Chapter 4

Reading The Face

The Influence of the Soft Tissues on Facial and Occlusal Characteristics.

Many of our patients are referred because they or their dentist is concerned that their facial proportions are not ideal. This is a delicate matter to discuss, as most parents love their children as they are and any suggestion of change can cause anxiety. The strength of the emotion can be judged by the acceptability of the following two statements "your daughter has irregular teeth" and "your daughter has an unattractive face". Many parents think that a slightly flat face or protruding chin is an attractive feature of their child's face but I warn them that if their child does not look quite like their friends they should watch out for increasing disproportion as they get older.

The mother of nine year old Louisa (figure IV/1) came to see me with a photograph of her as a six year old in her hand. Her mother had watched the lengthening of her face with mounting concern but remained unaware of its cause or what she could do about it. Clearly there had been a lot of vertical growth which was much more obvious from a lateral view (figure IV/2). The majority of parents fall into this category being unaware that early action is required and sadly their dentists and orthodontists usually offer little

Figure IV/1 Louisa

Louisa Age 6. Indicator Line 38

Louisa age 9. Indicator Line 42

help. My main objective in writing this book is to encourage the whole dental team to provide simple guidance which at the age of six can easily reduce and often prevent such problems. I am equally confident that the same approach could prevent most Ear Nose and Throat problems.

Figure IV/2

Because orthodontists initially train as dentists they usually place more emphasis on the teeth than the face, and as a result may be unaware of subtle changes in the profile that can occur naturally or sometimes follow treatment. Orthodontists in particular rely on their referring dentists for most of their patients. They often say to me "if I don't get nice straight teeth the dentists will stop referring patients to me". However the public as a whole certainly think that the face is more important than the teeth. The trouble is that neither group find it easy to assess changes to the face. Following a systematic review Bondemark and his colleagues (2007) came to the conclusion that it is "astonishing that only a few studies were found on patient satisfaction in the long-term, and furthermore most of them showed low scientific evidence and no conclusions could be drawn". They finally concluded "This review of the literature has thus exposed a great need for future studies in this area".

While all orthodontists accept that adverse facial change is possible following orthodontic treatment the majority feel it is rare and only follows inappropriate treatment. However there is poor consensus about which treatments are appropriate especially for severe cases. Of more importance research has confirmed (Faure 1998) that vertically growing faces are especially at risk. Downward growing faces are those that tend to look unattractive before treatment and can often look worse afterwards regardless of how they have been treated. Logic would suggest that the only way the face can be saved is to convert the Vertical growth to Horizontal and currently it seems that only Biobloc Orthotropics is able to do that.

My research with identical twins (to be discussed later) and my contacts with unhappy patients suggests to me that adverse facial changes following orthodontics are common and I have been quoted as saying "30% of orthodontic patients suffer slight facial damage and a further 20% suffer noticeable damage". In my opinion the worst of this damage is caused by fixed appliances. These carry a particular risk of worsening faces that are already growing vertically. However many Functional and Orthopaedic appliances also carry this risk and I am very sure that all these appliances are likely to cause more damage to a vertically growing face than good to the teeth. We will discuss the evidence for this later.

Not surprisingly some orthodontists are angry with me for saying this but it is really their responsibility to carry out clear cut research to find out the truth one way or the other. Currently as Bondemark says (2007) we just don't know.

I quote below a few of the letters and e-mails sent to me, showing that rightly or wrongly the public have real concerns about this.

'Laurie' age 49. I unfortunately had traditional ortho with head gear and all. All my life I knew something was wrong with my face, tongue and everything. My parents thought I was crazy to question it all. Well now at 49, to discover you, it shows my instincts were right. I also feel it effects depression, that I am struggling with.

'RN'. 29. "I asked him to just fix the gap but he insisted on fixing everything". "Now my face has sunken in I have a flat face and no cheeks". I'm a TV presenter, is there anything I could do?

'OF' my son, age 14. "I've been to visit three different orthodontists over the last three years and I have had conflicting advice and am deeply suspicious of the recommended treatment options". "He told we would need to consider Maxillofacial Surgery". "He was such a good looking child until about 10, now he is frequently called names such as Bucky Beaver." "He's gone from being a confident and happy child to feeling ugly". "I am so angry and will not forgive myself for having listened to the advice of so called professionals." "I found the website pertaining to Orthotropic Treatment and then the penny dropped!"

'TS' I am just looking to reverse what has been done to my mouth and face. I would like my teeth to go back to the way they were prior to orthodontic treatment.

'C.S'. Mother of 11 year girl. Let me open by saying that I stumbled across the "Orthotropics" website after years of struggling with the knowledge that my daughter needed more attention than she was getting with her teeth and jaw line.

When I first read about your approach I shed a few tears because finally I found someone who was saying the things I needed to hear. At age 3 we started taking Casey to a Paediatric Dentist Over the 4 years of seeing her regular Paediatric Dentist nothing was said to me about her teeth or jaw.

When she was 7 a "locum dentist" filling in for her Paediatric Dentist brought her concerns to me and suggested I send Casey to an orthodontist but she did not think early treatment made sense.

'WF' "I recently had 4 extractions done and I can see my profile starting to change!"

'TS' "I am having an awful experience with orthodontic treatment. I am noticing that my facial structure is changing". "My jaw seems to have moved forward, my face has become flatter". "This face is not mine".

'LD' Age 27. "I feel my face has been damaged with the procedure which included four extractions. I fear if I go to the doctor or dentist for an opinion, I will get a very defensive answer, as is common among professionals who do not wish to point the finger at one another".

'PJ' age 20. "I used to be a very good looking guy when I was of 18. I went for an orthodontic consultation but damn it proved to be the worst decision I had ever made in my life. My orthodontist asked me to get 4 healthy 1st premolars extracted and due to my enormous faith on my orthodontist I did what I was advised. This has really affected my self-esteem and my confidence. My doc pushed my front teeth backwards which resulted in degradation of my facial aesthetics.

'WF' age ? "I recently had 4 extractions done and I can see my profile staring to change!! I told the ortho that and he says it will be fine. I don't want have a flat face!! Is there something I can do? I just started 2 months ago? Can he push the teeth forward instead? Please help!!"

Provided patients cooperate the facial improvements with Orthotropics are likely to be positive and frequently dramatic, but this needs to be balanced against the superior abilities of fixed appliances to align teeth. It is important to consider faces and teeth as a single unit; and wise to assess the face first for if it is wrong then the teeth will be wrong and if facial growth is not corrected, long-term dental goals will rarely be achieved.

We now live in a consumer driven world and our patients come to us to improve their appearance. We may naively believe that aligning their teeth will achieve this but if patients are given the opportunity of comparing facial changes following treatment at the same time as dental changes, then a small improvement in the former will overwhelm those in the latter (Mew 2010). This would suggest that we need to pay more attention to facial changes during treatment.

The Psychology of the Face.

Facial beauty is arguably the most powerful generator of human emotion. In addition to serving the obvious function of attracting the sexes to each other it has also served to

inspire great works of art, prompt sadistic acts, initiate ferocious wars, and reputedly launch a thousand ships. Is it inherited? If it is, why do attractive parents often have plain children and vice-versa?

Great beauty is undoubtedly a very special asset, bestowed on very few people. Such is its power that those who possess it find it almost impossible to lead a normal life. Even those who are slightly more attractive than average appear to have many advantages in life while the less attractive are likely to suffer repeated discrimination and rejection.

Children grow up to believe that heroes are good looking, heroines are beautiful, and bad people are ugly. While many would assume that these stereotypes are fictional there is substantial evidence to suggest they are based on truth. Attractive babies receive more affection and attention from their parents and other adults, and are more likely to grow up to be well-balanced adults themselves (Bull and Rumsey 1988). Unattractive children are more likely to be bullied at school (Lowenstein 1978) and less adept at interacting socially. Good-looking people are likely to be perceived as more intelligent (Bull and Stevens 1979). Surprisingly they may actually be more intelligent (Clifford 1975)), possibly because they receive more attention at school. They are also likely to get better jobs, rise to higher positions, and earn more money (Bull and Rumsey 1988). You are considered to have a higher status if your partner is good looking than if they are plain (Hartnett 1973).

Handsome cadets achieve higher rank by the time they graduate (Ackerman 1990). A judge is likely to give an attractive criminal a shorter sentence (McFatter 1978). Unattractive people are associated with undesirable personalities and deeds. (Miller et al 1974), they are also perceived as deviants, feminists, homosexuals, and political radicals (Unger et al 1982). Criminals who have their appearance improved by facial surgery are less likely to re-offend (Lewison 1974).

Physiologically facial attractiveness, body symmetry and even intelligence are thought to be linked (Furlow et al 1997). The interplay of these variables merits further research.

Which Faces are Most Attractive?

In the last chapter we discussed how orthodontists find a 'straighter' (vertical) profile more attractive than the general public who prefer a more horizontally growing face. It is important that these differences are born in mind when debating the impact of treatment on the face. We should ask ourselves why orthodontists prefer flatter faces. Most orthodontic students are taught the Steiner analysis recommending an SNA of about 82° degrees and SNB of 78° (Fig IV/3A) but I think this looks rather flat.

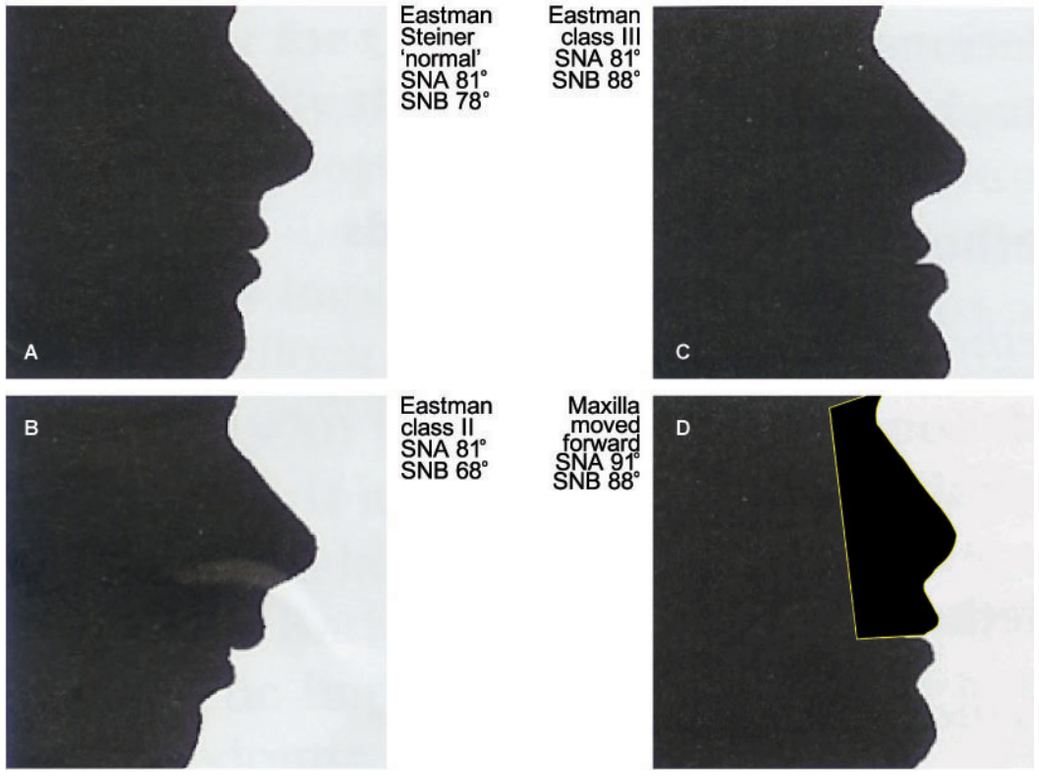
Johnston (et al 2005) experimented by moving the mandible of the Steiner profile backwards to an SNB of 68° (Fig IV/3 B) and forward to 88° (Fig IV/3 C). and found that 102 social science students preferred the recommended Steiner Profile with a 78° mandibular position. However they made no attempt to move the maxilla and if this is taken forward to 91° using a graphics program, then it matches quite nicely with the 88° mandible (Fig IV 3D). In fact it looks not dissimilar to the late Paul Newman the actor when he was a young man. Perhaps the answer to our initial question about orthodontist's preferences is because they have come to prefer the flat faces that their treatment tends to create.

The Golden Proportion.

Attractive appearance is a matter of proportion and ancient mathematicians suggested that the most aesthetically pleasing ratio of height to width was 1.6 (more accurately 1.61803398...). This is also referred to as the 'Devine Proportion' or 'Golden Ratio' usually denoted by the Greek letter ϕ (phi) and is actively promoted as a treatment goal by many clinicians who go to great lengths to demonstrate its veracity.

Ricketts (1982) was particularly keen to establish the merit of the 'Golden Proportion' which he applied to facial appearance. It is certainly an aesthetically pleasing ratio which fits the height and width of many attractive faces however it will also fit many unattractive faces. Moss and his colleagues (1995) have shown that faces that fit the golden proportion are at times associated with both skeletal and dental malocclusion and I remain less than convinced that its

Figure IV/3



rigid application assists in valuing facial proportions.

How Are Faces Judged?

The ability to recognise good looks starts very early in life. Its appreciation is undoubtedly influenced by cultural values and many people believe that 'beauty lies in the eye of the beholder'. However the classic study by Samuels and Elvey (1985) showed convincingly that babies as young as six months have a strong preference for the same good looks that adults appreciate, suggesting that these aesthetic values are probably specific and innate. This was first noticed many years ago when readers of a newspaper were found to agree closely about which individuals from a range of pictures looked most attractive (Illiffe 1960).

Subsequently Cross and Cross (1971) used impartial judges to compare photographs of a range of faces of different nationalities. Each Judge placed them into approximately the same rank-order of beauty, regardless of the race, colour, or background of either the subjects or surprisingly of the judges themselves. Many people find this hard to accept as personal preferences about facial beauty vary so widely, however my own research (below) suggests that our personal preferences only start to diverge when considering less attractive faces within the general population around us and this is probably the reason why so many people believe that "beauty lies in the eye of the beholder". It was to clarify this point that I undertook the research.

The Skeletal Foundation.

Facial form is obviously dependent on the facial skeleton and the soft tissues, the former providing the sculptor's armature over which the latter are draped. We have discussed how changes in the size or position of the bones, especially the maxilla, can make

Figure IV/4

Cartoonists know that a forward placed Maxilla is the key to a good looking face.

Note that the Cheeks are parallel to her nose. Also the nose is petite and the upper lip is slightly in front of the lower with a raised vermilion border all round.

a substantial difference to the appearance of the face. The position of the maxilla is also used by cartoonists to portray good or evil.

As it would seem from the e-mails quoted on the previous pages, many people believe that human maxillary growth can be affected by orthodontic appliances. Some of these facial changes are unfortunate even if the teeth are improved (figure IV/6).

The direction of maxillary growth has a strong effect on the teeth and Platou and Zachrisson. (1983) found that if the jaws grow 'horizontally' the teeth are less likely to become crowded, and Woodside (1996) found that this was especially true for the lower incisors. Franchi (et al 1997) agreed with this, saying "increased facial vertical relationships appear to be a skeletal feature correlated with higher degrees of incisor crowding" and suggested that crowded lower front teeth in any seven-year old child were a certain sign of current and probably future vertical growth. Woodside (1996) repeated the warning saying "anything that causes facial lengthening will increase incisor crowding" continuing, "Those faces which start to crowd after treatment are those whose faces have lengthened". It is clear that crooked teeth are closely and constantly

Figure IV/5

An evil face is drawn with the maxilla back, the outer cantous of the eye dropping, a hump on the bridge of the nose, the lower lip in front of the upper and a sloping forehead.

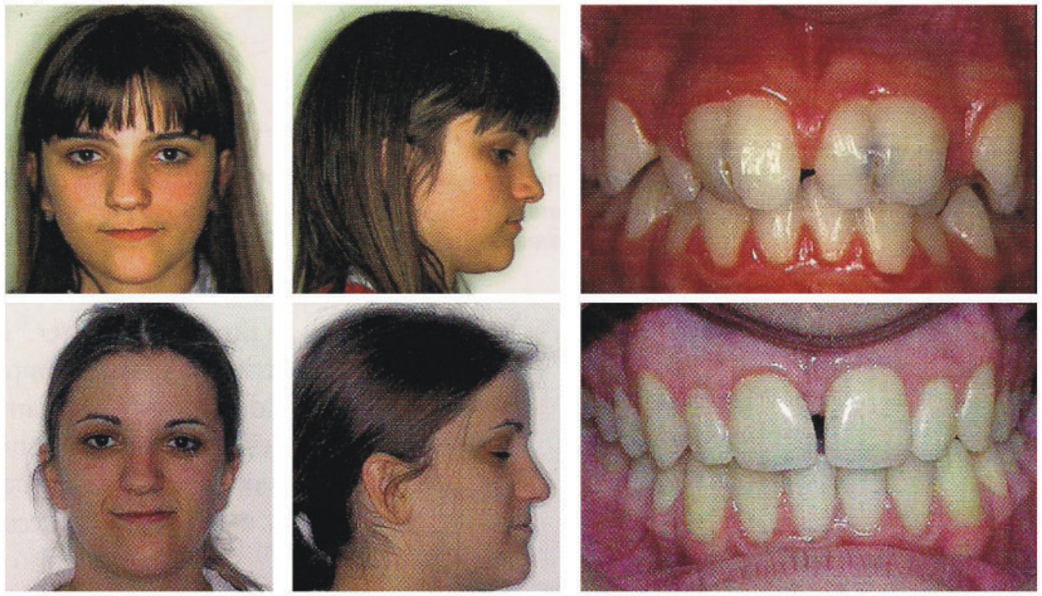
If he had been weak the chin would have been placed back, but determined (ruthless) people are drawn with prominent chins.

linked to vertical facial growth at all ages.

The Frequency of Adverse Facial Growth.

It is exceptionally rare for mature adults living in industrialised cities to have all 32 teeth in perfect alignment with space behind the third molars, although this was routine

Figure IV/6



Le Gall M, Philip C and Aboudharam G. Orthodontic treatment of bilateral geminated maxillary permanent incisors. Am J Orthod Dentofacial Orthop 2011; 139:698-703. Note the geminated teeth were removed and the spaces closed. This changed maxillary position and dimensions, altering the face.

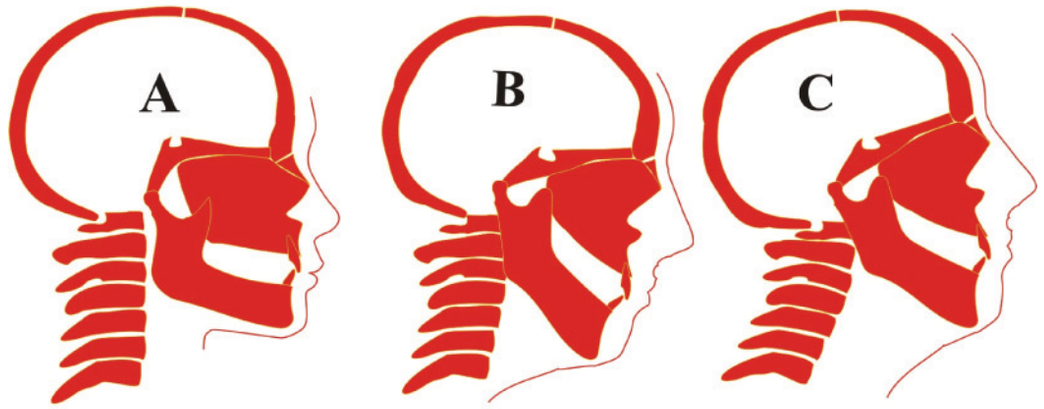
amongst our direct ancestors. Clearly adverse 'vertical' growth is now commonplace and ideal 'horizontal' faces are rare. It is almost impossible to gather an equal number of vertical and horizontally growing faces during research into facial beauty. Because of this most facial research has been undertaken on skewed samples of vertical faces.

As we discussed in the last chapter a vertically growing face can be recognised because the maxilla swings down and back leaving the nose looking more prominent and the teeth crowded. Frequently the dropping of the maxilla is followed by a hinging back of the mandible which creates a weak chin (fig IV/7 A and B) and this moves the tongue to the back of the pharynx. This in turn will partially block the airway making breathing difficult. I described these changes many years ago (Mew 1983) and explained how most people tilt their head back to restore the airway (Fig IV/7 C. In that article I also suggested that "Disproportionate facial growth is to some extent disguised by this backwards tilting of the head, which maintains the facial plane while permitting major adaptive changes to occur in other parts of the cranium". This disguises the weak chin and causes the forehead to slope back but results in the nose projecting even further, producing what orthodontists call a 'convex' face (figure IV/7 C). Although this article was prophetic the information it contained was largely ignored and unfortunately this is still often the case. We discussed the inappropriate treatment of 'Brian' in chapter 3 which was due to the widespread misunderstanding about such facial changes.

Psychological Assessment of Facial Appearance.

Classically, psychologists have used frontal photographs when assessing facial appearance. Horizontal and vertical lines are drawn across the facial features and this framework has been used to suggest specific rules for ideal facial proportion, involving the so called 'Golden' and other proportions. However, the changes in profile that we have just described are not easily

Figure IV/7



A correctly growing face.

If the maxilla drops the mandible swings back.

To open the airway the head is extended back creating a 'convex' face.

distinguished when looking at the frontal view of the face. If figure IV/8 is studied it can be seen that tilting the face forward or backwards can make a substantial difference to the proportions of the facial features. This problem was pointed out many years ago by Lucker and Graber (1980) who suggested that psychologists should rely more on lateral views. Surgeons and orthodontists have tended to use a lateral view, as this allows the image to be rotated in order to compensate for this type of distortion. In my opinion frontal photographs are not appropriate for assessing facial beauty, especially if the subject is smiling as this distorts the facial contours.

Figure IV/8

Photos of the same face from different angles

Psychologists are now increasingly using computer generated three dimensional images which can be rotated at will to give a much better idea of skeletal relationships with the soft tissues. The side view (Fig IV/2) shows the same girl as figure IV/1 but gives a much better idea of whether the face is growing horizontally or vertically.

Reading the Personality from the Face.

Although most of the public think that they can assess the personality of an individual from their face, there is little scientific support for this belief. Indeed Cunningham (1977) suggested that "The pseudo-sciences of phrenology and physiognomy may have made measuring the face seem disreputable to some scientists". This may have discredited the concept of judging the personality of an individual using objective measurement of their facial structures. A study by a psychologist and myself (Squires and Mew 1981) was one of the very few to have found a significant relationship between facial form and personality characteristics. It concluded, amongst other things, that people with vertically growing faces tend to be less conventional than those with horizontally growing faces. We know that reduced motor tone is associated with vertical growth and possibly unconventional people are more relaxed with a lower muscle tone than their

more conventional colleagues.

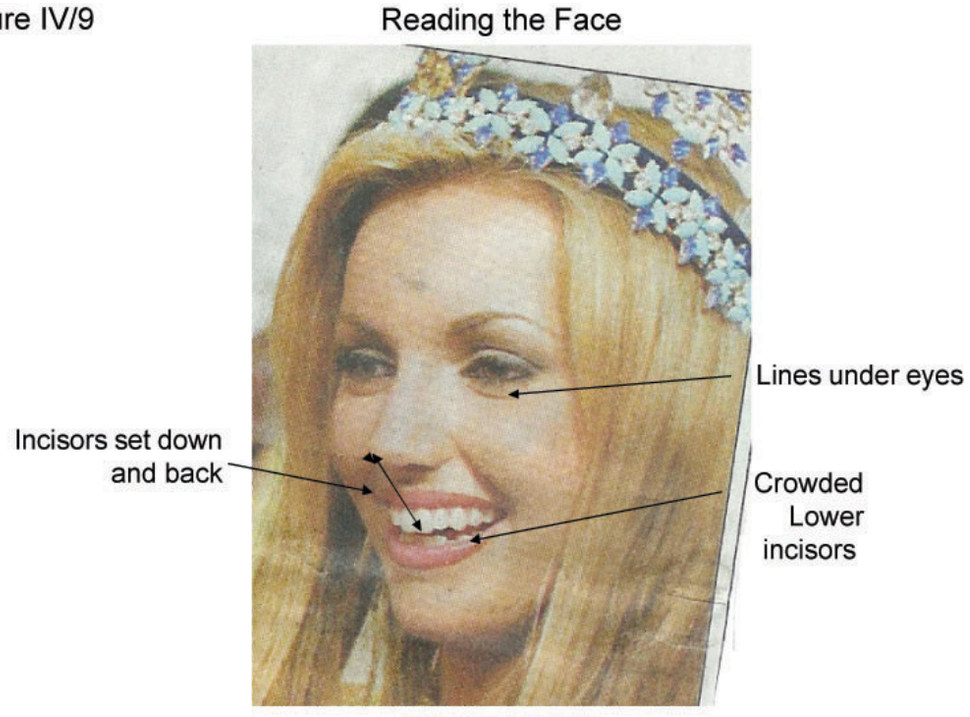
There has been recent interest in the use of imaging systems that are able to 'mix' a wide range of natural facial variations. If facial appearance were genetic then beauty would be randomly distributed throughout a population and one might expect a digitally created 'mean' to look more attractive than the extremes. However, Edler (2001) expressed doubts about the use of these composite averages, saying "The process of producing composites from a large number of individuals inevitably eliminates facial skin blemishes including creases, wrinkles, etc., thus providing the composite face with an 'unfairly' clear complexion".

On the basis of a series of 'average' faces Perrett (et al 1994) concluded that indeed they look more attractive than most individual faces. However he found that "highly attractive faces are systematically different in shape from average" and tended to be at one end of the range of variation. This conclusion was supported by Edler 2001 who similarly found that "There were a few exceptionally attractive individuals, who were more attractive than the composites

This strongly suggests that facial beauty is not randomly distributed within the genes. It is of interest that one of the features that Perrett found to be associated with attractive faces was prominent cheek bones. This is a constant feature of horizontal growth, and the attractiveness was rated even higher if this was emphasised by means of digital technology, strongly supporting the belief that the attractive faces are associated with a forward placed maxillae. This concept is further supported by the work of Sforza and his colleagues who compared attractive children with less attractive ones and concluded "The soft-tissue facial profile was more convex in attractive children, with a more prominent maxilla relative to the mandible". However both Perrett and Edler appear to believe that these features are related to inheritance rather than the environment.

In their search for the 'ideal' face, psychologists have often studied accepted

Figure IV/9



Miss World 2003

beauties. However, dental crowding, is common, even amongst beauty queens (Fig IV/9) which raises a number of queries. If we accept that crowding is linked to incorrect skeletal growth then either skeletal form is not related to beauty or Beauty Queens are just the best of a skewed sample from a population most of whom are a long way from the 'ideal'.

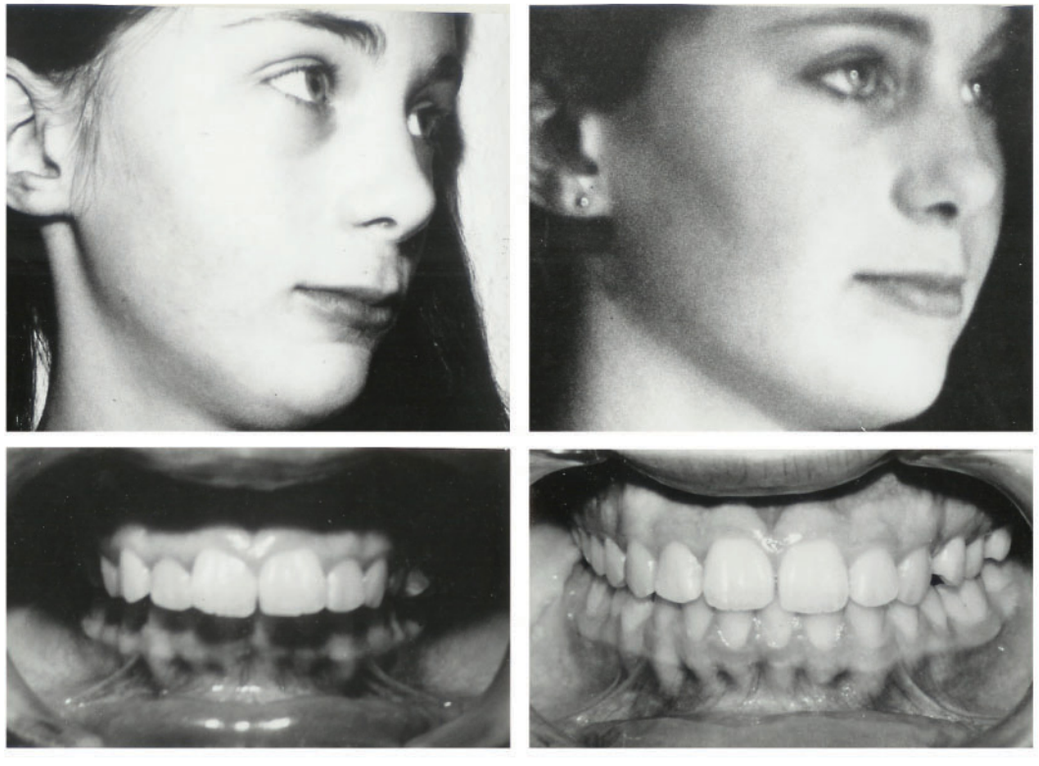
More recent research suggests that concepts of beauty are ever changing. Iglesias-Linares and her colleagues (2011) after studying attractive black and white subjects according to 'People Magazine' during previous 10 years, concluded that the concept of beauty and facial balance is evolving, with a predilection for increases in facial convexity and lip protrusion. Those considered beautiful had strikingly similar characteristics. However the authors had no control to represent past facial standards and the broad evidence suggests that protrusive faces have always been popular.

To answer some of these questions I designed a study to see how judgements about facial appearance are affected by small changes in facial form. Judgements are easier when comparing real faces but it would be extremely difficult to find a group of people with small specific skeletal differences that could be compared. Most research has been conducted using computer graphics or silhouettes but these do not always provide lifelike faces and so ¾ view outline drawings were used instead.

Method and Material.

This research was undertaken to examine the impact of aberrant 'vertical' growth, on facial attractiveness. Unfortunately neither a frontal or profile picture shows the cheekbones, which are so crucial to good looks and are so damaged if the maxilla fails to grow horizontally. It is also easy for skin quality, hair colouring and facial expressions to influence judges trying to assess facial

Figure IV/11 Before and after Biobloc treatment.

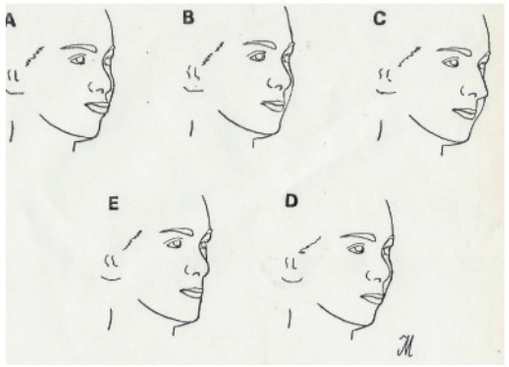


The girl whose face was used as a base for this research.

appearance. To eliminate any factors that might detract from the facial contours, ¾ view outline drawings were used in this project in preference to computer generated pictures.

One hundred and seven adults, selected at random and aged between 16 and 60, were

Figure IV/10



shown ¾ view outline drawings of five faces (Fig IV/10) and asked the following questions.

1/ "Which girl's face do you think is most attractive?"

2/ "Which girl's face do you think is second most attractive?"

The drawings were intended to illustrate different features of 'vertical' facial growth and this is in marked contrast to most pervious research, which has looked at incremental variations around a mean. Face 'B' was traced from a photograph of a patient who had actually been treated with Biobloc Orthotropics to convert her vertical growth to horizontal (Fig IV/11). In each of the other depictions one feature was manipulated by 5 mm on the life size scale. 'A' had thick lips such as would have been occasioned by a para-functional swallow commonly found with 'vertical' growers. 'C' had a large nose, a type of deformity that does not normally exist on its own as 'large' noses are the natural consequence of a vertical growing maxilla but this picture was modified to assess the effect of a large nose in isolation. 'E' had flat cheeks as seen with a vertically growing maxilla, note that the eyes, nose and chin also look different, although they are unaltered. 'D' had an undersized mandible. This would not normally exist without a 'vertical' growing maxilla but again it was desired to assess this feature on its own.

Results.

Face 'B' was preferred by 74%. 13% preferred face 'D', 8% preferred face 'C', 3% preferred face 'A', and finally 2% preferred face 'E'. When judging the second most attractive face, all but four who did not place 'B' first, placed it second. Face 'D' was selected by 24%, face 'C' by 23%, face 'B' by 19%, and 'A' and 'E' were both selected by 17%.

Discussion

In agreement with many previous studies, the results suggest that most people find horizontally growing faces attractive and any aspect of vertical growth is judged harshly. It would also seem that small changes in one feature may alter the appeal of the whole face and that a flat maxilla does special harm to a female face. This is followed in a less damaging sequence by thick lips, large noses, and receding chins, all of which are associated with vertical growth and para-functional habits. It could be argued that the constructed drawings did not fairly represent such environmental variations, however the face was taken from real life and every effort was made to mimic the changes seen in vertically growing faces. Of greater significance the near equal distribution of the second preferences would suggest that the facial model was a fair one.

These findings support those of Cross and Cross (1971) who found that there is close agreement when judging faces which are perceived as attractive, however the present study in addition suggests that our personal preferences diverge when considering less attractive faces within the general population who have been affected by vertical facial growth. Sadly, as we have discussed, the majority of industrialised populations fall into this latter category, and their individual preferences concerning flat faces, receding chins, large noses and thick lips clearly differ, with a similar proportion in favour of each feature. This may explain how the mistaken belief that "Beauty lies in the eye of the beholder" has arisen. We all agree about good looking faces but have different preferences when judging the less than perfect faces within our society.

Sadly I have been unable to get this research published, I think because psychologists, like orthodontists, see facial variations as genetic rather than environmental.

Surface Anatomy.

Reading the face should be one of the most important aspects of Orthodontics and before examining any new patient, it can be beneficial to spend a few moments studying their surface anatomy. The muscle bulges give a good indication of activity and as most orthodontists accept, it is primarily the soft tissues that determine the position of the teeth and alveolus. Unfortunately few current post-graduate students are given such guidance.

At the London School of Facial Orthotropics, students are taught to diagnose the dental malocclusion before the patient has opened their mouth. Surprisingly, with a little practice; the Indicator Line (to be described shortly), Overbite, Overjet, Angles relationship, crowding, cephalometric angles and even palatal width can be estimated quite accurately. This teaches students how to estimate the influence of various muscle bulges and the additional functional/postural information which can be assessed if the patient is then asked to talk or swallow.

Aesthetic and Functional Indicators.

The forehead.

If we start at the top of the face, we find there are often contrasts between the inclination of the forehead and the facial plane. Some minor variations are probably inherited but most sloping foreheads are related to the extension of the cranium on the vertebral atlas (tilting the head back). As we have already discussed, this is due to an increase in the Saddle angle following a lack of lower facial development and a resulting pharyngeal airway restriction which causes the patient to tilt their head to restore their airway. Many researchers (McDonagh et al 1997), and (McIntyre and Mossey 2003) have shown that the forehead is one of the most stable areas of the face and eminently suitable for superimposition. We also discussed how the angle between the frontal bone and the base of the skull frequently changes during both growth and treatment (Singh at al 1997). This is because; over time the face will move independently from the cranial vault (Fig III/8).

Figure IV/12

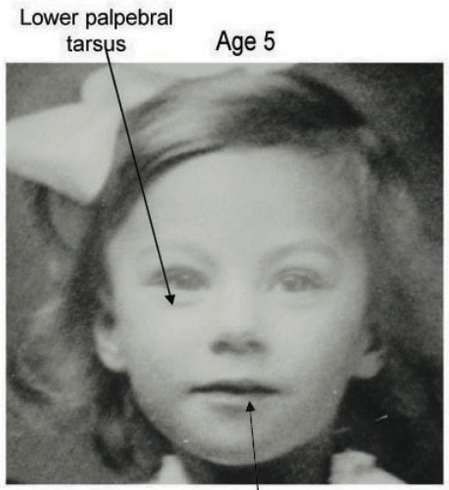
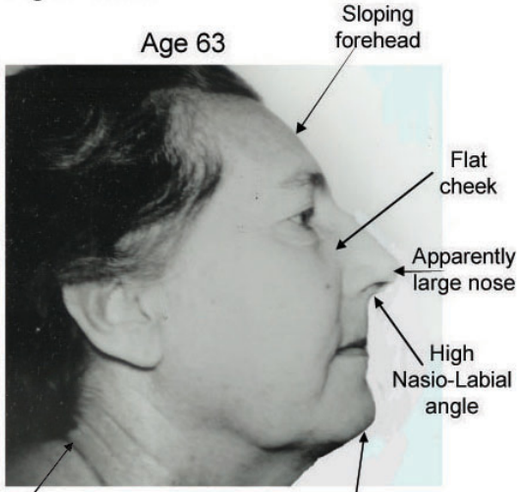


Figure IV/13

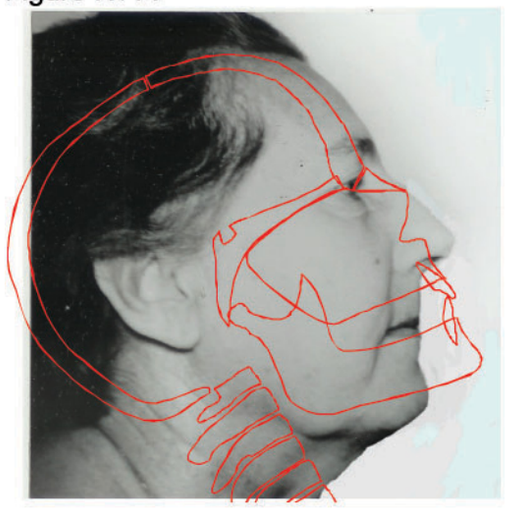


Growth associated with adverse oral posture

Let us look at an individual case. Fig IV/12 (left) shows a five year old girl with the early signs of facial flattening. Not only are her cheeks noticeably flat but the lower palpebral tarsus is prominent under both her eyes, this is one of the first signs of lack of forward maxillary growth and may be recognised in an infant as young as a year old. It is obvious that she has a resting open mouth posture of about four millimetres and this will certainly increase the collapse of her maxilla.

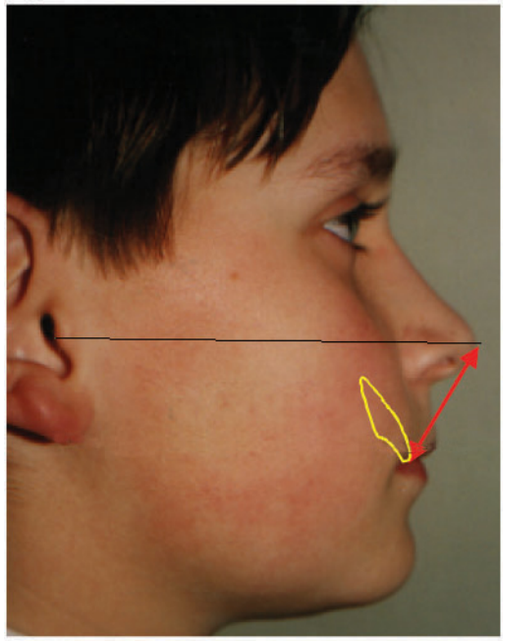
Figure IV/13 right shows her facial form at the age of 63. By then she was suffering from severe Temporo Mandibular Dysplaisia (TMD) together with neck and spinal difficulties. However the excess of vertical growth is not very obvious because her good muscle tone has ensured a forward placed chin. Many clinicians misdiagnose such cases as 'convex' profiles but the signs of vertical growth can still be recognised by her sloping forehead, curved neck and increased 'Indicator Line' (to be described shortly). She has extended her head on the atlas to open her airway and as a result the whole cranial vault is tilted back. She now has a class I malocclusion; but the crowding is not particularly marked because of her good muscle tone. Unfortunately on top of these developmental problems she has an intermittent clenching habit which, as we will discuss later, may explain her current TMD.

Figure IV/14



A good looking skeletal outline superimposed on the frontal bone.

Figure IV/15



Measuring the Upper Indicator Line

As we mentioned in the last chapter her facial plane has remained almost upright despite the fall back of the maxilla and it is not until the slope of her forehead is appreciated that the true extent of the lack of lower facial development becomes obvious (Figure IV/14)

The nose.

Large noses are a constant feature of severe malocclusions: think about it. The nose is supported above by the paired nasal bones which are firmly attached to the frontal bone and below to the septal cartilage, vomer and maxilla. Vertical growth of the maxilla is therefore reflected in the shape and position of the nose as it 'hinges' down from the lower edges of the nasal bones.

Robinson (1986) noticed that the size of the nose was inversely related to the size of the maxilla and considered that for some patients this was a genetic association however he does not appear to have considered the possibility that the nose might look larger by contrast when maxilla is set back and cases such as figure IV/23 show an apparent increase of nasal size as the maxilla falls back..

My early research convinced me that there was a fairly constant relationship between the apparent prominence of the nose and the collapse of the maxilla and this encouraged me to look for a linear measurement which could express this relationship.

The Indicator Line.

This is the distance from the tip of the nose to the incisal edge of the lowest upper central incisor (Fig. IV/15). The tip of the nose is defined as the furthest point from the Tragus of the ear. The length of the Indicator Line is then related to average values for Caucasians (Table IV/16), Scandinavians tend to be about 1mm greater and Orientals about 1 or 2 mm less, but as the values are only approximate this is hardly significant. We use a steel ruler to measure this distance (Figure IV/17 and 18). One caution is necessary when the maxilla is very retruded; the ruler must not be pressed against the nose but placed at a tangent to it and the line from the Tragus extended to where both lines meet figure

Figure IV/16

Age	Ideal indicator line mm.	Actual indicator line
5	28	
6	29	
7	30	
8	31	
9	32	
10	33	
11	34	
12	35	
13	36	
14	37	
15	38	

APPROXIMATE GROWTH DIRECTION

Millimetres over ideal	Approximate Direction of growth	Appearance
0	40°	Outstanding
1	43	Very Attrac
2	45	Attractive
3	49	Attractive
4	50	Attractive
5	52	Attractive
6	55	Nice
7	57	Nice
8	60	Satisfactory
9	70	Satisfactory
10	80	Satisfactory
11	85	Ordinary
12	90	Ordinary
13	100	Ordinary
14	110	Plane
15	120	Very Plane

Using the Indicator Line to assess the direction of growth

The Indicator Line will give you a rough guide of the direction of growth of very young children. It provides useful guidance in the absence of serial X-rays.

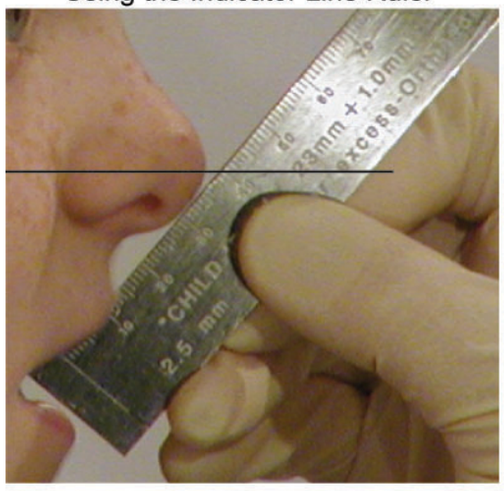
Figure IV/17
Using the Indicator Line Ruler

How to use the indicator line ruler.

IV/19). If desired the line can be measured on a lateral skull x-ray but do not forget to allow for enlargement. Clearly this measurement is no more than an 'indication', nevertheless it is surprisingly accurate.

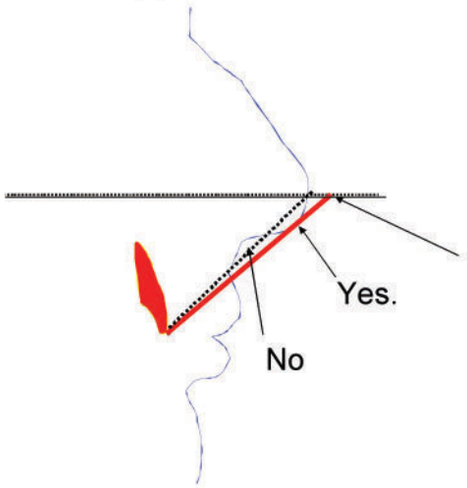
This unlikely measurement is now used to assess maxillary position throughout the world and is especially helpful for epidemiological studies where X-rays may not be possible. It provides an approximate guide of the relationship of the mid-face and the frontal bone, representing the 'fullness'

Figure IV/18
Using the Indicator Line Ruler



This close up shows that the Indicator Line reads 39 mm, an excess of 7 mm for this 9 year old girl.

Figure IV/19
The Upper Indicator Line



If the upper teeth are retruded, do not cut across the nose but extend Indicator Line to here.

of the facial profile. I have used the Indicator Line for over twenty five years and have found it invaluable. Not only does it provide an immediate assessment of maxillary position but it guides me during treatment, especially when deciding how far to advance the incisors or the maxilla and when to accept a compromise.

Peter Bushgang and his colleagues (1993) superimposed X-rays on SN and noticed that the "The upper dorsum (the area of the nasal bone) rotates upward and forward approximately 10 degrees between 6 and 14." while "The lower dorsum (the area of the cartilage) rotates downward and backward in persons who show greater vertical and less horizontal growth changes". These are relative changes but the most logical explanation must be because the saddle angle opens up increasing the angle between frontal bone and SN. Both Robinson and Bushgang presumed the nose was growing forward whereas I think the maxilla was rotating back. These changes can easily be measured by the increase in the Indicator Line.

It does appear that orthodontic retraction of anterior teeth emphasizes and perhaps increases the size of the nose, especially if accompanied by extractions. This pattern of treatment was common between 1940 and 1960 when many faces were badly damaged including my own. Sadly there are still many operators who extract and retract.

If the central incisors are not fully erupted, an assessment can be made using the occlusal plane. For a five year old it should ideally be about 28 and increase at approximately 1mm per year until puberty. In general girls are about 2mm less than boys. A simple rule is to add 23 to the age for a boy or 21 to the age for a girl. For instance if a boy is nine years old add twenty three and you know that his Indicator Line should be around thirty two millimetres.

It must be emphasized that these are ideals and are very rarely observed in industrialized societies as even good looking faces are likely to be increased by several millimetres. Some idea of 'ideal' values can be gained from various authors. Platou and Zachrisson (1983) studied a population of 568 twelve year old Scandinavian children but were able to find only 15 boys and 15 girls with class I occlusions and less than 1mm spacing or rotation. Reworking their material, I found that these boys had a mean indicator measurement of 43.9 (SD 2.79) while the girls were 41.5 (SD 2.62). The paper reported that the 30 selected children with ideal occlusion were "brachyfacial with somewhat procumbent incisors" compared with cephalometric norms and noted that "Remarkably the lower incisors were not behind the APO plane in any single case with ideal occlusion" suggesting that the mandible was also further forward. However the Indicator Lines of these boys and girls with 'ideal occlusion' were still nearly 4 millimetres higher that that suggested by the suggested 'ideals' and I am sure that this is a measure of the distance that the maxilla has to fall back before a malocclusion even starts to develop. Certainly my research with those living in more primitive environments has shown higher ratios of individuals with near 'ideal' Indicator Lines.

My belief is that it was the advent of cooking, circa 70,000 years ago, that led to the slow but progressive degeneration of the human occlusion and that any modern child who was brought up on a diet of unrefined, uncooked food, would develop normal occlusion. Living outdoors might also reduce the risk of allergies.

An unpublished study of my own, on 72 randomly selected twelve year old British schoolchildren (17 boys and 54 girls), showed that the Indicator Lines averaged 43.8 millimetres for the boys and 41.5 for the girls; remarkably similar figures to Platou and Zachrisson's group. It is surprising that the British group, a number of whom had malocclusions, did not score higher. Kerr and Ford's work (1986) would suggest that Scandinavians Indicator Lines are probably about 2 millimetres larger than Britons which may explain this but a number of children in the Scandinavian group had problems such as Bimaillary protrusion or lip apart postures which may have introduced confounding factors.

Kitafusa's work (2001) suggests that Japanese ideals are about 2 millimetres less than British. Clearly the contrasts created by tall Scandinavians would also apply to small individuals from other populations. All this emphasises how difficult it is to find ideal faces and occlusions in industrialised populations.

I recently researched faces of the Masai tribe in Kenya. The average indicator line was just over 40mm, but several of them had Indicator Lines in the region of 37 millimetres. Deeper analysis of Platou and Zachrisson's material shows that some conditions such as open mouth postures, and Bi-maxillary Protrusions are clearly related to maxillary position which can be identified using the Indicator Line. All orthodontists have experienced the irritation of children leaving their teeth and lips apart when the lateral skull X-ray is taken and I find it unsurprising that these particular children will have higher indicator lines. In Platou and Zachrisson's case the Indicator Line was on average 2mm higher for the 10 boys and 8 girls who had their lips apart when the X-rays were taken, remembering that despite this all of them had 'ideal' occlusion.

Five girls were separately classified by these authors as having Bi-maxillary Protrusion, because their lips were "forward by more than 2 standard deviations". Despite this their Indicator Line was on average almost 2mm higher showing that despite the teeth being substantially too far "forward", the maxilla was back and in fact their increased Indicator Lines suggests that this well known condition ought to be labelled "Bi-dental Protrusion" with the maxilla displaced down and back. In the same way nearly all patients with Anterior Open Bites have higher Indicator Lines (Figure IV/20). These explanations may seem confusing until it is realised that in all these situations (as well as in class II division 1 and 2) the teeth may be displaced in one direction while the maxilla can be displaced in another, a very important concept to understand.

Figure IV/20 The Upper Indicator Line

Two Identical Twins:
Which one has the highest Indicator Line?

Answer: On the left is 36 mm , on the right is 38 mm showing that her maxilla is about four millimetres down and back compared with her sister's.

Logically the Indicator Line should stop increasing when growth ceases, however the work of Rolf Behrents (1985) suggests that facial changes (mostly lengthening) continue throughout life. While this may be true, the situation is complicated by difficulties in achieving accurate superimpositions over long periods. Behrents was using the base of the skull as his reference plane which can be affected by long-term changes in the saddle angle. My own research suggests that the majority of this change is due to vertical remodelling of the facial bones, rather than growth. There is a strong tendency for increased vertical changes in old age as the muscle tone degenerates allowing the maxilla to drop back; which is why old people's noses so often appear to grow. This is associated with a flattening of the saddle angle as they get older.

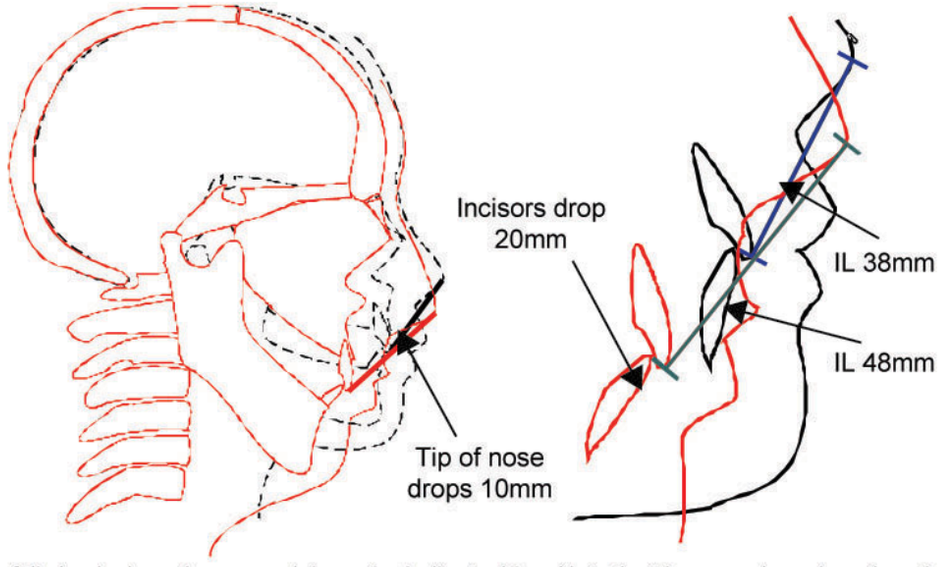
Problems with vertical growth.

Most orthodontic treatment tends to increase vertical growth by retracting the maxilla (Lundstrom et al 1980), (McDonagh et al 2001), (Melson et al 1999), (Ruf et al.2001) but clinicians are often unaware of the amount of vertical growth. As Battagel (1996) says, "Both fixed and functional appliance treatment of Class II division 1 malocclusions are accompanied by exaggerated vertical facial growth" and adds that "vertical changes are not easily detected by conventional cephalometric investigations". Although there are several short-term studies of bite planes and high pull headgear that show reductions in vertical height, I do not know of one long-term study that suggests these changes are other than temporary.

It concerns me how few orthodontists appreciate the frequency of increased vertical growth following treatment and its consequences in terms of facial damage, and long-term dental relapse. This is where the Indicator Line can provide on-the-spot information and we will discuss later how Biobloc appliances have the primary objective of moving the maxilla forward to avoid vertical growth.

While it normally takes two sequential X-rays taken a year or more apart to detect the direction of growth, the Indicator Line is quickly able to identify excessive vertical growth in quite young children, thus warning parents of the risk of future adverse growth.

Figure IV/21 The "Indicator Line"



Growth falls back along the same plain as the Indicator Line. Note that the nose drops less than the Maxilla so that the 'Indicator' line represents about half of the total increase in Vertical growth, which doubles its sensitivity. (Bushgang 1993)

We started this chapter with Louisa at the age of six (Figure IV/1) when her indicator line was 38 mm (seven millimetres too high), suggesting a downward pattern of growth, despite her attractive facial appearance (note the gum line). She received no treatment at that point and by the age of nine Louisa's Indicator Line was 42 (nine millimetres too high), and the previously hidden vector of vertical growth became very obvious. We will discuss Louisa's treatment later under 'difficult cases' (Chapter X). Table IV/15 shows the relationship between the Indicator Line and vertical growth. It is only approximate but can be helpful in anticipating vertical changes.

How useful is the Indicator Line?

The criticism has been made that because the Indicator Line is a linear measurement it can not assess a three dimensional change. As was discussed in the first chapter, because any movement has to be recorded with two pairs of X and Y co-ordinates it is difficult to use cephalometric X-rays to assess maxillary changes. However it will be appreciated that when the maxilla falls back it does so along the same vector as the Indicator Line itself (Figure IV/9) and this is probably why it is surprisingly accurate.

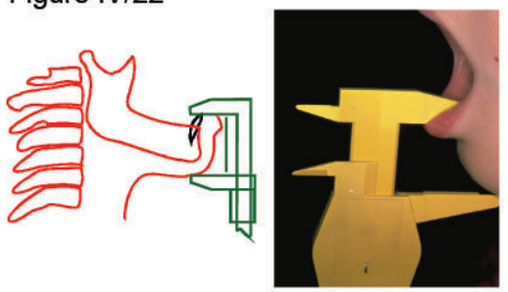
Another factor which increases its accuracy is that the nose also falls back in the same direction but less so than the maxilla, thus the distance from the nose to the teeth (the Indicator Line) represents about two-thirds the total increase (Figure IV/21) which almost doubles its accuracy.

Lower Indicator Line.

It was Tweed who many years ago noticed that straight lower incisors were usually at 90º to the mandibular plane. This encouraged generations of orthodontists to retract the upper incisors to match this angulation and was in my opinion the cause of much facial damage. I have no doubt that the wide variations we see in lower incisor angulation are due to tongue and lip postures, although habits, function and inter-incisal locking also play a part. We will discuss shortly the precise soft tissue factors responsible for the retraction and protraction of the lower incisors but in almost all instances the incisors themselves over-erupt. An increase in lower facial height is almost always aesthetically unpleasing and sadly a common sequel to fixed orthodontic treatment. To assess this we use the "Lower Indicator Line".

This is defined as "The distance in millimetres between the incisal edge of the highest lower central and the soft tissue of the mandible below it, measured at right angles to the occlusal plain" (Figure IV/22). Again it sounds rather simplistic but is surprisingly accurate. In a well balanced face this will be about 2 millimetres less than the Upper Indicator Line. The upper beak of the calliper should be in line with the occlusion and the lower beak in light contact with the tissue vertically below the incisors.

Figure IV/22



The Lower Indicator Line, is normally two mm less than the Upper Indicator Line

The Duke of Wellington (Fig IV/23) provides a good illustration of an increase in both the upper and Lower Indicator Line. It can be seen that in relation to the frontal bone, the nasal bones themselves remain relatively static causing the nose to become progressively hooked as the nasal cartilage drops back with the maxilla. This is sometimes called a Roman nose and if, as was suggested in Chapter I, facial mal-development is related to social standards and soft food; its initial manifestation in Roman high society who may well have had a very different diet from the plebeians they ruled, could have given rise to this expression. Certainly a large nose does not guarantee a satisfactory airway; in fact the reverse is usually true.

Centuries ago a large nose could be an asset because of the link between wealth and life style. To quote from William Seymour describing King Henry II, "he was a man of

Figure IV/23

The Duke of Wellington who was famous for his 'Roman' nose,. The flatness of his maxilla is also obvious. His maxilla would have been about 15 mm too far back and the lower incisors about 20 mm which is why his chin also looks prominent.

medium height and strong build with delicate hands and a handsome head enhanced by a strong nose".

It can be seen that the Iron Duke's lower indicator Line also increased excessively. The retroclination of the lower incisors gave him a prominent chin and the correction of the Lower Indicator Line will often restore a damaged profile Figure IV/24.

An increase in the lower Indicator Line is very common in class III cases (described later) and is principally due to a low tongue posture coupled with a tongue to lower

Figure IV/24

The lower incisors were proclined to reduce the Lower Indicator line.

lip swallow. Many long face class I's have a similar problem and yet orthodontists have traditionally been afraid to procline the lower incisors because it was believed that this would cause fenestration of the alveolar bone which is often quite thin in these cases. This was due to a misunderstanding of the aetiology of the problem, as the thinness of the bone is not inherited but due to long-term force from the mentalis muscle.

More recent work suggests that the risk of fenestration or 'clefting' due to incisor proclination is small (Woodside 1996) and Ruf and his colleagues (1998) concluded that. "Orthodontic proclination of lower incisors in children and adolescents seems not to result in gingival recession". However I do think it is wise to use a 'Purley Wire' to reduce contraction of the mentalis muscle (See chapter VIII appliances)

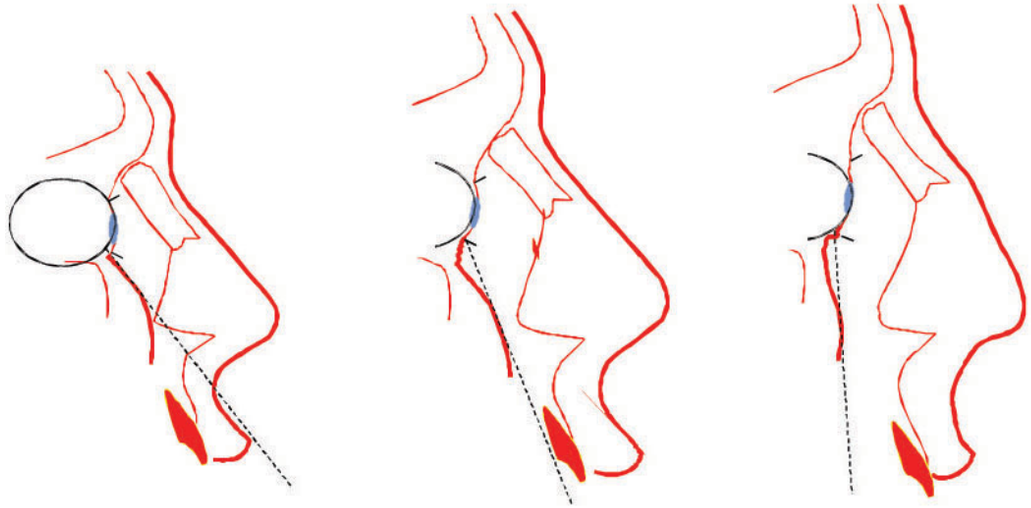
In my book Biobloc Therapy (1986), chapter IV, I described a father and son who demonstrated the progression of this condition from severe retro-clination, to a point where the apices of the father's lower incisors were actually projecting through both bone and gingeva. The same chapter discussed many other aspects of 'myotherapy' or Oral myology' as it is sometimes called and would make good adjunctive reading. This is discussed in Chapter VII.

As the lower incisors tilt back they usually continue to erupt until they reach the limit of bony support (figure I/4). Proclining the teeth to reduce the Lower Indicator Line can do much to improve the appearance of the face especially in class III cases with pointed chins, although this does require taking the maxilla an additional distance forward (Figure IV/24).

The Cheek Line.

This is the angle between the bridge of the nose and a line running sagitally down from the centre of the lower eye lid at a tangent to the soft tissue. If the maxilla is set back the angle may be as high as thirty degrees (Figure IV/25). Again this is not a precise measurement but is very helpful in assessing the face and is one of the first features of the surface anatomy that I note when a patient walks into the office. The Cheek Line of a mildly flat face will be at about 10° to the

Figure IV/25 The Cheek Line



Cheek line parallel to bridge of nose

Cheek line 15º to bridge of nose

Cheek line 30º to bridge of nose

bridge of the nose and a more obvious one will be at 20°.

It must be remembered that the maxilla provides three-quarters of the support for the eye and a retruded maxilla is likely to be associated with other features such as a prominence of the lower palpebral tarsus (Figure IV/26) and an increase of the white sclera showing below the Iris of the eye.

In addition the lateral margins of the maxilla below the eye seem more liable to drop more than the mesial, causing the outer

Figure IV/26

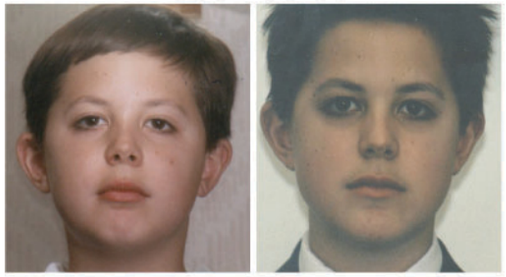
The effect of orthotropic forward movement of the maxilla on the Cheek Line and Eyes

Before treatment.
Note sclera showing under Iris

Four months later.
Note reduced sclera under Iris

Figure IV/27

Facial Balance



Nicholas aged 9. Note the dropped outer canthous of the eye.

Two years later, after his maxilla had been brought forward by Orthotropics.

corner (canthous) of the eye to drop more than the inner (Figure IV/27). In severe cases this may create an open space of one to two millimetres between the sclera and the lateral margin of the eyelid. Psychologists have found the eyes are the most important single feature in facial beauty and if anyone has doubts that the position of the maxilla is crucial, they should look at figure IV/28 and assess the personality of the girl on the left compared with the one on the right. Do this now and then read the next paragraph.

It is the same girl before and after surgery to move her maxilla forward. As

Figure IV/28

The Maxilla is the Seat of Facial Beauty

The girl before and after her maxilla was brought forward surgically.
James and Brook 1985 European Journal of Orthodontics, 7:231-247, 1985

demonstrated above (figures IV/4 and IV/5.), cartoonists are well aware of the importance of the maxilla but orthodontists often do not realize the degree of facial change that maxillary position can create. Sadly most current orthodontic treatment actually retracts the maxilla which exacerbates these problems.

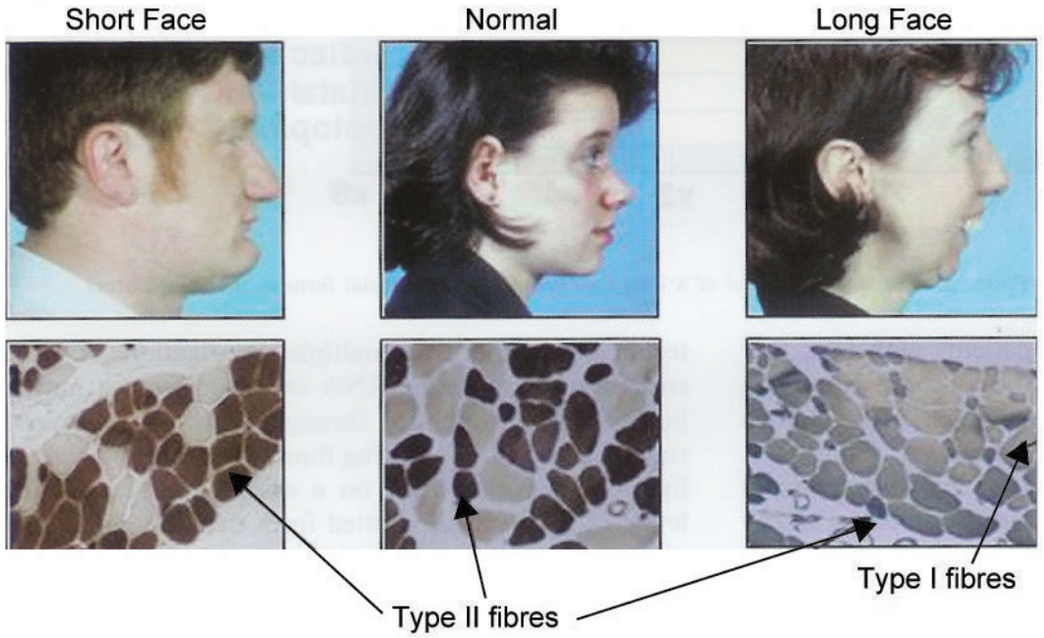
Muscle Bulges.

For the purposes of this chapter we will consider three muscle groups and their effect on the dental skeleton. Firstly, a reminder of the discussion in chapter I concerning the type 1 and type 2 muscle fibres; the fast acting (Type 2) are thicker and more powerful but are unable to maintain a pull for long periods because oxygen can not reach them while they are contracted. The slow acting muscle fibres (type1) are much thinner which enables oxygenation even if they are contracted and so they can maintain low levels of contraction for long periods. Essentially the fast acting fibres do the short-term powerful work like chewing while the slow ones maintain long-term posture, such as keeping the sphincters of the alimentary canal closed, including the lips.

The relationship between muscle fibre type and facial shape is shown in Figure IV/29. Professor Nigel Hunt who kindly lent me this slide, initially felt that fibre types were inherited but there is increasing evidence to suggest that these fibres can change from one type to the other or perhaps that new fibres can grow so that the ratio between the two types can change to meet different levels of activity required.

Because of the difference in thickness, the approximate ratio of each type of fibre within any muscle can be recognised by changes in its shape. If we look at an example (figure IV/30) we can immediately see that the upper lip is too thick and as a result the vermilion boarder between the skin and the mucosa is a rounded curve, whereas it should form an attractive raised ridge outlining the lip (see figures IV/36 and IV/37). It has thickened because there is a higher ratio of short acting fibres, a clear indication that her lips at rest are several millimetres apart and that she swallows with her tongue pushing against her lips. It can also be seen that the lower lip is thickened and a thickening of both upper and lower lips is a common feature in people with bi-maxillary protrusion. One might expect that powerful lips would cause retraction of the teeth but no; the tongue is more

Figure IV/29



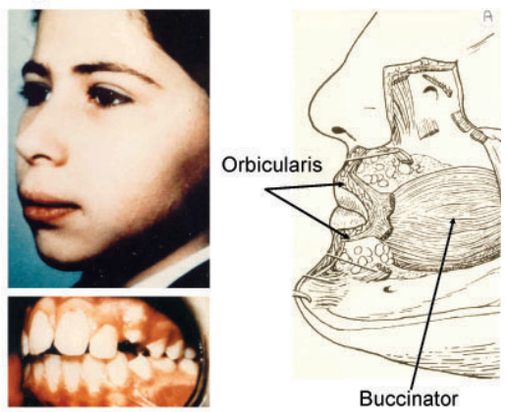
The slow acting muscle fibres (type1) are thin. The fast acting (type 2) are thicker and more powerful but are unable to contract for long periods.

By kind permission of Nigel Hunt. Hunt N, Shah R, Sinanan A, Lewis M. Journal of Orthodontics, 2006, 33: 187-197. Muscling in on malocclusions.

powerful but only at intervals. Her indicator Line is raised showing that the upper incisors are in fact too far down and back suggesting that incisor retraction might not provide the best result.

We can notice that her buccinators are

Figure IV/30



also thickened showing that she has a tongue between tooth swallow. The buccinator muscles are enlarged in suckling infants whose cheeks are described as 'cherubic' (figure IV/31) but should begin to become thinner after the age of fifteen months, following the eruption of the deciduous buccal teeth at which point the adult swallow

Figure IV/31

should develop with the tongue against the palate. However as we discussed previously early weaning often encourages children to develop tongue-between-tooth swallows for a life time.

A correct swallow is obtained by sealing the margins of the tongue against the palate to achieve the necessary negative suction but this is impossible if the tongue is partially between the teeth as air is sucked in between the contact points. To prevent this, the buccinators have to be contracted to seal these spaces and this contraction can be seen by a movement of the modiolus (the decussation between the Orbicularis Oris and the Buccinator) whenever such a patient swallows. This is a very important clinical observation as the force and bulk of the buccinators will tend to collapse the teeth lingually while the tongue-between-tooth posture will tend to disrupt the occlusal contacts as can be seen with this girl (figure IV/30).

Overclosed bites will frequently show gingival recession and possibly clefting at point 'B'. This is assumed by many to be due to a convoluted fold in the lower lip. However it is more complex than that as deep bites are due not only to powerful muscles but also to the tongue resting between the buccal teeth. This posture intrudes the buccal teeth but allows the anterior teeth to over erupt with an increase of the Lower Indicator Line

Figure IV/32

Hollow Cheeks are Essential in the Modelling World.

despite the reduction in the height of the lower face. This aspect is discussed in greater detail below under 'Tongue Posture' where the soft tissue postures relating to each category of malocclusion will be described.

If the patient has or develops a correct tongue-to-palate swallow the buccinators will become quite thin, creating 'hollow cheeks' which are said to be essential for anyone wanting to be a successful model (see figure IV/32). It is interesting to note that attractive men and women often have a narrow face with these 'hollows' (Figure IV/32) and the greater the hollows the more attractive the face is judged (Figure IV/33). Despite the narrow cheeks the dental arches are likely to be wide, giving a very attractive smile. Tongue to palate swallowing is also essential for forward growth of the maxilla and long term dental stability.

The Tropic Premise would suggest that

Figure IV/33

If a correct tongue-to-palate swallow develops then the dental arches widen to suit the tongue and the cheeks become hollow developing 'dimples' as are common in top fashion models and actresses.

ideal oral posture would create ideal facial aesthetics. We discussed earlier how the public appreciation of facial aesthetics is remarkably uniform but that few faces are judged perfect; for instance figure IV/9 showed an imperfect Miss World. All this goes to confirm the conclusion we came to in chapter I, that ideal facial development is rare.

We have been discussing the diagnosis of facial and dental anomalies by assessing the surface anatomy of the face but some anomalies can be created by inappropriate orthodontic treatment. As we discussed in the previous paragraph, these may be

Figure IV/34

Identical Twins

Age 12

Jane who had no treatment.

Age 38

Anne who was treated by extractions

Note how the buccinators have enlarged, her nasio-labial angle has increased and she has developed a double chin. Note also the lower palpebral tarsus. All signs of maxillary damage.

recognised by the surface anatomy. A large proportion of modern orthodontic treatment is retractive in nature and sometimes leads to a restriction of forward growth and increase in vertical (IV 6). These changes can certainly affect resting oral postures. For example figure IV/34 shows a pair of identical twins one of whom (Anne) was treated with the extraction of one second premolar and three second molars to avoid retracting the dentition or face. Her identical sister (Jane) had no treatment.

A panel of ten lay judges decided that Anne was the better looking before treatment by 8 to 2 but after treatment they thought Jane was the better looking by 9 to 1. The faces of identical twins can help us to identify some of the subtle long-term changes that can take place following treatment. What features were they looking at? The most obvious is the enlargement of the buccinators. This is because Anne now swallows with her tongue partly between her teeth, probably because of the reduction in arch size, a common consequence of orthodontic treatment. She now has to recruit the buccinators to seal the spaces between the contact points so that she can suck and swallow, this has caused them to enlarge. It also appears from the photos that the nasio-labial angle has increased despite the efforts of the orthodontist to avoid retracting the face by extracting posterior teeth. Certainly the lower palpebral tarsus is more obvious suggesting that the maxilla has fallen back and the inevitable sequel to this has been some retrusion of the mandible which is why she now has a 'double chin'. This plus the enlarged buccinators make Anne look fatter, although she is actually 6 pounds (2½ Kilos) lighter than her sister.

Many might protest that this is a single case and the changes could have been due to chance. While this is possible, they were identical twins and so whatever the cause,

Figure IV/35

the changes are presumably environmental. However such changes are a common sequel to a reduction in arch size following orthodontic treatment even if care is taken not to retract the incisors. For instance a similar pattern can be seen with another pair of identical twins Ben and Quinton (Figure IV/35). Note how Ben's buccinators enlarged following the start of fixed appliance treatment.

I have little doubt that similar changes take place whenever tongue room is reduced and once they have occurred the chances of long-term stability are severely reduced or lost, committing the child to a life time of retention. Sadly this sequence is not uncommon in post orthodontic patients. Until we can measure tongue posture we will never be sure but in my estimation the sequence was

1/ Reduction of tongue space following extractions.

2/ Development or increase of a tongue between tooth swallow.

3/ Enlargement of the Buccinator muscle.

4/ Maxilla dropping due to lack of tongue support.

5/ An increase in vertical growth (or vertical remodelling in adults). This sequence appears to be quite common during many forms of treatment.

Lip Form.

Most orthodontists believe that lip form is inherited, however I have been surprised how much the shape of the lip can change over time, with or without treatment and this has led me to believe that lip form is largely determined by lip posture.

I have heard many clinicians describe the characteristics of perfect lips and especially the perfect smile, but few of them relate

this to the position of the maxilla which to me is more influential. As we discussed earlier some use the 'Golden Proportion' but I do not find this helpful. Hunt and her colleagues (2002) found that "More attractive ratings were awarded to those smiles where the amount of gingival exposure was within 0-2 mm" and this measurement is closely linked to the vertical position of the maxilla and the tilt of the maxillary plane.

Kim and Gianelly (2003) compared dental casts of 30 patients treated with extraction and 30 patients without extraction, and found rather surprisingly that "the extraction group was 1.8 mm wider in the mandible and 1.7 mm wider in the maxilla". This is initially hard to rationalise until one realizes that the incisors were probably retracted in the extraction cases, giving them a relatively greater width in the second premolar area.

Shafiee and his colleagues (2008) suggested that smiling photographs are better than either frontal or lateral photographs. However, they used the faces of 45 patients with relatively mild malocclusions and I suspect that if the cases had been more severe the lateral views would have had most power. My own view is that smiles distort the face, making valid comparisons difficult but we need better evidence.

Figure IV/36

Illustrating how the lips will change shape if a lip seal can be developed. Note also the thinning of the buccinator.

Perhaps we should define attractive (ideal?) lip form. Figure IV/36 shows the maturation of a young girl as she learnt to keep her lips closed. On the left her lower lip is thick and protrudes slightly in front of her upper lip. Note that her buccinators are also quite thick suggesting that she has a tongue-between-tooth swallow. As she grew she learnt to keep her mouth closed with a corresponding improvement in lip form. As an adult in the right hand picture she has almost perfect lip form, while at the same time the buccinator has thinned to give her 'hollow cheeks'. The reader should work out how and why this has happened?

Like many of the sphincters in the alimentary canal, the lip has a dual enervation; part voluntary and part autonomic. The voluntary enervation facilitates speech and mastication while the in-voluntary control maintains the lip sphincter at rest. I remember a visit to the premature baby unit in the town of Soweto, South Africa where there were twenty four 'premature baby' cots each containing a baby, many of whom were close to death. Despite this, every one of them had their lips in contact. I have been told that if you pinch the nostrils of a new born, they will suffocate as they do not know to open their mouth.

Sadly, if this automatic lip seal is lost, it is frequently never regained. As we discussed in the last chapter young children in industrialised countries leave their mouths open over 80% of the time which is why damaged lip form is routine rather than occasional. As these children grow up many, will leave their mouths open for the rest of their lives, only closing them voluntarily for functional or social reasons. It is exceedingly difficult for a child who has lost their natural lip seal, ever to regain it and yet a good lip seal is essential for maintaining a good occlusion either natural or following orthodontic treatment. Think about it: an overjet or reverse-overjet of more than 2 or 3 millimetres can not exist if there is a lip seal.

If the lips are held together intermittently, the thick type 2 muscle fibres tend to be generated (figures IV/29 and 30). A natural lip seal requires minimal activity and this is why those with a natural seal have quite thin lips and the vermilion boarder is slightly raised (Figures IV/36). An example of this is given by two sisters who received exactly the same treatment (Figure IV/37). From the beginning Kelly made a great effort to keep her mouth closed (you can see the contraction of the Mentalis muscle) while Samantha never succeeded. It is salutary to see how the shape of Kellie's lip has improved while Samantha's has become worse. Situations like this are

Figure IV/37

Two sisters who had the same Orthotropic treatment

Sam who was unable to learn to keep her mouth closed

Her sister Kelly who made a big effort to keep her mouth closed. Note the establishment of the raised vermilion boarder.

quite common and have convinced me that lip form is volatile and far more dependent on posture than inheritance. If the upper lip is in front of the lower when the head is held upright (figures IV/4 and III/15), it can be safely assumed that the lips are sealed at rest and vice versa (figure IV/5).

It is not easy to interpret resting lip posture and many clinicians make the mistake of using terms such as 'competent' and 'incompetent'. These are rather misleading as they are measures of potential rather than reality and involve the subjective assessment of the contraction of the Mentalis muscle. I prefer to measure the distance the lips are apart at rest.

The most reliable way to do this is to ask the patient to talk (I ask them to count from one to six). During speech the tongue and lips tend to return to the rest position between each syllable. For instance someone with good occlusion and facial form will bring their lips into contact after most words (Figure IV/38) while some one with poor occlusion will sometimes speak an entire sentence without their lips touching (Figure IV/ 39) note especially how her tongue remains away from her palate. It is simple to observe these two contrasting patterns when watching a good looking television commentator interview someone with poor posture.

Having observed the patient count in this way the lips should be re-postured in what seems to be their most natural rest position and an accompanying adult can be asked if it seems natural. It is not difficult to train dentists and their staff to assess lip seal in this way with acceptable repeatability. If the panel of judges system (Shaw 1981) is

Figure IV/38

used, the opinions of three people (judges) will convert this subjective judgement into a scientific measurement which can be used for research into many aspects of malocclusion. I look forward to seeing an increasing number of papers by various workers on this subject. Hopefully my own research using these methods will be ready soon.

Many features of ideal lip form are obvious enough, however they have been misread by some specialists in facial aesthetics who believe that attractive lips are more dependent on inheritance than lip activity. The Tropic Premise would suggest that the height of the embrasure is dependent on the balance of upper Orbicularis and Mentalis activity. If the lips are sealed at rest then

Figure IV/39

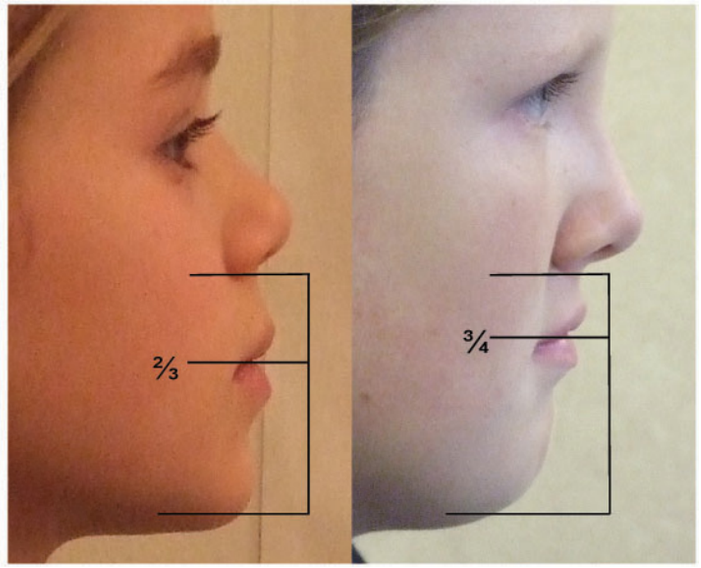
A patient with poor posture speaking. Note the tongue between the teeth, the lips apart and the facial appearance..

Figure IV/40

Lip Form.

Left. A girl treated by Orthotropics who developed a good lip seal. Her lip embrasure was ⅔ of the way up from the chin. Note the forward growing face.

Right. A boy whose lips were ¾ of the way up from his chin due to a lack of resting lip seal and the recruitment of the Mentalis muscle.



the embrasure will be about ⅔ of the way between the nose and the chin. On the other hand if the lips are apart at rest the Mentalis has to assist in obtaining lip seal and this activity will tend to lift the embrasure to a position of over three-quarters of the way up (See figure IV/40). Fortunately the re-establishment of a good lip seal will restore the lip form and position to the two thirds position within a year or so in any young patient but it can be hard work.

The Four Millimetre Rule.

This simple rule divides lip seal into five groups.

1/ Lips naturally sealed at rest. Rarely seen in industrial society and always associated with excellent appearance and occlusion.

2/ Lips up to 4 mm apart at rest.
Associated with mild lower crowding.

3/ Lips 4 to 8 mm apart at rest.
Associated with more general crowding

4/ Lips 8 to 12mm apart at rest. Will have a severe skeletal malocclusion.

5/ Lips over 12mm apart. Extreme vertical growth and will require surgery or alternatively Orthotropics from a young age.

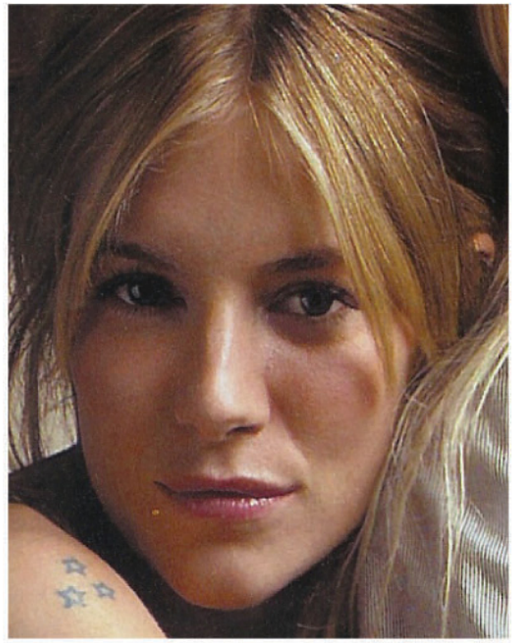
This information is of crucial importance for the prediction of stability or relapse and can be given to parents of children as young as three or four years old, who much appreciate guidance before bad habits become established. Interestingly parents are more likely to be forgiving about relapse of dental crowding if it has been forecast on this basis, as the responsibility of achieving lip seal can be seen to rest with the patient rather than the clinician.

Before I used Orthotropics I can remember retreating fixed appliance patients who had relapsed, free of charge, only to have them return two or three years later saying, "Dr Mew it was so kind of you to retreat little Johnny but I am sorry to say his bottom front teeth are becoming crooked again". By then 'little Johnny' was probably at university and did not want re-treatment. Now I have parents returning saying" "I am so sorry but 'Johnny' is still leaving his mouth open and it has undone your work" and I say "so it has, I can retreat him for you but they will crowd again unless he can learn to keep his mouth closed". I also charge them.

Many patients are concerned about having thin lips although they are not always able to vocalise this. It is normally the upper lip that is thin and this is usually due to a tongue to lip swallow, associated with a class II division 2 malocclusion. This posture and habit sucks their mid-face inwards and if I want to provide

Figure IV/41

An attractive girl with a thin upper lip.



Her sister, Actress Sienna Miller.

patients with an incentive to improve, I remind them of the witch in Walt Disney's 'Snow White' who was an extreme example of the long-term effect of mid-face retrusion. The long-term consequence is distalisation of both maxilla and mandible leaving the chin and nose protrusive, however an early sign may be no more than a thin upper lip (Figure IV/41).

Tongue Form and Posture.

The Tropic Premise says that the occlusal characteristics of malocclusion are largely determined by "inherited muscle patterns, primarily of the tongue". While many consider the shape and size of the tongue to be specific for each individual it is an amorphous organ that can change its form substantially within a short period. Harvold (1981) experimented with monkeys that had their noses blocked and noted that this created changes in tongue shape which did not revert until after the airway had been restored. He also noted that "Remodelling of the bones was most pronounced in the animals with a more consistently low postural position" of the tongue, a feature that is reflected in Class III human subjects. I am constantly amazed that the observations of this brilliant thinker and researcher are so ignored.

Unfortunately it is almost impossible to measure tongue posture over time, as the smallest instruments tend to disrupt its position. To assess tongue posture it can again be helpful to watch the patient talk or swallow. When talking the activity of the tongue can be divided into five categories (Figure IV/42). These may be easier to recognise if the patient is also asked to swallow, observing any conjunctive contraction of the buccinator, modiolus or lip.

Orthotropic Scale of Resting tongue Position.

1/ Against palate.

These patients will have 'Ideal Occlusion'

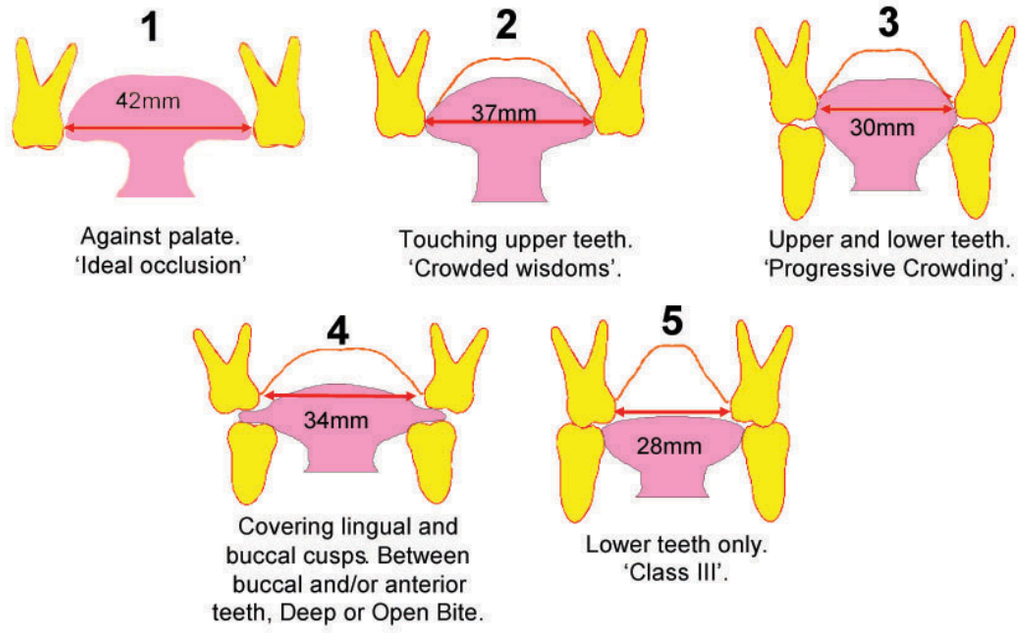
2/ Touching upper teeth.

These patients may have 'Slight Crowding'.

3/ Covering the lingual cusps.

Figure IV/42

Different tongue positions and their malocclusions



These patients will have 'Lingual Inclination'.

4/ Covering lower buccal cusps.

These patients will have a Deep or Open Bite depending on tongue position and Scalloping.

5/ Against lower teeth.

These patients will have 'Class III' (figure IV/43).

Clinically I find that there are virtually none in group 1. Many deep bite patients will claim to swallow with their tongue on their palate but if asked to swallow with their teeth biting together will say this feels strange. This is because they normally separate their teeth slightly and push the tongue between them, sucking as they do so. These 'tongue-between-tooth swallows' will usually be accompanied with varying amounts of scalloping on the margins of the tongue depending on the forces involved (Figure IV/44). In addition the tongue may be postured forward between the teeth and this is likely to be associated with either an open bite or a bi-maxillary (bi-dental) protrusion, depending on the reciprocal action of the lips.

The Tropic Premise suggests 'the occlusal characteristics of 95% of malocclusions are determined by a complex mix of inherited tongue postures superimposed on environmentally precipitated vertical growth'. Orthotropists accept that this is the cause of most malocclusion and that the only

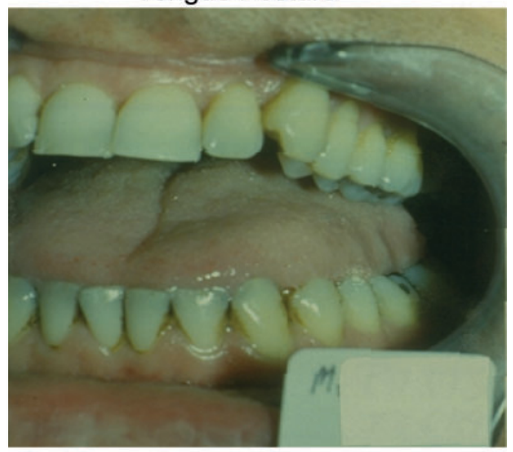
Figure IV/43

Tongue Posture

A typical class III tongue posture when swallowing.

Figure IV/44

Tongue Posture



Scalloping of the tongue with the tongue covering the lower cusps

long-term cure is to correct the oral posture, preferably before the age of eight other wise the skeletal damage may become irreversible.

Correct maxillary arch development requires good muscle tone and broad tongue to palate posture (figure IV/42 -1). Good muscle tone without tongue-to-palate posture is able to maintain quite a broad dental arch but will not take the maxilla forward and is likely to be associated with class I deep bite, class II division 2 or a class III malocclusion. Many Japanese and Korean people have this problem with a broad palate but retruded maxilla. In these cases the maxilla will be back with an increased Indicator Line. This is another important concept to understand and may be related to language as well as ethnicity.

Class III cases universally have a low tongue posture which fails to support the maxilla. Those with good muscle tone will develop a reverse over bite rather than an open-bite. Those with poor muscle tone will develop a long face with a reduced or open-bite.

It is not difficult for anyone to confirm this pattern of class III growth; try resting your tongue on the lower incisors with your teeth ten millimetres apart. You will find a natural tendency to advance your mandible 1 or 2 millimetres. This will trigger the long-term forward posture that leads to increased mandibular growth and it amazes me that I can find no reference for this constant observation in the literature.

Mild Class III patients are often treated by tilting the lower incisors back which is likely to lead to a pointed chin and unattractive lengthening of the lower face height. More severe cases may be referred for surgical correction but unfortunately this has a high rate of long-term relapse. This is probably why many experienced clinicians believe that class III growth is genetic and uncontrollable. To be sure of a long-term correction it is essential to re-establish a tongue-to-palate rest position. I have observed that speech patterns in Japan and Korea require less tongue-to-palate contact and in my opinion this is associated with the high ratio of class III patients in this part of the world despite their good muscle tone and wide upper arches.

Occlusion.

Although the science of orthodontics is essentially that of occlusion there is a degree of woolly thinking on this subject. Firstly occlusal inter-digitation is an entirely unnatural concept, as our ancestors wore the cusps of their teeth flat within two or three years of eruption. This does not necessarily invalidate the need to balance the occlusion but it is important to realize that concepts such as 'cuspal guidance' and 'opposite side contacts' are man made and relate to an artificial situation. Although the current 'rules' of occlusion may fit some situations they are unlikely to have natural validity.

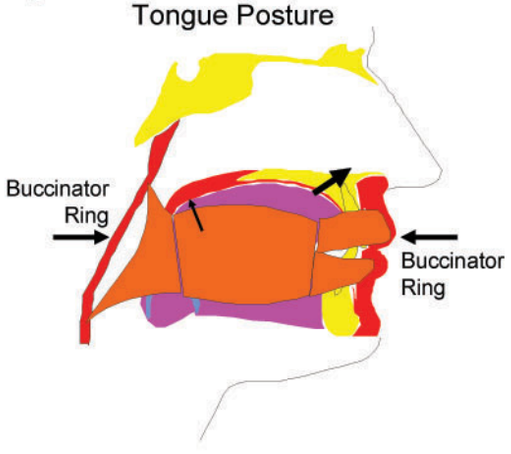
Secondly, as we discussed in chapter 1, Bill Proffit's work on eruption leaves little doubt that teeth will continue to grow until their eruptive potential is exhausted or they come into contact with opposing teeth or perhaps a tongue, thumb or pencil. There are three variables, the period of contact, the force and the height to which the teeth have already erupted. The level of everyone's occlusal table depends on the product of the first two balanced against the third. Proffit's figures suggest that light contact for between four and eight hours a day will maintain a constant height of eruption. These facts enable us to make a series of logical conclusions about dental occlusion.

Teeth that are out of contact will erupt into occlusion unless something stops them or they run out of eruptive force. Conversely over-erupted teeth will intrude if they are in contact for sufficient time and force. Therefore all teeth should meet evenly unless something intercedes or the eruptive potential of the tooth is exceeded.

Why then are unbalanced occlusions and long faces so common? Because tongue-between-tooth swallows and open–mouth-postures are the rule rather than the exception in industrialised society and as a result most people have their teeth out of contact or contacting soft tissues such as the tongue for long periods of time. These rules apply primarily to centric occlusion but in primitive environments the teeth would have worn to suit the full range of mandibular excursions as is seen in most omnivores and modern human bruxers.

On this basis occlusal equilibration has a limited validity. If the tongue is not interfering and the patient can be taught to keep their teeth in light contact for four to eight hours a day, then all the teeth will meet evenly regardless of age. The presence or absence of cusps should make little difference to this equation. Many clinicians find this hypothesis hard to accept but it is not so much a question of evidence as logic. Of more significance, I have never heard of any alternative logical explanation and we should remember 'the truth in retrospect is usually simple'.

Figure IV/45



With para-function the majority of forces are distal and over time this will retract the whole mid-face.

There is a clear message here for all dentists as well as orthodontists. If the occlusion does not 'sock in' after treatment, either there is a tongue-between-tooth posture or the mouth is open too much. Vertical elastics will rarely overcome these forces and even then only temporally. As will be explained later Orthotropics makes little attempt to establish occlusion other than correcting crossbites, all you need is correct oral posture and the natural forces will complete your correction. We will discuss this further in chapter VI.

The Aetiology of the Various Malocclusions.

Class I.

Muscle Tone

This influences the depth of the overbite, the Gonial angle, the arch width, the facial height and even the facial width. Work by Kiliaridis (1991 and 2003) shows that maxillary and mandibular widths are affected by muscle tone and this can even extend up to the eyes and cranial vault. Muscle Tone will also support the maxilla vertically but in my opinion has only a marginal effect on its forward development. In those patients with reduced motor tone there is a progressive reduction in the depth of overbite as the maxilla and mandible swing down and back towards the class II relationship.

Tongue position.

In class I cases the tongue is between most of the teeth, ranging from half a millimetre over the lingual cusps (figure IV/42, 43 or 44) to 8 or more millimetres between the teeth. When these patients swallow the tongue sucks against the teeth with a reciprocal contraction of the Buccinator, and Orbicularis Oris which are in turn supported from behind by the Superior Constrictor to form the 'Buccinator Sling' (Figure IV/45). This activity has a distalising effect on the whole arch and increases the inward and backwards collapse of the dentition already initiated by the tongue-between-tooth posture.

The Buccinators and Orbicularis Oris will be enlarged to varying extents causing the buccal and incisal teeth to incline lingually, the greater the retroclination of the incisors the thinner the vermillion boarder will be, giving the patient an unattractive thin lipped appearance (figure IV/41). There has been much debate on the damaging effect of extractions but regardless of whether premolars or second molars are extracted the evidence shows that the anterior teeth will fall back during orthodontic treatment and this may damage the facial appearance. However it can not be assumed that extractions will damage a face. Catherine Zeta-Jones is one of the worlds accepted beauties (Figure IV/46), and yet her close-up shows that she is missing her premolars. A good lip seal and tongue-to-palate posture will save almost any face.

The increase in vertical growth that results from conventional orthodontic treatment also reduces the arch length and this increases the risk of long-term crowding. In addition the archwires have a retractive effect which will cause a further reduction of tongue space. Long-term dental stability will almost certainly be prejudiced if tongue space is reduced.

Despite a small maxilla some patients learn to rest their tongue evenly between the upper and lower teeth so that it acts as a splint and the teeth remain well aligned despite the reduced arch size but scalloping of the tongue will usually be visible (Figure IV/44).

Figure IV/46

The interposition of the tongue between the teeth inevitably disrupts the occlusal contacts and will often make it difficult for orthodontists using fixed appliances to 'sock in' the occlusion at the end of treatment. Lip and cheek bulges will confirm this but also serve to emphasise the need to analyse the complex variables involved.

The larger the buccinators, the greater is the likelihood of a cross-bite on one or both sides. It always surprises me that there is such confusion about the cause of the cross-bites. The maxillary width collapses due to lack of tongue support, compounded by buccinator contraction and the lower dental arch becomes too wide for the upper. The cusps clash (usually the canines) and the unfortunate patient is forced to choose one or other side to chew on. They quickly learn to deviate to the side that fits best and if continued for a long time the postural deviation may become a functional one; almost always on the side on which they prefer to eat. Treatment by changing posture while young is simple, quick and remarkably permanent but do remember to expand enough (see chapter VII).

Maxillary position.

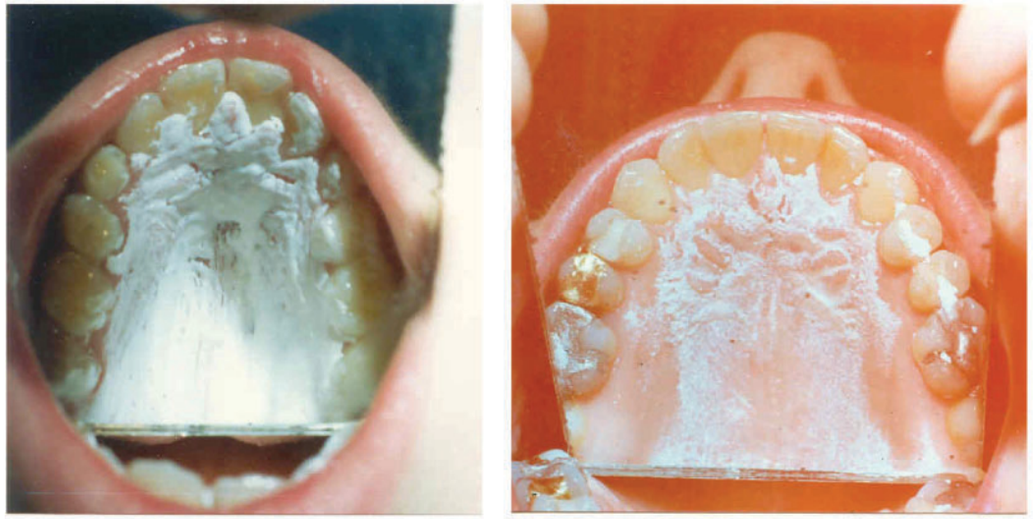
Although class I occlusions are defined as having normal skeletal relationships the maxilla is usually back with an associated increase of the Indicator Line and Cheek Line. Forward development of the maxilla requires constant contact from the tongue. Figure IV/47 shows how the pressure of the tongue will remove indicator paste from the rugae. The absence of this contact in class I malocclusions is the main reason why they have a retruded maxilla. It is worth examining the rugae, for they will be flattened if there is good contact but remain proud if the tongue does not regularly compress them. The degree of mid-face retrusion will be greater if there is also poor motor tone.

Lip posture.

Although many patients with mild class I malocclusions will have 'competent' lips they will often be 3 or more millimetres apart at rest. Their class I relationship depends on a reasonably good lip seal as a large positive or negative overjet can only exist when the lips are some distance apart. Lip seal is related to

Figure IV/47

Tongue Posture



The palates of both these patients were painted with indicator past and they were asked to swallow three times. The difference in the area of contact between the broad and narrow palate is obvious.

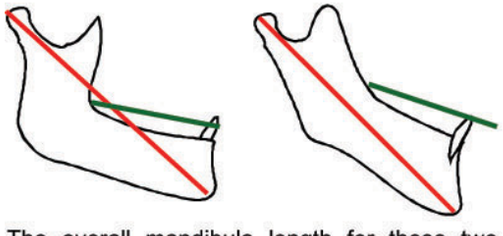
motor tone and with severe malocclusions the lips will be further apart with an increasing tendency towards a class II or III relationship.

Jaw position.

The mandible has huge plasticity depending on the posture in which it is normally held and is able to change shape, shrink or enlarge by several centimetres in different directions. (see chapter I fig 7 & 8). The freeway space will be increased depending on how far the tongue spreads between the teeth at rest. If this is coupled with increased motor tone, the patient is likely to bite gently on the tongue leaving small indentations which we call 'scalloping' (figure IV/44). This may intrude the teeth and reduce the facial height. If the motor tone is low the reverse will apply. The lowered rest position of the mandible restricts the pharyngeal airway (Mew 1983) and the posterior margin of the vertical ramus will resorb flattening the gonial angle. At the same time a co-ordinated deposition of new bone on the anterior margin will result in the vertical ramus moving forward. This will shorten of the arch length resulting in dental crowding which characterises this malocclusion (figure IV/48). The arch shortening will have most impact on the last teeth to erupt in each area of the arch, the wisdoms, the canines and the second premolars.

Figure IV/48

Bony Remodelling



The overall mandibula length for these two subjects is almost the same. However the arch lengths differ by 14mm.

Figure IV/49 shows this situation in reverse, as this patient received Orthotropic treatment which caused the vertical ramus to remodel distally within the relatively short period of nine months, providing room for a previously impacted wisdom tooth. Note also the changing relationships between the upper and lower teeth, sadly orthodontic treatment tends to have the reverse effect, opening the gonial angle rather than closing it and as a result shortening the arch lengths. This illustrates the contrast between Orthotropics and almost all other approaches to treatment.

Figure IV/49

Bony Remodelling

X-rays of Philip Age 14. After nine 9 months orthotropics.

Note that the ascending ramus has moved back 7mm relative to the Unerupted wisdom which now has room to erupt.

CLASS I Anterior open-bite.

Motor Tone.

There are two types of class I open bite, depending on motor tone. The first group have a higher tone with a good looking face and when they were infants, suckled the breast and/or their thumb very firmly. This has given them a near normal facial height, usually with their tongue between their teeth, mostly the anterior teeth. The second group have a low muscle tone with a thin Masseter muscle and an increased cheek-line angle. Many of this latter group never sucked their thumb but if they did so, used little force.

Tongue Posture. With both types the tongue will be postured forward between the teeth and not against the palate. During speech and swallowing the tongue will be seen to move forward and they are likely to speak with a lisp or 'blunt S'. It is the long-term tongue-between-tooth posture that is likely to maintain the open bite even if they stop thumb sucking. Essentially the thumb allows the posteriors to over-erupt rather than prevents the anteriors from erupting and frequently the upper central incisors are the only teeth in the correct position.

Maxillary position.

The high motor tone group will be one of the few situations when the Indicator Line is almost ideal. This is why it is incorrect to extrude or retract the upper incisors in these cases.

Figure IV/50 shows a six year old girl who was about to start a course or Orthotropics to create room for her permanent anterior

Figure IV/50

Thumb Sucking

Before thumb sucking | After thumb sucking | After Biobloc treatment

teeth (left picture). Sadly her father was killed in a road accident and the treatment was never started. However the emotional trauma caused her to start sucking her thumb although she had not done so before. She was not seen again for nearly two years a time gap which enabled the effects of an uncontrolled thumb sucking habit to become apparent. Not only did she develop a severe malocclusion with an open-bite but the damage to her face is obvious (centre picture).

She had developed a forward tongue posture but fortunately it was not too late for a course of Orthotropics to reverse the changes to both teeth and face (right picture). Note the maxilla was expanded to make room for the tongue; this moved the buccal teeth up and following some tongue training the incisors to came into contact without lengthening the face. The occlusion was then re-established by training her to keep her mouth closed and her tongue on her palate.

CLASS I Deep bite.

Motor tone.

These patients will have a motor tone of 1 or 2 on the Orthotropic scale, which will result in a low MM angle and quite a good Cheek Line. Apart from the lower incisors the crowding in these cases is unlikely to be severe because their Oral Posture is quite good. They respond very well to Biobloc treatment as it can correct the deep bite without lengthening the face.

Tongue Posture.

The tongue will be between the buccal teeth rather than between the anteriors but less so than with class II division 2 (See Figure IV/42 position 2 to 3). The action of the tongue depresses the buccal teeth and allows the incisors to over erupt. Slight scalloping may be visible on the side of the tongue.

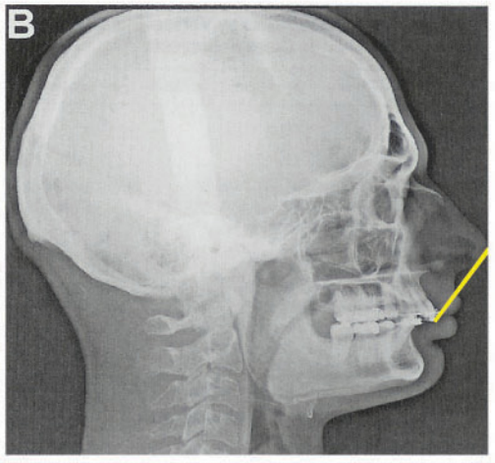
Maxillary Position.

Many clinicians see deep bites as a fault of the lower incisors and make the mistake of trying to intrude them which is one of the least stable corrections in orthodontics. Both upper and lower Indicator Line will be several millimetres too high and must be reduced to obtain a stable result. Figure IV/51 shows an older patient with a deep bite and this was associated with an Indicator Line of 54, showing that the maxilla was some 25 millimetres too far back, note the 'roman' nose. Many clinicians would diagnose this as an 'overclosed' case and try to open the bite by intruding the lower incisors, but even if he was much younger this would be treating the wrong jaw.

Figure IV/51

Effect of a Retruded Maxilla

Many people think that closed bites are the opposite of vertical growth and try to increase facial height.



Note the hinging down of the nose which reduces the increase in the Indicator Line.

In reality his maxilla is probably 25 mm or more too far down and back.

This patient's bite has deepened because the maxilla has dropped. His Indicator Line is 54 when it should be 38!

Moreover intruding the lower incisors nearly always lengthens the face which can break a tenuous lip seal and make the tongue posture even worse.

Lip Position.

The lips are usually 3 to 4 millimetres apart at rest.

Jaw Position.

The freeway space is increased to make room for the tongue to lie between the teeth. The depth of overbite is determined by the increase in freeway space.

CLASS I lateral open bite.

Motor Tone.

This will be slightly reduced (Orthotropic type 3).

Tongue Posture.

This is an unusual group where a wedge of tongue constantly lies over the lingual and buccal cusps of the posterior teeth. Its presence is enough to overcome the eruptive force of the teeth especially in the middle of the arch where it may cause some teeth to intrude. There is a classic X-ray of one such case where the first permanent molars are entirely covered with gum but one of them has an occlusal amalgam.

Many of these cases first become apparent following the eruption of the six year old molars. At this point the tongue may hold down the deciduous teeth creating a lateral openbite with only the first molars in contact, although the deciduous teeth had previously been in full occlusion. Because the integrity of the inferior dental nerve canal takes priority over root formation this intrusion can result in the roots of the successional pre-molars becoming distorted or even the entire tooth germ being suppressed,. This will usually be seen with patients with an increased curve of Spee and I have seen many papers on the subject most of which have mistakenly assumed there was an idiopathic disturbance of tooth formation (Mew 2004).

Ben-Bassat and Brin (2003) found that missing teeth were frequent when the "Maxillary and mandibular basal bones were more retruded than in normal populations", and also found that the shorter the maxilla the greater the number of missing incisors. Obviously a shorter arch length means less room for the dental lamina which contains the tooth buds. Many clinicians fail to appreciate quite how much arch lengths are shortened in industrial man; often by an inch or more.

The authors also stated that there were more missing teeth in patients with a "convex" profile. This might cause confusion in some people's minds but we discussed earlier how many orthodontists mistakenly diagnose cases as 'convex' when in fact the mandible is retruded making the face look convex. Certainly this research showed that these maxillas and mandibles were shorter than average.

They also found that the group with missing teeth "exhibited a reduced Frankfort mandibular plane angle" and "upright incisors" suggesting good muscle tone and a tongue between-tooth resting posture, with an increased curve of Spee. There is an accepted association between lateral open bites, tongue-between-tooth postures, intruded second deciduous molars and missing teeth, although there is some debate about which might induce which. It is my firm opinion that it will eventually be accepted that many if not most missing teeth are the result of arch shortening due to vertical growth of the face.

Philosophically it would be extremely difficult to conceive any genetic hypothesis that would fit the rather distinctive distribution of missing teeth. However, the evidence contained in this study appears to support the following environmental hypothesis "horizontal and/or vertical pressures on the dental lamina during growth may suppress or distort the tooth buds and the last teeth to erupt in each area are most likely to be affected". This could also explain why teeth are often smaller in crowded arches, and why missing teeth were far less common in the well developed jaws of our direct ancestors 30,000 years ago. The truth in retrospect is usually simple.

Many years ago a colleague of mine Ronald Tait found that the inclination of the third molar tooth germ reflected the curve of the neighbouring vertical Ramus. When

there was lots of room, it was correctly placed but inclined progressively when the Ramus remodelled forward, shortening the arch length. This gives additional support for the idea that the shape of the Dental Lamina is affected by the form of the neighbouring bone. The Lamina probably has an optimal length and does not take kindly to compression.

CLASS I Bi-maxillary protrusion.

This name is misleading as in reality they are bi-dental protrusions.

Muscle tone.

The muscle tone is usually 3 or 4 on the Orthotropic scale which is why most of them are vertical growers.

Tongue position.

The tongue is thrust forward against both the upper and lower incisors when swallowing. This causes the crowns of these teeth to procline making it appear that they are too far forward.

Maxillary position. In fact the maxilla is retruded and there will be an increase in the Indicator Line.

Lip posture.

The lip seal is very poor and the lips are sometimes 15 or more millimetres apart at rest. There is severe parafunction on swallowing with a major thrust from the tongue against both lips which causes them to hypertrophy Figure IV/52.

Jaw posture.

The gonial angle is very high thus reducing the lower arch length and precipitating marked lower incisor crowding see Figure (IV/53).

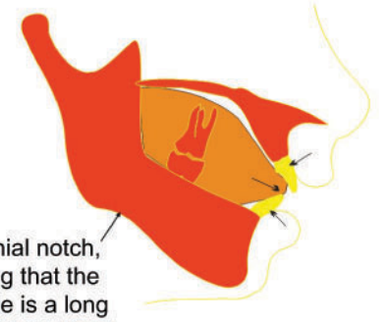
Figure IV/52

Bi-Maxillary Protrusion

Demonstrating change in lip form following a correction of a bi-maxillary protrusion. Treated by Orthotropics to make room for the tongue followed by postural training. Note the reduction in size of the Orbicularis Oris.

Figure IV/53

Bi-Maxillary Protrusion



Note the relative forces from the tongue and Orbicularis Oris muscle tends to tilt the teeth forward although the jaws are back.

CLASS I Scissors bite.

The lower buccal segments are inside the upper. This is a rare situation and may occur on one or both sides.

Muscle tone.

The muscle tone is moderate (about 2 on the Orthotropic scale).

Tongue position.

Unusually the tongue spreads right across the upper arch and the lower teeth bite up onto it. This posture tends to drive the upper teeth buccally and the lower teeth lingually and the tongue position must be changed if there is going to be any chance of a long-term correction.

Maxillary position.

The maxilla will be quite well placed with an attractive face and reasonable Indicator Line. The upper inter-molar width may be over 40 millimetres. The patient is often quite unconcerned and in view of the difficulty in correcting these cases treatment may not be justified.

Lip posture.

The lips will be in the region of 2 to 5 millimetres apart but can be more.

Jaw posture. Acceptable although the lower teeth will be collapsed lingually.

CLASS I Cross bite.

The aetiology of crossbites was described earlier and is due to a reduction of tongue support for the maxilla coupled with an over active buccinator muscle. This results in a narrow upper dental arch and the child is forced to bite one side or the other to achieve occlusion. After a time this becomes habitual and skeletal change to one side or the other is likely to follow.

Muscle tone.

Will be slightly low (Orthotropic scale 3 or 4).

Tongue position.

Orthotropic position 3 or 4 with obvious parafunction when swallowing.

Maxillary position.

Slightly displaced down and back. Lip posture. 3 to 5 millimetres apart at rest.

Jaw posture.

The jaw will always be deviated to one side on closure but may become central when partly open. Ultimately the condyles will adapt to the deviation unless the posture of the mandible is corrected.

CLASS II division 1.

Muscle tone.

The motor tone is significantly less than average and there is a mouth open posture at rest of 5 to 15 millimetres depending on severity. (Orthotropic type 3 or 4).

Tongue position.

The tongue usually lies between the upper and lower teeth, often lying passively in the mouth which is why these patients may have little crowding.

Maxillary position.

Despite the overjet the maxilla is routinely back from its correct relationship with the cranial vault. I can remember thinking this in the 1970s but the first man I met who shared this view was Bob Moyers at Ann Arbour. At

that time the Steiner analysis was dominant, suggesting a 'normal' SNA was 81 to 82 degrees.

In the 1980s Moyers was expressing the opinion that the maxilla was not always forward and this inspired much research in his department. Over the years attitudes have changed and his colleague Jim McNamara subsequently concluded that the maxilla was retruded in many class II cases putting forward the concept of the Nasion Vertical which we discussed in chapter III.

The Indicator Line may only be increased slightly because the upper incisors and their supporting bone are often held forward by a lower lip 'trap'. This at the same time will cause retrusion of the lower incisors with an increase of the Lower Indicator Line but surprisingly there may be little crowding in either arch because of the low muscle tone.

Lip posture.

The lips will be 5mm or more apart at rest and for those that have large overjets this may increase to 15 millimetres or more. Of particular importance the lips will also be apart during speech and eating and this must also be corrected if any stability is to be achieved. Failure to address this point accounts for the high ratio of class II cases that relapse after both mechanical and surgical correction.

Jaw posture.

Because the jaw is dropped the tongue will be away from the palate, which will allow the maxilla to fall back and its width to be reduced.

CLASS II division 2.

Muscle tone.

This will be moderate (orthotropic type 2) and results in quite attractive maxillary development.

Tongue position.

A thick wedge of the lateral boarder of the tongue will rest between the buccal teeth most of the time, even when talking, the thicker the wedge the deeper the overbite. In mild cases, only the lingual premolar cusps will be covered. When swallowing the tongue will thrust between the upper and lower buccal teeth preventing them from coming into contact but there may not be much peri-oral parafunction. Many of these patients are quite unaware that their tongue rests between the teeth although they will agree, if asked, that they suck their teeth when swallowing.

Maxillary position.

The cheek line and Indicator Line will both be increased but the face will not deteriorate unless the overbite is severe or complete.

Lip posture.

The lips are usually 2 or 3 millimetres apart at rest and normally look quite attractive. When the teeth are brought into occlusion the face will become over-closed, especially if the bite is very deep. This will produce what some clinicians describe as a convoluted lower lip.

Jaw posture.

The facial height may look normal at rest, because of the increased freeway space

CLASS III.

The development of class III malocclusion was discussed earlier in this chapter but in essence is quite simple. All these patients posture their tongue low in the mouth with the tip of their tongue resting against the lower incisors (figure IV/42) and the mandible held forward 1 or 2 millimetres depending on lip seal. When they swallow they push the tip of the tongue forward against their lower incisors and contract the lower lip back against it. The condylar joint is one of the most adaptive in the body and will always adapt to the resting posture. Therefore if the mandible is continuously postured forward, the head of the condyle will remodel back into the joint increasing the mandibular length.

The low tongue posture deprives the maxilla of its natural stimulus for forward growth and many class IIIs have normal sized mandibles which look large only by comparison with the maxilla. In addition to this, many young

children will actively posture their mandible forward or to one side at intervals which also stimulates growth. The only long-term cure is to control the posture.

It really surprises me that these obvious cause and effect relationships do not seem to have been recognized by the orthodontic specialty. I imagine it is because they are looking for an answer in the genes. It is quite possible that some of these postures are inherited but they will only be expressed if there is vertical growth and that is almost entirely environmental.

Muscle tone.

Class IIIs with a reverse overbite may have quite good muscle tone (Orthotropic 2) while those with an open bite have poor muscle tone (Orthotropic 3 or 4) and are thus very difficult to correct after the age of eight.

Tongue position.

This is low at rest, during speech and swallowing.

Maxillary position.

The Indicator line is increased especially if the motor tone is weak.

Lip posture.

Those with a deep bite will leave their lips apart 2 or 3 millimetres while those with open bites often leave their lips apart 12 millimetres or more.

Jaw posture.

As mentioned above the mandible tends to be held slightly forward at rest because "it feels more comfortable like this". I have noticed this when the patient is using the Purley Wire (to be described later) because sore places develop on the lower labial mucosa which can only come into contact the wire if the mandible is held forward for long periods. It is not easy to detect a 1 or 2mm forward posture.

Summary.

The science of Orthotropics is based on the Tropic Premise and the clinician should relate this to every new clinical situation that he or she sees. In my experience this will always provide an answer and generally the simplest answer. This is most likely to be correct.

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