The Aetiology of Malocclusion

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The Aetiology of Malocclusion

For thirty-three years I have been practicing orthodontics and dentofacial orthopaedics. I have observed abnormal muscle habits and breathing patterns that the child adopts in the first years of life. These habits can have an adverse influence on the growth and development of the jaws and the dentition. I have helped children modify these patterns and as a result have seen an improvement in the growth and development of the face, the jaws and the dentition.

The orthodontic teaching that I received as an undergraduate was based on the assumption that the shape and size of the jaws are fixed. We were taught that orthodontics is limited to moving teeth within the jaws. Any attempt to change the skeletal structure would later result in relapse with disappointment for the patient and practitioner.

We looked at the aetiology of malocclusion but there was no attempt when treatment planning to correct the cause of the problem. We would watch the child growing and developing in the mixed dentition but not start treatment until the patient was in the permanent dentition and most of the growth of the head and neck was complete.

Today, I like to see children in the mixed dentition, while they are still growing. When I observe habits and patterns that are having an adverse influence on growth and development I try to help the child modify those patterns and try to re-establish normal growth. When I succeed facial appearance improves.

I have studied with teachers who show that we can influence jaw shape, size and relationship. Also, I have learned that the bones of the jaws are an integral part of the cranium and we need to consider the whole cranium when diagnosing a malocclusion. The cranium is supported on the spine which itself is supported on the pelvis and feet. An imbalance or distortion in any part of the system will be reflected throughout the system.

My practice of orthodontics has changed in recent years. Today, when I look at the distortions of the jaws I see them as reflections of the distortions in the cranium and body and treat them accordingly. When diagnosing and preparing a treatment plan I consider form, function and posture in order to establish the aetiology and treatment of the malocclusion.

Form: The shape and size of the upper and lower jaws.

Function: The effects of breathing, swallowing, chewing and talking on the dentition.

Posture: Balance of the entire skeletal system or how the dentition is supported in space.

Form

The ideal form of the upper jaw is a Gothic arch shape.

The arch width tapers anteriorly and posteriorly with the widest part of the arch at the mesio-buccal cusp of the upper second molars. When no third molars are present the widest part of the arch is at the mesio-buccal cusp of the upper first molars. For this to be true the molars have to be correctly rotated. In most malocclusions the molars are mesially rotated.

Figure 1. An anatomical view of the maxillae showing a healthy arch form

The upper arch comprises four separate bones: two maxillae and two palatine bones. These bones are separated by sutures that are normally open throughout life. This is significant in therapy because the palatal roots of the second and third molars are located not in the maxillae but in the palatine bones. There is commonly a distortion in the relationship between the palatine bones and the maxillae. This is manifested by upper second and third molars, which erupt buccally and are mesially rotated.

The healthy form of the upper jaw is with a wide arch and low vault. The airway is directly above the hard palate; a high vault reduces this airway. We need the airway to be patent to facilitate normal nasal breathing. The importance of this will be discussed later in the chapter.

Figure 2. Anterior view of the maxillae.

It is also important to realise how the shape of the middle third of the face is determined by the shape and size of the maxillae. Two thirds of the floor of the orbit is the maxillae. When the maxillae are properly formed it gives an attractive shape to the face and good eye support.

In normal growth and development the upper arch form is determined and guided by the tongue. The tongue should rest and function in the palate. When the tongue is resting in the palate the teeth erupt around the tongue producing the normal or healthy arch form I have described. The mandibular growth follows the upper arch. With normal function and posture the mandible will develop so the upper and lower teeth occlude correctly.

The shape of the upper arch can be changed at any age. The width and length can be altered with orthopaedic appliances. I have seen and used a wide range of designs of orthopaedic appliances over the last thirty-three years. I favour designs that have the least impact on the reduction of tongue space.

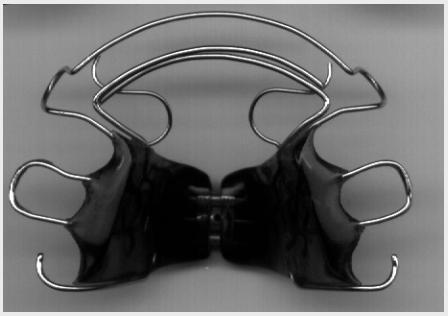

Figure 3. Dr Mew's Biobloc 1 is used to expand the upper dental arch with minimum impact on tongue space.

When the arch form has been altered very often that new form is unstable and relapse is common. Stability of the new arch form is dependent on making a change in either function or

posture or both. If neither function nor posture is changed in conjunction with changing arch form then relapse follows.

I have good records of arches that I have developed and then maintained that new arch by improving function.

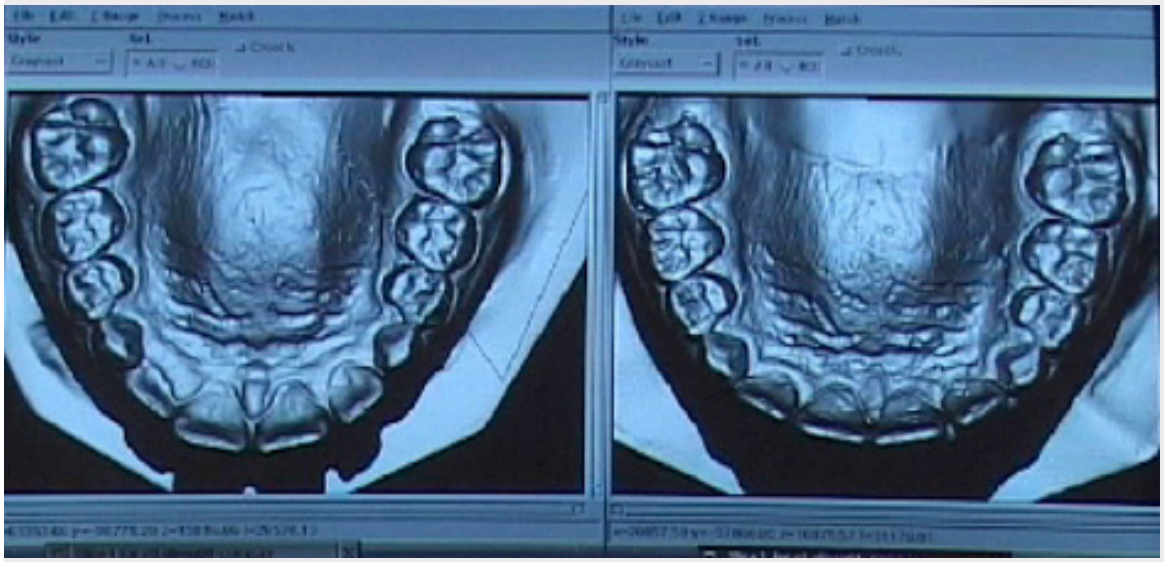

Figure 4. Laser scans of models before and after arch development.

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Function

We need to look at muscle function when looking for the cause of a malocclusion and poorly formed dental arches. Breathing, swallowing, chewing and talking use groups of muscles working together and sequentially. These muscle groups are an integral part of the cranio-facial muscle system. Bone acts very much as a slave to the requirements of the muscles attached to them. Abnormal muscle function can be seen to modify and distort the shape of the bones and have an influence on tooth position.

The first function that we need to look at is breathing. Numerous studies (1) have shown that in mouth breathing children the jawbones are distorted and misplaced. Mouth breathing is always associated with low tongue posture. When the tongue does not rest and function in the palate I always see an underdeveloped, retrognathic upper arch.

When Harvold did his experiments with monkeys (2) he found that all young monkeys who had their noses surgically blocked developed abnormal facial growth and malocclusions. What was interesting was that while they all had malocclusions they were different from each other. I observe the same range of malocclusions in the mouth breathing children that I see.

Establishing nasal breathing in growing children must be a priority to prevent abnormal growth and development of the face and jaws.

Figure 5. Change in arch form, occlusion and facial appearance after establishing nasal breathing

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A second group of experimental monkeys had inserts placed in the palate that lowered tongue posture. Again all these monkeys developed a malocclusion. All the children I see with their lips apart at rest will have a low tongue posture and all these children will grow an underdeveloped upper arch and malocclusion.

Establishing a lip seal in growing children must be the second priority to prevent abnormal growth and development of the face and jaws.

Figure 6. Change in arch form, occlusion and facial appearance after establishing lip seal.

Establishing a lip seal is an important part of therapy.

Edward Angle (3) noted nearly one hundred years ago malocclusions are related to abnormal swallowing patterns.

In the aberrant swallowing pattern it has been estimated that the lower lip (4) can apply a force of 100-300 grams and the tongue (5) up to 500 grams against the teeth. Studies have shown that very light forces are required to move teeth. This is why orthodontics works! Light forces, continuously applied, move teeth. (6)

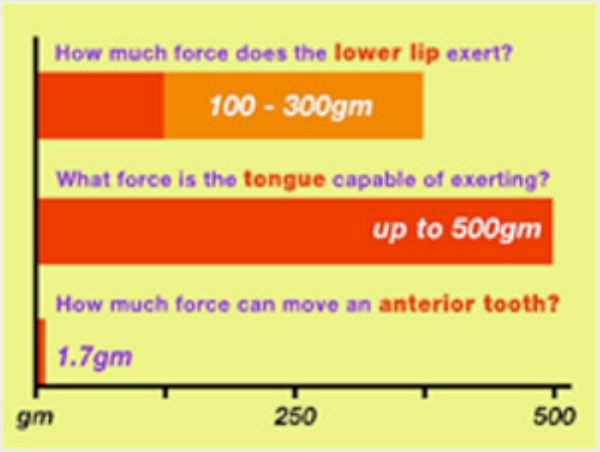

Figure 7. A graph showing relative forces applied to the teeth and the force needed to move teeth

We swallow consciously when we eat and drink and subconsciously while awake and asleep. It has been estimated that we swallow subconsciously about two thousand times a day: once a minute during sleep and twice a minute while awake. In a normal subconscious swallow the tongue should rest and function entirely in the palate and there should be no perioral muscle activity at all.

In abnormal swallowing patterns the tongue does not function in the palate and a range of muscles are used to complete the swallow. When the tongue does not rest and function in the palate it will either rest in the lower arch, between the teeth or a combination of both. When we can identify where the tongue rests and functions we can match that to particular malocclusions.

When I see a child for an initial orthodontic consultation, I watch them as they breathe, swallow and talk. By observing these patterns I can predict what the malocclusion is going to be like before I look in the mouth. Once we have established the incorrect muscle patterns the challenge then is to try to modify them.

Soft Tissue Dysfunction Analysis

When I assess muscle dysfunction the first question I ask is, "Is this child a mouth breather or a nose breather?" If the child is a chronic mouth breather, the tongue will neither rest nor function in the palate and so I would expect to see a narrow, retrognathic upper arch. Very often this is associated with a tongue thrust resulting in an anterior open bite. The 500 grams of tongue pressure has forced and is continuing to force a hole through the anterior dentition in order to establish an airway. Sometimes in the mouth breathing child the tongue will rest inside the lower anterior teeth producing a well-developed lower arch with well-aligned lower anterior teeth. These children often show a class 3 incisor pattern. When the tongue rests between the upper and lower teeth, both arches will be underdeveloped with crowded upper and lower incisors.

Figure 8. Mouth breather with tongue supporting lower teeth with tongue thrust

Figure 9. Mouth breather with tongue not supporting lower teeth with tongue thrust

The next question I ask is, "Are the lips together at rest? Is the mentalis muscle active in order to bring the lips together? " The mentalis muscle is under conscious control. So, I know that if the mentalis muscle is being used to create a lip seal the lips will be apart at rest and sleep. If the lips are apart at rest then the tongue is unlikely to rest or function in the palate and again we will see a narrow upper arch. If the tongue does not rest or function in the palate, we need to study the muscle activity to determine where the tongue does rest and function. Very often it rests between the teeth. If so, the buccinator muscle will be active on the swallow in order to bring the mucosa inside the cheeks in contact with the lateral border of the tongue to produce the seal that is required to swallow. If the tongue rests between the posterior teeth I would expect to see instanding lower molars. If the tongue rests and functions on top of the lower posterior teeth and inside the lower anteriors I would expect to see a deep Curve of Spee.

Figure 10. Active buccinator muscle and instancing lower molars

The next question I ask is "Is there any perioral muscle activity on the subconscious swallow?" When perioral muscles are active on the subconscious swallow they will place a lingual force onto the lower incisors. If this force is balanced by pressure from the tongue from the inside the lower anterior teeth may be well aligned. More often the tongue does not rest and function inside the lower incisors and the lower anteriors are pushed lingually and are crowded.

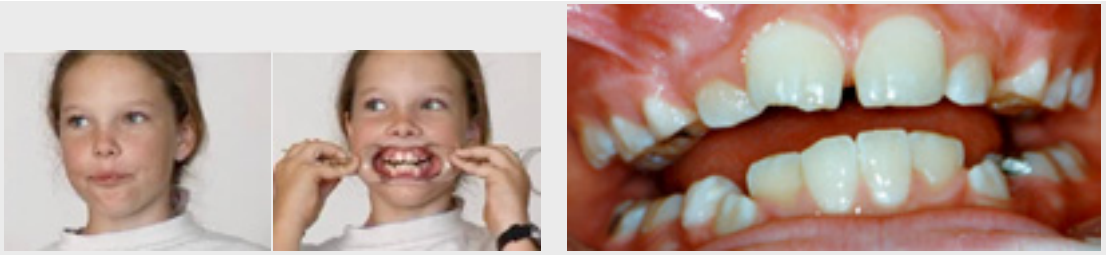

Figure 11. Active mentalis muscle with the lower teeth not supported by the tongue resulting in lingually placed lower incisors

The next question I ask is "Does the lower lip rest and function behind the upper anteriors?" If the lower lip rests behind the upper anterior teeth then it will be sucked into the mouth to make contact with the tongue on swallowing. The volume of the lower lip that rests and is sucked behind the upper incisors during the subconscious swallow is directly related to the size of the overjet.

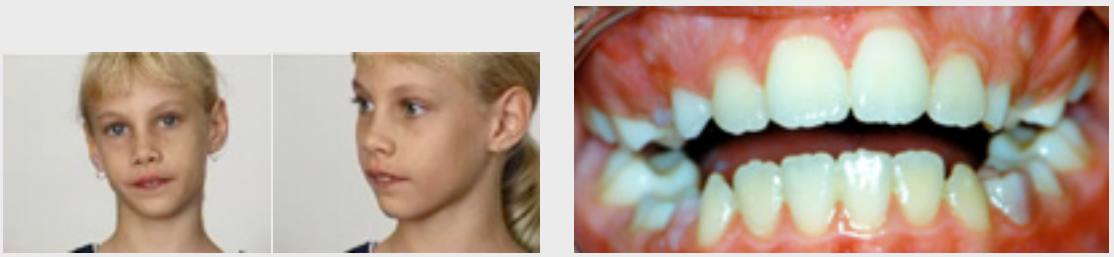

Figure 12. The lower lip rests and functions behind the upper front teeth; the tongue sits on the lower posterior teeth and inside the lower anterior teeth

Having shown the direct myofunctional influence on dental patterns we then need to know if it is possible to modify muscle activity in growing children. If it is possible to influence myofunctional activity in growing children, reliably and consistently, then we need to incorporate this as part of our therapy.

In order to help a child develop the correct tongue posture we need correctly formed maxillae that will allow the tongue room to rest and function in the palate. So we need good form to establish good function and good function to maintain that good arch form.

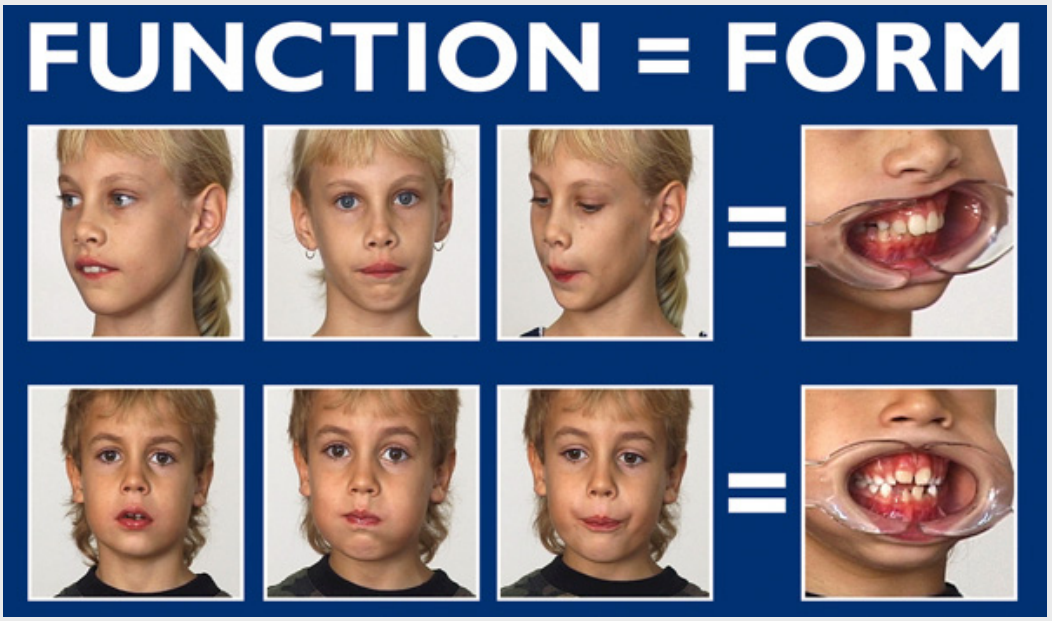

Figure 13. Showing two different patterns of muscle dysfunction and their associated malocclusions

After an expansion in mixed dentition the well-formed maxillae enables the mouth breather the opportunity to develop nasal breathing. It is difficult to establish nasal breathing until the nasal passages have been enlarged in conjunction with the maxillary expansion. For this reason I often develop the upper arch at the start of treatment in mixed dentition cases.

I then use appliances to train the tongue to rest and function in the palate, establish a lip seal, nasal breathing and reduce perioral muscle activity on the subconscious swallow.

I have extensive photographic and video records to show that it is possible help children improve myofunctional and breathing patterns reliably and consistently. I have travelled to forty-five countries in the world teaching these techniques.

Posture

The body can distort in three different planes. We call them roll, pitch and yaw.

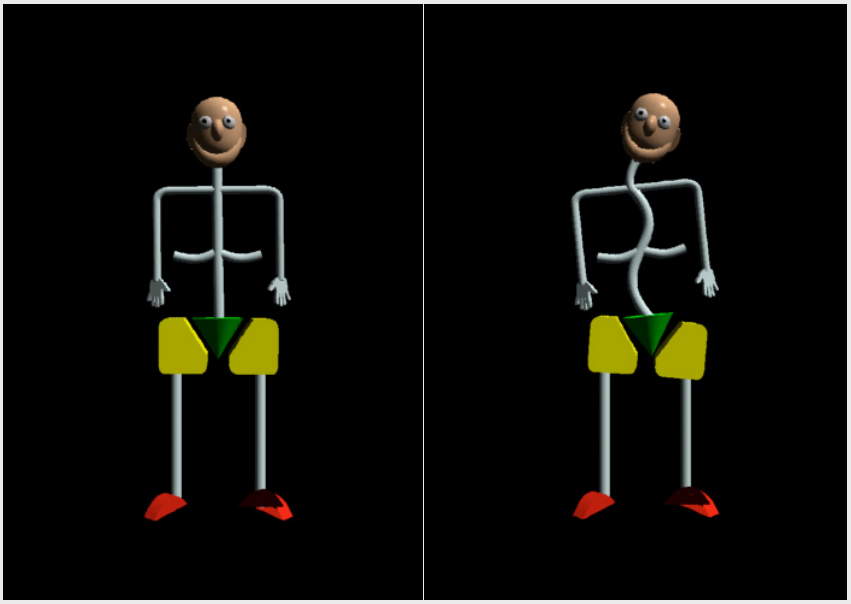

Figure 14. A typical roll distortion

A typical roll distortion with the pelvis high on the right side, the shoulder high on the opposite side on the left and the ear high on the right the same side as the high pelvis

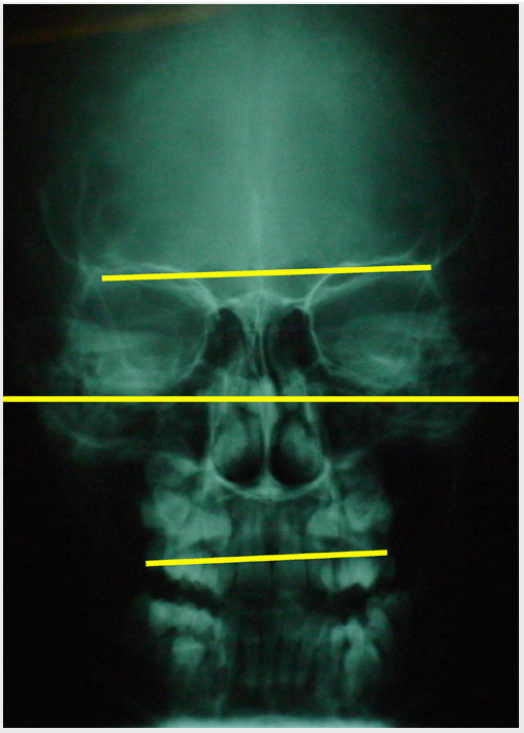

Figure 15. A PA cephalometric radiograph of the skull marking three planes through the fronto zygomatic sutures, the glenoid fossae and the maxillary occlusal plane showing a roll distortion in the cranium. These planes can be identified clinically

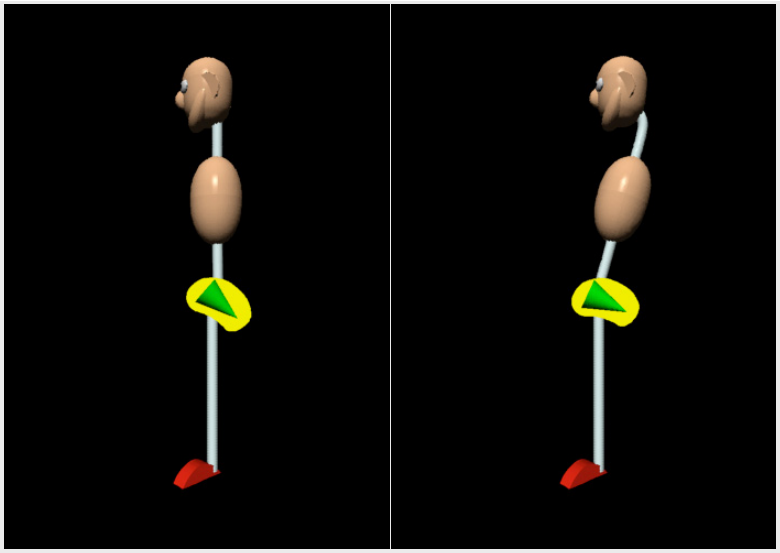

Figure 16. A typical pitch distortion

Showing a typical pitch distortion with the pelvis rotated forward the thorax back and a forward head posture.

Yaw is more difficult to demonstrate but it is where one shoulder is forward or one side of the pelvis is forward. This is also reflected in the cranium.

Figure 17. The stick is placed behind the upper canines and it shows a yaw distortion in the cranium

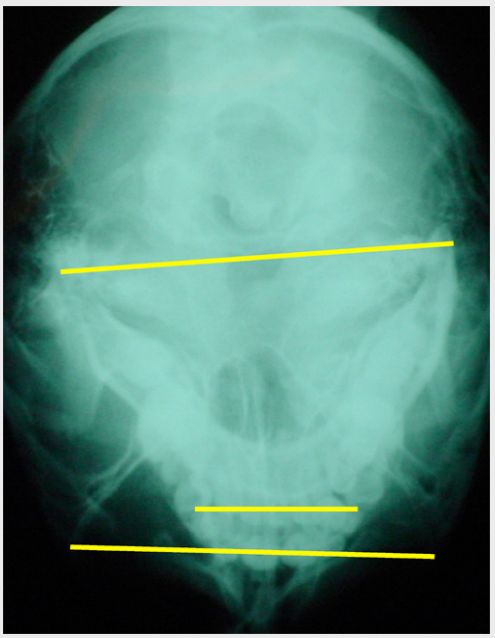

Figure 18. The same patient showing a submental view. This demonstrates a yaw distortion in the cranium. The lines demonstrate three planes through the glenoid fossae, the fronto-zygomatic sutures and the upper canines. These planes can be identified clinically.

The adult human cranium weighs about 4.5Kg and is supported on top of the spine. When the cranium is not held level the weight of the contents of the cranium will move "downhill". In the growing child this imbalance will cause the bones of the cranium to distort to compensate for

the extra mass on one side. We are dealing with a single system. There is no distortion in one part of the body that is not reflected throughout the body including the cranium. The greater the distortion in the body: the greater the distortion in the cranium.

Figure 19. Cranium showing distortions in Occipital bone, sphenoid and mandible

In order to evaluate head posture we need to look at the entire body. For a level cranium we need: level shoulders; a level stable pelvis and good support from the feet. I look at all of these when I am looking for the aetiology of the malocclusion. I note the distortions and imbalances. I do not treat these areas but I work closely with other practitioners who can help.

Cranial distortions are reflected in the shape and size of all the bones in the cranium, including the mandible and the maxillae. When we make a class 2 skeletal correction we bring the mandible forward but also we take the cranium back. This occurs every time even if we have not noticed or recorded it.

When I observe the posture of the chronic mouth-breathing child I see the head is tipped back. This imbalance will cause the cranial bones to distort. When I establish nasal breathing I record the change in the head posture. The head tips forward to a normal posture. This will create the opportunity to regain normal growth patterns within the cranium.

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Figure 20. A class 2 dental pattern is associated with a forward head posture. In therapy, when the mandible comes forwards the head has to go back at the same time. Patient treated by Dr Tony Simeone

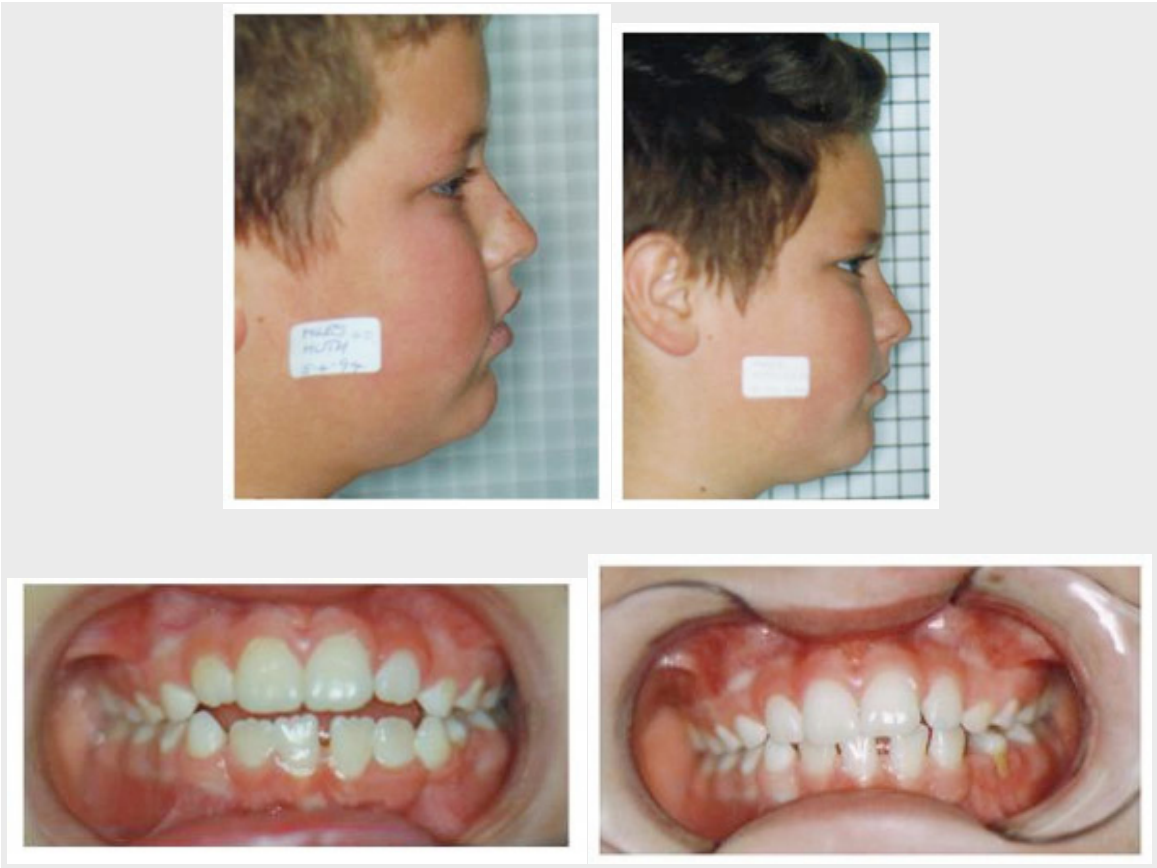

Figure 21. Change in head posture associated with the establishment of nasal breathing and bite closure. Patient treated by Dr Chris Farrell

The Influence of Posture on the Cranium and the Dentition

I want to consider the cranium in three different sections.

- The posterior section of the cranium comprises the occipital bone, the temporal bones and the parietal bones.
- The middle part of the cranium comprises the frontal bone and the sphenoid.
- The anterior part of the cranium comprises the Maxillae, the Palatine, Nasal, Lacrimal bones and the Vomer.

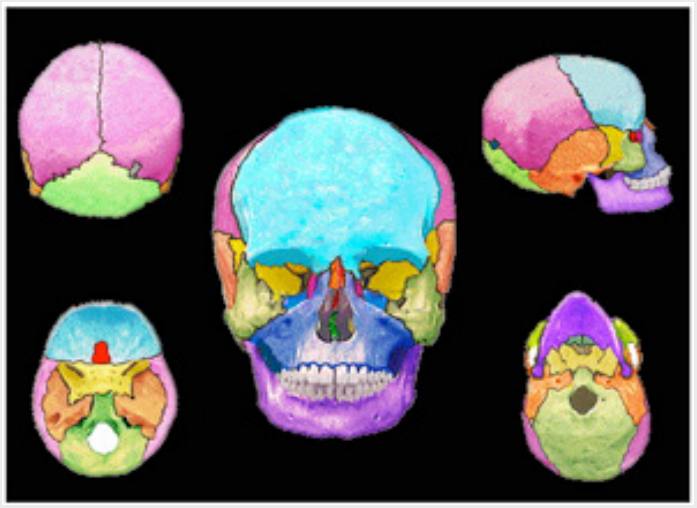

Figure 22. The cranium can be divided into three parts. Posterior, middle and anterior parts.

When there are distortions in these bones there will be a distortion in the relationships of the bones to each other. When I observe and examine patients faces and heads I see many areas of asymmetry. Facial and cranial asymmetry is evidence of a cranial distortion. The mandible attaches to the posterior section of the cranium at the temporal bone through the temporo mandibular joint. The mandible also connects to the anterior part of the cranium, through the dentition to the maxillae. In order to enable the mandible to match these two distorted parts of the cranium the body has to make compensations. It makes compensations at the temporo mandibular joint and at the occlusion. A malocclusion is a compensation for a distortion in the cranium, which reflects a distortion in the body.

I am working with non-dental practitioners who work to improve the posture of patients. They improve foot support, help to establish a level stable pelvis and level shoulders. This enables me to improve the balance of the cranium on the atlas. When we make the improvements in the growing child we will see those improvements reflected in an improvement in the occlusion.

Conclusions

I have treated hundreds of patients with dentofacial orthopaedics. I have excellent records of all the patients I have treated before and after treatment. I review every completed case with the patient and parent. I display before and after records and evaluate the changes I have made. I see a range of results. Using the same appliances used in exactly the same way I see some very good results with good permanent changes and some results showing virtually no permanent change at all. It is tempting to attribute this to poor compliance on the part of the patient but I think there are other factors at work.

Why is there so much variation in treatment results?

In order to make a permanent change on the occlusion we need to address form, function and posture.

Sometimes when I expand the upper arch (altering the form) the patient is then able to move the tongue into the palate (improving function) and they do so with no help. These are the expansion cases that are stable. In my experience most children do not make this change without help, which is why so many expansion cases relapse. Today the only reason I expand an upper arch is to assist the child to improve function. We need to create room in the palate for the tongue to rest and function in the palate. We then need to train the tongue to rest and function in the palate in order to retain the new arch form.

Stability and Relapse: three choices.

When I do my case presentation before I start every course of treatment and when I review every case I discuss relapse and stability. When we complete an orthodontic case the patient has three choices. Either they have corrected the function and posture, or they need permanent retention or there will be relapse. It is for this reason that many cases are completed needing permanent fixed or removable retention. My aim is to achieve stability which means no permanent retention, so I have to address form, function and posture.

To what degree the practitioner can influence function and posture will often depend on how well motivated the patient is. In my experience it is very difficult to encourage children to do regular exercises of any sort. To change function and posture, exercises and training are required. I use appliances that assist the child to improve myofunctional patterns. When I improve myofunctional activity in growing children I see an improvement in tooth position, jaw shape, size and relationship and facial appearance.

It is my experience that we do not need to make a complete correction of function and posture in order to record stable improvements in the occlusion and facial appearance.

I would urge all practitioners who are altering the occlusion to observe, measure and record function and posture. To assess the aetiology of the malocclusion, and then to address the

cause. We need to address the cause of the problem as well as treating the result of the problem.

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