Cranial strains and malocclusion VIII: palatal expansion

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Cranial Strains and Malocclusion VIII: Palatal Expansion

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Abstract: *Current techniques for palatal expansion are reviewed. Pre-treatment asymmetry of the palate and maxillary arch is shown to be almost universal and is not randomly distributed. The use of a symmetrical expansion appliance does not necessarily result in a symmetrical arch. ALF appliances provide a means of achieving orthopedic, symmetrical expansion of the palate by using very light force. This is demonstrated in seven subjects. It is argued that rapid palatal expansion is an inappropriate, potentially iatrogenic procedure which no longer has a place in the orthodontic armamentarium.*

Lateral expansion of the palate has always been one of the most frequently used procedures in orthodontics. It is an apparently simple procedure and over the years, a wide variety of fixed and removable appliances have been devised for this purpose. Similarly, the rate at which the expansile force is applied, and the subsequent level of force has also varied widely. This force can range from light to relatively massive. Palatal expansion, especially rapid palatal expansion (RPE), epitomizes the application of classical Newtonian mechanics to a biological system in the expectation of a classical, linear response. There is no question that palatal expansion is usually achieved. A more relevant question is whether the methods being used are appropriate in light of what is now known about physiological movement of the cranium, the face and how the body reacts to a stimulus.

In a previous series of articles,[1-9] osteopathic concepts were used to describe malocclusion. It was shown how an appreciation of different cranial distortions or strains leads to a more profound understanding of malocclusion and how orthodontic treatment can be directed to correct the effects of any particular cranial strain. In a second series,[10-14] the idea of the mouth as an integral part of the body's self-regulating system was developed. The significance of quantum mechanics in relation to biological systems is central to this idea. The combination of these hypotheses offers a major shift in thinking about orthodontics, a true paradigm shift.[15] This leads to a reassessment of how orthodontic intervention can be made more compatible with the body's overall physiology, thus taking advantage of its inherent ability to self-adjust and self-correct. Examination of palatal expansion shows how these ideas can be applied at a clinical level.

In 1968, Bertalanffy[16] proposed a General System Theory. In part, this was a response to the work of Nobel Prize laureate Szent-Gyorgyi. As long ago as 1941, Szent-Gyorgyi[17] suggested that there was some form of energy source in biological systems which was not being recognized. Bertalanffy's theory has subsequently given rise to whole new branches of physics, such as complexity theory and non-linear dynamics. These show that living organisms have

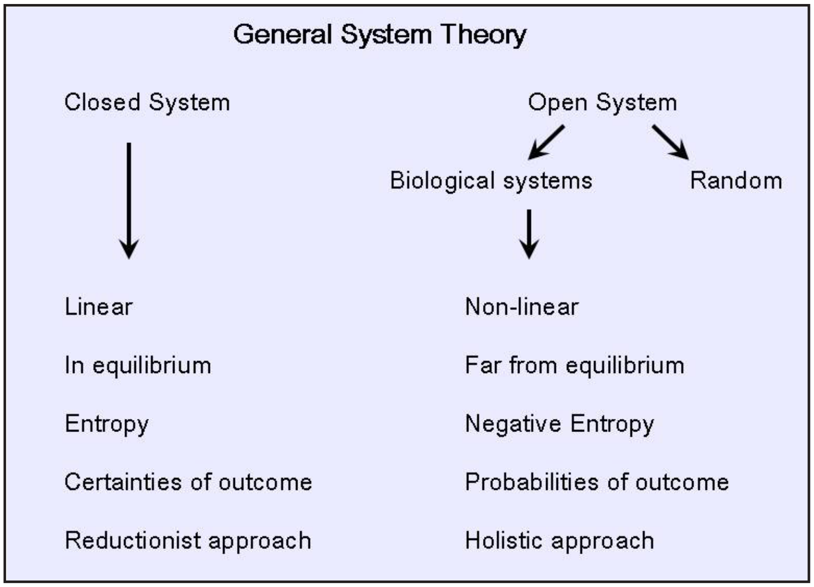

Figure 1 - Diagram showing principal characteristics of closed and open systems (Bertalanffy[16]).

characteristics which require us to think of them in a quite different way when compared to non-vital systems (Figure 1). Closed (non-vital) systems are linear; they tend towards equilibrium; they lose energy (entropy); with time they break down into increasing disorder; when they are involved in a reaction they have certainties of outcome if sufficient information is available. Open (living) systems are non-linear; they are far from equilibrium; they produce more energy than they lose (negative entropy); it is only possible to achieve a probability of outcome in any reaction.

A useful analogy involves kicking a stone down the road. If you know the weight of the stone, the amount of force delivered, the degree of friction from the road etc., it is possible to predict its final position with some accuracy. The stone goes from one state of equilibrium to another. If on the other hand, you are unwise enough to kick a large bad-tempered dog, you are dealing with probabilities of outcome. One or two of these are more likely than others, but they remain possibilities only. Biological systems, with all their complexities, simply do not offer the certainties of outcome we expect.

Another difference between the two systems is of particular importance for orthodontics since it deals with the response of each group to force.[18, 19] In a closed system, classical Newtonian mechanics apply. A large force produces a large response. In a living organism, a small force will also create a large response. This paradoxical result is due to the effect of quantum mechanics which is the mechanism active at cellular and molecular levels. For example, stimulation of a few cells triggers an almost instant reaction in a mass of other cells. This is known as a molecular cascade. As Ho[18] puts it, "being alive is to be extremely sensitive to specific cues in the environment, to transduce and amplify minute signals into definite actions."

Communication through the body has usually been thought of as a neurological or hormonal response. Cell biologists[18, 19, 20, 21] recognize that there is another means of bodily communication which is much more ancient. Unicellular organisms can locate food, digest it, excrete the waste products, move towards a favorable environment or away from an unfavorable one, all without benefit of nerves or blood vessels. These latter systems have developed in higher organisms but the primitive capacity for communication has persisted, partly overlaid by the more specialized ones. Several mechanisms have now been identified which are associated with this earlier type of response. These include amplification, quantum coherence, and the cascade effect. There is an instant transfer of energy/information through the body, by way of the facial tissue network which surrounds and penetrates into every cell. This network has been called a living or functional matrix.[18, 19, 22] It is only in the last two decades that the study of extra-cellular tissue, the cell itself and especially the cell membrane has led to these effects being recognized, understood and measured.[21] The immediate enhancement of a minimal force into a much greater stimulus is by reaction through this network. It offers an explanation as to why light force is so effective as a means of achieving tooth movement.

Even orthopedic expansion of the palate is achievable with minimal force. This statement is in sharp contrast to most current orthodontic thought which remains firmly attached to classical Newtonian mechanics. This article examines how an alternative hypothesis can be applied in a clinical context. Examples are shown of how this approach can be used to give a precise, predictable and stable outcome for palatal expansion.

Review of the Literature

Figure 2 is a diagram summarizing various methods of achieving palatal expansion. Most functional appliances include some means of expansion in their design. This results in an intermittent light force, which can be effective but is usually not the treatment of choice when more than minor expansion is needed. The Crozat appliance,[23] first introduced more than 80 years ago, uses a light continuous action. Although it is a removable appliance, with a framework of stainless steel and soldered attachments such as clasps, it is

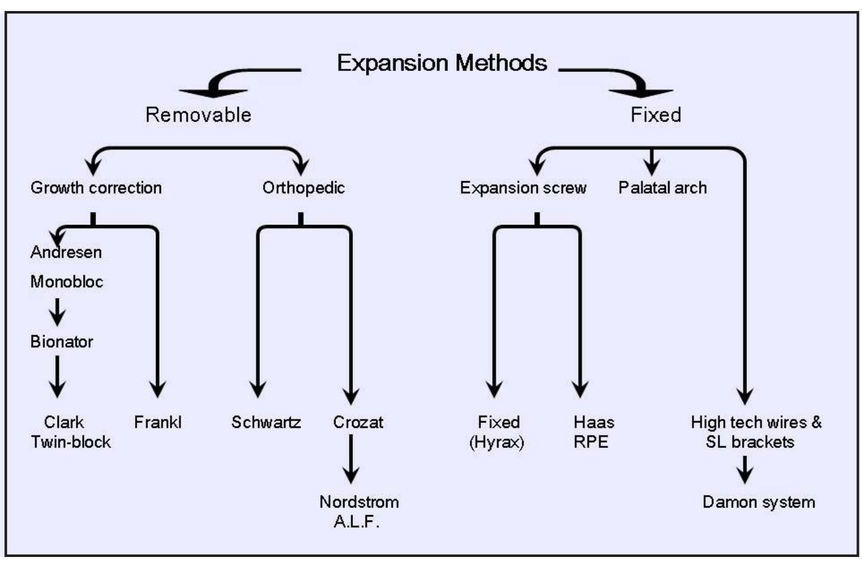

Figure 2 - Diagram summarizing palatal expansion technique.

recommended that it be worn 24 hours a day including meals.

Two techniques have been identified in the diagram as being of particular relevance. The Advanced Lightwire Functional (ALF) appliance developed by Dr. Darick Nordstrom,[24] is derived from the Crozat appliance. The ALF appliance is characterized by its versatility and its ability to apply a minimal continuous force in very specific ways. Light force principles also apply to the use of self-ligating brackets and light, highly resilient arch wires, such as with the SPEED[25] or Damon techniques.[26]

In contrast to these light force techniques, most expansion methods use a midline screw of some kind with a rigid transpalatal framework, usually anchored on the first permanent molars.

One approach, rapid palatal expansion (RPE), was popularized by Haas.[27, 28, 29] His appliances are primarily of acrylic, with bands for anchorage. The acrylic extends up into the palate so that the expansile effect is distributed over soft tissues as well as hard tissues. This requires trimming of the acrylic as the expansion progresses.

McNamara[30, 31] and many other clinicians favor a tooth-borne appliance such as a Hyrax type of device. The rationale is that both these devices give an orthopedic effect, as compared to orthodontic tooth movement. In RPE, the level of force rapidly becomes increasingly heavy, alveolar bone resorption is suppressed, and the primary effect is expansion of the basal bone. Visible evidence of this may include the appearance of a diastema between the maxillary central incisors as the two halves of the maxilla are separated and the palatal suture is opened.

The considerable interest of the dental profession in RPE has prompted extensive investigation of the subject. There are various reviews[31, 32, 33] describing different investigations of the procedure, including animal experiments and cadaver material. The review by Thilander et al.[34] is probably the most comprehensive. There is general agreement that while the palate responds quite rapidly by separation at the midline palatal suture, there is greater resistance from the circum-maxillary structures. As a result, the two halves of the maxilla swing out, pivoting at the junction of the frontal and nasal bones. This can cause buccal tipping of the posterior segments despite the use of a rigid banded appliance. Nevertheless, the dramatic and rapid movement which results from RPE had made it a popular treatment modality and it continues to be widely used, both by orthodontists and dentists.

Personal experience has demonstrated that there can be a variety of undesirable sequelae from RPE. Few articles in the orthodontic literature mention these. Reactions may include sensitivity of the teeth, swelling, discomfort or pain of the oral soft tissues and also facial pressure, discomfort or pain. Headaches are a common reaction. Even temporary disturbances of vision are not unusual. Temporomandibular disturbances can be an indirect effect, as the mandible adapts to the changing position of the maxillary dentition. When any such side effects develop, the usual response of the clinician is to reduce the frequency of application of the force, e.g. from one or even two turns per day of a midline screw to perhaps once every second day. The clinician's judgment and the patient's tolerance of pain are usually the deciding factors. A thought-provoking exercise is to go online and read the comments of actual patients who are receiving or have received RPE.

The age of the patient is generally thought to be crucial, with the consensus being that RPE should be limited to adolescents or children.[30] In adults, RPE is usually undertaken after surgical mobilization of the two halves of the maxilla.[35] However, there are several reports on adults for whom RPE was done without previous surgical preparation.[36, 37] The primary objective with RPE is to achieve as much orthopedic change as possible, as opposed to the reaction obtained with a slower rate of expansion, in which orthodontic movement only is considered to be more likely.

A major consequence of RPE is a strong tendency to relapse. Haas[28] deals with this by deliberate over-expansion to the point that the maxillary teeth are completely buccal to the mandibular teeth. He then maintains this overexpansion for a prolonged period either with the original appliance or a heavy transpalatal arch. McNamara[30] does not overexpand to the same extent, placing the maxillary lingual cusps into contact with the buccal cusps of the mandibular teeth. He maintains the fixed expansion appliance in place for at least 6 months after completion of active treatment, then places a removable appliance for another year. The hope in each case is that the dental and facial structures will eventually stabilize, finding a balance between the forces of the occlusion, the soft tissues of the cheeks and the tongue. In response to a questionnaire sent to a group of orthodontists,[38] it appears that there is much uncertainty and debate over the various aspects of RPE, with little consensus as to what combination of factors is the best approach.

Expansion of the palate in this fashion has always felt counterintuitive, despite our both having used RPE for many years. The fact that the palate can be split is spectacular, but the procedure introduces a large degree of uncertainty as to both its immediate and long term effects. In order to minimize any undesirable sequelae, many clinicians favor a slower rate of expansion, e.g. one or two turns per week if a Schwartz type expansion screw is used. A fixed appliance design incorporating bands or bonding for retention is usually preferred as it gives the clinician more control and lessens the tendency for lateral tipping of the posterior teeth. The use of a removable appliance dictates a slower pace in any event, since otherwise the appliance slips down the teeth and the patient has difficulty reinserting it.

This slower rate of expansion is certainly less traumatic than RPE. However, there are still significant problems with this. One is the presence of an appliance occupying a large part of the palatal space. The bulk of the appliance prevents the tongue from developing a normal adult swallow with the teeth together and the tongue rising up into the palatal vault. The normal swallowing reflex creates reinforcement by the tongue contacting the palatal tissue. As tongue function is a key factor in the development of the palate, the appliance effectively prevents the tongue from fulfilling this role. The presence of a palatal obstruction forces the tongue to displace anteriorly, laterally, or both, thereby maintaining or recreating an infantile swallowing pattern.

The rigidity of any transpalatal device has the obvious effect of restricting the natural expansion and contraction of the palate as it reacts to the rhythmic movement of the cranio/facial structures. An osteopathic evaluation of a sample of patients with transpalatal appliances, compared to a control sample without appliances has not been done, as far as we know. Anecdotal reports from osteopathic colleagues describe a variety of findings indicative of restricted cranial movement when such a device is in place. Neuropathic entrapment of cranial nerves as they exit from the cranial base is a possibility. Magoun has described this phenomenon.[39] It may explain why auditory or visual disturbances are not uncommon.

Self-ligating Brackets and Resilient Arch Wires

One of the most interesting developments in orthodontics over the past two decades has been the introduction of self-ligating brackets, such as the SPEED[25] or the Damon[26] bracket, combined with light, very resilient arch wires. Damon, in particular, has argued in favor of light force. To take maximum advantage of this, he leaves the initial light wires in place for a much longer time than is the usual practice, which is to move to a heavier arch as soon as it can be seated. This delay in changing the wire is said to allow the lighter wire to express its full potential. Cases presented by Damon show impressive amounts of arch formation, with significant palatal expansion. These have been shown to be stable several years after retention has been stopped. Damon attributes the effectiveness of his system to the light force avoiding the compression of tissue, especially the arterioles. The work of Reitan[40] in the middle of the last century and subsequently with Thilander,[34] supports the argument in favor of light force. However until recently it has been considered primarily in relation to functional appliances or with the use of the Crozat appliance.

Awareness of the piezoelectric effect has been touched on by Roberts[41] and in much more detail by Bassett[42] and Becker[43, 44] but to a great extent discussion of tooth movement has been based on histological, biochemical, and radiographic findings. Thilander et al[34] acknowledge the limitations of these procedures as a means of reaching a full understanding of tooth movement, but the conclusions drawn from these techniques continue to dominate orthodontic thinking. The problem with this approach is that it is reductionist, i.e. it is concerned with details in isolation. As Oschman[20] points out, "important, even vital collective properties cannot be predicted from the study of the system's components, taken one by one." In other words, the whole is greater than the sum of its parts. Ho[18] describes how electromagnetic activity in living organisms, observed by specialized recording devices, gives quite a different picture of what is happening when compared to conclusions derived from the microscopic or biochemical analysis of dead tissue. As cell biologists continue investigations of this kind, it is clear that orthodontics is in urgent need of a fresh point of view.

The results of expansion with light wire techniques such as the Damon are a considerable step towards the use of physiologic force in orthodontics. However, this also falls short in several important ways. The first is the lack of explanation other than in histological terms, as to why there is such a favorable reaction to a light force. As was pointed out earlier with regard to biological systems, a small force results in a large response. The light wire techniques almost certainly achieve their initial excellent expansion of the palate from this effect. As long as treatment is continued with flexible wires, there is benefit from this. However, in his Phase III of treatment, Damon prescribes the use of coordinated, patient-specific arches of rectangular stainless steel wire. Although arch forms can be shaped to match patients' anatomical variations, the rigidity of the wire produces serious inhibition of the body's adaptive capacity. While these wires give more precise control of the teeth, it means that the biologically favorable response that was previously obtained is lost. The self-adjusting ability of the body is overridden and treatment possibilities are therefore diminished.

Palatal Asymmetry

A major factor in regards to palatal expansion in general, is the presence of asymmetry of the maxillary arch prior to treatment. A search of literature on palatal expansion shows that this feature has been overlooked almost entirely. One notable exception is in the literature on the Crozat appliance. The Kernott Analysis[45] used in this technique identifies asymmetries of the maxillary arch in the lateral, anteroposterior and vertical planes of space. Appliance design is planned accordingly. RPE is not used as part of this technique.

Examination of numerous individuals in our practices has shown that almost invariably there is asymmetry of the maxillary arch prior to treatment. One maxillary quadrant is closer to the palatal mid-line, i.e. more internally rotated, in osteopathic terms. The other quadrant, which is further from the mid-line, is then said to be more externally rotated. This asymmetry is of major importance in treating palatal expansion. When a symmetrical force is applied, the more internally rotated quadrant is much more resistant to pressure than the more externally rotated quadrant. It follows that the result will not be a symmetrical reaction. The more externally rotated side will move more readily than the more internally rotated side. The arch is indeed expanded but the asymmetry may actually increase. Fortunately, ALF appliances can be designed so as to mobilize the more resistant quadrant as the first step in treatment. This is demonstrated later in the article.

An obvious question is to what extent the presence of maxillary arch asymmetry is of clinical importance. If orthodontics has managed this far without really noticing such asymmetry, is it of any consequence? In order to understand why it does matter, it is necessary to recall the cranial concept and its implications for orthodontics.[1-9] The presence of cranial, facial and dental arch asymmetry is a major result of the various cranial strains. By identifying these strains, effective steps can be taken to correct any dental or facial imbalance.

Correct treatment sequencing with ALF appliances leads to mobility of both halves of the maxilla. By mobility we mean of the basal bone components and not the teeth. This mobility is probably due to all the maxillofacial sutures becoming more flexible as well as the piezoelectric stimulus resulting from the appliance. In this scenario, if there is increased mobility of the teeth, it means that too much force is being applied. Therefore the orthopedic effect resulting from a very light force is being lost. This is a challenging concept since it runs counter to the idea of heavy force being necessary for orthopedic expansion of the palate.

Development of mobility of the separate halves of the maxilla is important. Symmetry of the arch is the goal, rather than having the asymmetry worsened by expansion. The mobility of the two halves also helps achieve facial symmetry as opposed to the possibility of greater facial distortion. Mobilization of the maxilla provides more treatment possibilities since the increased mobility applies in all three dimensions of space, not just in the lateral dimension.

Identification of Maxillary Arch Asymmetry

As part of our pre-treatment evaluation of patients' records, all cases are mounted on an articulator using a facebow. A detailed assessment of the shape of the maxillary arch and of the palate is important as part of the diagnostic workup. This involves using the patient's maxillary model. The protocol is as follows:

1. The palatal mid-line is drawn on the model. This is important as it provides a useful reference line (Figure 3).
2. The distance of the first bicuspids and the first molars from the mid-line is noted. The more internally rotated quadrant is closer to the mid-line (Figure 3). Use of the cuspids is not recommended. As these teeth are the last to erupt in that part of the mouth, they may be displaced due to crowding.
3. The anteroposterior occlusal grooves of the posterior teeth are noted as they diverge distally (Figure 3). The externally rotated quadrant will diverge more than the internally rotated quadrant. A useful indicator is that the occlusal surfaces of the teeth will flare more buccally on the externally rotated side (Figure 3).
4. The model is examined from the rear aspect (Figure 4). The steeper palatal slope is indicative of the more internally rotated quadrant. Osteopaths consider that the palatal outline is one of the most reliable indicators of the position of the greater wings of the sphenoid bone.[39]

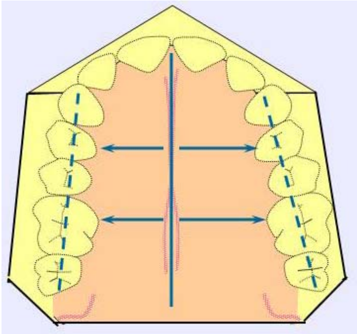

Figure 3 - Palatal view of maxillary model. Right quadrant is nearer the mid-line and is less flared buccally than the left quadrant.

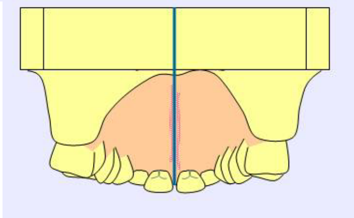

Figure 4 - Maxillary model from rear aspect. Right quadrant is nearer the mid-line and palatal slope is steeper.

Another clue as to palatal asymmetry is when the maxillary impression is taken. It is often easier to see any asymmetry by studying the palatal shape of the impression (Figure 5). This information should be noted and recorded. The observation can then be incorporated into the examination of the maxillary model once it is available. It can be a useful extra guide when the asymmetry is not obvious on the model.

Uneven Distribution of Palatal Asymmetry

When we first began to evaluate the palate as a routine part of our model analysis, we noticed that perfect symmetry of the maxillary arch was rare, but as we were dealing with malocclusion, this was to be expected. What was not expected was that palatal asymmetry is not randomly distributed. The right maxillary quadrant appeared to be more internally rotated that the left one, in most instances. Eventually, the frequency of this initial observation prompted an evaluation on a more rigorous basis. Three hundred patients were selected at random for examination of the maxillary models. All classes of malocclusion were included in the sample, not just individuals for whom expansion was planned. Using the criteria outlined above, 285 (95%) proved to be more internally rotated on the right, 14 (4.7%) were more internally rotated on the left and 1 (0.3%) was so symmetrical that it was difficult to assign. This uneven distribution seemed extreme but subsequent observation using the methodology described, continues to support this.

This anomaly has not to our knowledge been observed or commented on in the literature, with one notable exception. Hockel[46] observed that asymmetries of the maxillary arch are very commonly found with malocclusion. He described the characteristics of an internally rotated maxillary quadrant and then added that in the great majority of asymmetries, the more internally rotated quadrant is found on the right side, not the left. He attributed this to sleeping habits, with the right fist being used to pillow the face.

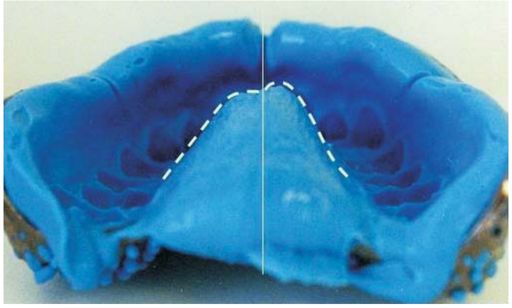

Figure 5 - Maxillary pretreatment impression of Patient K.R. (see Figures 11a-c). The impression clearly shows the palatal outlines. Right quadrant is more internally rotated.

We are not, at this point, able to give a properly researched explanation for this finding. Whether it is linked to asymmetry of the brain is an interesting question. This possibility prompted a pilot study of the p-a radiographs of 100 subjects, selected at random from our patients. A vertical mid-line was drawn through the cranium, using mid-line structures such as the crista galli to determine midpoint (Figure 6). The width of each half of the cranium, at its widest diameter, was then measured. The outer border of the cranial outline was used, as it is better defined. One half of the cranial width was compared to that of the other half. On 100 crania, the left half was wider than the right in 71 cases. In 8 cases, the difference in width was less than 2.0mm. This was accepted as indicating a symmetrical cranium. In 21 cases, the right half of the cranium was wider. The range of measurements on the left was from 2mm to 13mm with an average of 5.2mm. On the right side, the range was 2mm to 13mm with an average of 2.5mm. Therefore in this sample, not only was the left half of the cranial space wider than the right in a majority of patients, but the average width was greater on the left.

This evidence of asymmetry in the cranial width is less dramatic than the palatal asymmetry previously noted, but tends in the same general direction: right-side cranio/facial dental structures are more internally rotated than the left. A more thorough analysis of the face as well as the cranium is needed before reaching any firm conclusion about facial asymmetry. With the newer imaging devices now becoming available, it should not be difficult to explore this idea further.

With regard to any case where palatal expansion is being considered, the reader is encouraged to examine the maxillary model, using the technique outlined above. This will show the maxillary asymmetry we have

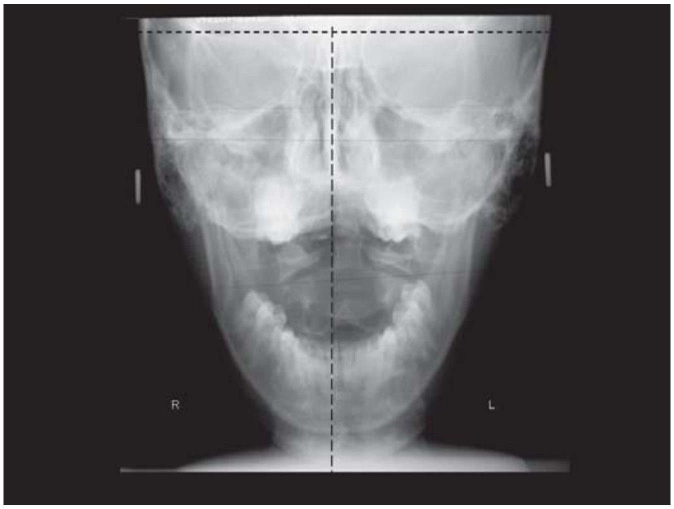

Figure 6 - Postero-anterior (p-a) skull radiograph showing vertical and horizontal reference planes used to compare width of right half of cranium with left half.

described. The right quadrant is more internally rotated in most cases. An interesting exercise is to look through an orthodontic textbook or orthodontic journals which show palatal expansion and where pre and post treatment photos of the maxillary arch are included. In many instances, the asymmetry we have described can be seen in the pre-treatment photos. After treatment, the asymmetry is often visibly worse. The left externally rotated quadrant has moved much more than the right. It is remarkable, once the anomaly is recognized, how prevalent it seems to be. What is even more remarkable is that this variation is not commented on, even where the asymmetry has obviously worsened with treatment. It makes sense to reduce any tendency to asymmetry, rather than have it worsened by the expansion. Perhaps true symmetry of the maxilla is not a practical, achievable goal for most patients. However, it is surely good clinical practice not to worsen it by inappropriate treatment.

Most of the appliances currently used for expansion of the palate are incompatible with the rhythmic physiological movement of the cranio/facial structures. Similarly, the application of a rigid mid-line expansion technique to an asymmetrical arch does not result in a symmetrical arch; in fact it often worsens the existing asymmetry. An alternative treatment modality is now presented which addresses these problems.

Appliance Design

The ALF appliance was designed by Dr. Darick Nordstrom,[24] to assist him in his work with osteopathic physicians. The primary function of the appliance was to help release the various cranial strains being treated by the osteopaths and then to correct the malocclusion. The ALF has been used as the principal treatment modality in each of the cases described below. These show considerable variation in their level of complexity and the amount of treatment required, but the first objective in each instance was to mobilize the more internally rotated maxillary quadrant. To do this, palatal expansion was initiated in a very specific way. The degree of expansion in each case depended on whether just mobilization of the quadrant was the objective, or whether significant expansion of the palate was also needed, e.g. as a means of gaining space.

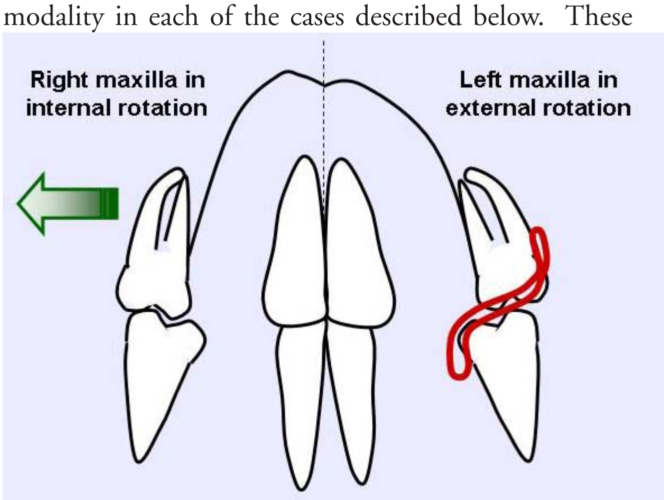

Figure 7 - Diagram of anterior view of molar occlusion with right maxilla in internal rotation. The light elastic on the left side acts as a "brake" on the externally rotated left side, when ALF appliances are in place. Arrow shows preferred direction of arch development.

Figure 7 is a diagram of this sequence. Once the appliance has been inserted and slight lateral expansion has been started, a through-the-bite elastic is placed from the buccal aspect of the more external quadrant to the lingual aspect of the mandibular ALF appliance. The purpose of this elastic is to limit the lateral movement of the left maxillary quadrant, so that the more restricted right quadrant is activated. In effect, the elastic acts as a brake on the left maxillary quadrant. If there is a tilt of the lateral plane of occlusion, a unilateral posterior occlusal pad is added to the mandibular ALF, so as to elevate the lower maxillary quadrant.[6] In this case, when a unilateral pad is placed, the elastic also brings down the higher maxillary quadrant and thus helps to level the lateral plane of the occlusion.

Our experience with the ALF has been increasing realization of its potential. With experience, it has proven to be a sophisticated device of great versatility. Any eventual transition to brackets and arch wires has increasingly been postponed until later in treatment, using these more for detailing rather than as the principal treatment method. We have developed a DVD showing the insertion and the adjustment of ALF appliances.* However, for the purposes of this article, we have concentrated on the first phase of treatment.

Case Reports

Patient H.S.: (Figures 8a-d)

This 12 ½ year old female had a history of ear infections in childhood, with fluid accumulation in the sinuses and nasal passages. A restricted nasal airway caused her to mouth breathe. The Angle classification is an Angle Class I. The maxillary teeth were comparatively more crowded on the right side because of narrowness of the right half of the maxilla which is described as being more internally rotated. The maxillary right lateral incisor is displaced lingually and

*Obtainable by contacting gavjam@cogeco.ca or destrokon@shaw.ca. Drs. James and Strokon have a direct financial interest in the sale of this DVD. Information regarding seminars on the use of the ALF appliance is available from Dr. Strokon via email. Copies of previous articles by Drs. James and Strokon are available to members of the IAO online at iaortho.org. Bound copies can be purchased at cost by contacting either doctor at his e-mail address.

is in crossbite. The right second molar is erupting in buccal crossbite. ALF appliances were used selectively to develop the right maxilla. The photographs demonstrate the palatal correction, with the final model showing an almost symmetrical maxillary arch. Total treatment time was 28 months with the ALF being used for 10 months.

The treatment resulted in restored patency of the nasal airway with relief of sinus congestion and cessation of mouth breathing.

Figure 8a - Patient H.S. Pre-treatment occlusion.

Figure 8b - Patient H.S. Maxillary cast comparison, pre and post treatment.

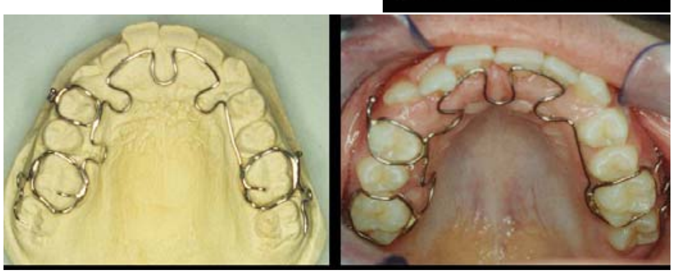

Figure 8c - Patient H.S. ALF appliance on model and in the mouth. Composite button added to mesial of right lateral incisor to stop appliance sliding down the tooth.

Figure 8d - Patient H.S. Post-treatment occlusion.

Patient C.Y.: (Figures 9a-d)

This is an adult female, aged 20 years. Her expectation was to improve the appearance of her smile. She had a severe Class II div. i malocclusion and significant crowding. The maxilla was short in dimension and retrognathic in position. The maxilla was also canted upward on the right side. She had an inferior vertical strain, plus a right torsion, in osteopathic terminology.[5, 6] The right quadrant was more internally rotated in comparison to the left which was also narrow. The dentition was more crowded in the right quadrant, due to the greater internal rotation on this side. ALF appliances were used for 19 months, followed by a course of treatment in straight wire. The final maxillary model shows that there is symmetry of the arch and that the posterior maxillary teeth are not flared.

Figure 9a - Patient C.Y. Pre-treatment occlusion

Figure 9b - Patient C.Y. Maxillary cast comparison pre and post treatment.

Figure 9c - Patient C.Y. ALF appliances in place. Thru-the-bite light elastic on left to control maxillary left quadrant and minimize lateral movement. Tension in elastic just sufficient to keep elastic in place with teeth in occlusion.

Figure 9d - Patient C.Y. Post treatment occlusion.

By specifically developing the internally rotated right maxilla, symmetry of the lateral arch form is achieved. Using a rigid appliance with gear expansion technique would likely have worsened maxillary asymmetry in this case. A probable consequence of this is deviation of the mandible to match the skewed maxillary arch form. Unfavorable joint mechanics would result from this effect.

Patient M.S.: (Figures 10a-g)

This male patient, age 11 years, had an Angle Class III with an underlying hyperextension cranial strain.[4] The right maxillary quadrant was severely rotated inwards. The maxillary right second bicuspid was palatally impacted and the right first molar was in crossbite. Both sides of the maxilla were narrow, but the right side was significantly more crowded and closer

Figure 10a - Patient M.S. Pre treatment occlusion. Maxillary right second bicuspid is impacted palatally.

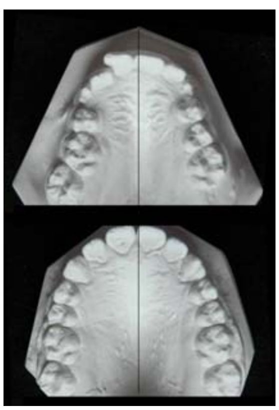

Figure 10b - Patient M.S. Maxillary cast comparison, pre and post treatment.

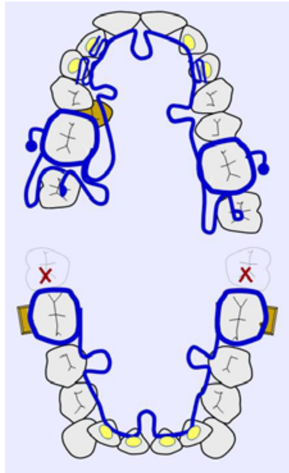

Figure 10c - Patient M.S. ALF design. Mandibular second molars extracted.

Figure 10d - Patient M.S. ALF appliances in place. Appliances removed for adjustment then re-cemented.

Figure 10e - Patient M.S. Post treatment occlusion. Retainer was designed to prevent over eruption of maxillary second molars.

Figure 10f - Patient M.S. Comparison of palate, pre and post treatment. Note: development of right quadrant, both laterally and anteroposteriorly.

Figure 10g - Patient M.S. Pre and post treatment full facial views. There is increased facial symmetry. Increased vertical dimensions partly due to facial growth.

to the mid-line than the left. The mandibular second molars were extracted and the mandibular posterior segments were distalized as the maxilla was developed. In this case, the maxillary ALF was cemented in place but removed for adjustment. The development of the right maxillary quadrant has produced a dramatic expansion of the whole area. Alignment of the second bicuspid was possible due to the gain in arch length. The maxillary ALF was used for 26 months prior to finishing with brackets and straight wire arches.

Patient K.R.: (Figures 11a-c)

This is a 12 ½ year old female. Dentally she has an Angle Class I with mild crowding. Osteopathically, she has a severe inferior vertical strain.[5] There is an extremely small mandibular dimension with excessive proclination of the mandibular anterior teeth and an anterior tongue thrust. At rest, the tongue is interposed between the anterior teeth. The right maxillary quadrant is internally rotated and narrower than the left quadrant. ALF appliance therapy was used along with a myofunctional trainer to help modify tongue behavior. Straight wire therapy was used for final detailing and the myofunctional therapy was continued through this phase. Total treatment time was 26 months, with the ALF being used for 12 months.

The unique design of the ALF appliance allows the tongue to assume a normal position in swallowing,

Figure 11a - Patient K.R. Pre treatment occlusion.

Figure 11b - Patient K.R. Maxillary cast comparison pre and post treatment.

Figure 11c - Patient K.R. Post treatment occlusion.

resulting in the patient's tongue thrust being fully controlled. If a transpalatal gear device was used in this case, it would limit the ability to restore a normal tongue position.

Patient L.M.: (Figures 12a-f)

This 13 year old female patient has a Class I relationship on the left side and a Class II relation on the right. Both quadrants were severely internally rotated, the right side to a greater extent. This dental configuration suggested the presence of a right sidebend cranial strain,[7] but the facial and radiographic evidence did not support this. There was a history of persistent right-handed thumbsucking until shortly before she commenced treatment. There was a marked lateral shift of the mandible to the right on closure. The maxillary ALF appliance was used throughout the whole treatment. In the mandible, a straight wire appliance was placed but the amount of spontaneous correction in the maxilla resulted in very little use of elastics being required. In the maxilla, brackets and a sectional arch wire were placed only on the six maxillary teeth for final detailing, and only for the last four months of active treatment. Retention was for six months with a maxillary Hawley retainer.

A comparison of the pre and post treatment p-a radiographs shows the development of the palate and the increase of nasal airway which was achieved. This could truly be considered as orthopedic expansion. In this case, considerable self-correction of the

Figure 12a - Patient L.M. Pre treatment occlusion, anterior view.

Figure 12b - Patient L.M. Casts of pre treatment occlusion.

Figure 12c - Patient L.M. Maxillary cast comparison pre and post treatment.

Figure 12d - Patient L.M. ALF appliance used throughout treatment. Anterior maxillary brackets and sectional arch wire used for last 4 months of active treatment.

Figure 12e - Patient L.M. Post treatment occlusion.

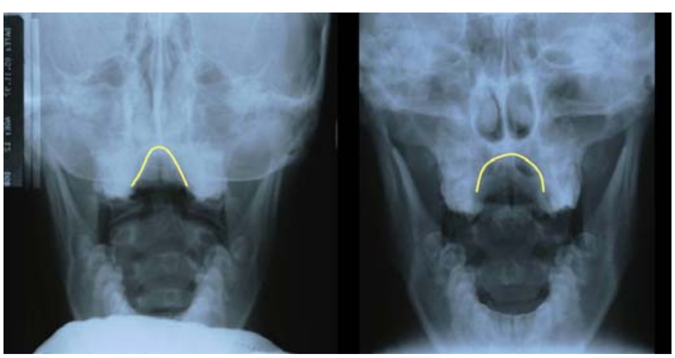

Figure 12f - Patient L.M. Pre and post treatment p-a radiographs showing changes in palatal outline and increased width of nares.

malocclusion occurred as the maxilla was mobilized. The mandible centered itself as the occlusal picture in the maxilla was altered.

Patient R.Q.: (Figures 13a-f)

This 12 year old male had an Angle Class II div. i malocclusion with an underlying inferior vertical strain.[5] There was bimaxillary crowding, severe enough for extractions to be considered. It was decided instead to use the ALF approach. Treatment time was 24 months, with the ALF appliances being used for 14 months. There has been symmetrical expansion of the palate. The p-a radiographs show evidence of orthopedic palatal expansion. On completion of active treatment a mandibular fixed cuspid-to-cuspid retainer was placed. In the maxilla the patient was fitted with a Hawley retainer to be worn only at night. This was broken three weeks after it was fitted, but it was decided not to replace it. The photographs of the treated occlusion were taken one year after the removal of the brackets, i.e. there has been virtually no

Figure 13a - Patient R.Q. Pre treatment anterior view.

Figure 13b - Patient R.Q. Casts of pre treatment occlusion.

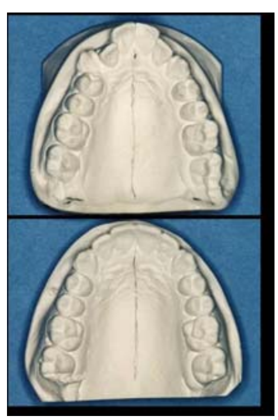

Figure 13d - Patient R.Q. Maxillary ALF appliance.

Figure 13c - Patient R.Q. Maxillary cast comparison pre and post treatment.

Figure 13e - Patient R.Q. Post treatment occlusion 1 year after brackets removed. No retention used in maxilla.

Figure 13f - Patient R.Q. Pre and post treatment p-a radiographs showing reshaping of palate and increased width of nares.

retention at all in the maxilla. The stability of the result is striking.

Patient L.S.: (Figures 14a-j)

This patient had an Angle Class II occlusion on the left and a Class I relationship on the right. The whole maxilla was rotated to the right, while the mandible was rotated to the left. The facial appearance shows the displacement of the mandible. She had a left sidebend cranial strain, confirmed by the radiographic evidence. The problem was compounded by an open bite all along the left side of the occlusion. Unlike all the previous cases, this patient was more internally rotated on the left. This is usual in a left sidebend strain. The impression of the maxilla shows the skewing of the palate to the left. However as with the previous cases, the first objective was to mobilize the more internally rotated maxillary quadrant, in this case the left one.

In conventional orthodontic terms, it would seem logical to attempt to move the high left quadrant downward and outward with a direct elastic from the lingual of the maxillary left first molar to the buccal of the mandibular left first molar. In contrast, the ALF approach was to mobilize the maxillary left quadrant by placing a through-the-bite elastic *on the right side*, i.e. the lower side of the maxilla. Direct placement of the elastic on the left would result in too much force. This would have depressed the tissue reaction, thus restricting the lateral movement of the maxillary left quadrant.

A unilateral pad on the right side of the mandibular ALF started the leveling of the maxilla by elevating the maxillary right quadrant. This helped to close the open bite on the left. In the second phase of treatment, once the left quadrant had been moved buccally and the lateral occlusal plane was more or less level, a class 111 elastic was placed on the right side and a class 11 elastic on the left side. This was to rotate the maxilla to the left and the mandible to the right. Vertical left-sided elastics were then used to settle in the dentition. Fixed appliances were placed for final alignment. Upper and lower ALF retainers were worn for 12 months after active treatment was completed. The occlusion has remained closed on the left. There has been very significant expansion of the left maxillary quadrant, enabling the tongue to adopt an adult swallowing pattern.

A logical initial step in the treatment sequence for this patient is palatal expansion. It is reasonable to assume that a midline expansion gear would serve as the appliance of choice. However the problem which arises with this approach is that the right and left quadrants will respond differently to a lateral expansile force. As we have stressed, the internally rotated quadrant is more resistant to lateral development. In this case, it is the left quadrant which is internally rotated and thus

Figure 14a - Patient L.S. Pre treatment occlusion. Complete open bite between left quadrants. Maxillary left quadrant is in partial cross bite due to its being internally rotated.

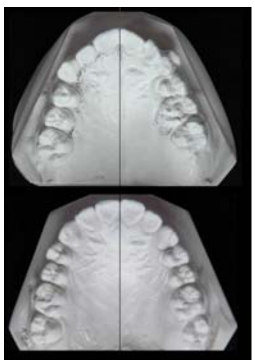

Figure 14b - Patient L.S. Maxillary cast comparison pre and post treatment.

Figure 14c - Patient L.S.   Pre treatment maxillary impression showing that the left quadrant is more internally rotated.

Figure 14d - Patient L.S. ALF appliances in place. First phase of treatment to develop left maxillary quadrant.

Figure 14e - Patient L.S.   Second phase of treatment. Class III elastic on right was supplemented with Class II elastic on the left. Effect was to rotate maxilla to the left and mandible to the right. Vertical elastics now being used to settle in the dentition.

Figure 14f - Patient L.S. Final phase of treatment with full brackets and arch wires for final alignment.

Figure 14g - Patient L.S. Post treatment occlusion. ALF retainers worn for one year. Occlusion has remained stable following retainer removal.

Figure 14h - Patient L.S. Anterior view of pre and post treatment occlusion.

Figure 14i - Patient L.S. Palatal view, pre and post treatment.

Figure 14j - Patient L.S. Pre and post treatment views. Mandible is now centered.

requires more lateral movement to correct the symmetry. If a rigid screwdriven appliance is used, the left quadrant will remain locked with little or no movement, while the right quadrant will be over-expanded. This result would be contrary to what is required here. The asymmetry in fact would be worsened. It would be extremely difficult to close the unilateral open bite. The use of heavy force to close the bite would run the risk of root damage and lead to a very unstable result. This is an excellent example of where the ALP appliance and cranial principles can solve a technical dilemma which would otherwise have a much less desirable outcome.

By any standard this is a complex case. The left-sided open bite with the lateral tongue thrust, as well as the rotation of the maxilla to the right, were especially challenging. The successful outcome reflects an appreciation of the osteopathic features underlying the malocclusion and the effectiveness of light force. The treatment sequence for the initial expansion, while successful, seems counterintuitive until these factors are considered.

This patient's treatment demonstrates the effectiveness of the ALF philosophy as the principal modality in a difficult case. With a grasp of the cranial factors underlying the malocclusion, the treatment plan could be directed to deliver appropriate forces.

Conclusions

To date, the most popular method for palatal expansion used in orthodontics has been a rigid, fixed, transpalatal appliance incorporating some form of mid-line expansion device such as the Schwartz screw. We have argued that an alternative approach to palatal expansion is preferable and shown how this can be achieved. Our conclusions are summarized as follows:

- Asymmetry of the palate and the maxillary arch is the norm for most patients.
- This asymmetry is not randomly distributed. The right quadrant is much more likely to be nearer the mid-line (internally rotated) than the left one, which is said to be more externally rotated.
- Maxillary arch asymmetry is of clinical importance. The more internally rotated quadrant has greater resistance to a lateral expansile force than the externally rotated one.
- It follows that the application of a symmetrical force to an asymmetrical arch will not produce a symmetrical result. The asymmetry may actually worsen with treatment.
- The first step in almost every case requires mobilization of the more internally rotated quadrant. Failure to do so leads to the asymmetry persisting throughout treatment. The internally rotated quadrant becomes an obstacle, creating resistance and resulting in an uneven response of the maxillary arch.
- Rigid transpalatal appliances not only impose an arbitrary expansile force preventing independent movement of each maxillary quadrant. They also severely restrict the physiological rhythmic expansion and contraction of the cranium.
- This rhythm may not fully recover after removal of the transpalatal expansion device. This creates long term imbalance throughout the whole stomatognathic system.
- The insertion of a bulky appliance into the palatal vault and the activation of a mid-line expansion screw is the application of classical Newtonian mechanics. It is based on a mechanistic approach to the body which is seriously out of date. It ignores individual variation and limits the body's ability to self-correct. In particular, the use of rapid palatal expansion is contra-indicated. It is an inappropriate, potentially iatrogenic technique which introduces a large degree of uncertainty as to its immediate and long term effects. It requires overcorrection and prolonged retention to offset the anticipated relapse. It has been shown that RPE is not only inappropriate but is unnecessary.
- Permanent symmetrical expansion of the palate can be achieved by the use of suitably designed appliances and an understanding of how cranial strains can affect the dentition. ALF appliances enable the maxilla to be treated virtually as two separate halves, giving much greater possibilities for a symmetrical outcome.
- Orthopedic symmetrical expansion of the palate is practical with properly directed light forces. Overexpansion and prolonged retention are not required.
- The equating of orthopedic movement with heavy force is actually counterproductive. The continuing use of light force throughout treatment ensures effective orthopedic and orthodontic movement of the tissues, while allowing maximal self-correction of the entire stomatognathic system.

It is possible to use the maxillary ALF appliance just as an expansion device and incorporate it as such into current treatment protocols.[47] However, the successful treatment of the seven cases presented has been due to the recognition of the etiological factors underlying the malocclusion and the ability of the ALF philosophy to address these. Limiting the use of the ALF appliance to palatal expansion is a failure to appreciate the fundamental change in thinking, *the paradigm shift,* which was outlined in the introductory paragraphs of the article and demonstrated in the case reports.

In regard to the self-ligating light wire techniques, especially the Damon system, they provide independent evidence of the effectiveness of light force. Our view is that by combining ALF appliances and ALF philosophy with the Damon system, a powerful alternative to traditional edgewise orthodontics is created. Despite the considerable merits of the Damon technique, it does not, in our opinion, offer the range of possible solutions available with the ALF approach. The anatomical and physiological principles, on which the Damon system is based, are still those of the old paradigm, hence the present disagreement among orthodontists as to its effectiveness.

In this article, we have demonstrated the need to revise the fundamental principles underlying current orthodontic thinking. These principles are derived mostly from the histological evidence of dead tissue and from classical Newtonian mechanics. Useful as these have been, they are no longer sufficient. The gaps in understanding account for many of the disagreements still bedeviling orthodontics. Biological systems need to be approached in another way, as we have discussed previously and have shown in this article. The literature in biology and physics which provides the evidence for this has been available for many years. We have shown how this information can be applied at a practical clinical level in orthodontics, using lateral expansion as an example. This new approach also has major implications in other areas of orthodontics. We hope to explore these in future articles.

Addendum

The body is a non-linear, integrated, self-regulating system, far from equilibrium.[10-14] It is characterized by the instant movement of electrons through the system, requiring us to rethink how the body responds to a stimulus. The mouth plays a major role in the process of transferring energy/information throughout the body.[10-14] This information transfer is necessarily active in all states of health or ill-health. The mouth may act at times as a cause of imbalance and at other times as a corrective or compensatory mechanism.

One way of understanding body information is with the use of Applied Kinesiology.[48, 49] Applied Kinesiology (AK) has proved to be a valuable tool in judging the body's response to a stimulus or intervention. It enables the clinician to assess the body's reaction to a specific level and/or direction of force. It is possible to assess when activation of an appliance is required and then to confirm that any such activation provides an optimal force. It ensures that the body's ability to adapt to the force is not overwhelmed.

AK records a disturbance in the body's energy field. Similarly, it indicates when the field is restored to a balanced state, i.e. closer to a state of ideal health. The body thus provides its own indicator of balance. The recent advances in the understanding of electromagnetic field theory[18, 19, 20, 21, 43] as applied to the body, provide a scientific basis for AK, supporting its use as a practical clinical procedure.

"The significant problems we have cannot be solved at the same level of thinking with which we created them."[50] This is as true of orthodontics as of any field of science. The proposed hypotheses offer a new way of thinking about our profession, a true paradigm shift.[15] They incorporate ideas as to how quantum mechanics applies in biological systems while also recognizing the importance of osteopathic concepts concerning cranial movement and cranial strains.

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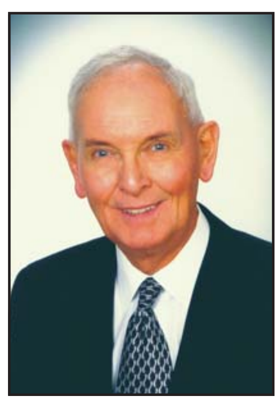

Dr. James is an orthodontic specialist in Niagara on the Lake, Ontario. He maintains a part-time practice, working closely with osteopaths and cranial therapits. He also works as a consultant helping to develop a team approach towards the management of problems of the stomatognathic system.