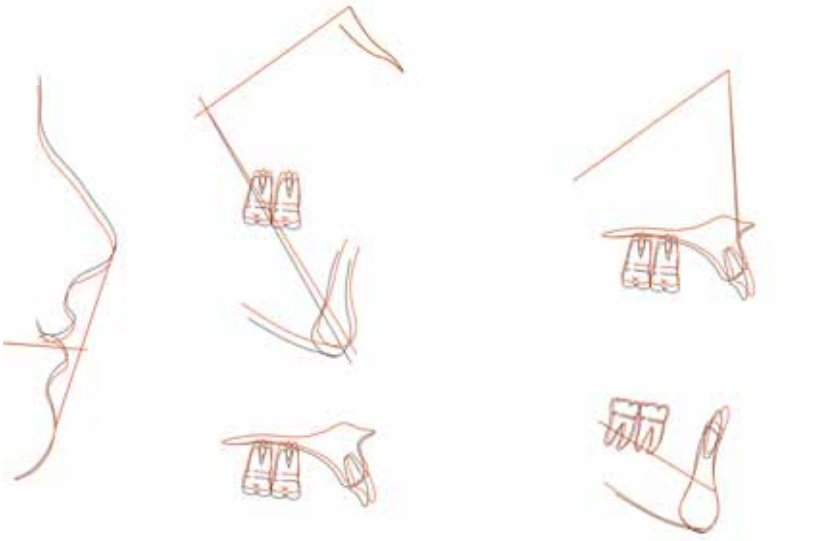
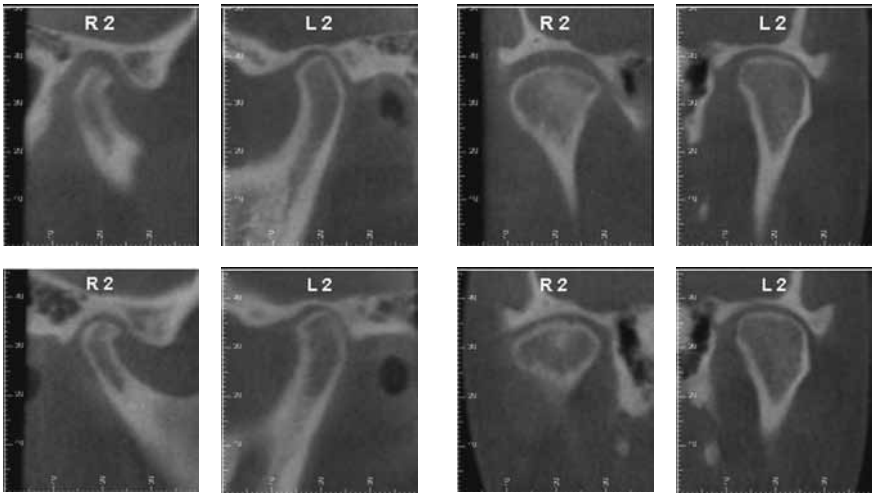


Figure 18: Superimposition of pre- and post-treatment tracings: intrusion of upper molars and successful vertical control with closure of the facial axis

- Lingualizing of second molars: attaching lingual buttons and pulling with elastic chains from the hooks welded to the omega of the TPB.
- Light force wires to align teeth.
- Levelling of upper and lower gingival margins of anterior teeth.
- Post-orthodontic phase: bioesthetics (splint therapy before reconstruction of anterior teeth) to obtain tooth proportions for esthetics and function.

COURSE OF TREATMENT WITH SWA

- First molar intrusion with Skeletal anchorage + Transpalatal bar.
- Second molar intrusion and lingualization, with elastic chains from welded hooks on the TPB to the molars *(Figs. 14-16)*.



Figures: 19, 20, 21, 22, 23, 24, 25, 26 Pre- and Post-treatment comparisons – Note the right condyle settling in the fossa after splint wear and aspects of healing

BIOESTHETICS

As final step for the completion of the treatment goals, we proceeded to restore the worn teeth, for the esthetics as well as for occlusal function. Incisors, canines and all first molars had their anatomy altered.

To achieve this the patient had to use a splint to ensure mandible stabilization. After the mounting we saw that there were interferences in

Figures 27, 28, 29, 30: Initial-end comparison of facial profile: the chin was brought forward and the lips were relaxed, providing a balanced facial profile

Figures 31, 32, 33

Figures 34, 35, 36

the "arc of closure" and proceeded to restore her anterior teeth along with occlusal adjustment.

DISCUSSION

The treatment goals were achieved, and facial esthetics, tooth alignment and mandibular position were improved with orthodontics *(Figs. 17, 18)*. Full-time stabilization splint therapy identified in which planes the problem existed and whether the problems were dental or skeletal, greatly facilitating diagnosis and treatment planning. The antero-posterior problem was corrected together with the vertical problem, as the mandible rotated counterclockwise thanks to the intrusion of molars and coordination of arches. The mandibular deviation was functional and was corrected with the correct positioning of the right condyle in the fossa *(Figs. 19–26)*.

As a result of facial axis closure, the lower facial height was decreased, the chin was positioned forward and favorable soft tissue changes were produced. The labial incompetence was also reduced.

To finish the multidisciplinary treatment, the restorative treatment of posterior teeth (first molars) will shortly be completed.

CONCLUSION

As orthodontists we are used to looking at the occlusion with regard to the teeth themselves, but must pay close attention to the joints to achieve long-term occlusal stability. In my treatment philosophy, which coincides with the FACE philosophy completely, final diagnosis and the treatment plan is made after stabilization of the mandibular position. The evaluation of and treatment approach to vertical problems are unique to the philosophy.

The goal of this philosophy is to harmonize the facial profile, tooth alignment, periodontium, functional occlusion, neuromuscular mechanism and joint function.It certainly takes a great deal of effort to implement this style of orthodontics, but it is also true that there are many patients who respond only to the treatment based on this philosophy.

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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.

Keywords
Second Premolars, Treatment Mechanics, Preadjusted Appliance

> *"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"*

INTRODUCTION

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[1-6].

Their recommended technique follows sound orthodontic principles and involves full arch mechanics, using the .022 slot and accurately manufactured tie-wing brackets[7]. There is a requirement for precise bracket positioning, and repositioning where needed[6]. During levelling and aligning, anchorage control is maintained with appropriate use of lacebacks and bendbacks[1-3]. 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[2,3].

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[2,3].

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 of 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.

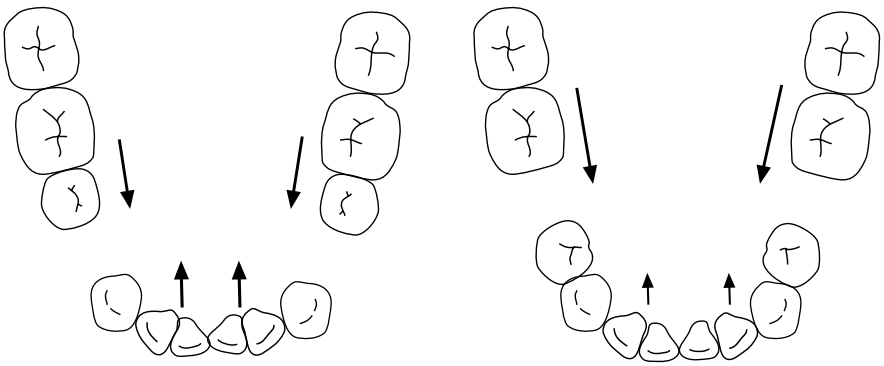


Figure 1: During treatment planning less anchorage can be expected after second premolar extractions than from first premolar extractions, provided treatment is started without delay.

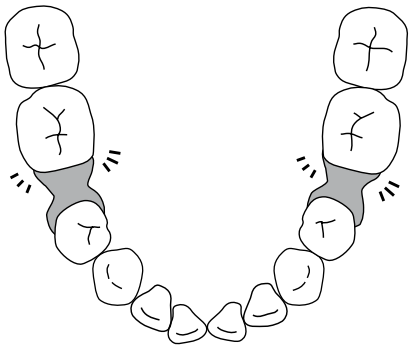


Figure 2: In most cases space closure of the second premolar extraction sites should begin without delay. If there is bone narrowing, it can restrict the mesial movement of molars in cases where there is a need for minimal anchorage.

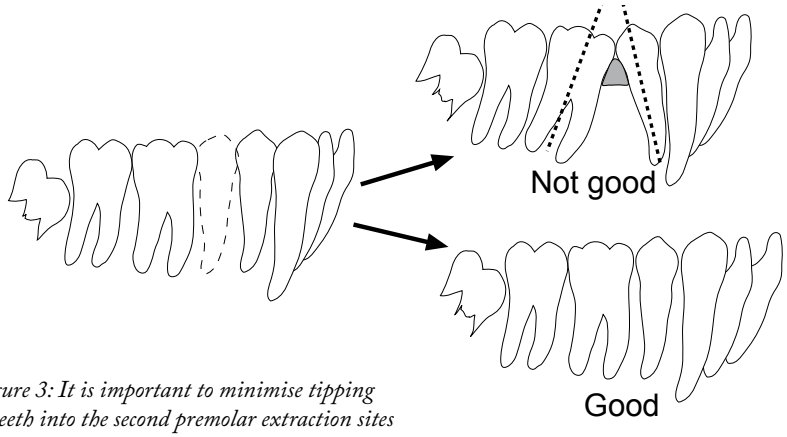


Figure 3: It is important to minimise tipping of teeth into the second premolar extraction sites during closure of the extraction site. Tipping can occur if the sectional wires are not thick enough, or the forces are too high.

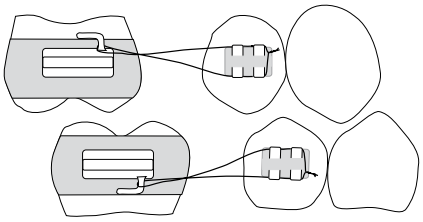


Figure 4: Modified lacebacks are placed from first molars to first premolars. These should be passive, and should not be overtightened to produce blanching of the tissue. If bands are used for molars, they should have lingual or palatal buttons or cleats.

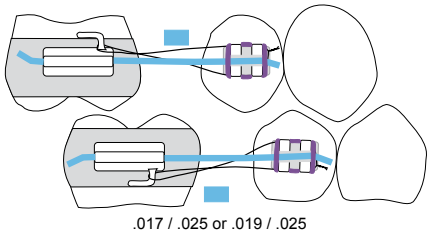


Figure 5: Gable bends should not be needed if sectional .019 / .025 steel wires are used in an accurately manufactured .022 bracket of adequate width (Ref. 7).

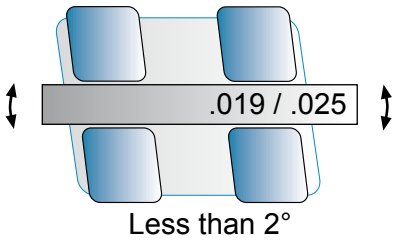


Figure 6: Precisely manufactured brackets should express tip within 2° of the prescription, and there will be good root paralleling. However, if inaccurate or narrow brackets are used, gable bends may be needed, even when using sectional .019 / .025 steel wires.

THE USE OF SECTIONAL MECHANICS

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.

Figure 7: Light elastic chains can be used on the lingual and palatal sides of the teeth from time to time. They assist in rotation control, but are very effective and are not needed at every visit. They should not be used excessively, or unwanted tooth movements can occur.

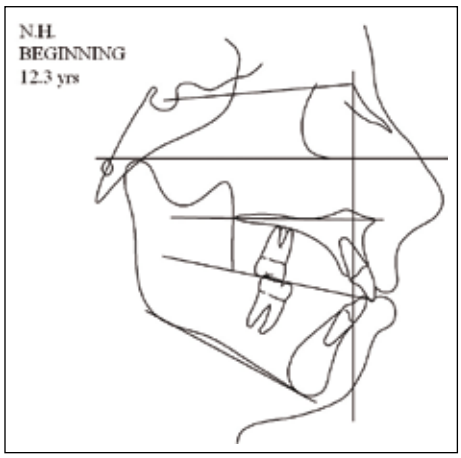
CASE REPORT

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.

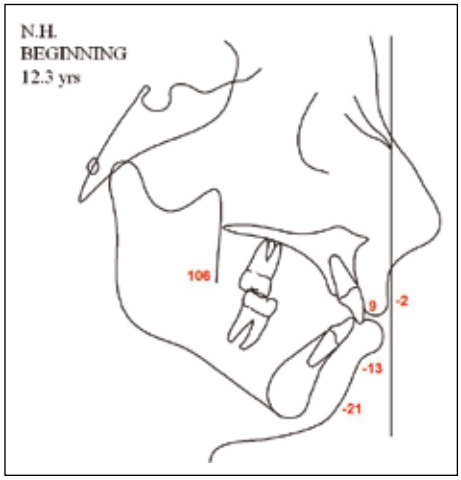
Figures 10, 11, 12

Figures 13, 14, 15



SNA 89°
SNB 82°
ANB 7°
A-N ⊥ FH 4 mm
Po-N ⊥ FH -9 mm
WITS 1 mm
GoGn SN 29°
FM 28°
MM 28°
↑1 to APo 10 mm
↓1 to APo 7 mm
↑1 to Max Plane 116°
↓1 to Mand Plane 102°

Figure 8: Conventional cephalometric values



↑ Incisor torque to occl. plane 52°
↑ Incisor tip to TVL -12 mm
↑ Lip thickness 9 mm
↑ Lip to TVL -2mm
Max. anterior height 21 mm
↑ Lip length 18 mm
↑ Incisor exposure 3 mm
Inter-labial gap 2 mm
Occlusal plane to TVL 106°
↓ Incisor torque to occl. plane 61°
↓ Lip thickness 12 mm
↓ Lip to TVL -4 mm
Soft tissue 'B' point -13 mm
Soft tissue pogonion -21 mm

Figure 9: Selected Arnett values

Figures 16, 17

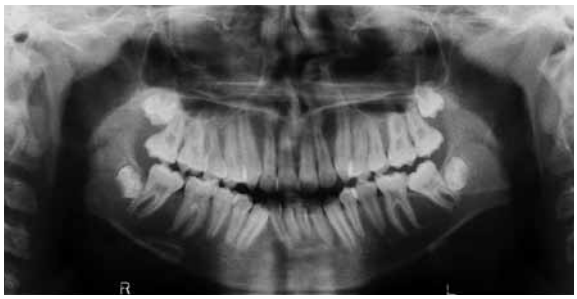


Figure 18

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

Figures 19, 20, 21

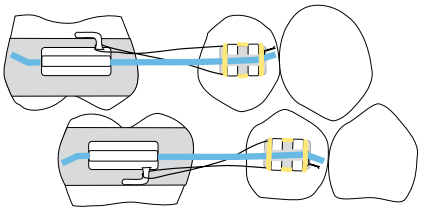


Figure 22

Figures 23, 24

Figures 25, 26, 27

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.

Figures 28, 29, 30

Figures 31, 32, 33

After eight months of treatment, the anterior teeth were bracketed with accurately manufactured milled brackets[7] 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.

Figures 34, 35, 36

Figures 37, 38

Figures 39, 40, 41

Figures 42, 43, 44

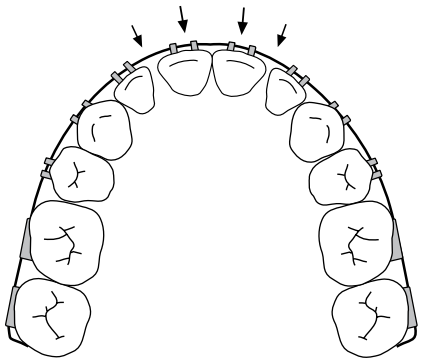


Figure 45

Figure 46

Figure 47

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.

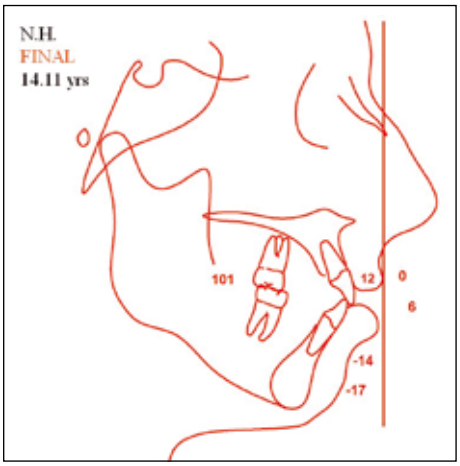
The upper incisor position shows

Figures 48, 49, 50

Figures 51, 52, 53

SNA 87°
SNB 84°
ANB 3°
A-N ⊥ FH 1 mm
PO-N ⊥ FH -6 mm
WITS 0 mm
GoGn SN 27°
FM 26°
MM 29°
↑1 to APo 10 mm
↓1 to APo 8 mm
↑1 to Max Plane 116°
↓1 to Mand Plane 94°

Figure 57: Conventional cephalometric values



↑ Incisor torque to occl. plane 55°
↑ Incisor tip to TVL -13 mm
↑ Lip thickness 12 mm
↑ Lip to TVL 0 mm

Max. anterior height 22 mm
↑ Lip length 17 mm
↑ Incisor exposure 5 mm
Inter-labial gap 6 mm

Occlusal plane to TVL 101°
↓ Incisor torque to occl. plane 65°
↓ Lip thickness 15 mm
↓ Lip to TVL -3 mm
Soft tissue 'B' point -14 mm
Soft tissue pogonion -17 mm

Figure 58: Selected Arnett values

Figures 54, 55

Figure 56

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.

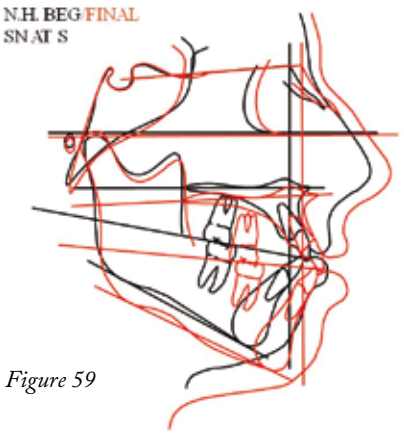


Figure 59

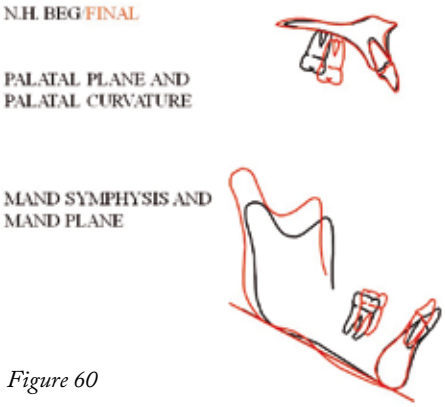


Figure 60

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Early treatment of Class III malocclusion by RME and face-mask therapy with deciduous dentition anchorage

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"The use of RME and FM in the early mixed dentition"

Abstract

OBJECTIVES. It is widely recognized that the first phase of mixed dentition is the best timing for maxillary orthopedic treatment in Class III malocclusions. The aim of this preliminary study was to evaluate the skeletal effects in two groups of growing patients with Class III malocclusion treated using a Rapid Maxillary Expander (RME) and Facial Mask (FM) anchored on permanent teeth (Group "6") and on the deciduous teeth (Group "E") in early mixed dentition.

MATERIALS AND METHODS. In order to asses cephalometric changes, 44 cephalometric headfilms of 22 growing patients were traced and subjects were analyzed pretreatment (T0) and after treatment (T1), following bony stabilization. The mean duration of treatment was 1y 1m. Two statistical analyses were carried out: a paired t-test was performed to evaluate changes during T0 to T1 in each group and an unpaired t-test was used to study intergroup comparison.

RESULTS. In both groups, Class III correction was a result of a forward movement of the maxilla with no downward and backward rotation of the mandible. However, improvement of the skeletal profile is greater in Group "E", in which devices were anchored on deciduous teeth.

CONCLUSIONS. The use of RME and FM in the early mixed dentition is effective in maxillary advancement using both permanent and primary teeth as anchorage. Furthermore, the use of deciduous teeth could reduce the risk of damaging permanent teeth and limit the dentoalveolar compensation on first permanent molars. Further studies with larger samples are needed to confirm these findings and evaluate the long-term stability of the skeletal changes.

Keywords
Class III, Deciduous dentition, Face mask

1. INTRODUCTION

According to several Authors, early mixed dentition is the best timing for maxillary orthopedic treatment in Class III malocclusions[1-4]. Overall, skeletal growth ranged before CVS1 and CVS2 seems to be the ideal time for intervention[2-4]. In Class III maxillary deficiency, the combining of face mask (FM) and rapid maxillary expander (RME) are reported to be the most effective therapy in the short[1-3] and long term[4-5]. While many studies have indicated a high response to maxillary advancement[1-4], the same cannot be said with regard to mandibular growth control[6]. It is a commonly held view that solving maxillary hypoplasia by RME will produce a slight advancement of the basal bone[7] and, in association with face mask therapy, facilitate and improve maxillary protraction. The high stress generated in various craniofacial sutures after RME probably disrupts the bones and promotes a cellular response in the circummaxillary sutural system but there is no unilateral consensus on the clinical advantages of using RME in Class III. A recent prospective, randomized clinical trial[9] showed that face mask therapy, with or without palatal expansion, produced equivalent changes in the dentofacial complex. Similar outcomes are reported by Tortop et al[10]. According to this criterion, RME can only be used to correct a transverse deficiency to neutralize possible constrictive forces from maxillary protraction[11] to limit unwanted tooth movement and to increase arch length[3].

Further studies, however, should be made on the type of anchorage, because there is as yet little data regarding the use of permanent or deciduous teeth.

The main side effect in choosing permanent teeth as anchorage includes external root resorption, enamel demineralization and loss of periodontal attachment. Because of orthopedic forces resulting in external root resorption on teeth[12-14], anchorage on deciduous teeth instead of permanent may be an advisable procedure. Furthermore, if the RME is fixed only on deciduous teeth, first permanent molars will not tip buccally and they would be free to move and touch in occlusion spontaneously, optimizing the intercuspation[15].

The aim of this pilot study is to compare deciduous vs. permanent anchorage in Class III malocclusion with early orthopedic correction. Verifying the null hypothesis that there is no difference between deciduous and permanent teeth, 11 cephalometric measurements in 22 patients are traced and statistical evaluation performed.

2. MATERIALS AND METHODS

In this preliminary study cephalometric data obtained in two similar groups of Class III growing patients, treated in the early mixed dentition, over the same average period of 1y1m, were performed.

A sample of 49 growing patients was obtained from 3 Board Certified Ortodontists and divided into two different anchorage groups: in Group "6" the appliances (Haas RME + Delaire FM) were banded on the first permanent molars *(Fig. 1.A)* and in Group "E" on the second deciduous molars and bonded on deciduous canines *(Fig.1.B)*.

All patients satisfied the absolute inclusion criteria and at least one of the secondary inclusion criteria *(Tab. 1)*. From the initial sample 27 patients were excluded according to defined criteria, as summarized in *Tab. 2*. The final sample consisted of 22 patients.

As can be seen in *Tab. 3*, no statistical difference between treatment times was found. The average treatment time was 1y 1m (sd 2m) in Group A while 1y 1m (sd 4m) in Group B. For each patient 2 cephalograms were carried out with an average observation period of 1y8m (sd5m) and 2y0m (sd 8m) respectively.

Samples were compared on the base of cervical vertebral maturation method (CVM)[16-17] and all patients presented a prepubertal stage of skeletal maturity (CS1). All the patients were equally distributed by sex and divergency. All RME appliances were cemented and activated the same day. The trasversal correction was considered as completed when the permanent molars reached a correct trasversal occlusion (immediately before resulting in a buccal cross bite). In group "E", frequently deciduous molars appear over-expanded in a scissor bite.

Regarding the face mask appliance, the patients were asked to wear it all night and for a couple of hours in the day. Two 1/2" 14 Oz elastics of 350-400 grams per side were applied from two hooks placed at the upper deciduous canines with a 30° down-angulation from the occlusal plane. In both Groups the treatment obtained at least an edge to edge Class II occlusal relationship but most of the patients were overcorrected to a full Class II occlusal relationship.

Figure 1A: Appliances on first permanent molars.

Figure 1B: Appliances on second deciduous molars.

Primary inclusion criteria
1. no CO/CR discrepancy
2. no mandibular shift
Secondary inclusion criteria
1. Anterior cross bite
2. ANB angle of 0° or less
3. Witts index of 0mm or less

Table 1: Samples Selection and Inclusion Criteria

	Group "6"	**Group "E"**
Initial sample of inclusion criteria	25	24
Primary exclusion criteria		
1. Poor film quality	3	4
2. Lack of consensus	1	0
3. Incomplete records	5	3
Secondary exclusion criteria		
1. T0 to T1 > 18 months	5	6
Final Sample	11	11

Table 2: Sample Selection and Exclusion Criteria

period/interval	**Group "6"**				**Group "E"**				
	Mean	SD	Min	Max	Mean	SD	Min	Max	Sig
T0	8y2m	11m	6y9m	9y6m	7y2m	5m	6y11m	7y9m	0.005**
T1	9y3m	9m	8y	10y6m	8y4m	6m	7y9m	8y11m	0.004**
T1-T0	1y1m	2m	1y	1y6m	1y1m	4m	6m	1y7m	NS
*implies significance at p<0.05; **implies significance at p<0.01; ***implies significance at p<0.001.									

Table 3: Demographics of observation periods and observation intervals

2.1 Cephalometric analysis

Two lateral cephalograms were taken for each patient of both groups at the following time:

- T0 at the beginning of treatment;
- T1 with bony stabilisation after FM treatment.

While waiting for mandibular relocation, lateral headfilms at T1 were taken 6 months after face mask removal in both Groups.

Each lateral cephalogram was traced by one investigator for each group and cephalometric analysis was based on 11 traditional measurements *(Fig 2)*.

In order to minimize misidentification to the landmark, a second operator verified them.

The mean and the standard deviation of each cephalometric measurement was calculated for each group.

2.2 Statistical analysis

Since the plot of the outcome follows a T distribution, a T test was applied: a paired t-test to evaluate changes during T0 to T1 in each group and an unpaired t-test to study intergroup comparison.

Cephalometric measures Group "6"	T0		T1		
	Mean	SD	Mean	SD	Sig
Sagittal skeletal relations					
Maxillary position SNA	82.68°	3.33°	84.14°	2.64°	0.009**
Mandibular position SNB	81.14°	3.76°	81.5°	2.52°	NS
Sagittal jaw relationship ANB	1.55°	2.43°	2.64°	2.23°	0.008**
Witts Ao-Bo	-4.27	1.69	-3.5	1.61	0.049*
Vertical skeletal relations					
Mandibular inclination SN^MP	32.5°	6.23°	33.27°	5.7°	NS
Vertical jaw relation PP^MP	26.41°	4.76°	26.64°	4.33°	NS
Maxillary inclination SN^PP	6.18°	2.65°	6.64°	2.38°	NS
Dentoalveolar					
Maxillary dentoalveolar 1^PP	108.41°	7.4°	112.36°	4.05°	0.040*
Mandibular dentoalveolar 1^MP	88.36°	6.66°	88.18°	8.23°	NS
Interincisal angle +1^-1	136.59°	13.85°	132.63°	8.56°	NS
Facial convexity					
NAPg	177.82°	5.34°	177.55°	5.97°	NS
*implies significance at p<0.05; **implies significance at p<0.01; ***implies significance at p<0.001.					

Table 4: Cephalometric changes in Group "6" before (T0) and after (T1) treatment

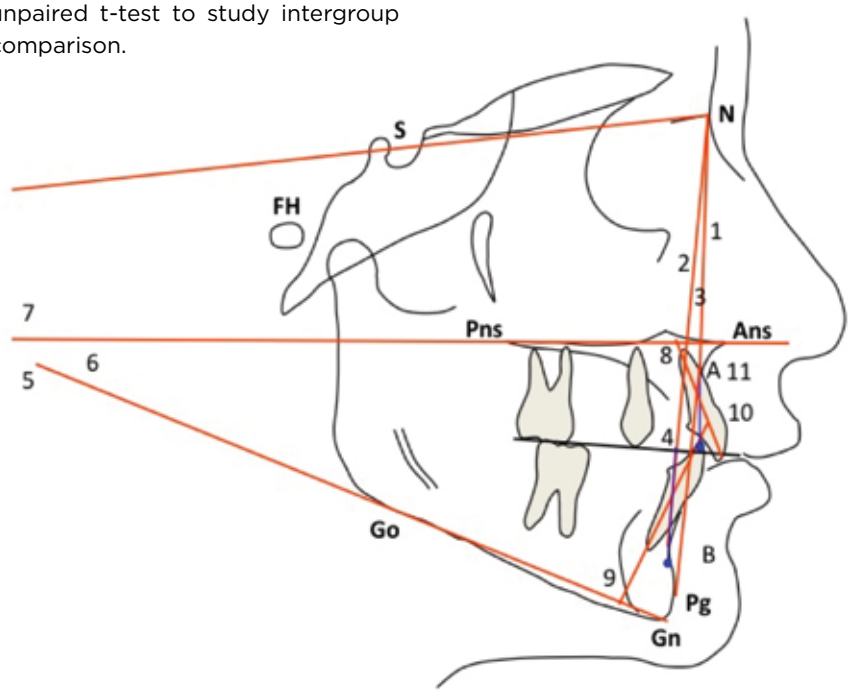

Figure 2: Cephalometric skeletal and dental measurements: (1) SNA Maxillary Position; (2) SNB Mandibular Position; (3) ANB Sagittal Jaw Relationship; (4) Witts Sagittal Jaw Relationship; (5) SN^MP Mandibular Inclination; (6) PP^MP Vertical Jaw Relationship; (7) SN^PP Maxillary inclination; (8) 1^PP Maxillary Incisor Inclination; (9) 1^MP Mandibular Incisor Inclination; (10) Interincisal Angle; (11) Facial Convexity

2.3 Method error

To determine the intra-examiner error resulting from landmark selection, 10 cephalograms chosen at random were retraced by the same examiner two weeks later. According to Dahlberg's formula the random error was calculated at 0.092, well below the maximum limit of 0.25.

3. RESULTS

The results of the statistical evaluation of both groups are listed in the *Tab. 4-5*. Intergroup comparison is shown in *Tab. 6*.

3.1 Group "6" T1-T0 cephalometric changes during active treatment

A significant increase in SNA,ANB angle, and in AoBo value has been recorded in Group "6", as results of maxilla anterior displacement. However, no statistical significance was detectable in skeletal convexity improvement. No statistically significant increase in facial height (SN^GoGn) was reported, just as no significant changes were

found in the vertical and sagittal position of the mandible: point B still remains in the same relation to cranial base.

The only remarkable dental effect is the significant proinclination of the upper permanent incisors relative to the palatal plane.

Cephalometric measures Group "E"	T0		T1		
	Mean	SD	Mean	SD	Sig
Sagittal skeletal relations					
Maxillary position SNA	77.36°	1.9°	80.32°	4.06°	0.025*
Mandibular position SNB	77.95°	2.18°	77.91°	3.83°	NS
Sagittal jaw relationship ANB	-0.14°	1.45°	2.41°	2.45°	0.002**
Witts Ao-Bo	-5.14	1.66	-3.09	3.13	0.008**
Vertical skeletal relations					
Mandibular inclination SN^MP	38.41°	3.21°	38.36°	5.84°	NS
Vertical jaw relation PP^MP	27.77°	5.25°	28.59°	5.95°	NS
Maxillary inclination SN^PP	10.63°	3.83°	9.77°	2.68°	NS
Dentoalveolar					
Maxillary dentoalveolar 1^PP	109.41°	10.98°	115.91°	6.6°	0.048*
Mandibular dentoalveolar 1^PM	84.68°	7.72°	87.77°	6.41°	NS
Interincisal angle +1^-1	136.64°	16.65°	127.45°	8.80°	0.034*
Facial convexity					
NAPg	180.5°	4.01°	175.86°	6.18°	0.008**
*implies significance at p<0.05; **implies significance at p<0.01; ***implies significance at p<0.001.					

Table 5: Cephalometric changes in Group "E" before (T0) and after (T1) treatment

Cephalometric measures	Group "6" T1-T0		Group"E" T1-T0		
	Mean	SD	Mean	SD	Sig
Sagittal skeletal relations					
Maxillary position SNA	1.46°	1.51°	2.96°	3.74°	NS
Mandibular position SNB	0.36°	2°	-0.04°	3.58°	NS
Sagittal jaw relationship ANB	1.09°	1.11°	2.55°	2.09°	0.05*
Witts Ao-Bo	0.77	1.15	2.05	2.05	NS
Vertical skeletal relations					
Mandibular inclination PM^SN	0.77°	2.39°	-0.05°	4.52°	NS
Vertical jaw relation PM^pp	0.23°	2.78°	0.82°	3.62°	NS
Maxillary inclination pp^SN	0.46°	1.72°	-0.86°	3.59°	NS
Dentoalveolar					
Maxillary dentoalveolar +1^pp	3.95°	5.58°	6.5°	9.58°	NS
Mandibular dentoalveolar -1^PM	-0.18°	4.14°	3.09°	5.82°	NS
Interincisal angle +1^-1	-3.96°	8.63°	-9.19°	12.41°	NS
Facial convexity					
NAPg	-0.27°	1.25°	-4.64°	4.68°	0.007**
*implies significance at p<0.05; **implies significance at p<0.01; ***implies significance at p<0.001.					

Table 6: Intergroup comparison

On the other hand, the inclination of the lower incisor (1^MP) was not affected by treatment.

3.2 Group "E" T1-T0 cephalometric changes during active treatment

Statistically significant changes of all cephalometric measurements regarding maxillary position were found for SNA, ANB, AoBo and, compared with Group "6", these changes contributed to profile convexity increase.

No statistically significant increase in facial height (SN^GoGn) was reported, as no significant changes were found in the vertical and sagittal position of the mandible: point B still remains in the same relation to cranial base. In Group "6", there was a significant change in the upper incisors position, while no lower incisor inclination was observed.

3.3 Comparison of group "6"-"E" in the observation period

During the treatment period, statistical improvement was observed only in ANB and NAPog. No other significant differences were observed.

4. CASE REPORT: RPE and FM anchored on deciduous teeth

The case of a 7-year-old male patient in early mixed dentition with a Class III molar relationship and anterior cross-bite is described.

The extraoral examination showed a proportional and slighly asymmetric face. The profile was straight with a moderate midface retrusion *(Fig. 3. A-B-C)*.

The x-ray evaluation was performed with a lateral x-ray (TRX LL) with its tracing *(Fig. 3. D-L)*.

The lateral ceph showed a skeletal Class III relationship, open bite, and an hyperdivergent pattern of growth *(Tab. 7)*.

The intraoral examination showed a Class III molar relationship, open bite, infraocclussion of the upper central incisors, with slight crowding of the upper and lower incisors *(Fig. 3. E-I)*.

Periodontal conditions and the oral hygiene levels were good and there was no general disease.
The treatment consisted on the application of the RME and face mask appliance for an overall period of 1 year and 2 months.
The treatment began with the application of the RME appliance with vestibular hooks for the extraoral traction. The central screw was daily activated until the desired upper molar position and the correct space for the upper lateral incisors were achieved *(Fig. 4. A-B-C-D)*.
Once upper arch expansion was obtained, the facemask was applied *(Fig. 4. E-F)*.

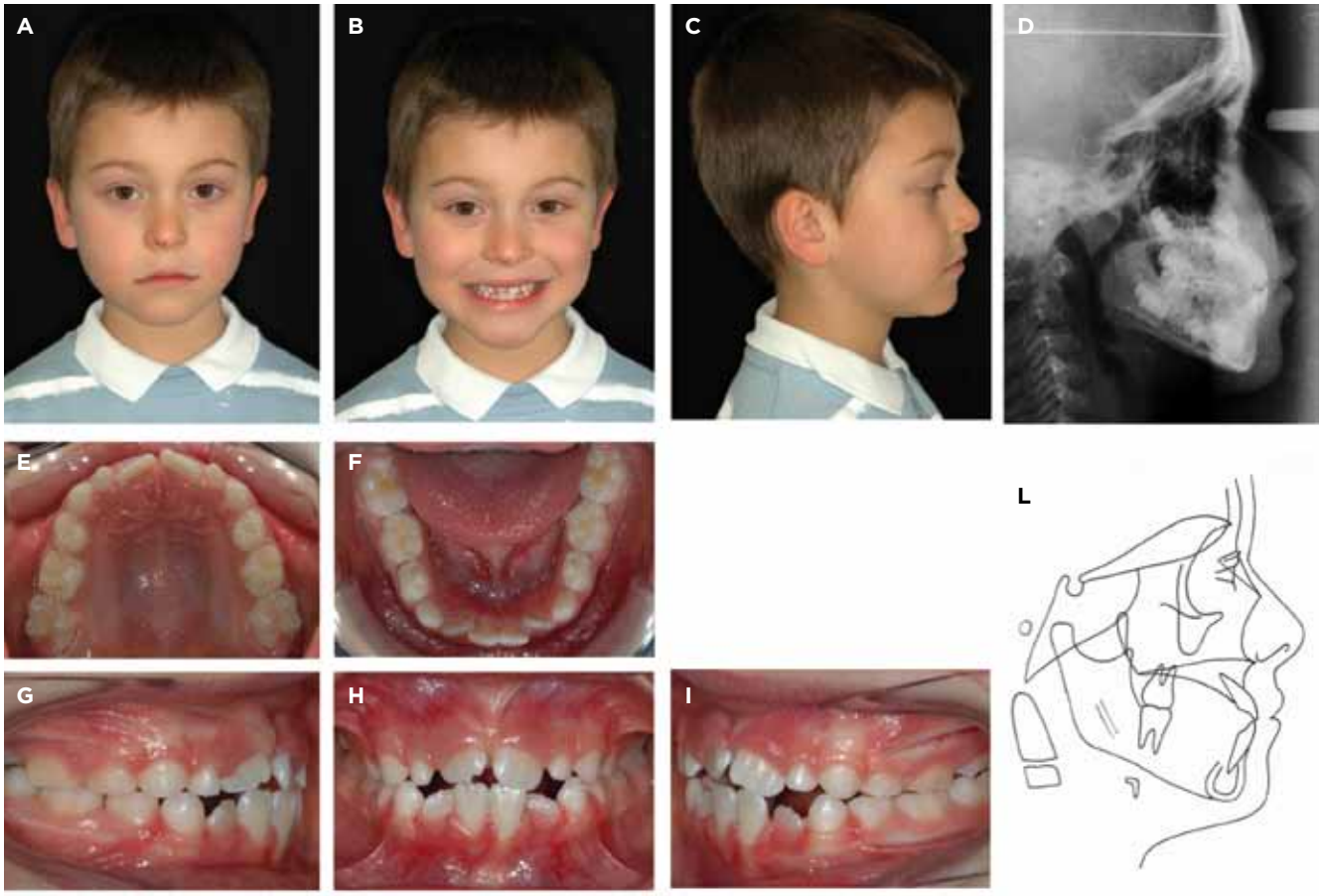

Figure 3 (A-B-C-D-E-F-G-H-I-L): Pre-treatment records (CG 7y).

	Norm	Pre-treatment	Post-treatment	1yPost-treatment	Difference
SNA	82° +/- 3.5°	78°	80°	80°	2°
SNB	80° +/- 3.5°	78°	76°	77°	-1°
ANB	2° +/- 2.5°	0°	4°	3°	3°
AoBo	2mm +/- 2mm	-5mm	1 mm	-1.5mm	3.5mm
NAPg	170° +/-5°	179°	168.5°	174.5°	4.5°
SNMP	32° +/- 2°	34°	37°	36°	2°
PPMP	20°+/- 5°	27°	32°	30°	3°
SNPP	12° +/- 3°	7°	5°	6°	-1°
1PP	110° +/- 6.0°	122°	116°	116°	-6°
1MP	94° +/- 7°	94°	96°	97°	3°
+1-1	130° +/- 10°	117°	116°	116°	-1°

Table 7 Clinical case – Cephalometric Variables

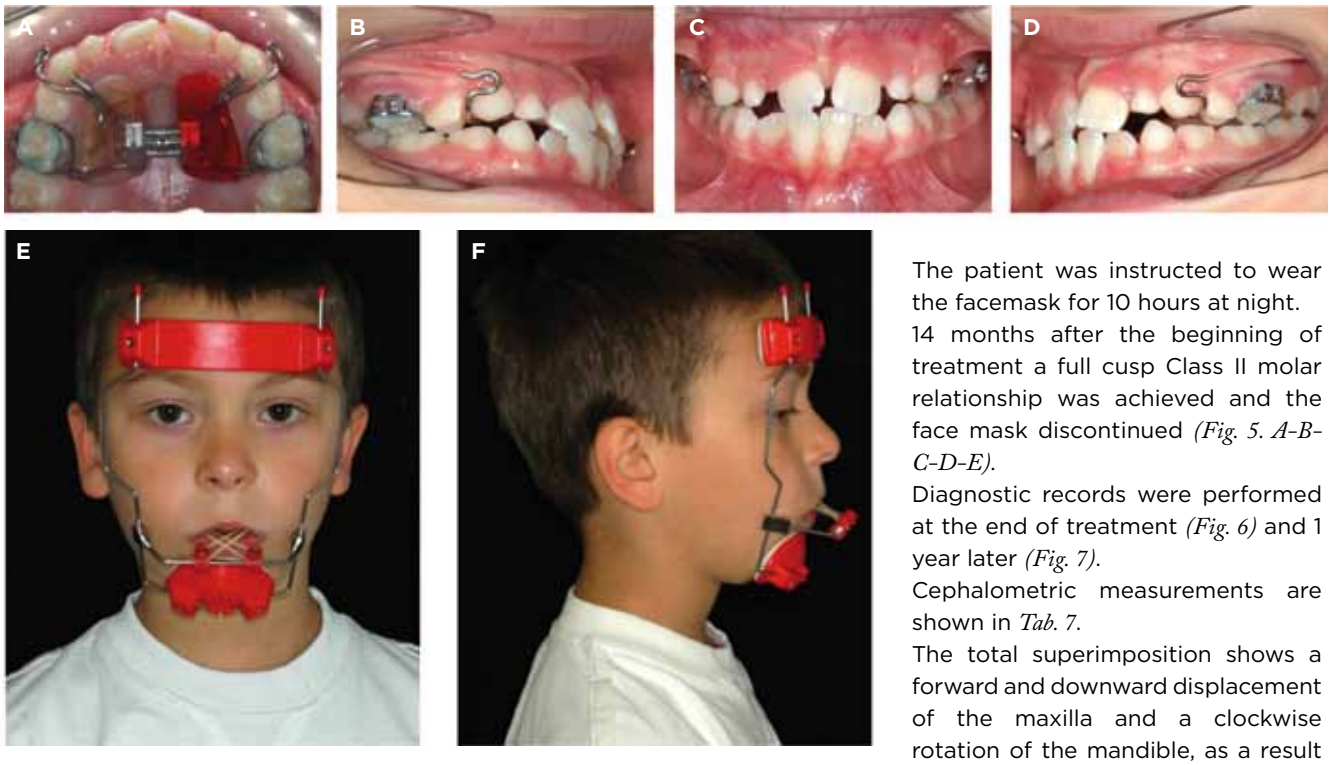

Figure 4 (A-B-C-D-E-F): Patient immediately after expansion at FM application.

The patient was instructed to wear the facemask for 10 hours at night.
14 months after the beginning of treatment a full cusp Class II molar relationship was achieved and the face mask discontinued *(Fig. 5. A-B-C-D-E)*.
Diagnostic records were performed at the end of treatment *(Fig. 6)* and 1 year later *(Fig. 7)*.
Cephalometric measurements are shown in *Tab. 7*.
The total superimposition shows a forward and downward displacement of the maxilla and a clockwise rotation of the mandible, as a result of his hyperdivergent growth pattern *(Fig. 8)*.

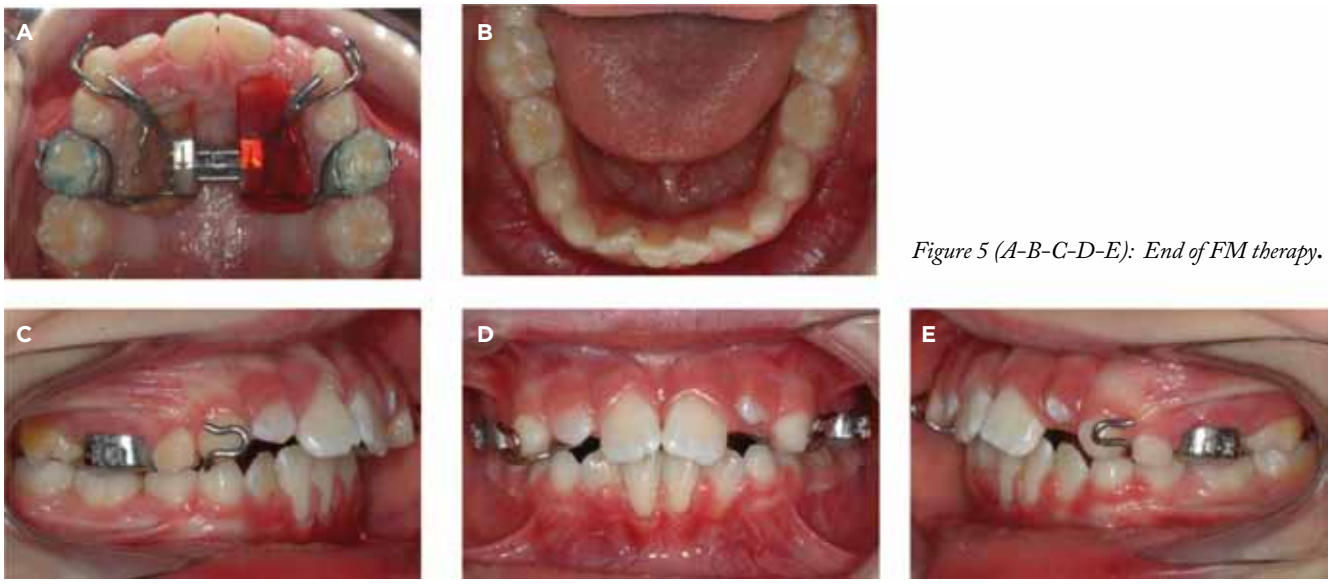

Figure 5 (A-B-C-D-E): End of FM therapy.

5.DISCUSSION

5.1 Therapeutic approach

All the patients enrolled in the study present both sagittal and transversal maxillary deficiency. It is often thought that circumferential sutures distraction using RME it is crucial for maxillary protraction, even if recent studies[9] have reported that expansion is not essential for the anterior maxillary movement in Class III malocclusion correction. In this context, maxillary expansion was performed in the two samples in order to correct transverse deficiency.
Little data is available in the literature about the efficacy of RME anchored on deciduous teeth[18-19], and there is still less on studies combining RME and FM banded and bonded on primary dentition.
Because of the cohort study, in order to minimize the significance related to the clinicians and to

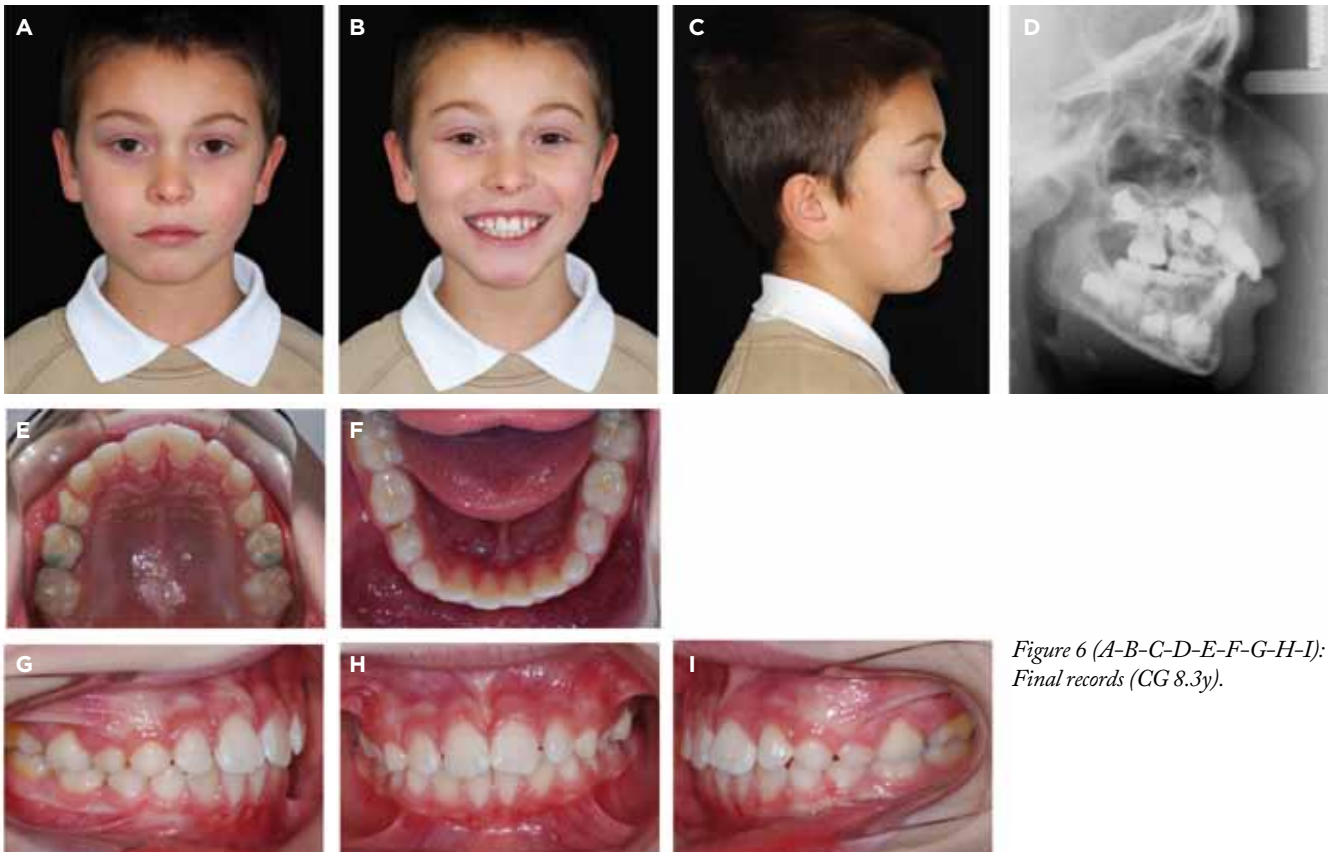

Figure 6 (A-B-C-D-E-F-G-H-I): Final records (CG 8.3y).

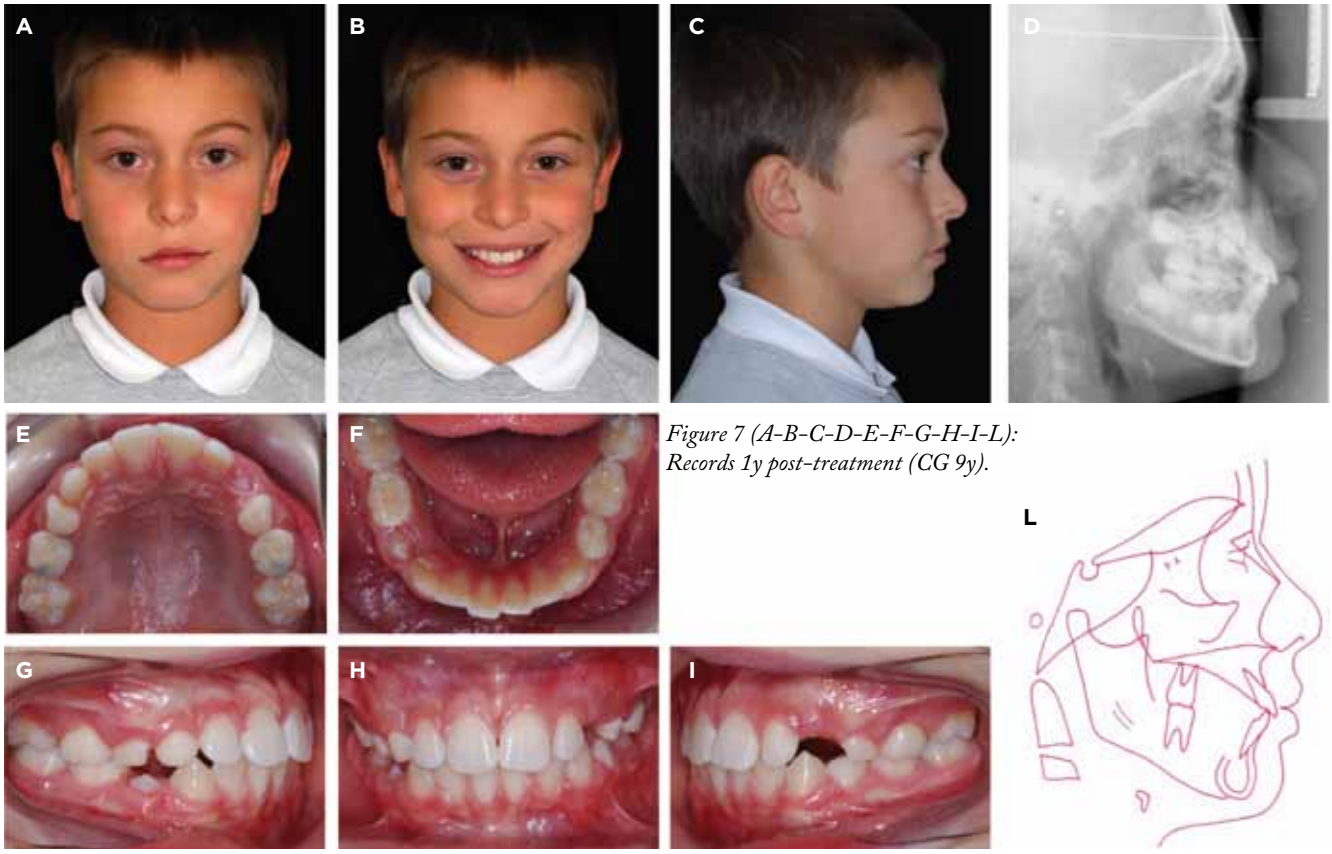

Figure 7 (A-B-C-D-E-F-G-H-I-L): Records 1y post-treatment (CG 9y).

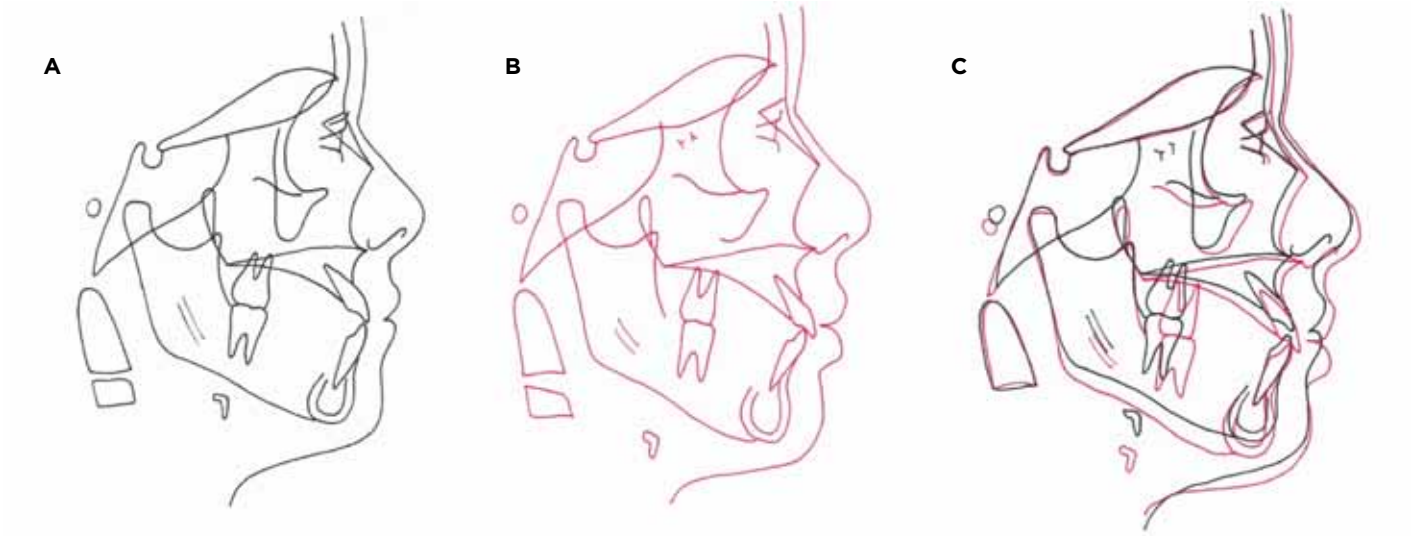

Figure 8 A: Pre-treatment cephalometric tracing. B. Post-treatment cephalometric tracing. C. Superimposition of cephalometric tracings. (CG 7-9 y)

the patient's compliance, only the treatment time (mean 1y 1m) was considered in the statistical evaluation.

5.2 Group data distribution

Although distribution by sex showed a difference between the two groups, De Toffol[16] et al. did not observe any influence by gender on treatment effects. At T0 the two samples were not homogeneously distributed by age. However, all the patients were in the early mixed dentition phase stage, CVS1[17]. The average age in Group "6" at T0 was 8y2m+/-11m whereas Group "E" average age was 7y2m+/-5m. This difference in age is probably related to the need to wait for the complete eruption of the first permanent molar for Group "6", in order to anchor the appliances on permanent teeth. The average treatment time was almost the same for both groups: 1y 1m +/- 2m in Group "6" and 1y 1m +/-4m in Group "E".

Likewise, the lateral x-rays traced were performed before and after treatment with a similar average observation period of 1y8m+/-5m and 2y0m+/-8m respectively.

5.3 Group "6" results

In agreement with previous findings[1,9,20-21] in Group "6" a significant increase in SNA, ANB, AoBo and upper incisal proclination values was shown.

SNA, ANB and AoBo improvement are expressions of the skeletal effect on the maxilla by using FM.

The increase in upper incisors inclination, even if it helps to reduce the amount of maxillo mandibular sagittal discrepancy, is proof of dentoalveolar compensation. This means that the treatment fails to achieve a profile improvement. This finding is in accordance with Cozza[1]. The increase in skeletal divergency was not considered clinically important. At the same time mandibular measurements failed to demonstrate significant changes. This result is in conflict with those of several Authors[21-23] who have observed a counterclockwise rotation of the palatal plane and a backward rotation of the mandible. The absence of divergence increasing and palatal plane inclination may suggest a different application of the elastic tractions in force and direction or an overall favorable growth pattern of the Group "6".

5.4 Group "E" results

Group "E" shows similar cranio-facial changes to the previous group. All maxillary measurements, facial convexity included, demonstrate significant statistical improvement, as already emphasized in studies previously mentioned[2-4,9]. As just increase was observed in SNA ($p<0.05$) ANB ($p<0.01$), AoBo ($p<0.01$). Furthermore, the decrease in NAPg ($p<0.01$), as evidence of maxillary forward displacement, demonstrate the efficacy of the treatment. Dental analysis suggests a compensation of the upper incisor, maybe related to the presence, also in this sample, of 3 patients with the deciduous incisor at T0. The inclination of the palatal plane relative to the cranial base remains unchanged both in Group "6" and Group "E", although the point of application of the appliances has a different distance from the maxillary center of resistance and from its sutural system. At the same time we found no evidence of mandibular clockwise rotation which contrasted with the findings of Cozza, Ngan, Vaugh, Nartallo Turley[1,4,9,23] but agreed with those of Mermigos[24].

5.5 Group "6" and "E" comparison

Both types of anchorage demonstrate efficacy in skeletal improvement. In each group a satisfactory correction of Class III skeletal malocclusion was obtained by a significant amount of maxillary forward movement without touching the position of the mandible.

The significant increase in vestibular inclination of the upper incisors

could be associated with the different inclination of those during its eruption or to the different torque of the deciduous teeth.

Despite what has been observed by many Authors[1-4,9,21-23], no rotational changes occured neither in the palatal nor in the mandibular plane. As observed by others[11] the force and direction of the FM traction had no influence on the clockwise rotation of the palatal plane even if the high percentage of hyperdivergent subjects could suggest an increase in the facial high depending on this growth pattern. In Group "E" no statistical significance in divergency increase is probably related to the free movement of the first permanent molar. No appliances anchored on the permanent dentition allows their spontaneous intercuspation without extrusion.

Anyway Class III correction resulted only from forward movement of the maxilla and not from downward and backward rotation of the mandible. The most notable differences between the two treatment protocols concerns facial convexity and ANB angle. This could be linked to a different sensitivity of the 3 clinicians in hypercorrection of the maxillary position.

6. CONCLUSIONS

The results demonstrate that both anchorage systems are efficient.

The deciduous second molars, as reported in many studies[18-19], are able to bear the load of the facemask and RME. For this reason using second deciduous molars during the early mixed dentition as anchorage, should be considered a reliable alternative. The complete prevention of anchoring teeth damage caused by the appliances[12-14], such as external resorption, junction loss, enamel demineralization, is also helped by the absence of mesial and vestibular inclination of the first permanent molar. The permanent molars, even if already erupted, seem to be mesially pulled through the trans-septal fibers and move spontaneously together with the deciduous dentition.

Because of encouraging clinical outcomes, further studies with larger samples are recommended to demonstrate our findings with a greater statistical significance. Further data are needed to evaluate the long-term stability of the dento-alveolar and skeletal changes seen at appliance removal.

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To open or to close spaces for congenitally missing upper lateral incisors: is this really the question?

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Abstract

INTRODUCTION. Treatment planning for patients with congenitally missing upper lateral incisors remains a controversial topic. Former scientific studies have evidenced that space closure with canine substitution leads to healthier periodontal conditions and to greater patient satisfaction in the long run. The aim of the article is to show that comparable long-term results can also be achieved with orthodontic space opening and implant substitution, even in situations with previous suboptimal periodontal conditions.

METHODS. Three exemplary patients and recent scientific studies are presented to corroborate this paradigm shift.

RESULTS. Adequate orthodontic space opening with subsequent meticulous surgical reconstruction of the hard- and soft-tissues prior to a slightly more palatal implant placement, and utilizing tooth-colored abutments and all-ceramic crowns could achieve esthetic and periodontally stable results.

CONCLUSION. Today there is evidence that predictable and excellent long-term results cannot only be achieved by orthodontic mesialization of the canine, but also by parallel and sufficient space opening and subsequent correct implant placement, if the latest surgical techniques and newest materials are implemented.

"collaboration between the orthodontist, the implantologist and the prosthodontist can achieve an excellent esthetic prosthetic result"

Keywords
Space opening, Implants, Periodontal reconstruction

INTRODUCTION

Since the early times of orthodontics, the discussion on whether it is preferable to close the spaces by mesializing the posterior segments or to open the spaces for substitution of congenitally missing laterals by implant-born crowns is ongoing. The supporters of space closure invoke either single case or small sample size reports of unsuccessful outcomes,[1,2,3] or rely on two relatively old studies from 1975 and 2000, which described healthier periodontal conditions of the adjacent teeth, comparable occlusal functional and more satisfied patients after treatment with space closure.[4,5] These results seem to be corroborated by a long-term study which emphazises a continuous loss of the bony crest of the central incisors and the canines next to the implant.[6] The interpretation of these studies has led to a consensus of the Angle Society of Europe in 2012 that space closure in the upper anterior area is the preferred choice of orthodontic treatment – especially in patients with a high smile line.[7]

A closer look at the above cited studies, however, reveals some weaknesses in their design:

1. The two studies from 1975 and 2000 did not examine implant restorations for replacement of missing upper laterals, but only fixed bridgework.[4,5] It seems far-fetched to compare the periodontal status and patient satisfaction of patients with tooth-borne metal-ceramic prosthodontics from the last millennium with patients who received implant supported all-ceramic crowns on customized zirconia abutments for the substitution of congenitally missing lateral incisors.
2. In the study from 2000, the implants had been placed in 18 adolescents between 13-17 years with "very different stages of skeletal maturation", which is questionable because of the high risk of progressive infra occlusion.[6] Therefore the "reduction of the marginal bone level at the teeth adjacent to the implants" that "was observed in some patients" might at least be partly due to the ongoing eruption of the adjacent natural dentition and not to a pure resorptive process. Taking this atypical sample as a reference for evaluation of the periodontal status of implant-borne crowns which have been inserted correctly after the end of growth might lead to false conclusions.
3. However, the study corroborated an important issue: the amount of bone loss was significantly greater when the distance between the implant and the adjacent teeth was below 1.5mm. In other words: the determinant factor for long-term instability is not related to the presence of the implant itself, but to insufficient mesiodistal space conditions. Unfortunately, no control group was examined.

In contrast to the orthodontic literature, we find very pleasing and stable long-term results of implant borne restorations in highly regarded prosthodontic journals.[8,9] According to the authors important prerequisites for these long-term success are:

1. sufficient mesio-distal orthodontic space opening (6.0-6.2mm in females and 6.4-6.6mm in males)[10,11],
2. a more palatal insertion of the implant with at least 1.2-1.5mm width of covering vestibular bone and [12]
3. a 5mm distance between the contact point of the crown and the osseous peaks to complete papillary formation.[13]

How can these differences between the orthodontic and the prosthodontic literature be explained?

It has been reported that orthodontic distalization of a canine can generate an osseous crest which provides sufficient foundation for an implant and which remains stable over time,[14,15] but this does not occur in all patients - at least not to a satisfactory extent. Careful adequate orthodontic space opening might generate sufficient osseous width for immediate implantation, but the alveolar ridge will not present a natural looking emergence profile ("bombé")due to the lack of the characteristic bony bulge over the missing root *(Fig. 1)*.

Therefore, when the implantologist confines her/himself to simply placing the implant more palatally in order to counteract any imminent vestibular bone resorption in the long term, the esthetic result will (nearly) always remain suboptimal. A perfect bombé can only be created by meticulous reconstruction of the osseous and eventually even of the soft-tissue framework. This may not only require a bone graft, but also a connective tissue graft. [16-19] Mutual understanding of comprehensive orthodontic skills and sophisticated surgical procedures and close interdisciplinary collaboration from day 1 is mandatory for optimum patient management.

A typical agenda for patients with space-opening and tooth substitution with an implant borne crown is the following:

1. Satisfactory orthodontic mesio-distal space opening with a periapical radiograph taken to check for root parallelism *(Fig. 2)*.
2. Surgical exploration of the implant site:
   a. a more palatal insertion of the implant relative to the adjacent teeth *(Fig.3)*.
   b. an abundant reconstruction of any osseous defect with demineralized human bone matrix *(Fig. 4)*.
3. Replacement of the orthodontic appliance or cementation of an immediate provisional crown (dependent on the primary stability of the implant) with 5mm distance between the contact point and the osseous peaks for complete papillary recovery for at least 4-6 months.
4. In the case of any residual tissue defect: surgical re-entry for a connective tissue graft to create a thicker periodontal biotype and placement of a second provisional crown for further 6 months waiting for completion of tissue maturation.
5. Insertion of the definitive customized zirconia abutment and an all-ceramic crown *(Fig.5)*. Note the complete filling of the preexisting osseous defect and the natural looking emergence profile *(Fig.6)*.

The following case presentations

Figure 1A: The canines have erupted close to the central incisors.

Figure 1B: Although the canines have been slowly distalized depressions in the future implant site are noticeable.

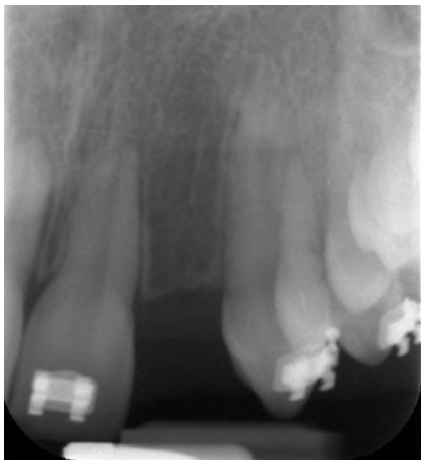


Figure 2: Periapical radiograph prior to debonding to check for sufficient interradicular space and root parallelism.

Figure 3: The implant is inserted parallel and more palatally to the alveolus of the tooth to counterbalance future bone resorption.

Figure 4: The vestibulopalatal dimension is augmented with a bone graft to create a natural-looking bony emergence profile over the implant.

Figure 5: After 4–6 months of tissue maturation an all-ceramic crown can be cemented.

will systematically illustrate how close collaboration between the orthodontist, the implantologist and the prosthodontist can achieve an excellent esthetic prosthetic result and healthy periodontal conditions even after prior unsuccessful treatments. The key factor for the long-term stability seems to be the meticulous reconstruction of the entire periodontal framework, which may not only require a bone graft but also a soft-tissue graft in order to create a resistant thick periodontal biotype.

Figure 6A: Insufficient vestibulopalatal bony support immediately after removal of the orthodontic appliances.

Figure 6B: Natural bombé created with an implant and a demineralized human bone graft.

CASE PRESENTATION 1

A 17-year-old female student presented with a normodivergent pseudo-Class III malocclusion with a congenitally missing upper right lateral incisor and a resultant 4mm upper midline deviation to the right and interdental spacing. The upper right canine had spontaneously erupted close to the central incisor. Oral hygiene was unsatisfactory with gingival swelling and bleeding *(Fig. 7, 8)*. The orthodontic treatment plan consisted in space opening for a future implant-supported lateral incisor crown after distalization of the canine and correction of the upper midline deviation *(Fig. 9, 10)*. After complete space opening, a periapical radiograph of the implant site was taken, which revealed excellent root parallelism and a sufficient 6.2mm interradicular space with preservation of the osseous peaks *(Fig. 11)*.

Figure 7(A-C): Dentally compensated Class III malocclusion with a congenitally missing upper right lateral incisor.

Figure 7D: Upper dental midline deviation to the right side.

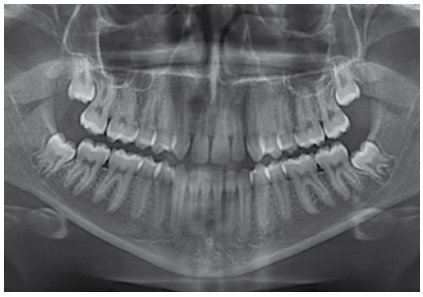


Figure 8: Panoramic radiograph before treatment

Figure 11: The periapical radiograph shows excellent root parallelism and sufficient interradicular space for implant placement.

Figure 9: Sufficient mesio-distal space for implant placement 12 was opened and the upper midline deviation was corrected.

Figure 10: Symmetrical upper arch form.

The archwire was temporarily removed and the patient was referred to the implantologist. Clinically, a moderate osseous depression with adequate gingival coverage was evidenced *(Fig. 12)*.

In order to achieve a natural-looking emergence profile, an implant was inserted more palatally and parallel to the imaginary natural alveolus to avert future bony resorption, and the vestibulopalatal osseous dimension was enlarged by an augmentation with demineralized bone covered by a pericardial membrane *(Fig. 13, 14)*. The correct parallel and central implant position was checked with a periapical radiograph *(Fig. 15)*.

After 4 months of orthodontic finishing procedures, carefully avoiding any manipulation near the implant site, the appliances were removed *(Fig. 16)*. A lingual 1-1 retainer was bonded in the upper arch and a removable retainer with a resin tooth for substitution of the upper right lateral incisor was handed to the patient. Critical evaluation of the implant site revealed a residual shallow vestibular depression causing an unsatisfactory emergence profile *(Fig. 17)*. It was decided to perform a secondary connective tissue graft over the regenerated vestibular bone covering the implant for enhancing the "bombé". Particular attention was given to meticulous mattress suturing with fine ophthalmologic thread for stabilization of the graft and of the coagulum. Immediately after surgery a provisional crown was placed *(Fig. 18)*.

Six weeks after the second surgery, the papillae had practically already fully recovered. The surgical development of the hard and soft-tissue framework had achieved a comparable anatomy to its left counterpart *(Fig. 19)*. After another 4 months the definitive zirconia crown was cemented with an exact 5mm distance between the contact points and the osseous peaks. One year after secondary soft-tissue grafting the papillae have fully recovered and the periodontal conditions appear very stable *(Fig. 20)*. Three years after surgery the overall situation has remained practically unchanged *(Fig 21)*.

Figure 12: The vestibular bony depression requires bone grafting for achieving a natural bombé.

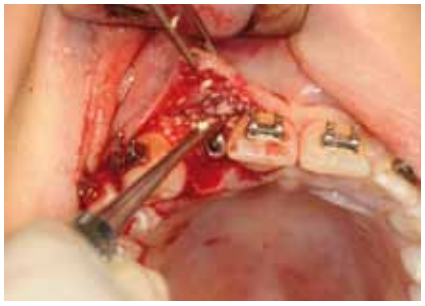


Figure 13: After a palatally orientated insertion of the implant a vestibular bone graft is performed.

Figure 14: The preexisting bony depression has been completely filled up.

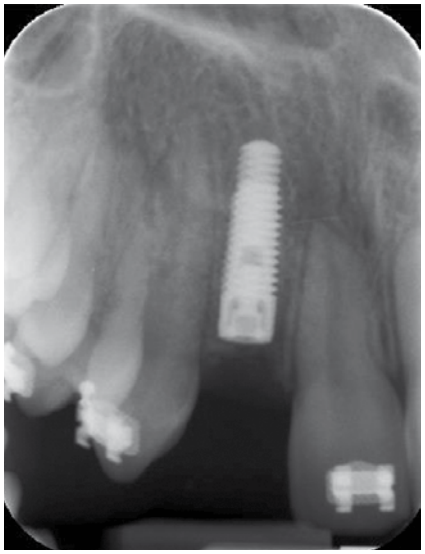


Figure 15: The postoperative periapical radiograph reveals a centered implant position with correct distance to the adjacent teeth.

Figure 16: Immediately after removal of the orthodontic appliance.

Figure 17 (A, B): Despite the bone graft a residual depression is present after the 6 months healing period.

Figure 18 A, B: A connective tissue graft is harvested from the palate and placed over the bone graft to fill up the defect.

Figure 18 C: After meticulous suturing of the flap a provisional resin crown is cemented to allow maturation of the papillae.

Figure 19: 6 weeks after grafting the papillae have nearly fully recovered.

Figure 20 A, B: Complete maturation of the papillae 12 months after soft-tissue grafting. The anatomy of the implant site appears identical to its left counterpart.

Figure 21 A: Excellent overall periodontal stability 3 years after the secondary connective tissue graft.

Figure 21 B: Close-up after 3 years.

CASE PRESENTATION 2

A 20-year old student had already received orthodontic treatment 4 years previously, after which the congenitally missing upper lateral incisors had been substituted with a Maryland bridge. The patient presented with a brachycephalic Class II division 1 skeletal pattern and full Class II occlusal relationships on the right and a 1/2 Class II occlusion on the left side. Due to a mild dentofacial asymmetry a 2mm lower midline deviation to the right side could be evidenced *(Fig. 22, 23, Table 1)*. The patient reported chronic muscle soreness around her right TMJ and frequent episodes of migraine since her former orthodontic treatment. She was not all satisfied with the esthetic treatment outcome and willing to undergo a second therapy. The panoramic x-ray revealed insufficient space opening and unparallel inclination of the adjacent central incisors and canines, which made insertion of implant-supported crowns impossible *(Fig. 24)*.

Figure 22 (A, B): Frontal and lateral profile pre-treatment.

As the patient's major motivation for seeking therapy was a substantial enhancement of both dental and facial esthetics, it was decided to propose a combined orthodontic-orthognathic approach, which included sufficient mesiodistal and parallel space opening for future implants 12 and 22 and a deliberate surgical rotation of the maxillomandibular with bimaxillary surgery for better exposure of the upper anteriors, for lengthening the lower anterior face height and for

Figure 22 (C-G): The patient had already undergone orthodontic treatment. She presented with a Class II malocclusion. The congenitally missing upper lateral incisors have been substituted with a Maryland bridge.

Figure 23: Pre-treatment lateral headfilm and cephalometric analysis.

Figure 24: The pretreatment panoramic x-ray reveals convergence of the upper canine and and of the central incisor roots.

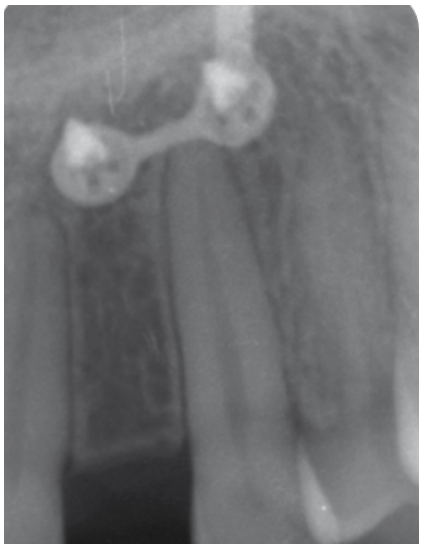
* HORIZONTAL SKELETAL *					
SNA (°)	81.1	82.0	3.5	-0.3	
SNB (°)	76.9	80.0	3.0	-1.0	*
ANB (°)	4.2	2.0	2.4	0.9	
Maxillary Skeletal (A-Na Perp) (mm)	1.6	0.0	3.1	0.5	
Mand. Skeletal (Pg-Na Perp) (mm)	2.3	-4.0	5.3	1.2	*
Wits Appraisal (mm)	3.6	0.0	1.0	3.6	***
* VERTICAL SKELETAL *					
FMA (MP-FH) (°)	9.2	26.0	5.0	-3.4	***
MP - SN (°)	19.7	33.0	6.0	-2.2	**
Palatal-Mand Angle (°)	12.2	28.0	6.0	-2.6	**
Palatal-Occ Plane (PP-OP) (°)	6.5	10.0	4.0	-0.9	
Mand Plane to Occ Plane (°)	5.7	17.4	5.0	-2.3	**
* ANTERIOR DENTAL *					
U-Incisor Protrusion (U1-APo) (mm)	1.6	6.0	2.2	-2.0	**
L1 Protrusion (L1-APo) (mm)	-3.6	2.0	2.3	-2.4	**
U1 - Palatal Plane (°)	109.8	110.0	5.0	-0.0	
U1 - Occ Plane (°)	63.6	57.5	7.0	0.9	
L1 - Occ Plane (°)	76.6	72.0	5.0	0.9	
IMPA (°)	97.8	95.0	7.0	0.4	

Table 1.

correction of her facial asymmetry.
After 17 months of treatment the appliances were removed. Apart from a solid bilateral Class I occlusion, the patient's esthetics had undergone significant enhancement *(Fig. 25)*. Satisfactory mesio-distal space opening and perfect root parallelism was checked with periapical radiographs *(Fig. 26)*. Two implants were placed parallel to the theoretical alveolus of the lateral incisors and close to the palatal cortical bone to counterbalance looming vestibular bone resorption. In order to create sufficient vestibular osseous support and the best possible natural-looking emergence profile over the implant a bone graft was performed. A meticulous suturing technique and immediate placement of provisional crowns respecting the correct 5mm distance between the contact point and the cemento-enamel junction should help tissue maturation and complete filling-in of the developing papillae *(Fig. 27)*.
The orthopantomogram revealed a central and parallel implant position *(Fig. 28)*.




Figures 25 A-E: A solid bilateral Class I occlusion has been achieved and sufficient mesiodistal spaces have been opened. Note the shallow vestibular depressions which need to be grafted to create a natural-looking bony emergence profile over the future implant.

Figures 26 A, B: The periapical radiographs reveal sufficient mesiodistal space and perfect root parallelism.

Figure 27: Two provisional crowns are cemented after careful suturing.

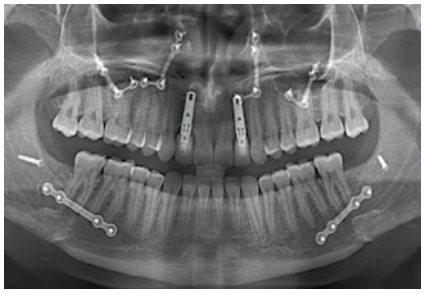


Figure 28: Final panoramic x-ray.



Figures 29 A-D: The intraoral situation after the end of treatment. Note that the implants 12 and 22 have been placed palatally to the theoretical alveolus to counterbalance imminent vestibular bone resorption.

Figure 29 (E, F): The patient's smile and lateral profile after combined orthodontic-orthognathic-implanto-prosthodontic treatment. Surgery by Prof. Mirco Raffaini, Parma/Italy.

Figure 30: Post-treatment lateral headfilm and cephalometric analysis.

Eight months after implant insertion, the patient received the permanent all-ceramic crowns. She was not only very pleased with the esthetic outcome, but reported that her former muscle pain had completely disappeared and that her migraine attacks had become less frequent *(Fig. 29, 30, Tab. 2)*.

Two years after implant placement the close-up photographs reveal excellent overall periodontal stability with natural-looking emergence profiles over the implants *(Fig. 31)*.

* HORIZONTAL SKELETAL *					
SNA (°)	81.1	82.0	3.5	-0.3	
SNB (°)	79.5	80.0	3.0	-0.2	
ANB (°)	1.6	2.0	2.4	-0.2	
Maxillary Skeletal (A-Na Perp) (mm)	3.2	0.0	3.1	1.0	*
Mand. Skeletal (Pg-Na Perp) (mm)	4.7	-4.0	5.3	1.6	*
Wits Appraisal (mm)	-1.3	0.0	1.0	-1.3	*
* VERTICAL SKELETAL *					
FMA (MP-FH) (°)	12.1	26.0	5.0	-2.8	**
MP - SN (°)	24.2	33.0	6.0	-1.5	*
Palatal-Mand Angle (°)	16.9	28.0	6.0	-1.8	*
Palatal-Occ Plane (PP-OP) (°)	8.7	10.0	4.0	-0.3	
Mand Plane to Occ Plane (°)	8.2	17.4	5.0	-1.8	*
* ANTERIOR DENTAL *					
U-Incisor Protrusion (U1-APo) (mm)	3.3	6.0	2.2	-1.2	*
L1 Protrusion (L1-APo) (mm)	0.3	2.0	2.3	-0.7	
U1 - Palatal Plane (°)	109.2	110.0	5.0	-0.2	
U1 - Occ Plane (°)	62.2	57.5	7.0	0.7	
L1 - Occ Plane (°)	77.7	72.0	5.0	1.1	*
IMPA (°)	94.1	95.0	7.0	-0.1	

Table 2.

Figure 31: Close-ups 24 months after implant placement.

CASE PRESENTATION 3

A 25-year-old bank clerk was referred to the office by her new prosthodontist. The patient wanted to improve her smile esthetics with a ceramic veneer on the right upper peg-shaped lateral incisor and a new crown on the implant which substituted her congenitally upper left congenitally missing lateral incisor, but the dentist refused to proceed her without pre-restorative orthodontic correction of her bite *(Fig. 32, 33)*.

She presented with a normodivergent mild Class II skeletal and dental pattern. The upper central incisors were retroclined and the lower anteriors exhibited a 4.5mm crowding. A 5mm overbite was present due to overeruption of the upper and lower incisors, which had caused major incisal wear and enamel fractures. The thin gingiva over the implant appeared greyish and a shallow osseous depression revealed the missing natural root *(Fig. 34)*.

Figure 32: Pre-treatment smile.

Figure 33: Pre-treatment panoramic x-ray.

Figure 34 (A-E): A mild bilateral Class II occlusion is present. The patient complains about the left peg-shaped lateral and the greyish color of the gingiva around the implant-born crown 22.

Pre-restorative orthodontics aimed at

1. creating sufficient torque of the upper incisors and simultaneously opening mesial and distal spaced for the future veneer 12 and the new crown 22,
2. opening of the anterior deep-bite by leveling of the dental arches,
3. harmonization of the gingival contours 13-23 by sequential intrusion/extrusion,
4. alignment of the lower anteriors and
5. correction of the dental Class II relationships *(Fig. 35)*.

After 13 months the appliances were removed, a lower lingual 3-3 retainer was bonded, and an upper removable Essix retainer was handed to the patient *(Fig. 36)*.

As it was not possible to remove the implant 22, her dentist performed a connective tissue graft to improve her thin and translucent periodontal biotype covering the implant. After six months, the definite ceramic veneer 12 and a new all-ceramic crown 22 could be inserted *(Fig. 37)*. Due to perfect leveling of the curves of Spee the fractured edges of the lower incisors could be reconstructed with composite material *(Fig. 38)*.

The photographs show a clear improvement in the periodontal condition around the implant (yet not ideal) and the patient's smile *(Fig. 39)*. 36 months after grafting, the tissues appear healthy and stable *(Fig. 40)*.



Figure 35 (A-E): Opening of mesial and distal spaces for a veneer 12 and a new crown 22 was performed, the arches were aligned and leveled and a bilateral Class I occlusion was achieved.


Figure 36: Immediately after appliance removal.

Figure 37: After gingival grafting of the implant 22 a new crown was cemented and a ceramic veneer was bonded on 12.



Figure 38 (A, B): After complete leveling of the lower curve of Spee the worn incisal edges of the lower incisors were reconstructed with composite material.

Figure 39: A net improvement of the periodontal condition and dental esthetics was achieved.

Figure 40: A close up and the patient's smile 3 years after the end of prosthodontic treatment.

DISCUSSION

The orthodontic literature is full of upsetting reports and negative assessments of the long-term stability of prosthodontic replacement of congenitally missing upper lateral incisors. This has led to the consensus that orthodontic space closure is the first choice leading to "a natural dentition over a long life".[3] But can a dentition which requires six porcelain veneers for optimization of the esthetic result really be considered "natural"?

In the last decade, major advancements both in surgery and in prosthodontics have developed new techniques for achieving great esthetic results of implant-borne crowns in a healthy periodontal environment. It is possible to change an unfavorable thin hard- or soft-tissue framework into a thick and resistant periodontal biotype prior or during implant insertion and by utilizing tooth-colored abutments and all-ceramic crowns the translucency of a natural tooth can be imitated as never before.

Our case presentations are backed up by a recent orthodontic controlled study by Manzotti de Marchi et al. who reported that the long-term periodontal status of patients with congenitally missing lateral incisors who had been treated with orthodontic space closure, and those who had undergone space opening with implant substitution was comparable in the presence of a "thick periodontal biotype" and a minimum 1.5mm distance between the implant and the roots of the adjacent teeth[20]. While the orthodontist is responsible for satisfactory mesiodistal and parallel space-opening, the implantologist must create a favorable thick vestibulopalatal hard- and soft-tissue framework which may require not only bone, but also connective tissue grafting. If these tasks are carefully performed, we will very likely find a much higher percentage of successful long-term outcomes of implant-born restorations for congenitally missing laterals in the future orthodontic literature.

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X-RAY ODDITIES

Many times, when we see in our practice a radiograph, we have the opportunity to note images that may or may not influence directly our diagnosis and our treatment plan.
This feature of EJCO gives us the opportunity to show these images and to make some brief observations about them. The style is concise: the images largely speak for themselves.
Your suggestions for future topics as well as your comments will be very welcome.

The Ghost Bicuspid

- The patient, a 9-year-old girl, was seen in October 2000 for the correction of a Class III malocclusion.
  The OrthoPanTomography (OPT) showed an early mixed dentition with the absence of 35 and 45 *(Fig.1)*.
- Orthodontic treatment started in January 2001 with an upper removable appliance to expand transversally and sagittally the upper arch.
- After two years from the start of treatment a new OPM was made. The image showed surprisingly the presence of the lower second right bicuspid *(Fig. 2)*.
- If you look at the first OPT carefully you will observe the crypt of the bicuspid near the distal root of the second lower right deciduous molar.

OBSERVATIONS

One of the most detailed studies on tooth development and emergence has been carried out by Demirjian evaluating panoramic radiographs. Eight stages in tooth development have been defined ranging from the early mineralization of the crown to completion of root formation[1].
Generally there is a marked symmetry in the emergence times between teeth on the right and left sides, as well as the individual stages of tooth development.
Local and systemic factors can influence tooth development and emergence[2].
Local factors are: extractions of primary teeth, sequelae of caries in primary teeth.
Systemic factors are: genetics, sex, skeletal age, pubertal growth spurt, body weight and height, endocrinological disturbances (hypopituitarism, hypothyroidism, hypoparathiroidism) and nutrition.
From the radiographic point of view the crypt of a non calcified tooth seems a prymary cyst or another isolated radiotransparency[3].

CONCLUSION

There is a great variability of the odontogenic processes also in the same patient and also for the specular teeth.

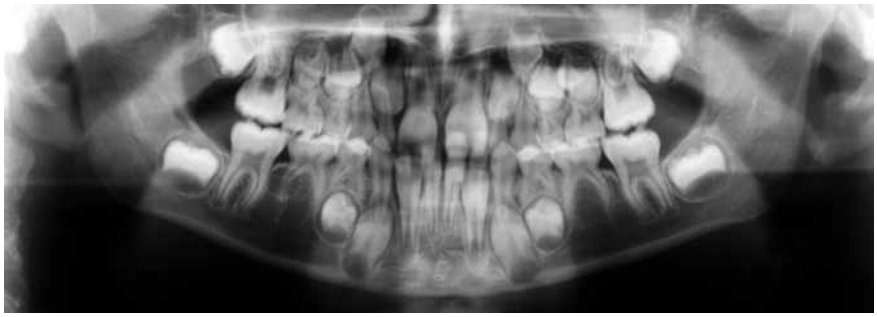

Figure 1: OPT of the patient when she was 9 years old.

Figure 2: OPT of the patient when she was 11 years old.

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Temporo Mandibular Joint (TMJ) Registration device

FOREWORD

An increasing number of orthodontists have recently understood the limitations of traditional orthodontic treatment based on hand-articulated casts and have incorporated the use of diagnostic casts mounted on articulators in centric relation (CR) into their practices in an attempt to assess the component of the malocclusion due to mandibular displacement.

It is generally agreed that a difference exists between the dental arch relationship in centric occlusion (CO) and that in CR. A difference consequently exists between the condyle position in CO and that in CR. This positional difference has been defined "condylar displacement."

MPI (mandibular position indicator) – a synonym of CPI (condylar position indicator) – is a reliable, inexpensive and easy-to-use device for measuring changes in the condylar position on three spatial planes between CO and CR. The method is moreover not at all invasive.

WHAT IS IT?

It is an average value articulator with face-bow and TMJ registrational accessories.

WHAT IS IT FOR?

It can be used as a normal average value articulator. Moreover, inserting the TMJ registrational accessories, it is possible to record, measure and compare the positional changes of the condylar axis between CO and CR.

WHY SHOULD WE USE IT?

Because we can use a simple and precise average value articulator that also provides all the information that we need about the discrepancy between CO and CR in the different space planes. In other words, we can visualize what happens in the TMJ in patients who slide from CR to CO.

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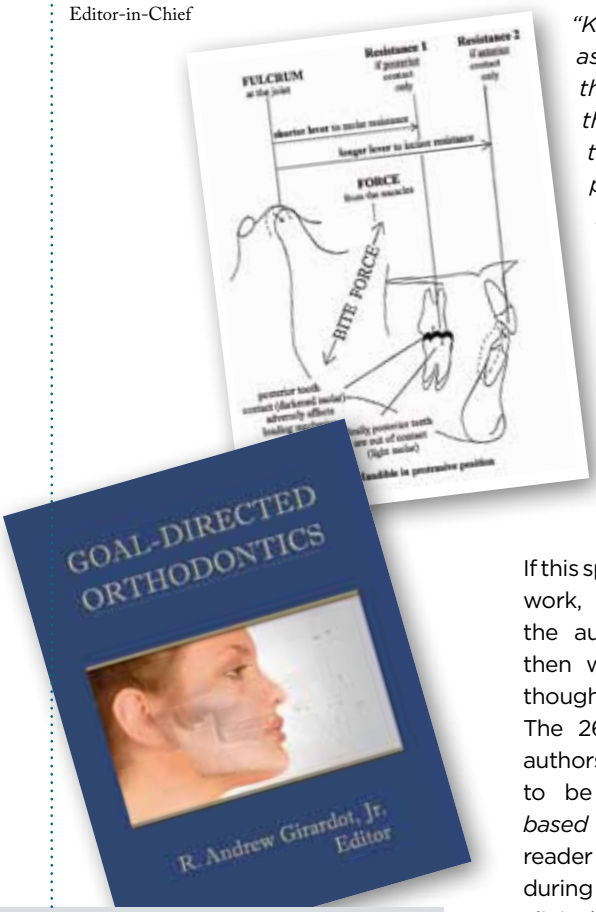
BOOK REVIEW

Goal-directed orthodontics

R. Schiavoni
Editor-in-Chief



"Keep your mind open; always ask why; be willing to learn new things even when it requires that you change some of your thoughts and how you treat patients.".

I would like to quote my former teacher, partner and friend, Dr Roth: "Doctor, it is not about you; it is about the patient".

These are among the final comments in the excellent mixed dentition treatment chapter by Robert E. Williams in the book edited by R. Andrew Girardot Jr. If this spirit, long embodied in Williams's work, informs the contributions of the authors brought together here, then we can expect a well argued, thoughtful and methodical work.

The 26 chapters written by the 24 authors are what I would consider to be good examples of *clinically based research.* The articles guide the reader through the authors' reasoning during diagnosis, treatment planning, clinical treatment, evaluation of results and long term follow up. All are accompanied by a full bibliography.

The book is dedicated to Dr. Ronald H. Roth, whose philosophy, more than any other, has brought particular attention to the significance of the tooth/joint relationship. Two giants in the field of full-mouth reconstruction and occlusion, Charles Stuart and Peter Thomas influenced Roth in his findings. His philosophy is thus based on the basic principles of functional occlusion. The illustrations are in this regard fully exhaustive. He shows, for example how a Class III type lever changes to a Class I type lever in the presence of posterior precontacts (whose absence in protrusion movements is one of the basic goals of the technique). This is very well demonstrated in *fig. 26, pag. 13.*

As R. Andrew Girardot Jr. says in his forward: "*the articulator is a vital tool if one is to recognize and correct the disharmony between the dentition, the musculature, and the temporomandibular joints. To date, the articulator is the only way to differentiate between the vertical and horizontal components of the malocclusion*". In relation to this a good deal of space is given over to the gnathological approach to orthodontic treatment, in the strictest sense of the term. The chapters written in particular by Frank E. Cordray, R. Andrew Girardot jr, Theodore D. Freeland, Stanley Crawford and Ryan K. Tamburrino unequivocally and in detail consider the relationship between occlusion and articular dysfunction.

The references in this field are very numerous and offer the reader much scope for further study in this area if he or she wishes.

Well worthy of particular mention are the chapters penned by Jorge Ayala "Treatment Mechanics", Gonzalo Gutierrez "Class II Treatment with Extractions of Maxillary Bicuspid", Domingo Martin and Renato Cocconi "Extraction for Function and Aesthetics". The visual documentation is excellent, as is the text itself, characterised by methodological rigor, and it would be difficult to find a better example of how to carry out clinically-based research.

Last but not least, there is an extremely interesting chapter on Sleep Disordered Breathing by Joseph Yousefian and Behjat Moghadam. The extensive bibliography on the subject is not especially easy to find.

The work has certainly been awaited and well-received by orthodontists, regardless of their philosophical beliefs. This book provides food for thought on how patients are treated. It is a text that is well worth reading even with - why not ?- a fair critical spirit, that of course has to be constructive, rigorous and intellectually honest. A book for beginners? Certainly not! This is not a book for beginners, but it is a book that beginners must have, absolutely!

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