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Cranial Strains and Malocclusion VII: A Review

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In our introductory article[1] we outlined a working hypothesis, the first part of which was regarding cranial movement and the significance of cranial strains in understanding malocclusion. The cranial concept comes from the osteopathic profession.[2] With this concept, they approach cranial and facial anatomy from a different perspective than our dental training provides. Osteopathic research[3,4] has shown that the way a skull is configured has a bearing on all parts of the craniofacial structures, including the position, relative placement and shape of the dental arches. This means that skull morphology has a significant influence on the position and function of the patient's occlusion. We have to consider the parts in relation to the whole. It means accepting that cranial morphology is influential at every step we make, from our first view of the patient, throughout orthodontic treatment and in the final retentive phase.

How can we make the transition from traditional diagnostics to seeing the distortions within the craniofacial complex, not just mal-positioned dental units? The first step as a clinician is to observe the characteristics of the face and head and to become familiar with common variations of these. Rather than trying to categorize the patient immediately by slotting him or her into a cranial strain pattern, it is best to just start looking at faces and recording what you see. One eye may be lower than the other. The lateral occlusal plane may be horizontal, parallel to the ocular plane or divergent from it. One ear may be more flared, lower or more forward than the other, with the mandible usually displaced towards the more flared side. The malar processes may differ one side from the other. In profile view, the relationship of the forehead, maxilla and mandible to each other is significant. By looking at the patient in this way from both a full face and profile view, you begin to recognize frequently occurring patterns and common correlations. Eventually, you can tell from the visible landmarks of the face what the cranial base orientation might be, i.e. the relationship of the sphenoid, the occiput and the temporal bones. It takes time and practice to develop this ability to recognize the cranial strain patterns, but the effort is hugely rewarding.

Our articles provide a foundation on which to build this new way of thinking. Not every patient will fit neatly into an exact strain category, but by using this approach you can gain an understanding of what is the general configuration of a specific face. While each patient is unique, patterns can be detected. The cranial strain concept offers a logical explanation of what you see and it takes into account characteristics which are simply dismissed or ignored at present. It also offers a broader more comprehensive view of the head and neck than is currently used. We give two examples of how cranial strains may influence the diagnostic process in orthodontic evaluation.

Airway Factors and Cranial Strains

Distortions brought about by cranial strains can cause anatomical encroachment on the airway. Two strains are of particular importance. In both hyper-extension[5] and an inferior vertical strain[6] there is lateral constriction and elevation of the maxillae. There is constriction within the nares themselves resulting in obstruction through the nose. There is also obstruction in the post-nasal area of the pharynx. In the case of the inferior vertical strain, the distal position of the mandible also encroaches on the lower pharynx. To meet the demand of the airway, there is considerable functional adaptation both in terms of the tongue and lips and also head and neck position. This functional adaptation has been well documented elsewhere.[7,8,9,10] An appreciation of the cranial strains helps in understanding the structural characteristics which predispose to airway obstruction. Treatment can be designed accordingly to deal with this concern.

What is common to both the hyperextension and inferior vertical strain is the inward and upward rotation of the body and greater wings of the sphenoid, causing the maxilla to be contracted laterally and drawn up and

back. Figures 1, 2 are of a hyperextension individual showing the high Angle Class III malocclusion found with this strain. Figures 4, 5 are of an inferior vertical strain patient with a Class II, division i malocclusion. The constriction of the sphenoid which occurs in each strain affects the anterior portion of the mid-face and dentition in a similar way.

Fig. 1 - Hyperextension patient. Facial and profile photographs, pretreatment. Maxilla is elevated and back. Patient EW.

Fig. 2 - Intra-oral photographs with A.L.F. appliances in place with Class III elastic hooks for intra-oral traction and Reverse pull facemask. Patient EW.

Fig. 3 - Lateral and A-P development with elastic attachment for reverse pull facemask.

Treatment has to address the maxillary constriction and distal placement. Figures 3, 6 show the Advanced Lightwire Functional (A.L.F.) appliances used in each case in conjunction with Class III elastics during the day and reverse pull facemask at night. Full treatment of the inferior strain patient is described in our article on that strain.[6] By developing the maxilla and repositioning it anteriorly, a significant alteration in airway can be achieved.

Temporomadibular Joint Dysfunction and Cranial Strains

Thirty years ago temporomandibular joint dysfunction was considered primarily as a problem of occlusion.[11] Treatment largely hinged on equilibration of the teeth.[12] We now recognize how restricted this point of view was. As a result of work by Farrar and McCartney,[13] Gelb[14] and Witzig[15] among others, there has been a major shift towards understanding the intricacies of the temporomandibular joints and the myofunctional component.[16,17] With this shift in emphasis, there has been extensive development of various technical means of identifying the problems, e.g. computed tomography and magnetic resonance imaging,[18,19] joint vibrational analysis[20] and myofunctional analysis.[21,22] The focus of treatment has shifted toward stabilizing the mandible as an initial step to allow joint reorganization.[23,24] A second phase of treatment may be required to maintain a new mandibular position. This may involve restorative or orthodontic means.[25,26]

Fig. 4 - Inferior vertical strain patient. Facial and profile photographs, pretreatment. Severe maxillary and mandibular retrusion. Patient KM.

Fig. 5 - Intra-oral photographs. Patient KM. Note mandibular anterior crowding and lack of space for three cuspids.

With an understanding of the cranial concept, current thinking about temporomandibular joint dysfunction is no longer sufficient. What happens posterior to the glenoid fossae is as important as what is happening anterior to the fossae. In other words, an evaluation of the occiput and temporal bones is as important as is the relationship of the mandible to the maxilla.[27] This evaluation of the cranial mechanism is crucial in temporomandibular joint assessment. The cranial diagnostic process is also helpful in establishing the relationship of the maxilla to the cranium as well as the mandible to the maxilla.

The flexibility of the cranium and face, which is present throughout life, offers enhanced possibilities for treatment of a temporomandibular joint dysfunction. This flexibility can be used positively to enhance treatment. A lack of understanding of cranial movement represents a missed opportunity for correction. For example, if there is a significant

torsion[28] with a cant of the maxilla up to the torsion side, the temporal bones, and with them the glenoid fossae, will be at different levels to each other. If treatment is directed towards stabilizing the mandibular position while accepting the torsion component, this falls well short of what could be achieved in the way of change. It leaves the cranial aspect of the dysfunction untouched, i.e. there is an imbalance of the cranial structures which is not being addressed. This creates a risk of the joint dysfunction reappearing despite stabilization of the mandible and the temporo-mandibular joints. If extensive restorative procedures have been done to maintain the correction, this perpetuates the cranial imbalance. In contrast, in a balanced state the cranial mechanism functions without restriction. This is paramount in achieving both dental correction and stability of the temporomandibular joint function.

Fig. 6a - A.L.F. appliances. Class III intra-oral elastics. Reverse pull elastic attachment to first bicuspids.

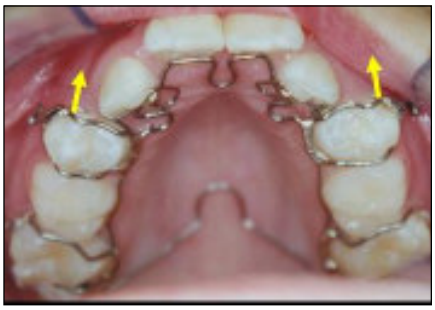

Fig. 6b - Lateral and A-P expansion with elastic attachment for reverse pull facemask.

Cranial Strains and Osteopathic Treatment

The effects of a cranial strain are by no means limited to the head, face and dentition. A discrepancy in the level of the temporal bones is usually accompanied by a pelvic tilt and a compensatory scoliosis.[2] Where there is a cranial strain of any degree, we normally request an evaluation by an osteopathic physician, if available, or alternatively a health practitioner in another discipline who has some osteopathic manipulative training. Treatment initiated by an osteopath may give some relief.[4] However, if malocclusion is a primary factor in the cranial strain, then the osteopathic adjustment may be compromised by the forces of occlusion canceling the effects of the manipulation. This demonstrates the need for an approach where both dental intervention and osteopathic adjustment can be combined, giving a synergistic effect. We appreciate that not every dentist has access to an osteopath or a therapist with cranio-sacral skills. However, it is well worthwhile trying to find someone with whom to work both to benefit our patients and to gain a perspective of the cranial concept from the viewpoint of another discipline.

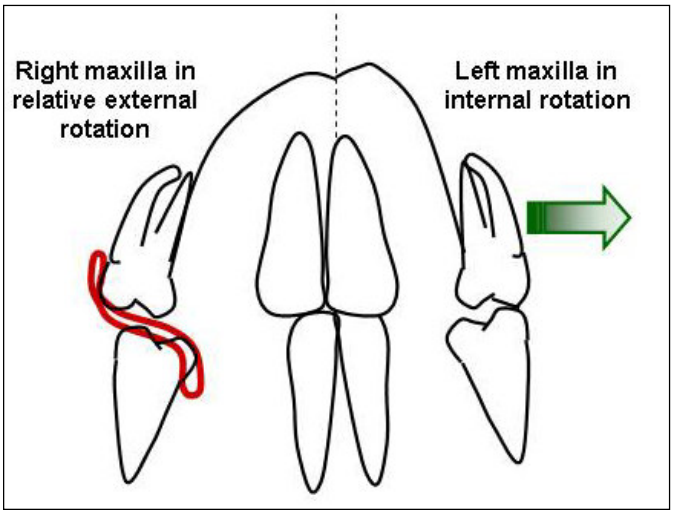

Fig. 7 - Anterior view of molar occlusion with left maxilla in internal rotation. Note difference in palatal vault shape right to left. Through-the-bite elastic on the right side acts as a "brake" on the externally rotated side. A.L.F. appliances are in place. Arrow shows preferred direction of arch development.

Treatment

As with diagnosis an understanding of the cranial concept leads to a radically different approach to treatment. The existence of a rhythmic flexion and extension movement of the cranium throughout life indicates flexibility in areas where this has not been seen as possible, at least in adults. By recognizing the influence of the cranial strain or strains, treatment can initially be directed towards correction of the strain as much as possible by way of the dentition. To date, our most effective tool to achieve this is the use of the Advanced Lightwire Functional (A.L.F.) appliance. The effects of this can correctly be described as orthopedic treatment since it is aimed at the skeletal structures rather than just the dentition. Traditional orthopedic type forces, e.g. rapid palatal expansion, neck strap therapy or high pull headgear are not appropriate. These heavy forces can restrict or overwhelm normal physiological movement of the cranium. Indeed, they can severely limit treatment possibilities or actually worsen the cranial distortion. The use of light force mechanics enhances rhythmic cranial function.

The modified Crozat appliance, known as an A.L.F. appliance, was developed by Dr. Darick Nordstrom.[29] He utilized the Crozat design but substituted a highly flexible wire (Rocky Mountain Yellow Elgiloy) for the alloy normally used. This provides a greater degree of flexibility of the appliance, which he was able to use for his patients who were receiving osteopathic care. The A.L.F. appliance permits the use of very specific force applications. For example, where palatal lateral expansion is required it is usually the case that one side is more internally rotated (closer to the mid-line) than the other. In practice, the more internally rotated side is much more resistant to movement than the external side. Application of a typical mid-line expansion device may result in little or no movement on the internal side and excessive movement on the externally rotated side. In contrast, the A.L.F. appliance is very effective in dealing with this problem by indirect means. In Figure 7, a through-the-bite elastic to a mandibular appliance is placed on the external side, thus stabilizing or anchoring this. Movement is then directed to the internal side. The low level of force is effective in releasing this common palatal restriction. Other technical advantages of the A.L.F. appliance can be listed as:

- The force level can be kept inside the biocompatible zone.
- A maxillary cant can be treated by elevating the low side. This is a response of the whole spheno-maxillary complex, not just a dental intrusion.
- Individual molar rotation can be achieved very efficiently.
- The position of the maxilla can be changed, either by rotation of the whole maxilla using Class II and Class III elastics or by a forward movement with a reverse pull facemask and light force.
- The A.L.F. appliance and use of a lip bumper can address premaxillary constriction and dental crowding.

Treatment sequencing is important. By dealing with the maxillary disharmony early on, effective craniofacial change can be established. Failure to correct an internally rotated maxillary quadrant early in treatment can result in this problem carrying over into later treatment. Similarly, failure to recognize and treat a maxillary cant in the first phase of treatment creates ongoing difficulties at a later stage.

Historical Review

Crozat,[30] who practiced in the first half of the last century, was not aware of physiological cranial movement but was very much in favor of light force. He felt that "only mild processes are needed to create change as long as they are applied in a proper direction." He wished "to deliver stress through the medium of the teeth to the supporting structures." His objective was to achieve skeletal change by the use of a light force system over extended periods of time. He had an appreciation of the importance of soft tissue behavior and the need to develop good function. Extraction of teeth was generally not considered necessary and heavy orthopedic type force such as rapid palatal expansion or headgear therapy was not used. Latterly, clinicians using the Crozat approach have also developed an awareness of physiological cranial movement.[31]

Crozat's ideas from more than 70 years ago are of particular relevance at this time. The combination of self-ligating low friction brackets[32,33] with highly flexible arch wires has been one of the most interesting and controversial developments in orthodontics over the past ten years. These advances in bracket design and wire technology have resulted in a marked reduction in the extraction of teeth and in the avoidance of heavy orthodontic mechanics. The A.L.F. appliance has always been a low force, low friction system. The interesting question arises as to whether the new bracket systems and light wires are achieving some of the cranial correction we know is possible with A.L.F. appliances. The cranial concept may be the key to understanding the effectiveness of these systems.

Physiology of the Cranial Mechanism

To bring the cranial concept from theory to practical application, it is important to recognize the extent of the ability of the cranial sutural mechanism to adapt. The cranial sutures are a physiological mechanism designed to accommodate or adapt to the existing anatomical make-up, with or without an imposed strain or restriction being present. As an extension of this idea, we can utilize the patient's inherent adaptive capacity to implement a corrective change. If appropriate force is used, this will result in improved range and amplitude of motion within the cranial mechanism. This is the body's natural reaction to very light and favorable forces. It represents a biological rather than a mechanical response. At the sutural level, this biological change (adaptation) allows correction of areas where restriction of movement has occurred. Freeing of sutural restrictions enables auto-correction so that structures can relate more harmoniously in function. The cranial concept supercedes the mechanistic approach for the correction of skeletally based dental abnormalities.

We conclude this article with a summary of our original hypothesis.

- There is a rhythmic physiological movement of the cranium throughout life. This movement centers around the junction of the sphenoid and occiput, the spheno-basilar symphysis.
- Distortion can develop at the spheno-basilar symphysis. These distortions or strains give rise to characteristic cranial and facial features.
- By extending Sutherland's[34] cranial classification to include the dentition, it can be shown that each strain, singly or in combination, predisposes to a specific type of malocclusion.
- Classification of the cranial strains supercedes the Angle Classification as a way of describing the face and dentition.
- By recognizing the presence of cranial movement, orthopedic type change in the skeletal structures can be achieved but with the use of very light force, which does not distort or overwhelm physiological cranial movement.
- An appreciation of cranial strains provides a basis for orthodontic diagnosis and treatment, which is more comprehensive than current practice.

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