Craniofacial dystrophy. A possible syndrome?

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IN BRIEF

- Describes a possible pathological process underlying malocclusion, which relates malocclusion with a range of other diseases and problems.
- Proposes a hypothesis for open discussion by all members of the dental and medical profession
- Questions the current assumptions supporting orthodontic therapy and proposes a radical shift in thinking that extends far beyond the teeth.

OPINION

This article proposes a possible syndrome, craniofacial dystrophy (CFD), as one of the underlying causes of malocclusion and a range of other symptoms. These symptoms have seen a dramatic rise in the twentieth century, lack a clear aetiology and are currently treated symptomatically. Over the last 10,000 years there has been a progressive downswing in the anterior craniofacial structure (ACS), possibly due to a combination of changes in the masticatory effort and the posture of the tongue and the mandible. If the mouth is postured open and the muscles are weaker the face lengthens, a downswing, reducing the cross sectional area at the level of the oropharynx. This leads to less space for the tongue, the airway and the teeth, and is exacerbated by an increasingly evident 'suckling like' swallowing pattern. Changes in the shape of the ACS affect the functions for which this structure is responsible, leading to a range of symptoms, including malocclusion. Certain compensatory responses are possible to maintain these functions, primarily the airway. These vary between individuals, may be under genetic influence and may also influence the ACS and dentition, at times creating vicious cycles.

INTRODUCTION

It is projected that the next generation will live beyond 90 years and many can also expect to be dentate for most of this.[1] Few, however, will have an ideal occlusion for a significant period of this lifespan. The general dental profession has achieved much by understanding the causes and pathology of decay and periodontal disease. However, despite great efforts there is inadequate evidence for the orthodontic profession to draw clear conclusions regarding the causes and pathology for malocclusion.

What evidence we do have is limited by the lack of sound theories to test. It is clear that the environment can, at times, have a large influence on facial development and malocclusion, but there are few theories that explain the observed environmental effects.[2,3] We also seem to have forgotten that our ancestors had complete and reasonably good occlusions from birth to death,[4] as do nearly all dentate vertebrates today.

Opinion articles should act as a platform to make openly, speculative suggestions, to find common ground with other professionals to either support or detract. This article proposes a possible pathology underlying malocclusion, to act as a null hypothesis to be tested. To avoid preconceptions, a favourable, anterior rotating,[5] horizontal growth pattern will be referred to as upswing and the opposite as downswing.

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Accepted 12 February 2014
DOI: 10.1038/sj.bdj.2014.401
©British Dental Journal 2014; 216: 555-558

AETIOLOGICAL FACTORS

Masticatory effort

Between the Neolithic and Medieval periods it was common to completely wear away the clinical crown by the age of 45.[6] This was due to a tougher, more fibrous, less calorific diet and non-nutritive uses, such as leather processing and tool making. Compared to modern attrition this suggests a massive reduction in muscle usage over this time period. The effect of changes in the action of the masticatory muscle due to strokes, nerve damage, muscular dystrophy or animal experiments[7] on the anterior craniofacial structure (ACS) are well established and well-marked.

Posture

Over the last century and certainly the last few decades, the incidence of nasal congestion has risen considerably.[8] If the nasal airway is blocked then the tongue and mandible are lowered, the lips separated and the head postured forwards.[9] While initially this facilitates breathing the change can become habitual. At puberty, as individuals become socially aware, lip seal may improve but it appears that the 'tongue to palate' posture is rarely re-established. The effects of a change in the mode of breathing[10,11] and tongue posture in isolation[12] on the AFC are unequivocal.

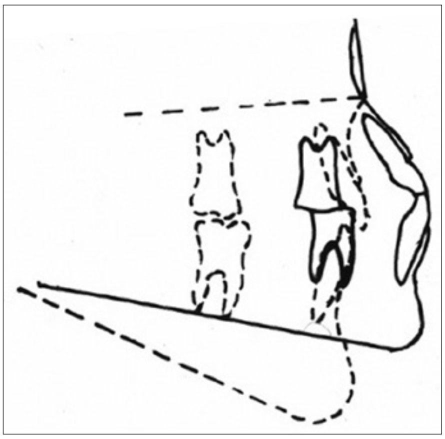

Fig. 1 Tracings comparing ancient and modern (mid twentieth century) skulls – both have naturally aligned teeth and are considered good examples of their period. Note the difference in molar position, due in part to changes in arch widths

Swallowing pattern

In an ideal adult swallow, the tongue should push upwards, outwards and forward on the palate and the perioral muscles should be passive.[13,14] This now seems rare, with most individuals displaying some perioral activity, with a 'suckling like' swallow, that pulls backwards and inwards on the dentition and does not support the maxilla. The teeth and alveolus are pulled inward and backwards, reducing the tongue space. The suggested cause has been a lack of breast-feeding,[13] however, the author also proposes the early introduction of semi-solid foods before the adult swallowing reflex is fully developed as a factor.

COMPENSATORY MECHANISMS

Changes in the shape of the ACS disturb many of its functions, some of which such as breathing and swallowing are vital. To facilitate these, certain compensations are possible, which vary both at a group and individual level, influencing both the signs and symptoms of craniofacial dystrophy (CFD).

1. The head can be postured forward by flexing the neck while maintaining the inclination of the head. This opens the airway by extending the head
2. The tongue can be moved up out of the airway, usually with some of its bulk placed between the teeth in a variety of positions, affecting mandibular position (the 'tongue' effect).
3. The mandible can be lowered and postured forwards, backwards, laterally or remain central. It is influenced by the position of the tongue and the need to maintain a comfortable intercuspal position (the 'mandibular' effect).

The exact nature and sequence of these compensations is not clear, however, some exacerbate their causes creating self-reinforcing 'vicious' cycles. For example both the change in swallowing pattern and a lower maxilla reduce the tongue space encouraging a 'tongue-between-tooth' posture which encourages a 'suckling like' swallowing pattern and reduces the support of the maxilla.

SIGNS OF CRANIOFACIAL DYSTROPHY

The entire cranium is affected by a downswing; the saddle angle (BSN) increases; the interpupillary distance decreases; the temporomandibular joint (TMJ) moves posteriorly; and the occlusal plane usually drops anteriorly. The ACS lengthens and the cross-sectional area at the level of the oropharynx reduces.

The maxilla and the surrounding bones are the most affected, both in position and shape, although their overall volume remains relatively constant. The direct forces of the tongue on the palate and indirect forces via the teeth influence the growth direction of the maxilla. When both are reduced in duration and force, the maxilla drops down and back (Figs 1 and 2). This reduces the eye support; flattens the cheekbones; narrows the nasal airway; lengthens the mid facial third; and lowers the palate, which narrows.

As the maxilla descends and the teeth over erupt (and are worn less), the mandible hinges open. The ascending ramus appears largely unaffected due to remodeling, to prevent it encroaching on the functional matrixes of the neck, also, the angle is less pronounced from less muscular activity. Consequently the mandible flattens and the gonial angle increases (Fig. 3). There is usually little variation in its ultimate length, except in some extreme Class III's.

SYMPTOMS OF CRANIOFACIAL DYSTROPHY

Most of the functional systems associated with the ACS are affected, although in this article malocclusion will be considered in more detail, with an attempt to illustrate this graphically (Figs 4, 5 and 6). There is a wide variation in incidence due to the variation in individual's responses.

Malocclusion

Considering the difficulty in artificially emulating and maintaining a good occlusion it seems near miraculous that our ancestors and other animals achieved this naturally. This is due to the dentoalveolar compensatory mechanisms (DCM),[3] the balance of the soft tissues surrounding the dental arches in both function and posture. The change in the ACS and the associated compensatory responses disrupted this system affecting the position of the teeth.

Ideal occlusion

This is a position prognathic and brachyfacial of most cephalometric normal values. It is observed in ideal occlusions,[15] attractive faces[16] and indigenous populations. It is also called the Mesolithic norm[17] and is not considered a malocclusion. It is typical of individuals who rest with their tongues on the roof of their mouths, lips together and teeth near contact[18] with good head, neck and body posture.

'MANDIBULAR' EFFECT

Class I

This is the most diverse pattern of malocclusion extending from very mild malocclusions with all but the wisdom teeth in good occlusion, to severe malocclusions with large downswings and gross dental crowding. Typically the mandible rests centrally below the maxilla and the dental arches are in a Class I relationship as judged from the first molar.

Fig. 2 A treated case that illustrates the opposite effect of CFD. Note that the mandible does not appear to change length but angulation, with changes occurring in the maxillary position and shape

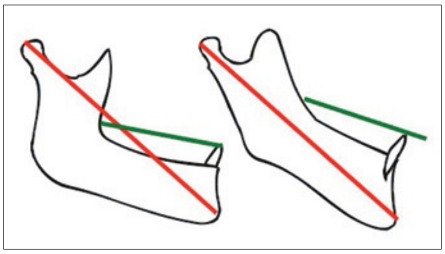

Fig. 3 The overall mandibular length for these two subjects is almost the same. However, the overall shape and arch lengths differ, with the wisdom teeth and incisors the most affected areas

Class II

The mandible hinges open and back, and the tongue moves forwards into the space provided. Often associated with a forward head posture.

Class III

The mandible is held forwards, bringing the tongue forwards, possibly increasing the length of the mandible.

Cross bite

When the upper dental arch is moderately narrowed a more comfortable intercuspal position can be created by shifting laterally to the left or right, which can account for some cross bites.

'TONGUE' EFFECT

Making an assessment in the intercuspal position is reproducible but does not always represent the habitual position and distorts the examiners viewpoint, especially with deep bites. At rest the tongue is moved up out of the airway, usually crossing the periphery of the dental arches to rest in a variety of positions.

Bimaxillary protrusion and anterior open bite

The tongue is postured forwards. In a mild downswing (mainly vertical at this geometry)

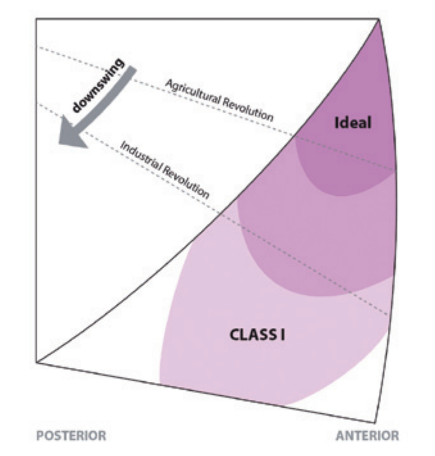

Fig. 4 The estimated effect of antroposterior mandibular rest position (horizontal) and swing pattern on the occurrence of Ideal and Class I occlusal patterns

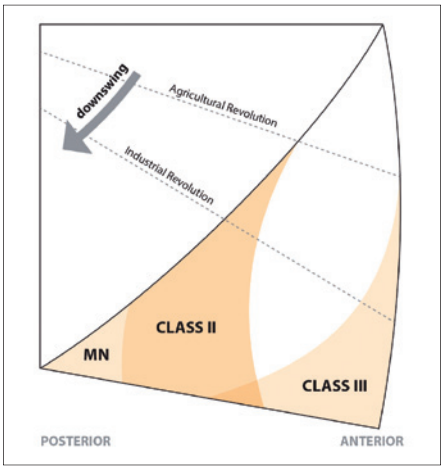

Fig. 5 The estimated effect of antroposterior mandibular rest position (horizontal) and swing pattern on the occurrence of Class II and Class III occlusal pattern, and micrognathia

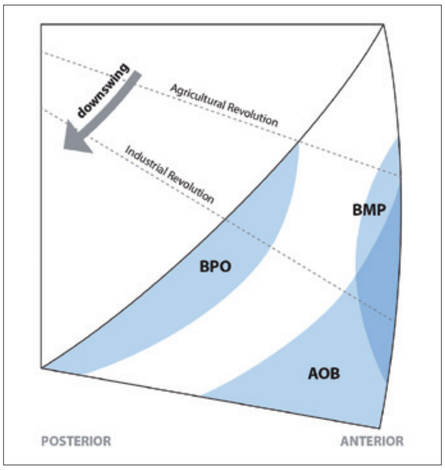

Fig. 6 The estimated effect of antroposterior lingual rest position (horizontal) and swing pattern on the occurrence of bimaxillary protrusion, anterior open bite and bilateral posterior open bite-deep bite

this causes the incisors and alveolus to tip forward, and in more severe downswings an anterior open bite is created.

Unilateral open bite

Usually seen with a moderate or severe downswing. The tongue is postured laterally separating the teeth. Often seen in conjunction with other patterns.

Complete open bite

This is usually a Class I situation, being mild when the tongue covers just the lingual cusps of the molars and severe when both cusps are covered, disrupting the pattern of interdigitation.

Bilateral posterior open bite (deep bites)

The tongue is postured between the molars and often premolars preventing their eruption, but not the canines or incisors, increasing the freeway space and causing a deep bite (if assessed in the intercuspal position). When biting fully together the incisors interfere, contacting prematurely, usually distalising the mandible encouraging a Class II/2 pattern and affecting the TMJ. Some individuals bite onto these tongue sections 'tongue splinting', which leaves marks on the lateral borders of the tongue increasing the depth of bite.

Class III

The tongue is placed low in the mandible which is held forwards. Being further from the palate, this leads to a collapse of the maxillary arch and the whole maxilla in severe cases.

Each variation is dependent on the severity of the swing pattern and the individual's compensatory responses. Certain responses are seen at a group level and may follow genetic predispositions. For example peoples of Caucasian, Negro and Mongolian decent have a tendency towards Class II, bi-maxillary protrusion and Class III patterns respectively. Consistently sealed lips reduce the downswing, align the anterior teeth and establish a Class I incisor pattern. High muscular forces tend to widen the ACS and upright the teeth, even if these are long lasting low forces directed through sections of tongue resting between the teeth.

ADDITIONAL POSSIBLE SYMPTOMS: AN OVERVIEW.

Breathing

Snoring and sleep apnoea are strongly associated with craniofacial traits that is consistent with a downswing and its effects on the airway.[19] The compensatory mechanisms are effective when conscious but difficult to maintain when asleep, leading to the tongue compromising the airway. The associated health implications of this are outside the scope of this article.

Ear, nose and throat

Deviated nasal septums, sinusitis and narrow nasal passages are a product of changes in the shape of the small bones of the midface. Glue ear and blockages in the Eustachian tube are related to a lack of air movement within the tube, caused by a change in the swallowing pattern and the architecture of the nasopharynx.

Bruxism

A less certain postulation is that the tongue acts as the antagonist against the jaw closing muscles. In this regulatory system, the tongue would contact the palate, in a unique situation as an agonist muscle unattached at one end, and inhibit the action of the jaw closing muscles and control the freeway space. A habitual lowered tongue posture in infancy would prevent the development of this system leading to unregulated clenching and grinding.

Temporomandibular disorders

The TMJ, like any joint, adapts to be centric in the position in which it is held. If the habitual postural position is with the jaw open then this is where the joint adapts to, so that the condyle is unbalanced, ie superior and distal, in the intercuspal position. This only usually becomes symptomatic if the joint is also loaded in this position, such as periods of stress or bruxism, in individuals with reasonable muscle tone.

Body posture changes

A change in the head and neck posture certainly influences the general body posture; the reverse is also possible, however, such discussions are outside the remit of this article.

CONCLUSION

This immense change in our environment and masticatory usage seems to have passed almost unobserved as we are immersed in our modern lifestyles. This potentially leads to a distorted view of normal, and may lead us to overlook its effects and limit our focus to the genetic influences. The pathological process of CFD proposes a mechanism to explain the genetic and environmental interactions. Environmental changes influence the severity of the malocclusion while the individual's responses determine its characteristics and type. Our genes vary and while we all have the potential for an ideal occlusion, our response to the environmental stresses differs.

CFD provides a new way of looking at malocclusion and challenges existing beliefs, which is never easy. If accepted, it also leads to the socially uncomfortable conclusion that the facial development of most modern humans is not attaining its full genetic potential. Discussing this can be an emotive issue; while people are happy to acknowledge manifestly crooked teeth, many find an implied criticism of their facial development too personal, particularly so if that criticism relates to their children. Fatalism is often more comfortable than determinism.

It is important that our profession works together to consider the possibility of a better solution to this problem, since the possible ramifications extend far beyond teeth. Although we cannot turn the clock back, and changing posture, habits or muscle tone is extremely difficult, it is vital to understand the aetiology and pathology of malocclusion.

Following scientific protocol the concept of craniofacial dystrophy is proposed in an open forum to encourage debate and responses. Attempts to constructively critique or falsify this hypothesis with quality evidence and sound logic are welcomed.

Further information on this complex subject is available at www.orthotropics.com/craniofacialdystrophy

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