THE TWEED PROFILE

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IN MEMORIAM
ALAIN DECKER

Alain Decker left us on February 8th 2013 at the age of 67. He leaves behind his wife Marie-Madeleine and four wonderful children: Géraldine, Lionel, Leslie and Jennifer. He graduated from Medical School of Paris in 1970 and continued his dental studies at the Tour d’Auvergne Dental School. As a young graduate, he began his career in Savigny sur Orge in 1970 and specialized in Prosthodontics.

In 1974, he took his first EPGET course under the supervision of Professor RX O’Meyer. In 1977, he became an EPGET instructor with Jean-Pierre Ortial and André Horn.

In 1982, as a specialist in Orthodontics, he established his practice in the Parisian suburb of Savigny sur Orge, with Geneviève Guillaumot, his lifelong friend and partner. He continued practicing orthodontics there until the end of 2012 when he retired from private practice.

He was a member of the European College of Orthodontics (Collège Européen d’Orthodontie). He assumed its presidency from 2003 through 2007. He was chief editor of the Edgewise Journal from 1985 – 2003 when the journal became International Orthodontics with the collaboration of Jean-Pierre Ortial. He remained its publishing director from 2003 through 2007 and continued to be its co-editor with Jean-Pierre Ortial.

In 1979 he began his academic career in Professor Pierre Cousin’s ODF department as a voluntary instructor. He was nominated to be an instructor (Assistant Hospitalo-Universitaire) in 1981 at Paris 5 René Descartes University, where he became Maître de Conférences des Universités. In 1996, he established the first University Diploma in Lingual Orthodontics (Diplôme Universitaire d’Orthodontie Linguale). With the help of Didier Fillion and Gérard Altounian he introduced European orthodontists to this type of technique. During all these years, he organized many courses in edgewise orthodontics for French students at the Tweed Foundation in Tucson. In 2005 he started the inter-university seminars in orthodontics and brought together all the French postgraduate orthodontic students. Alain was a teacher who was respected by all; appreciated by his colleagues; worshiped by his students. Alain was to retire from academia in September 2014.

He had a natural and unequalled charisma. He knew when and how to compassionately use provocation. He always spoke his mind, never afraid to disturb established ideas. He was, as we say, a “shaker and a mover”. He was a man of Art, a man of Heart, a grand sportsman, a rugby player in his youth; he ran many marathons with his wife Marie-Madeleine.

Alain will remain an unforgettable figure in French orthodontics because of his academic commitment and his active participation in shaping the French and the European Scientific Societies.

Robert Garcia
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**Key Point 1:**
Evidence-based Dentistry has a well-defined “Hierarchy of Evidence.” This scheme illustrates the accepted strength of the various study designs, and should be kept in mind when reading the orthodontic literature.

**Key Point 2:**
In the past, we have relied heavily on expert opinion and case reports/case series. These types of evidence are low on the hierarchy of evidence, as results from these studies are highly susceptible to various types of bias.

**Key Point 3:**
Well-designed cohort studies and randomized controlled trials offer much higher levels of evidence. In particular, randomized trials try to ensure that comparisons between experimental groups and controls are valid and unbiased.

**Key Point 4:**
Systematic reviews and Meta-analyses are a valuable resource for busy clinicians. When good evidence is available, they can assist clinicians with treatment decisions.

**Key Point 5:**
There are three components to evidence-based practice – the doctor’s education/experience, the evidence, and the patient’s values and preferences.

**Key Point 6:**
There are many resources for evidence-based information, such as:

- The ADA Center for Evidence-based Dentistry (ebd. ada.org)
- The Cochrane Collaboration (Cochrane.org)
- The AAO Evidence-based Orthodontics Research Database(aaomembers.org/resources/library/sysreviews.cfm)
- Evidence-based dentistry journals and textbooks

**Key Point 7:**
There is a great need for good evidence. Perhaps practice-based networks may be a good setting for orthodontists to conduct multi-site randomized trials.

**Key Point 8:**
Keep an open mind. Evidence for medical and dental topics continues to accrue, and recommendations for specific medical conditions often change or are even reversed. Dentistry, and orthodontics, should not expect to be exempt from changes to treatment guidelines.
Through the annals of time, symmetry, harmony and proportion of the human form have caught the eye of man. These qualities, which are the foundation of the visual interpretation of beauty, give pleasure to the senses. It has evolved thru thirty five thousand years of artistic endeavor. Some of the earliest depictions of human form have been found in pteroglyphs and carvings (Figure 1). All civilizations from the Paleolithic era thru the Renaissance had their own concept of facial beauty (Figure 2). Leonardo and Michelangelo were very influential with their paintings and sculptures as in the Mona Lisa and the David. As evidenced in his notebooks, Da Vinci sought the ideal facial proportions. He defined proportion as the ratio between the respective parts and the whole. From the Renaissance to the present day, art and sculpture have influenced our interpretation of facial beauty and the human form.

While at St. Louis University, Edward Hartley Angle, the founder of our specialty, was strongly influenced by the artist Edmund Wuerpel. Wuerpel told Angle that “the principle consideration is that we shall encourage the thought that we shall become addicted to the observation of esthetic relations”. We, as orthodontists, should be concerned with the concept of facial esthetics because of the influence our treatment has on it. The results of our work can positively or negatively affect self-image, self-confidence and social ability.

**Facial Esthetics – A Perspective**

In order to develop an appreciation for facial esthetics, we must first develop a perspective for it. To us as orthodontists, our focus on the face is concentrated on the dental and the soft tissue aspects. Dentally, we evaluate the teeth and their position in the face. We look at the amount of tooth and or gingival display. We ask ourselves, is the smile “too gummy”? The presence or absence of large buccal corridors quantifies the appearance of the buccal segments within the commissures of the mouth. The smile arc relates the curvature of the upper incisal edges to the lower lip. Anterior dental crowding also effects our perception of the harmony of the face.

Probably more noticeable than the position of the teeth in the mouth is the effect the soft tissue drape has on the shape of the face. In evaluating the soft tissue we must look at the aspects of the profile. Ideally, the face should be divided into thirds.

From the hairline to the brow line, from the brow line to the base of the nose, and from the base of the nose to the bottom of the chin (Figure 3). The upper lip should not be straight. It should have a slight forward cant.
with an inward curl from subnasale to the vermilion border. The lower lip should curve inward from the vermilion border to soft tissue B point and then outward to the roundness of the chin. The face will lose balance if the lower lip is in front of the upper lip. The chin is a key building block. A well proportioned chin is a characteristic of facial beauty and balance. The lips will not be in balance if the chin is too weak or too strong.

These aspects of the facial soft tissue dictate the facial profile. The nose, lips and chin play an integral part. Many lines and angles to measure the soft tissue profiles have been established by our forefathers: Burstone, Steiner, Holdaway, Ricketts, Merrifield, and Kushner to name a few. With this information, we must realize that we cannot reduce something as abstract as a profile to a number, be it from a line or an angle. It needs to be a concept of what is pleasing to the individual observer. So where should the lips be in order for the profile to be considered esthetic? Our interpretation should be predicated on a concept which is not all defining. This concept should have leeway for acceptance by observers with different opinions. In this light then, if we construct a line from subnasale to soft tissue B point and use the E line, we would have a zone in which the lips would fit that might be pleasing to all. This would be identified as the “esthetic zone” (Figure 4).

With this in mind, we must realize that facial esthetics is an abstract impression of what the individual mind interprets as beauty. Because as Plato said almost 2500 years ago, beauty lies in the eye of the beholder.

So, if we ask ourselves, “is facial esthetics a valid treatment concern?,” we must realize that regardless of the magnitude of tooth movement, our treatment impacts facial appearance on a daily basis. If this is so, then it is imperative that we gather data prior to treatment so that we may plan the result. This approach is paramount for a successful treatment outcome. We must plan with the end in mind. A differential diagnosis, which is a systematic method for identifying a problem, is a necessity.

In developing the diagnosis, the components of the face should be evaluated to properly identify the problem. These include the face, the jaws and the teeth. In the face we should be aware of the dental as well as the soft tissue aspects and remember that the profile defines the current state of facial balance. Are the lips in the “esthetic zone”? Is there a problem with jaw alignment and what are the relationships and proportions of the skeletal relationships? Are the teeth crowded and if so, is there an anterior, mid-arch or posterior TSALD? Are the lower incisors positioned properly, is there a curve of spee and/or an occlusal disharmony? In using this information to assess the problem, is there facial imbalance, a skeletal issue, a dental discrepancy or a combination? What are the space requirements (Figure 5) to correct these problems?

Utilizing this information, we must make the decision to maintain or to improve facial balance, coordinate and/or correct the occlusion and eliminate the dental crowding. Are the lips protrusive due to the position of the incisors? Are the jaws favorably aligned and is the height of the face proportional? If there is dental crowding, the dimensions of the dentition have to be considered because there are limits to the magnitude of tooth movement. This movement is limited anteriorly, posteriorly, laterally and vertically by the size of the jaws and the quality of the bone present. Is the face unbalanced due to lip or muscle strain that places the soft tissue out of the esthetic zone? Does the occlusion need a dental or skeletal correction and will the final result have a functional occlusion? Is the crowding located in the anterior, mid-arch or posterior part of the jaw? Will space be needed? If so, how much and where will it come from? Should the patient be treated non-extraction and if so, do we use widgets, expansion or IPR? If extraction is indicated, which extraction sequence will we use? Will the treatment require orthodontics, orthopedics, orthognathics or a combination of all of them?

Clinically, the key goal of the diagnosis is to gather data on which to base these decisions. The information should be used judiciously to develop a workable treatment plan. A visual treatment objective might improve the prediction of
CASE #2
An African-American female presented to Dr. John Bilo-deau as a transfer patient with partial appliances in place. The diagnostic records revealed a dentoalveolar protrusion with edentulous spaces in both arches (Figure 8). After discussing the problem and her desires for soft tissue profile improvement, she was retreated with the extraction of three premolars. Mini-anchors were used for absolute anchorage. The protrusion was reduced and all edentulous spaces were closed. The facial change was evident due to the reduction of the protrusion (Figure 9).

Figure 8. Mulu Pretreatment

Figure 9. Mulu Posttreatment

CASE #3
Patient CW’s chief complaint was her “crooked teeth”. Her diagnostic records revealed 6mm of TSAL and about 6mm of protrusion (Figure 10). Due to the low mandibular plane angle, the crowding and the protrusion and an already pleasing profile, a non-extraction treatment plan utilizing interproximal reduction was selected. The result reveals good tooth and dental arch alignment, a slight reduction in the dental protrusion and no change in the profile (Figure 11).

Figure 10. CW Pretreatment

Figure 11. CW Posttreatment

CASE # 1
Patient SK’s chief complaint was her “crooked teeth” and not being able to “get my front teeth together”. A review of her records showed a total discrepancy of approximately 15mm, which included 5mm of crowding, and 10 mm of cephalometric discrepancy. Skeletally she had an open bite tendency as well (Figure 6). With a history of previous orthodontic treatment and the obvious relapse due to the large discrepancy, an extraction treatment plan was chosen. The results (Figure 7) show nice soft tissue profile improvement into the esthetic zone due to the alignment and retraction of the anterior teeth.

Figure 6. SK Pretreatment

Figure 7. SK Posttreatment
CASE #4
MT demonstrated a severe Class II division dento-skeletal problem. The profile was mandibular retrusive and there was an impinging overbite (Figure 12). Because of the low mandible plane angle, the impinging overbite and the severe skeletal retrusion, non-extraction treatment along with a fixed functional appliance for the skeletal correction was selected. The result (Figure 13) shows good improvement in the chin position and the overall profile as well as good dental correction.

CONCLUSION
“In Man, the lower face serves not only in the interests of digestion, speech and respiration, but it also influences to a large extent the social acceptance and psychological well being of the individual. Appearance, therefore, is one of the primary functions of the face”. Dr. Charles Burstone made this statement in 1958. We must realize that facial appearance must be a mandatory consideration in planning orthodontic treatment.

In recent years there has been much discussion about the idea of evidenced based treatment. It has been touted as the direction of the future of our specialty as well as dentistry overall. It seems to me that there is a multitude of evidence available. Although some may say that it is merely clinical in nature, orthodontics is actually about clinical application of principals that work. It would appear that we are not listening. The direction of the future that I have seen is profit consideration, ease of treatment, marketing efforts, vicious competition and a downright lack of respect for scientific principles. I think that we need to get “back to the future” we had 30 years ago and stick to the basics given to us by clinical evidence. It appears that we have forgotten that orthodontics is both an art and a science. The use of science shows us what is possible and the application of art gives us the end result.
Dr. Merrifield defined the Z-angle as the angle formed by the profile line (a line from the chin to the most procumbent lip) and Frankfort Horizontal. Ideally it should form an angle of 75° - 88° for all races. On Caucasians the profile line should bisect the nose. Some examples of beautiful faces throughout history and their Z-angles:


Nefertiti 1345 B.C.

Ancient Egyptian Statues 1479 B.C.

Aphrodite 2nd Century B.C.
The following records are those of a 12-year-old girl. She had no crowding and a Class I malocclusion with overjet. She was treated non-extraction.

Although an acceptable occlusion was achieved for this patient, upon closer examination one can see that her face got longer, her mandible rotated down and back, and her smile got gummier.

These unfavorable sequellae were the result of lack of vertical control. The cephalometric analysis shows an FMA of 35°, ANB of 7°, FMIA of 48°, and a facial height index of 50.

One should have been able to instantly know what would happen if the patient was treated non-extraction. Although an acceptable occlusion was achieved, facial balance was worsened. The molars erupted. There was extrusion of incisors and clockwise mandibular rotation.
Once the first archwire is inserted into the appliance without proper vertical control, the molars will erupt. This happened to the patient whose records were previously shown. Orthodontists should make the teeth fit the face, not the face fit the teeth.
This patient has crowding and is slightly more cephalometrically challenging than the one whose records were previously shown.
Pretreatment

Posttreatment

4 Years Posttreatment
No Retainers for over years

Deband

4 Years Posttreatment
She was treated with Tweed-Merrifield mechanics and extraction of four first premolars. The mandibular arch was supported with a high-pull J-hook headgear to counteract the intrusive/flaring force to the mandibular incisors and the resultant molar eruption reaction. This force system resulted in a clockwise or forward mandibular response with reduction of gingival display and an improvement in the Z-angle. The upper arch was treated with a T-loop archwire to facilitate incisor intrusion and gingival display reduction. Note that when a Class II relationship is changed to Class I, the patient it continues to grow as a Class I.

Note below the difference in mandibular response between the two patients. The difference is due to vertical control. In the non-extraction patient vertical control was impossible. In the extraction patient vertical control was enhanced with high pull headgear to both arches.
**T-loop Mechanics**

Incisor intrusion with T-loops is an augmentation of traditional incisor intrusion methods, especially for the low angle patient and for the less than ideal cooperator. It is absolutely imperative that it be done with stainless steel archwires to give the resilience needed to control anchorage and vertical dimension. The high-pull J-hook headgear’s importance as an auxiliary increases in proportion to the increase in the degrees of FMA. When the FMA is 25° or higher, it is essential. In patients who have an FMA greater than 30°, one must be very careful with T-loop use in order to control the canine and occlusal plane as well as the molars.

If the space between the canines and lateral incisors is greater than 3.5 mm, it is best to place the headgear to soldered hooks between the central and lateral incisors. Once the space is less than 3.5mm, it is usually advisable to place the headgear mesial to the canines (which are ligated with wire ties from the distal to prevent rotation) to prevent canine extrusion and tipping reaction from the incisor intrusion on the T-loops. The high-pull J-hook headgear should deliver 14 -18 oz (400 – 500 g.) of force per side.
This will Increase the Amount of Incisor Intrusion

Maintains the Central Intrusion and Intrude the Laterals

Control Posterior Vertical

Step –up and Tip Canine to Counter Reaction

Always Check the 3rd Order Before Tying In
The following patient's records illustrate the efficacy of T-loop use in conjunction with Tweed-Merrifield mechanics.
A .020 x .025 stainless steel T-loop archwire is an excellent adjunct for correcting overbite. As the FMA increases, the need for support with the high pull j-hook headgear increases proportionally. The T-loop utilizes a 10-2 system in that it intrudes the centrals, then the laterals, then the canines. It is a sequential system that has been quite effective in my practice over the last 30 years.

However, one must be very careful when using it and pay very close attention to the canine reaction. If the canines begin to extrude or tip, a compensation 2nd order bend with at least a 7° distal root tip, must be made distal to the canine. Once the canine has been stabilized in a good position, the 10-2 system of incisor intrusion can be reinstated, first intruding the centrals and the mesial of the laterals (thus creating distal root tip), then stepping up the T-loop and flattening the curve to intrude the laterals.

A word of caution – preformed T-loop archwires are ineffective because they are incorrectly formed and the location of the T-loops is not precise. Orthopli makes a T-loop plier that you can order if you mention my name. (I receive no royalties). If you are interested in the construction of the T-loop, e-mail me (bob@stonerortho.com) and I will send you a PDF on how to construct the T-loop archwire with the T-loop plier.
It is a well established fact that increases in dental arch width during orthodontic treatment tend to return toward pretreatment values during and after retention. However, changes in arch width inevitably occur during and after orthodontic treatment as a result of growth or treatment. In this literature review the historical background of maintenance of arch width is studied and some consequences of changing of arch width during treatment are also discussed.

**MAINTENANCE OF ARCH WIDTH DURING ORTHODONTIC TREATMENT**

In the middle 1920s, the apical base school formed around the writings of Axel Lundström who suggested that the apical base was one of the most important factors in the correction of malocclusion and maintenance of a correct occlusion. Nance noted that “if a stable result is to be attained, mandibular teeth must be positioned properly in relation to basal bone.” McCauley made the following statement, “since these two mandibular dimensions, molar width and cuspid width, are of such an uncompromising nature, one might establish them as fixed quantities and build the arches around them.” After measuring a large number of cases, including successes and failures, Strang drew certain conclusions and said, “Stable results can only be gained when the width of the mandibular denture in the canine and molar areas is maintained inviolate.”

The ‘lateral limit’ is referred to as one of four basic premises defined by Merrifield’s ‘diagnostic concept of dimensions of the dentition’. Vaden said, “lateral expansion works if you believe in permanent retention.” and “the dentitions that exhibited the most relapse are, in most instances, the ones that have undergone the most mandibular canine expansion.”

**COMPARISONS OF THE ARCH WIDTH CHANGES BETWEEN EXTRACTION AND NON-EXTRACTION TREATMENT**

Motivated by a question that concerned the possibilities of dental arch expansion and the maintenance of such expansion, Walter investigated 50 non-extraction cases and 50 extraction cases. Intercanine width and intermolar width were measured before treatment, following completion of active treatment, and at least one year following removal of retainers. In 31 or 62% of the non-extraction cases, an increase of 2.0 mm of intercanine width was obtained and maintained. And in the extraction cases 31 or 62% showed an increase of 1.4 mm of intercanine width which was also obtained and maintained. In 36 or 72% of the cases in the non-extraction group an average increase of 1.8 mm was obtained and maintained in intermolar widths. Conversely, in the extraction sample intermolar widths, 35 or 70% of the cases demonstrated a contraction or decrease of 2.9mm. Overall, the intercanine distances behaved the same in the non-extraction and extraction cases: the intermolar distances of the non-extraction cases tended to increase and those of the extraction cases to decrease.

Bishara et al. evaluated treatment and posttreatment changes in the dental arches of patients with Class II, division 1 malocclusions. Half the patients (N=46) were treated with a non-extraction approach; treatment
for the other half (N=45) included the extraction of four first premolars. Arch parameters were measured pretreatment, immediately following treatment and at least 2 years posttreatment. In both the extraction and non-extraction groups there was a tendency for an increase in mandibular intercanine widths during treatment with a decrease observed posttreatment. Mandibular intermolar width changes were significantly different between the extraction and non-extraction groups with the extraction group showing a decrease in width during and following treatment. In the non-extraction group width increased during the same periods.

While some advocates of non-extraction therapy criticize extraction treatment and maintain that it results in narrower dental arches. Gianelly published a comparative study on changes in arch widths. Arch widths of 25 patients treated with four first-premolar extraction and 25 patients treated without extractions were measured and compared. At the start of treatment, the mandibular intercanine and intermolar widths of both groups did not differ statistically. At the end of treatment, the arch widths of both groups were also statistically similar with one exception; the average mandibular intercanine dimension was 0.94 mm larger in the extraction sample than in the non-extraction subjects. This indicates that extraction treatment does not result in narrower dental arches than does non-extraction treatment and an esthetically compromising effect of narrow dental arches on a smile is not a systematic outcome of extraction treatment.

**Long-term Stability after Non-extraction Treatment**

Sadowsky et al. examined a sample of 22 treated patients to evaluate long-term stability. All patients were treated non-extraction with fixed edgewise appliances and were without retainers a minimum of 5 years. The average retention time with a mandibular fixed lingual retainer was 8.4 years. The majority of the patients were initially treated with tandem mechanics that involved cervical headgear combined with light Class III elastics to move both upper and lower arches distally. During treatment, the maxillary and mandibular dental arches were notably expanded in a transverse dimension. All variables showed posttreatment relapse except for the expanded maxillary canine and premolars. For example, mandibular canines lost 50% of the expansion achieved during treatment. However, the mandibular anterior segment demonstrated relatively good alignment at the long-term stage, which may be a reflection of prolonged mandibular retention.

Glenn et al. evaluated 28 non-extraction patients at an average of almost 8 years postretention. The treatment technique incorporated some basic Tweed philosophy and cervical headgear was used in the majority of the patients. Sixty-eight percent of the patients showed increases in intercanine width with treatment. At postretention 89% of the patients showed some constriction of their intercanine widths. Intermolar width was increased in 71% of the patients during treatment and decreased in 60% of patients postretention. Overall, the impression gained from the data was of considerable long-term stability for the majority of the evaluated parameters. The relapse patterns seen were similar in nature, but intermediate in extent, between untreated normals and four first premolar extraction patients.

The long-term stability of Class II, division 1 non-extraction therapy was evaluated by Elms et al. All 42 subjects were treated with full fixed appliances and cervical pull face-bows. The pretreatment, posttreatment, and postretention records were taken at 11.5, 14.5 and 23.1 years, respectively. Mandibular and maxillary arch widths were increased significantly during treatment. Mandibular intercanine width decreased 0.3 mm during the postretention period and the remaining width measures increased or remained stable; the treatment changes showed little or no relapse. In conclusion, most of the posttreatment changes observed were expected as a result of normal growth changes.

**Long-term Stability after Premolar Extraction Treatment**

Boley et al. evaluated 32 Class I, four premolar extraction patients who had been out of retention a minimum of 5 years (mean, 11.7) and who were treated by one specialist. During treatment, maxillary and mandibular intercanine widths increased 1.0 and 1.7 mm, respectively; maxillary
and mandibular intermolar widths decreased 1.7 and 2.1 mm, respectively. Whereas maxillary widths remained unchanged over the postretention period, mandibular intercanine width decreased 1.4 mm. Mandibular incisor irregularity was reduced 5.3 mm during treatment and increased only 0.7 mm during the postretention period. Based on this study, the following conclusions can be drawn; satisfactory long-term results can be achieved for most Class I, four premolar extraction patients for whom evidence based treatment objectives including minimal alteration of the mandibular arch form and the retraction and uprighting or maintenance of mandibular incisors in their original position have been met.

An article by Vaden et al. quantified changes in tooth relationships in a series of cases (N=36) at 6 years and again at 15 years after treatment. All patients were treated with the extraction of first premolars, second premolars, or a combination of first and second premolars after a careful differential diagnosis. All patients were treated in adolescence by one clinician with an edgewise appliance. During treatment, maxillary and mandibular intercanine width was expanded slightly, more in the mandible than the maxilla. After treatment, most of the modest expansion in the maxilla remained, but half the canine expansion in the mandible was lost (Fig. 1). Fig. 2 compares the average changes in mandibular intercanine width during and after treatment reported in the literature, with the changes found in the studied sample. Arch widths in the buccal segment (5-5 and 6-6) decreased significantly during treatment, more

so in the premolar than the molar region and more so in the mandible than in the maxilla. All four of the arch widths continued to decrease through the first recall examination and the second recall period. Overall, the rate of change in variables decreased with time, supporting the contention that most “relapse” occurs soon after treatment; continued change generally cannot be distinguished from normal aging processes. This study was followed by a new study, where Dyer et al. examined records of 52 American women an average of 24 years after active treatment. Forty percent of participants had participated in a previous study. Mandibular intercanine width increased significantly, from an average of 30.3 to 32.5 mm, during treatment and subsequently decreased to a significant extent (1.2 mm) during the posttreatment to recall period. Maxillary intercanine width significantly increased by an average of 1.7 mm during treatment and decreased significantly by 0.7 mm during the posttreatment period. Interpmolar widths in both arches decreased significantly by 0.7 mm each during posttreatment interval. Intermolar widths in both arches significantly decreased during treatment, by 1.3 and 2.2 mm, but changed little during posttreatment period. Mandibular incisor irregularity at recall was less than 3.5 mm in 77% of the patients and correction of the maxillary incisor irregularity remained relatively stable over the time interval. Buccal segment Class II correction remained stable at the recall examination. It can be concluded that orthodontic treatment can yield reasonably good long term stability in both occlusal correction and

![Fig. 1. Graphs of changes in arch dimensions. (Vaden, Harris, and Gardner. Relapse revisited. Am J Orthod Dentofacial Orthop 1997;111:543-53)](image1)

![Fig. 2. Plot of changes in mandibular intercanine widths of orthodontically treated cases. (Vaden, Harris, and Gardner. Relapse revisited. Am J Orthod Dentofacial Orthop 1997;111:543-53)](image2)
Tooth alignment. Long term stability of a malocclusion correction is an achievable goal.

**Conclusions**

The articles confirm some common findings. For mean changes in arch width from each study, refer to Table I and II.

1. In both extraction and non-extraction patients, mandibular intercanine width increases during treatment and decreases posttreatment.
2. Mandibular intermolar width changes are different between the extraction and non-extraction groups during treatment; the width decreases in the extraction group and increases in the non-extraction group.
3. Maxillary intercanine width increases during treatment in both the extraction and non-extraction cases.
4. Maxillary intermolar width changes differently between the extraction and non-extraction groups during treatment; the width decreases in the extraction group and increases in the non-extraction group.
5. In various studies of non-extraction treatment with distal movement of one or both arches, overall long-term stability was achieved. According to the articles, proper mechanics is required and providing prolonged retention is suggested.
6. When evaluating premolar extraction treatment, long-term stability turned out to be successfully achieved even after the significant decrease in arch width in the premolar and molar regions and the subsequent decrease in intercanine width posttreatment. The success is due to evidence based treatment objectives and the clinicians’ diagnostic and treatment ability.

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Table II. Mean changes (mm) in intercanine and intermolar width in the maxilla

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<th>T3-T1</th>
<th>T2-T1</th>
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REFERENCES
ENRICO ALBERTINI
REGGIO EMILIA, ITALY

ABSTRACT
Objective: the aim of this study was to evaluate skeletal and dento-alveolar effects of RME on permanent and on deciduous teeth by means of volumetric tomography.

Materials and Methods: The sample included 12 patients with transverse maxillary hypoplasia (6 treated with RME on permanent first molars, 6 treated with RME on deciduous second molars) in the mixed dentition. Beginning and post-expansion CBCTs were compared to analyze skeletal and dento-alveolar effects of the two devices.

Results: RME treatment significantly increased palatal volume in both groups (10.78% for RME on permanent teeth and 9.89% for RME on deciduous teeth). Intermolar width increased for both skeletal and dental measurements. Greater maxillary first molar tipping was observed on first permanent molars when RME was anchored on deciduous teeth than when anchored on permanent teeth (4.02° vs 2.13°). Mandibular molar decompensation was higher in patients treated with RME on permanent teeth than on deciduous teeth (4.58° vs 1.71°).

Conclusions: RME treatment significantly increased palatal volume. RME anchored on permanent teeth determined a higher dental intermolar width variation and significant difference in mandibular molar decompensation. RME anchored on deciduous teeth was more effective in increasing skeletal intermolar width and had more effect on molar inclination.

INTRODUCTION
Rapid maxillary expansion (RME) is the most common treatment employed for the correction of transverse maxillary hypoplasia. Many studies have demonstrated its benefits in terms of posterior crossbite resolution, breathing improvement, arch length increase and impacts on permanent teeth retention. Side effects of maxillary expansion include downward displacement of the maxilla, dental extrusion, lateral rotation of the maxillary segment, opening of the bite, gingival recession and nasal width increase. Dental tipping also occurs during maxillary expansion and leads to subsequent alveolar bone changes.

Orthopedic maxillary expansion is the result of skeletal (173 sutural openings), dental (tipping), and alveolar (bending and remodelling) changes. As a child matures, more force is required, less skeletal expansion and more dental tipping occur. In his study, Krebs demonstrates that children have 50% skeletal and 50% dental expansion, whereas the adolescent showed 35% skeletal and 65% dental expansion.

Many studies have shown the effectiveness of maxillary expansion both on skeletal and dental structures. Prior research utilized dental casts, two-
dimensional lateral and posteroanterior cephalograms, and occlusal radiographs to assess the effects of RME. Although these studies were able to highlight changes with bidimensional measures, a tridimensional evaluation of the dento-skeletal changes is needed.

The diffusion in clinical orthodontic practice of the employment of cone beam computed tomography (CBCT) has led to the development of several studies aimed at evaluating the RME effects in a tridimensional view. During the last few years, the author investigated variations in oropharyngeal airway volume, suture opening, skeletal and dentoalveolar expansion components, radicular resorption, airway and breathing, comparison between Haas and Hyrax devices and variation of palatal volume.

The aim of this study was to assess the dentoalveolar and skeletal effects by means of CBCT of an RME appliance anchored either on permanent or on deciduous teeth.

**MATERIALS AND METHODS**

A sample of 53 patients actively treated in the School of Specialization in Orthodontics (University of Ferrara, Italy) for the correction of transverse maxillary hypoplasia was submitted to the following inclusion criteria: unique treatment with RME, mixed dentition phase and pre-treatment CBCT availability (T0). Patients respondent to the following criteria were excluded: treatment with other appliances, attendance of “dental anomalies”, presence of hereditary syndromes. The final sample was made up of 12 patients, 6 treated with RME on deciduous second molars (4 males, 9 females; average 9 years 4 months), 6 treated with RME on permanent first molars (1 male, 3 females; average 10 years 1 month).

The CBCTs were repeated after an interval of 10 months (T1): this time interval was chosen after considering the extent of the active and passive phases of rapid maxillary expansion (9 months of retention).

The Hyrax type “New REP” was cemented on maxillary deciduous second molars or on permanent first molars depending on the availability of root support. Whenever possible, it was anchored on deciduous second molars in order to avoid side effects on permanent teeth and to minimize dental effects on transverse correction. (Fig. 1 - Fig. 2)

The expansion protocol included 1 activation per day (0.2mm) until the achievement of a slight overcorrection, with maxillary palatal cusps in contact with mandibular vestibular cusps (meantime of 4 weeks).
The “New REP” was retained for 9 months in order to ensure some bone formation.

NewTom 3G VGI with an effective dose of 50.2 ml Sievert\textsuperscript{28,26} was employed to obtain a scan. The settings were the following: field of view, 12 in; 110 kV (AP-LL); 2.00 mA (AP) and 1.00 mA (LL); exposure time, 5.4 seconds and section thickness, 0.50 mm. The volumetric data was imported in the NewTom 3G software and converted in the DICOM format. The software Osirix (v.3.9.1) was used to perform linear and bidimensional measures (followed by a volumetric reconstruction).

All measures were classified as volumetric, skeletal or dental.

**Volumetric Measures**

- Palatal volume: creation of areas on coronal slicing, using the CEJ as the vertical reference and the PNS as the posterior one. Osirix Software calculated the palatal volume with the aid of a mathematic algorithm (Fig. 3- Fig. 4)

- Space volume between mandibular first molars (volumetric evaluation of inferior molar decomposition): creation of areas on 5 consecutive slices between mandibular first molars using lingual dental surfaces and mandibular inner cortical bone as references. Osirix Software computed the volume with the aid of a mathematic algorithm (Fig. 5- Fig. 6)

**Skeletal Measures**

- Transverse skeletal diameter measured on axial slices at canine (apex) and molar (mesiovestibular root apex) level until the end of buccal cortical bone (Fig. 7- Fig. 8)
- Mandibular alveolar bone thickness: measured both at apex and furcation height as the distance between the external cortical bone and the inner one (Fig. 9)
- ANS-PNS: distance between anterior and posterior nasal spine measured on sagittal slices (Fig. 10)
**DENTAL MEASURES:**

- Palatal vault height: measured on sagittal slices using as a reference a line passing through the central incisor CEJ and parallel to the bispinal plane (Fig. 11)

- Maxillary first molar inclination with respect to the nasal base horizontal plane (Fig. 12)

- Mandibular first molar inclination with respect to the nasal base horizontal plane (Fig. 13)
- Intercanine diameter: measured on axial slices at apex and crown tip height (Fig. 14- Fig. 15)
- Intermolar diameter: measured on axial slices at palatal root apex and crown height (center of palatal surface) (Fig. 16- Fig. 17)
- Maxillary right central incisor-PNS (projection): measured on sagittal slices at apex, CEJ and margin height (Fig. 18)
- Maxillary right molar-PNS (projection): measured on sagittal slices at distovestibular root apex, CEJ and distal cusp height (Fig. 19)

**Statistical Analysis**

Data was examined with SPSS v.18.0 software (Chicago, Illinois, USA). Statistical analysis was carried out with U Mann-Whitney test for the two unrelated group comparison. T-test for paired data was used for the comparison of pre and post treatment values. Significance level was set at 0.05.
RESULTS

VOLUMETRIC MEASURES
Palatal volume increased between T1 and T2 from 9.35 cm³ to 10.48 cm³ (10.78%) for group I and from 9.38 cm³ to 10.41 cm³ (9.89%) for group II. Airway space volume included between lower first molars perceived a reduction from 1.57 cm³ to 1.30 cm³ (-17.19%) for group I and from 1.84 cm³ to 1.33 cm³ (-27.71%) for group II.

SKELETAL MEASURES
Transverse skeletal diameter at the canine increased from 3.59 cm to 3.66 cm for group I and from 3.82 cm to 3.87 cm for group II. Transverse skeletal diameter at the molar increased from 5.77 cm to 5.80 cm for group I and from 5.17 cm to 5.73 cm for group II.

A decrease was recorded in mandibular alveolar bone thickness: 1.46 cm - 1.40 cm (-1.0%) on average for group I and 1.34 cm - 1.28 cm (-1.0%) on average for group II.

Measures on sagittal slices revealed an increase in the distance ANS-PNS equal to 0.09 cm (5.04 cm - 5.13 cm) for group I and equal to 0.17 cm (4.64 cm - 4.81 cm) for group II. Palatal vault height increased by 0.07 cm (1.40 cm-1.47 cm) for group I and by 0.09 cm (1.82 cm-1.91 cm).

DENTAL MEASURES
Inclination of maxillary first molars increased to 2.13° (93.42° - 95.55°) on average for group I, 4.02° (104.06° - 108.08°) on average for group II.

Mandibular first molars showed a reduction of 4.58° (100.38° - 95.78°) on average in group I, 1.77° (101.99° - 100.29°) on average in group II.

Intercanine diameter at the apex showed an increase of 0.13 cm (2.48 cm – 2.61 cm) for group I and 0.10 cm (2.82 cm – 2.93 cm) for group II. At tip variation was 0.36 cm (2.92 cm – 3.28 cm) for group I and 0.07 cm (2.81 cm - 2.89 cm) for group II.

Intermolar diameter measured at the apex showed an increase of 0.40 cm (3.04 cm - 3.44 cm) for group I and 0.09 cm (3.08 cm - 3.17 cm) for group II. At the crown variation was 0.40 cm (3.20 cm - 3.60 cm) for group I and 0.25 cm (3.30 cm - 3.54 cm).

Sagittally, the distance between maxillary right central incisor and PNS showed a variation of 0.05 cm (4.10 cm - 4.15 cm), 0.00 cm (4.20 cm - 4.20 cm), -0.03 cm (4.79 cm - 4.77 cm) respectively for apex, CEJ and crown for group I and 0.16 cm (3.59 cm - 3.76 cm), 0.31 cm (3.67 cm - 3.98 cm) and 0.43 cm (4.24 cm - 4.67 cm) for group II.

DISCUSSION
The aim of this research was to evaluate the tridimensional effects of RME when employed for transverse maxillary deficiency correction; in particular, a comparison of the effects of RME on permanent and RME on deciduous teeth was done. The employment of CBCTs allowed analysis of volumetric, skeletal and dento-alveolar parameters.

The applicability of CBCTs in orthodontics has been limited by high costs, the long attainment time (MRI) and the high radiation dose. Nevertheless, in the last few years, CBCT images are becoming more and more common in clinical practice because of their ability to visualize pathologies in three dimensions and their evolution in terms of cost, access and decreased overall effective absorbed doses of radiation.

The accuracy of linear and volumetric measurements obtained by CBCT have been tested by many authors, such as Mischkowski et al., who used gutta-percha markers and concluded that the CBCT device provides satisfactory information about linear distances, and Lagravere et al., who used titanium markers with a hollow cone on a synthetic mandible and concluded that volumetric renderings from the CBCT device produce a 1:1 image-to-reality ratio.
The second CBCT was repeated 10 months after the insertion of the two appliances; this interval was chosen by estimating 1 month for the activation and 9 months for the stabilization of the RME. Some variations should be imputed to the growth during this period, although the extent is assessable as non-significant. The type of expander employed was a Veltri “New REP” without palatal arms to be able to examine skeletal effects and to avoid distortions on results determined by tipping action on adjacent teeth.

In the studied interval a significant palatal volume increase was achieved in both groups; when RME was anchored on permanent teeth a slightly higher variation was recorded (10.78% vs 9.89% on average).

Mandibular molar decompensation phenomenon following the transverse maxillary expansion was first investigated by Lima et al. by means of plaster model measurements. Until now, to our knowledge, no one has investigated mandibular molar decompensation by means of volumetric tomography.

In a recent study that used CBCTs, Kartalian et al. noticed a buccal dento-alveolar tipping of 5.6° following RME treatment: since buccal teeth inclination was unchanged between pre and post treatment (<1° variation), the authors concluded that this effect was determined only by an alveolar bending.

According to Kartalian, it is possible to conclude that the greater tipping found in both groups is due to alveolar bending created by RME action, as a consequence of higher resistance in the sphenoid and zigomatic bones.

The results of the studies of the two groups confirm Kartalian’s and Wertz’s theories: maxillary molar inclination increased more in group II (RME anchored on deciduous teeth, 6 patients) compared to group I (RME anchored on permanent teeth, 6 patients). A variation of 4.02° and 2.13° was recorded (on average between 16 and 26). Since in group II first molars were not RME anchorage units, the increase registered was due to 4.02° of alveolar bending.

The expansion obtained at the canine cusp level might be linked to physiologic canine straightening during eruption, following the ‘ugly duckling’ phase. As shown by Broadbent’s studies, the canine eruption route on the frontal plane follows a common theme with an initial mesialization of the cusp associated with an increase in inclination (with the maximum value at 9 years), followed by a second eruption phase characterized by a gradual straightening of the canine, which will come out with an axial inclination of about 0°.

There is no agreement in the scientific literature about rapid maxillary expansion effects with respect to palatal height. Linder-Aronson and Lindgren, using plaster model measurements, detected a significant increase on palatal vault height. But recent Gohl research performed by CBCTs showed no difference in palatal vault height, attributing the variation obtained in the previous study to soft tissue stretching caused by expansion.

In the present study, although the method was the same as Gohl’s, a variation was recorded with an enhancement of 0.07 cm for group I and 0.09 cm for group II. We can conclude that RME has a minimal influence on palatal vault height. More research is anticipated.

**Conclusions**

In the present study RME treatment of 10 months significantly increased palatal volume in both groups. It also created a statistically significant intermolar diameter increase that is desired for posterior crossbite resolution: specifically, RME anchored on deciduous teeth achieved a greater intermolar skeletal transverse variation, while RME anchored on permanent teeth produced a greater intermolar dental variation. Maxillary molar buccal tipping increased in both groups, but it was greater when RME was anchored on deciduous teeth due to the alveolar bending effect. Mandibular molar decompensation was more effective when RME was anchored on permanent teeth.
REFERENCES


**SIMPLIFIED TAD MECHANICS FOR MOLAR UPRIGHTING**

**Nicola Derton**  
Conegliano, Italy

**INTRODUCTION**

Preprosthetic orthodontic treatment plays a fundamental role for adult malocclusion correction. Mandibular molar uprighting is a huge help to both the surgeon and the prosthodontist because it creates ideal conditions for prosthetic rehabilitation of edentulous areas. Conventional orthodontic appliances, when used traditionally, can present some problems that are detrimental to the malocclusion correction. These problems can include: molar extrusion, undesirable movements of an anchorage unit, a need for extended appliance wear, the need for auxiliary devices and/or a long treatment time. During the last several years, skeletal anchorage miniscrews have proved to be a reliable, efficient, and simple adjunct to any biomechanical system. The aim of this paper is to illustrate, by means of a case report, the guidelines for a simplified TAD approach to molar uprighting for prosthetic rehabilitation prior to restoration.

**CASE REPORT**

An adult woman presented with a Class I malocclusion and several missing teeth. (Figs. 1, 2, 3) The mandibular right second molar exhibited mesial inclination. After consultation with the prosthodontist, the plan that was developed was to insert two implants in the mandibular left quadrant and one implant in the mandibular right quadrant. Prior to implant insertion in the mandibular right quadrant, the mesioangular inclination of the mandibular right second molar had to be corrected. (Figs. 4, 5) Because of insufficient bony support, the orthodontic treatment plan called for TAD anchorage in order to simplify the mechanics. To accomplish molar uprighting, a 1.5 mm x 9 mm miniscrew (Spider C2HDC, Sarcedo Italy) was inserted distal to the mandibular second molar and a metal button was bonded to the mesial surface of the molar. The force from the TAD to the inclined tooth was accomplished with an elastic chain. (Figs. 6, 7) To enhance the stability of the TAD, it was inserted in an outer oblique line to the retromolar area where thicker cortical bone can be easily found. The TAD was screwed deep into the bone in order to develop a vertical force vector system that would result in an intrusive effect on the molar. (The head of the TAD was more cervical than the application point on the tooth.)
**DISCUSSION**
The described clinical approach allowed the mesially inclined mandibular molar to be uprighted in 19 weeks. Proper space was created for the prosthetic rehabilitation of the edentulous area. (Fig. 8, 9, 10, 11, 12, 13 and 14) This TAD based mechanics approach has proved to be an efficient method that allows the clinician to avoid undesirable effects which can occur with conventional orthodontic appliances. No extrusion of the mandibular molar occurred because of the intrusive moment created by the miniscrew and the position of the button that was bonded to the mesial surface of the molar.

**CONCLUSION**
This case report illustrates the rational use of a TAD to simplify orthodontic mechanics, reduce treatment time and allow the clinician to reach a predictable and proper outcome. The result that was obtained can be achieved routinely without the risks of undesired tooth movements.

**REFERENCES**
**THE TWEED MERRIFIELD “SYSTEM” – INFORMATION IS IMPORTANT!**

KOHO HASE
YOKODAI KAZO SAITAMA JAPAN
E-MAIL: TORAHASE@YAHOO.CO.JP

**INTRODUCTION**
Since 1940, the Tweed technique, and later, the Tweed Merrifield force system, has been presented to the public through various meetings and programs. At the same time many other orthodontic techniques have been presented. Tweed Merrifield orthodontic treatment has been provided to patients in Japan for 17 years by the author. Satisfactory results have been achieved for most patients. Before and after facial photographs, lateral cephalometric X-rays and plaster casts have all played important roles in assessing the success of Tweed Merrifield technique. But mere illustrations of Tweed orthodontic treatment results do not provide enough information to patients who want to compare the Tweed Merrifield approach to other orthodontic techniques. Dr. Tweed’s concept of creating balance of the dentition and a beautiful facial profile has been called into question by some who espouse other techniques.

More recently, there have been several turning points that have proved to be positive for spreading knowledge to patients about the Tweed Merrifield technique.

- Data/results from treated patients who were treated with the Tweed Merrifield method (Hase Dental Clinic) show the positive effects of the chin’s response to the treatment.
- Visual display of the lateral cephalometric superimposition of the jaw movement (clockwise or counterclockwise) is a positive development.
- Showcasing images of those who have obtained improved facial profiles via a computer predicted personal image profile picture is very well received by patients.
- Orthodontic movie illustrations are good tools that can be used to educate patients.

**MATERIALS AND METHODS**
Ninety two Angle’s Class I and II patients (46 in each sample) were examined. Lateral cephalograms and study casts were analyzed and measured. The cephalograms were taken either by traditional means and/or by digital radiography; the digitized images were created through use of the soft Google Sketchup 8 application provided free-of-charge on the Google website.

Of 33 Tweed Merrifield treated patients, three or four have been randomly selected to be presented at past biennial Tweed meetings and at our annual Japanese Tweed meeting. These patient records were also used to survey the relationship of the lower lip to the esthetic line (E-line). Fig 1 Adobe Photoshop 7 was used to superimpose the before and after cephalometric images. The anima-
The fear of teeth extraction and application of high-pull headgear can be avoided.

Fig. 2

The average changes to the lip and chin position were measured on the 33 Tweed Merrifield treated patients. Fig 3,4 To work out the simulation of the improved facial profile, Photo Shop 7 and its Rectangular Marquee tool & Smudge tool were used to compose the predicted image pictures. Fig 5,6

Pictures for the movies were taken with the Nikon D-70 camera and the movie source was the Sony Video camera Nex-VG20H. Video movies were made and edited using Adobe Premiere Pro CS5.
**RESULTS**

The average pretreatment values of the 92 malocclusions, both Class I and II were: FMIA 50.41°, FMA 33.73°, IMPA 95.61°. Following Tweed Merrifield treatment, the average values had improved to the following measurements: FMIA 58.36, FMA 33.99, IMPA 87.71. Table 1

Before treatment, the average value of the lower lip to E-line was 5.2mm (SD 2.8mm). Following treatment, the average value had decreased to -0.1mm (SD 1.5mm). Three months after debonding, the value had dropped even more to -1.6mm (SD 0.7mm).

The superimposed images of the before & after cephalometric images were shown to patients as is described by Fig 2 and also in the video movie.

The average change to the position of the tip of the chin was 4.7mm (SD 3.2mm). The changes to the lip positions were: -2.3mm (SD 2.6mm) for the upper lip and -2.3mm (SD 3.1mm) for the lower lip.

The Tweed Merrifield orthodontic movie has been uploaded to a YouTube website.

**DISCUSSION**

The average values of the Tweed triangle for Tweed Merrifield treated patients were almost the same as the values the author reported four years ago at a biennial Tweed meeting. Following Tweed treatment, the final IMPA values remained very stable at an average of around 88 degrees. Based on the author’s results, the Tweed-Merrifield technique has generated positive results and is a reliable method for malocclusion correction, especially for those Japanese who have unfavorable chin and lip positions.

Speaking of facial esthetics, popular movie actresses are often chosen to illustrate superior orthodontic treatment. Two popular Japanese movie stars – Takei Mie and Kitakawa Keiko, and two American movie stars – Amanda Seyfried and Natalie Portman - have favorable chin appearance and seem to have IMPA angles around 88 degrees. IMPA angles were surveyed from the actresses’ lateral photographs and were similar despite differences in ethnicity and genetic makeup. Fig 7

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<tr>
<td></td>
<td>Before</td>
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<tr>
<td>FMIA</td>
<td>51.55°</td>
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<tr>
<td>FMA</td>
<td>32.71°</td>
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<td>IMPA</td>
<td>95.72°</td>
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Table 1

Although Japanese people favor a certain type of facial beauty, it is ultimately subjective and transitory because it is dependent on fashion and culture. Its perception, therefore, is constantly changing. As a result, studies of treatment can be difficult to express in the form of data. For example, in the Bioprogressive system, originally developed by Dr. Rich ketts’, the esthetic line (E-line) measurement was well known and defined as a standard guide to ideal values (lip protrusion, for example) for facial esthetics: -2mm for Caucasian, +2mm for Japanese. During the author’s 17 years of using Tweed Merrifield treatment, all of his patients have expressed satisfaction with their facial profile changes which vary from the +2mm to a minus value. The average of the E-line values of the 33 patients evaluated by the author is -1.6mm (SD ±0.7mm). -1.6mm (SD ±0.7mm) is within the range of a Caucasian’s -2mm which is likely to be more ac-
ceptable and favored by the Japanese on the basis of facial esthetics.

Showing a video of the lateral cephalometric superimposition of the jaw movement (clockwise or counterclockwise) instead of a superimposition tracing will make patients aware of the importance of the application of high-pull headgear for successful results. Also, the discrepancy (dental crowding) between the available space and the total teeth widths, which will inevitably result in the flaring of the anterior teeth or lip protrusion, can be visually understood. The fear of both tooth extraction and the application of high-pull headgear can be avoided with good explanation and illustration.

The most effective way to explain good treatment is to show the simulation of improving the facial profile via the computer predicted personal image profile picture. The computer predicted facial image can provide a clear and imaginable picture of a patient’s prognosis. Therefore the computer images help the patient make a proper decision. Fig 8,9

Orthodontic illustration movies/videos are some of the best ways to heighten the understanding of Tweed Merrifield orthodontics and gain acceptance for Tweed Merrifield orthodontic treatment. Fig 10

**Conclusion**

In addition to traditional photographs and cephalometric analyses, digital simulations can play an important role in enabling patients to better understand Tweed Merrifield treatment. Tweed Merrifield techniques and the primary goal of pleasing facial esthetics are worth promoting and sharing with a global orthodontic audience. It is our turn to “shine”!
CASE REPORTS
Tweed-Merrifield force systems provide one of the most effective ways to correct dentoalveolar protrusions and Class II malocclusions. Class II correction methodology must allow the counterclockwise rotation of the mandible via a force system that maximizes skeletal change during the adolescent period. Even for an adult patient who has a severe bialveolar protrusion Class II malocclusion, a greater than expected esthetic change can be achieved with a proper directional force system.

**DIRECTIONAL FORCE SYSTEM:**
This system can be defined as controlled forces that place the teeth in the most harmonious relationships with their environment. The resultant vector of all forces should be counterclockwise so that the opportunity for a favorable skeletal change is enhanced, particularly for dentoalveolar protrusion and Class II malocclusion correction. An upward and forward force system requires the mandibular incisors be upright over basal bone so that the maxillary incisors can be moved distally and superiorly. For the upward and forward force system to be a reality, vertical control is critical. To control the vertical dimension, the clinician must control the mandibular plane, the occlusal plane, and the palatal plane. Source: Seminars in Orthodontics, Vol. 2, No. 4 (December), 1996: pp 237-240, 254-267

**CASE REPORT I**

**CLINICAL FINDINGS AND DIAGNOSIS**
The patient is a 45 year, 9 month old female. She presents with a Class II bialveolar protrusion malocclusion. The canines and the molars have an Angle’s Class I occlusion. To off-set the protrusion, plastic surgery was performed on her nose. Even after the plastic surgery, the evidence of facial imbalance, hyperactivity of mentalis muscle, mouth breathing, and gummy smile remained. At the time of her visit, her chief complaint was “I’m still not beautiful.” Due to such a lack of self-confidence, she was an extremely motivated and co-operative patient.
There was an improper prosthesis on the maxillary incisors and generalized periodontitis. It seems that the prosthesis was placed on the maxillary incisors to conceal the spacing. The spacing was caused by small tooth widths and large alveolar bone dimension. Before the orthodontic treatment, the removal of the improper prosthesis and flap surgeries for the generalized periodontitis were necessary. The improper prosthesis was replaced with four separate provisional restorations prior to treatment.

Generalized periodontitis was evident, especially, in the mandibular right lateral incisor area and in both mandibular molar areas. Also, there are mandibular third molars. The cephalometric analysis findings were: FMIA 38°, FMA 33°, IMPA 109°, SNA 85°, SNB 77°, ANB 8°, AO-BO 5mm, occlusal Plane 13°, Z angle 46°, upper lip 10mm, total chin 9mm, posterior facial height 42mm, anterior facial height 69mm and Post/Ant facial height index .61. The cranial facial difficulty was 138, while the total space difficulty was 20.1. Hence, the total difficulty index was 158.1. In addition, the total dentition space difficulty was 21.6. For this patient, most of the problems were in the anterior area.

### TREATMENT PLAN

What can we do for this adult patient? As orthodontists, we must consider esthetics as well as functionality. However, in many instances, we are forced to make compromises due to various constraints: age, time, financial aspects, oral and general health conditions, patient’s expectations, feasibility, etc. In addition, we must also consider restorative requirements, periodontal condition, prosthetic requirements, and orthodontic problems. A careful examination of all these conditions and requirements, before and after the orthodontic treatment, is extremely important since they heavily influence the retention.

With all the factors considered, the following treatment plan was formulated: removal of the prosthesis from the maxillary anterior teeth, flap surgeries in the whole dentition, extraction of the four first premolars and of the three third molars, application of high pull J-hooks and elastics for maximum anchorage, periodic plaque control, a new prosthesis, retainers, and bleaching. The high pull J-hooks had to be
applied for 10 to 12 hours a day and the Class II elastics at all times.

**TREATMENT RESULTS**

Treatment time was 30 months. The protrusion was corrected, the old prosthesis was replaced with a smaller one, and the periodontal condition was improved. Also, the third molars were extracted during the flap surgeries but before orthodontic treatment. After orthodontic treatment, both the root paralleling and the patient’s profile improved favorably.

The difference is also shown in the cephalometric analysis. While keeping the FMA at 33, the occlusal plane has been decreased from 13 to 8. The mandibular plane has been maintained while achieving the desired vertical control. The IMPA changed from 109 to 82. Because she was an adult patient without further growth, the ANB did not change. The Z angle has been changed remarkably, from 46 to 65. The total chin increased from 9 to 12. The mentalis muscle was no longer tense.

The pre/post treatment superimposition shows the drastic movements of the incisors. Per the patient’s request, the prosthesis on the maxillary incisors was molded with a steeper incline than usual. The mandibular incisors were uprighted and intruded.
Clinical Findings and Diagnosis

This patient is a 37 year, 4 month old female. Her chief complaints are the protrusion of the anterior teeth and incompetent lip seal. There is generalized periodontitis, especially in the maxillary left first premolar area. A bypass bite of the maxillary and mandibular left first premolars was noticed. The mandibular left second premolar was missing and the mandibular left first molar was tilted mesially. Also, there are a lot of old restorative materials. The presence of a TMJ (temporomandibular joint) problem was noticed. The condyles are slightly blunted on the panoramic radiograph. Patients with such TMJ conditions require a more cautious approach when applying the Class II treatment mechanism.

The cephalometric analysis findings were: FMIA 47°, FMA 32°, IMPA 101°, SNA 80.5°, SNB 73.5°, ANB 7°, AO-BO 8mm, occlusal plane 12°, Z angle 56°, upper lip 10mm, total chin 9mm, posterior facial height 52mm, anterior facial height 72mm, and Post/Ant facial height index .72. The cranial facial difficulty was 100.5. The total space difficulty is 39.9. Therefore, the total difficulty index was 140.4. The total dentition space difficulty was 32.4.

Treatment Plan

Based on the analysis, the treatment plan was: extraction of the three first premolars and of the three third molars, application of high pull J-hooks and elastics for maximum anchorage, periodic plaque control, production of prosthesis of the mandibular left first molar and retainers. The J-hooks needed to be applied for 10 to 12 hours a day and the Class II elastics at all times.
**TREATMENT RESULT**

The patient was treated for 28 months. Teeth are well-aligned and there is good arch form. Also, the periodontitis has been controlled. In addition, the prosthesis for the mandibular left first molar has been made. The canines and the molars have an Angle’s Class I occlusion. The third molars have been extracted. The curve of Spee has been eliminated. Lastly, the root paralleling has been corrected.

In the cephalometric analysis, the FMA changed from 32° to 30°. The mandibular plane angle slightly decreased. The IMPA changed from 101° to 97°. The ANB remained at 7°, because she is an adult. The Z angle improved from 56° to 68°. She has a good profile although the mandibular incisor’s inclination did not change much. The total chin increased from 9 to 11.

By wearing a headgear, her maxillary incisors moved both superiorly and posteriorly. And, the mandibular incisors became intruded and uprightened. In short, the headgear provided the controlled force. The Z angle was improved. Now, her straightened profile allows her to close her mouth comfortably.

**CONCLUSION**

Class II correction methodology must allow the counterclockwise rotation of the mandible via a force system that maximizes skeletal change during the adolescent period. Fortunately, such efficacy is not limited to the adolescent period. Even with an adult patient who has a severe bialveolar protrusive Class II malocclusion, a surprising esthetic change can be achieved with a proper directional force system. Of course, in treating severe bialveolar protrusion, there are various treatment methods other than application of headgears, such as micro-implant anchorage, orthognathic surgery, etc. However, regardless of the method chosen, the basic concept of the use of a directional force system is strongly recommended.
Many times missing or fractured anterior teeth are clinical situations that the orthodontist must consider. It is often difficult to produce a successful esthetic result when these conditions exist. The irregular appearance of the anterior teeth can be improved by altering the clinical crown lengths and gingival contours of the affected teeth during orthodontic treatment.

The following case report illustrates Tweed-Merrifield directional forces therapy in which clinical crown lengths of the anterior teeth was intentionally modified and periodontal procedures were followed to produce a more esthetic result.

**CASE DESCRIPTION**

The case report of an 18-year old Mexican patient is presented. He had a Class I malocclusion with a negative medical history. The patient’s complaint was that he exhibited unesthetic dental appearance when smiling. There was good facial balance (Fig 1).

Intraorally, there was a moderately deep overbite, dental fractures, very severe crowding, gingival margins that were not level and midline discrepancies.

Occlusal views showed considerable dental crowding, rotations and Bolton discrepancies (Fig 2).

The panoramic radiograph showed the complete dentition and no signs of pathology (Fig 3).
Cephalometrically, there was a good skeletal pattern, a good maxillo-mandibular relationship and angulations of teeth. Occlusal plane and Z angle were ideal (Fig 4).

**DIAGNOSIS AND TREATMENT PLANNING**
The cranio-facial analysis revealed no skeletal problem and Merrifield’s total space analysis indicated space requirements in the anterior and posterior area. The total difficulty score was only 29. Orthodontic treatment was planned. The extraction of maxillary and mandibular first premolars and all third molars was indicated.

This patient’s malocclusion correction serves as a good example of how Tweed-Merrifield directional force technology can help the clinician achieve a good result regardless of the space severity. However, it is important to summarize some issues that were relevant during the correction of this treatment:

- Maintenance of arch form and archwire coordination
- The use of proper directional forces
- Second order bends – good and efficient anchorage preparation
- Leveling and reshaping anterior teeth

Periodontal concerns were also considered. The periodontist recontoured both gingival and alveolar bone margins to a more ideal level after the anterior teeth were leveled and Bolton discrepancies eliminated. Since the patient presented with severe anterior crowding, the periododontist also did a supracrestal fiberotomy from premolar to premolar in both arches three months prior to the removal of orthodontic appliances. The patient was periodically examined during orthodontic treatment to evaluate oral hygiene and tissue conditions (Figs 5 and 6).

Figure 7 shows changes in the gingival outline of the anterior teeth before and after treatment.

**RESULTS**
The face shows harmony and balance. The smile line and buccal corridors have improved as has the nose-lip-chin spatial relationship (Fig 8).

Teeth and gingiva are healthy and esthetic. Good “architecture” of the gingival complex is evident (Fig 9).

A Class I occlusion was maintained along with proper canine guidance. The maxillary arch has harmony in shape and proportion of the teeth because the Bolton discrepancy was eliminated. The mandibular arch shows nice dental alignment. The occlusal plane was controlled while overbite and overjet were overcor-
rected, thus providing for optimal anterior guidance (Fig 10).

The panoramic radiograph and periapicals show good root parallelism with good health of the alveolar bone (Fig 11).

Superimposition on S-N confirms excellent control of FMA, ANB and anterior and posterior facial heights. There was good control of the maxillo-mandibular complex since teeth were moved with vertical, sagittal and transverse control (Fig 12).

Harmony and balance of face was preserved with treatment (Fig 13). Patient cooperation was excellent. Treatment time was 22 months.
REFERENCES

In 1996, I joined the Tweed Course as the first Asian female instructor. It was a great honor for me. At that time, Dr. Merrifield was marvelously gentle to me. I will never forget his heartfelt support.

In 1999, the last year of the 20th century, I joined the Tweed Course as an instructor again. It was the last course that Dr. Merrifield attended. I was so fortunate to be with him. At that course, I received a T-shirt on which was the illustration – Darth Vaden. George Lucas, who made ‘Star Wars’ constructed the image of Darth Vader from the code of the Japanese warrior: ‘Bushidou’. ‘Bushidou, the Soul of Japan’ was written by Inazo Nitobe in 1899 and became popular among Western intellectual people. The president of the US, Theodore Roosevelt, distributed the book among his friends. ‘Bushidou, the Soul of Japan’ is composed of justice, courage, benevolence, politeness, sincerity, honor, and loyalty. The Tweed-Merrifield philosophy and Japanese Bushidou have a common “spirit.” Michael J. Sandel’s justice and Peter F. Drucker’s management are now popular in the US and Japan. They proclaim both ethical humanity and integrity. I am happy to be a part of this great Tweed-Merrifield philosophy. Because of this philosophy, I am an orthodontist who has the opportunity to spread my professionalism in my community.

Presented is the treatment of two difficult Angle’s class II division 1 malocclusions. The first one was complicated by an open bite and the second one had a hyperdivergent facial type that was characterized by a steep mandibular plane and short posterior facial height. The two patients did not accept any surgical treatment. They were treated according to the principles espoused by the Tweed-Merrifield philosophy.

Case 1
The patient was a 20 year, 11 month old female. Her chief complaint was a protrusion and an anterior open bite. Profile and full-face photographs indicate a lack of facial balance. (Fig 1) The oral photographs (Fig 2) exhibit labially flared mandibular incisors, a class II molar relationship and an anterior open bite.
The panoramic X-ray (Fig 3) shows no pathology. The third molars are present. The pretreatment cephalometric tracing (Fig 4) shows an ANB of 8° and an AO-BO of 4mm—a reflection of the class II problem. The FMA is a normal 27°, but an IMPA of 117° and FMIA 36° indicate severe dental protrusion. The 49°Z angle also reflects the facial protrusion. Total space analysis was 44.8mm. The total difficulty was 136.8.

To correct the open bite and the protrusion, four first premolars were extracted. Even after first premolars were removed, a space deficit existed due to the class II correction requirement. Therefore, it was necessary to study the posterior denture area. The mandibular third molars were extracted so that maximum anchorage could be prepared during treatment. After maxillary space closure and mandibular anchorage preparation the malocclusion was re-evaluated. For patients with an end on or a full step class II relationship of the buccal segment, a new system of forces must be used to complete denture correction. It is necessary to make a final diagnostic decision for class II correction based on 1) the ANB relationship, 2) a maxillary posterior space analysis, and 3) patient cooperation. The maxillary second molars were extracted for this patient to provide space for maxillary posterior distal tooth movement. The total active treatment time was 39 months.

The posttreatment facial photographs (Fig 5) show a dramatic facial change and a favorable smile line.

The posttreatment intraoral photographs (Fig 6) show the class I interdigitation of the buccal segments and the open-bite correction.

The posttreatment cephalometric tracing (Fig 7) confirms that the mandibular incisors were uplighted since the FMIA increased from 36.0° to 56.0°. The Z angle improved from 49.0° to 64.0°.
The composite cephalometric tracings (Fig 8) illustrate the upright mandibular incisors and the upward and backward movement of the maxillary anterior teeth with good vertical control of posterior teeth.

**CASE 2**

The second patient is a 23 year, 2 month old female. The facial photographs (Fig 9) show a lack of facial balance because of the retruded chin. The patient’s chief complaint was the maxillary protrusion and crowding of anterior teeth. The intraoral photographs (Fig 10) exhibit a class II molar relationship with crowding of anterior teeth. The panoramic X-ray (Fig 11) shows no pathology with the maxillary and the mandibular third molars present.

The pretreatment cephalometric tracing (Fig 12) demonstrates the class II skeletal and dental relationship. The FMA of 42° indicates that this patient has a severe hyperdivergent problem, therefore the control of the vertical dimension is crucial. The FMIA of 41° and IMPA of 97° confirm the need to upright the mandibular incisors. The ANB of 8° and the AO-BO of 4mm illustrate the class II skeletal pattern. The cranial facial difficulty was 222.5. The total space analysis difficulty was 49.8. The total difficulty was 272.3.

To correct the crowding and the maxillary protrusion, four first premolars were extracted. Even after first premolar removal, a space deficit still existed as did the class II correction requirement. After space closure and mandibular anchorage preparation the malocclusion was re-evaluated. The maxillary second molars were extracted to provide space for maxillary posterior distal tooth movement. The total treatment time was 27 months.

The posttreatment facial photographs (Fig 13) show a pleasing facial change, a balanced facial profile and a nice smile. The posttreatment oral photographs (Fig 14) exhibit a class I intercuspation of the buccal segments, overbite and overjet correction and no crowding. The posttreatment panoramic X-ray (Fig 15) shows good root parallelism. The posttreatment cephalometric tracing (Fig 16) shows the FMIA increased from 41° to 50°. Reflecting vertical control, the FMA remained at 42° and the occlusal plane also remained at 16°.
The pretreatment and the posttreatment composite cephalometric tracings (Fig 17) show the upright mandibular incisors and good vertical control of posterior teeth.

Two-year retention records (Fig 18, 19) confirm a stable treatment result. The facial photographs show a balanced face. The intraoral photographs illustrate the settling of the occlusion into a stable buccal segment correction. There is stable mandibular incisor alignment.

**SUMMARY**

For these patients the outcomes of orthodontic treatment were pleasing and the objectives of treatment were accomplished without surgical intervention. The Tweed-Merrifield philosophy enables us to routinely and successfully correct the difficult class II malocclusion. This is a great gift to patients.
At the time of examination Claire was a fourteen year old Caucasian female. She presented with a Class II division 1 malocclusion. Diagnostic records consisted of cephalometric and panoramic radiographs, study models, and facial and intra oral photos.

The hallmark of the Tweed-Merrifield Directional Force technique is its organized and meticulous diagnostic regimen. The face, skeletal pattern and dentition are analyzed individually and then collectively to assimilate a treatment plan.

In the mid 1970s Dr. Ed Noffel coined the phrase "Faces First.” The effect orthodontics can have on the subsequent appearance of the human face is of primary focus and importance. From the lateral aspect Claire presents with her facial thirds in balance, an obtuse nasolabial angle, a bulbous lower lip, relative retrognathia and a shallow Z angle (Figure 1). The frontal aspect displays an asymmetric relationship, a bulbous orbicularis oris, a hypertonic mentalis and a lack of proportion between her upper and lower lips (Figure 2). The degree of irregularity, lack of harmony and imbalance are evident when viewing her smile photograph (Figure 3).

The second section of the diagnostic process is an evaluation of the skeletal pattern. When Claire's cephalometric radiograph is examined, the excessive overjet, steep mandibular plane, deep curve of Spee and retrusive mandible are easily discernible (Figure 4). The cephalometric measurements and tracing can be seen in figure 5. The very short ramal height and
the rather short anterior-posterior arch length should be noted. Indeed, the mandibular first molars are juxta-posed with the inferior border of the ramus. When Claire's key skeletal measurements were evaluated using the Cranio Facial Analysis developed by Dr. Jim Gramling, she had a skeletal difficulty of ninety six (Figure 6).

The final section of the differential diagnosis is a thorough evaluation of the dentition (Figure 7). Claire presented with a Class II division 1 malocclusion with a full step class II molar relationship on her right side and an end-to-end relationship on the left. The total space analysis illuminated the areas of discrepancy. Her anterior denture has a 7.2 mm arch length deficiency, the mid arch has a 3.85 mm deficiency and the posterior has a 25.34 mm deficiency. Her total tooth size to arch length discrepancy was 36.39 mm (Figure 8). When the space analysis difficulty was added to the cranio facial difficulty, the total of 136.72 placed Claire's malocclusion in the difficult range (Figure 9).

Many factors needed to be considered when formulating Claire’s treatment plan. The short ramus, the severe posterior discrepancy, the high mandibular plane angle, and the very steep curve of Spee had to be considered. After combining the facial, skeletal and dental diagnostic factors, the decision to extract maxillary first premolars and mandibular second premolars and the use of Tweed-Merrifield directional forces offered the best alternative for Claire's treatment.

The steep curve of Spee dictated that care had to be taken when uprighting the mandibular first molars. Meticulous use of the "cherry loop" arch wire and careful read outs were evaluated monthly until a mandibular first molar measurement of +5 degrees was obtained prior to use of the "shoe-horn" loop to protract the molars.

Claire's treatment was completed in twenty-two months. Facial changes can be seen in figures 10 through 12. Of particular note is the much more symmetric and proportional relationship of her lips in repose. This type of response is typically seen when the teeth are placed in an upright and harmonious position within the patient’s cranio-facial complex.
The posttreatment skeletal change can be seen in figures 13 and 14. All cephalometric measurements improved except for the occlusal plane. Due to the steep curve of Spee, some incisor intrusion was to be expected. This was noted when the regional superimpositions were evaluated (Figure 15). The overall superimposition illustrates the forward mandibular response typically seen with vertical control (Figure 16).

The prudent use of anchorage preparation in the mandibular arch provided both vertical control and stabilization of the mandibular teeth during class II
correction which, in turn, allowed for the exceptional mandibular response. The overcorrected dentition can be seen in figures 17 and 18. Lastly, the dentition recovery photographs taken two months post deband are shown in figure 19.

The treatment of this patient demonstrates the quality of control typically seen when employing directional force mechanics to achieve treatment goals. Predictable and esthetic facial, skeletal, and dental results are routinely produced when the diagnostic process and associated mechanics as taught in Tucson are employed. My heartfelt thanks goes out to Dr. Herb Klontz for taking an interest in me twenty-nine years ago.