

CLASS III MALOCCLUSION (Angle)-

A CRITICAL REVIEW OF THE LITERATURE.

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CLASS III (Angle) MALOCCLUSIONA CRITICAL REVIEW OF THE LITERATURE.INTRODUCTION.

Compared with other Orthodontic subjects, especially Class II (Angle) Malocclusion, the literature on Class III (Angle) Malocclusion is not extensive; however, references to this form of malocclusion in writings on broader subjects are quite numerous. Literature related specifically to the surgical correction of the prognathous mandible is more plentiful, but such a subject is rather more in the realm of the topic of Oral Surgery. Nevertheless, the Orthodontist may seek the aid of the Oral Surgeon in the correction of this deformity, and some mention of this approach is indicated. Basically, however, this work seeks to piece together the diversely scattered information relating to the orthodontic significance of the prognathous mandible, or those conditions which tend towards this condition.

When I think of Class III Malocclusion, I visualise a condition opposite to that of the widely discussed Class II relationship or other relationship of maxillary protrusion; and so various degrees of mandibular prenormality are considered as a whole, and, in my mind, embraced by the term Class III Malocclusion. In other words, the visual signs of this physical defect are characteristic, and the basic needs of correction obvious; therefore, for the purpose of this review, discussion relates to this impression, regardless of the technical verity of the classification. In any case, interpretation of variations of the basic physical deformity seems warranted, if only for the purpose of differentiation.

To illustrate this point, I should say that the facial features of the patient in Fig. 1. would indicate the need for treatment of a characteristic form of malocclusion, and require reduction of the maxillary protrusion, while

the patient in Fig. 2. requires an opposite plan of treatment to reduce the mandibular protrusion, characteristic of another form of malocclusion. Neither may be a pure type, according to Angle's classification of malocclusion of the teeth, but each is distinctive, and without studying occlusal relationships of the teeth, one might be forgiven for indicating that the cases pictured are broadly, Class II and Class III, respectively.



Fig. 1.



Fig. 2.

It is concerning the latter type of case, with its variations of occlusal relationships, that this work is written.

CLASSIFICATION, DIAGNOSIS, AETIOLOGY.

The term Class III Malocclusion infers the condition of mandibular prognathism and is characterised, according to Angle,¹ by "mesial occlusion in both halves of the lower dental arches. The extent to which the mesial occlusion must exist in order to place the case in the division of this class is slightly more than one half the width of a single cusp on each side, but in cases that have been allowed to develop - and these cases are always progressive - the mesial occlusion becomes greater, even to the full width of a molar or more. In cases belonging to this class the teeth in their respective arches vary from quite regular arrangement to considerable crowding especially in the upper arch. There is usually a lingual inclination of the lower incisors and canines, which becomes pronounced as the case progresses, and which is due to the pressure of the lower lip in the effort to close the mouth and disguise the deformity." Like other observers, Angle frequently noted in this type of malocclusion, the habit of protruding the mandible to assist respiration, with the association of enlarged tonsils.

Angle also made a subdivision on this class, and this referred to the defect on one side of the arch only.

We recognise the value of Angle's basic classification and of his pioneer thoughts on aetiology and progression, but is the definition unduly restrictive? Still, Angle was careful not to enunciate his observations in the form of a classical definition, and, perhaps if he were here today he may include in this class those cases which we presently describe as apparent or "pseudo" class III malocclusions, and perhaps he may tend to classify, not purely in terms of occlusal relationship, but in the light of the relationship of the mandible to cranial anatomy. Naturally, concerning aetiology and development, observations over a long period of time and better means of analysis, have resulted in conclusions which vary from those proposed by Angle.

Salzman² interprets true Class III Malocclusion as

meaning that the mandibular dental arch and the body of the mandible are in bi-lateral mesial relationship to the maxillary arch; he describes that the mesio-buccal cusp of the maxillary 1st permanent molar occludes in the interdental space between the distal aspect of the distal cusps of the mandibular permanent 1st molars and the mesial aspect of the mesial cusps of the mandibular 2nd permanent molars.

In the same treatise, Salzman mentions that certain types of class III malocclusions may be the result of chondrodystrophy in the growth cartilage at the base of the skull rather than of an overgrowth of the mandible. Further, concerning aetiology, he mentions that sucking habits have been known to produce class III malocclusions where the lower jaw is pulled forward by the fingers.

In clinical practice we may see many cases where the overall aesthetic picture is one of mandibular procumbency, or where the occlusion of the teeth appears to be in characteristic class III relationship. For convenience and despite the concepts of occlusal classification given to us by Angle, we tend to include in the Class III type, cases which are in fact, not true Class III malocclusions. Parker³ asks "are we mistaking the occlusion of the teeth in a characteristic class III relationship, with a true class III malocclusion?"

What does constitute a true class III malocclusion? Parker, recording the findings that in certain class II cases the mandible may be of normal size, and the bone, including the temporo-mandibular joint, posteriorly placed, asks "surely we can accept a normal sized bone anteriorly placed as a class III?" He further states that, clinically, it is possible to divide class III malocclusion into two types.

(1) The type conforming more closely to Angle's conception, in which the mandible is overdeveloped and the lower incisors are labially placed in relation to the upper

incisors, and with marked spacing between the lower teeth.

Here I would comment that surely the tongue must be overdeveloped to maintain the interdental spaces, and an enlarged tongue must be just as much a characteristic in this type of case as the result it produces. Now, one might well ask could an enlarged tongue be a cause of this type of class III malocclusion?

(2) A similar type of occlusion, but with no spacing between the teeth of the mandibular dentition, and there may be crowding, from which it may be inferred no overdevelopment.

Parker emphasises individuality of types within the breadth of the classification and stresses the following points associated with class III malocclusions:-

(i) True class III malocclusions are characterised by anterior positioning of the mandible.

(ii) There is not always an overdevelopment of the mandible associated with this anterior positioning.

(iii) The angle of the mandible is not always more obtuse than in other cases.

(iv) In class III malocclusions the lower incisors tend to be more lingually inclined.

(v) All cases classified clinically as class III have not an anterior positioning of the mandible and may have a distal positioning of the maxilla.

It is then inferred that Parker recognises three basic clinical types:-

(a) True Class III with an overdeveloped mandible.

(b) True Class III with a normal sized mandible, and therefore, invariably, with crowding of the teeth.

(c) Pseudo Class III exemplified by distally placed or micro-maxilla - according to Angle's definition, this clinical type is, in fact, a class I malocclusion.

I believe that Parker has summed the situation very well. It is not that there is disagreement with Angle's definition or even a loophole; to me the important point is the one that

Parker significantly makes, concerning the characteristic anterior positioning of the mandible, and the fact that some cases with this clinical characteristic should, by Angle's definition, be properly described as class I; yet the overall clinical picture makes the class III category an inviting storehouse for these cases.

In their classical text book, Colyer and Sprawson⁴ use the term "inferior protrusion," and recognise two basic types:-

(1) faulty occlusion of the teeth in jaws otherwise properly developed

(2) faulty growth of the bones themselves.

Causes mentioned, concerning type (1) are - (a) habits - constant protrusion of the mandible; hooking the fingers over the mandibular teeth.

(b) eruption of the maxillary permanent incisors internal to the existing deciduous teeth - not a true class III malocclusion, however, for the molar relationship is normal. Aetiology of type (2) is stated to be obscure - (a) defective growth of the maxilla generally, or the premaxilla only, with consequent involvement of the incisors only; the mandible is not defective.

(b) unduly large mandible yet with proper proportions of body and ramus.

(c) unduly large ramus with consequent forward thrust of the body: here the mental process, often, is large and of hereditary origin.

(d) abnormal forward position of the condyle, and possibly associated with the use of forceps at birth, or with a difficult breech birth.

(e) Acromegaly, with the mandible enlarged.

These authors note that, often, in the rest position, the incisors may be in contact, but with a space between the posterior teeth, and, in occlusion, the mandible is forwardly placed.

Further basic observations are made by Dewey⁵ who adds to Angle's Class III thus:-

Type 1. The dental arches are well developed and the teeth are in normal alignment in the respective arches when considered individually. In occlusal contact however, there is an edge to edge bite, and the impression is that the mandibular dental arch has been moved bodily forward.

Type 2. The mandibular incisors are crowded and in lingual relationship to the maxillary incisors.

Type 3. The maxillary arch is underdeveloped and the maxillary incisors crowded. The mandibular arch is well developed and the mandibular teeth in normal alignment.

All of these observations presuppose the characteristic class III molar relationship, described by Angle, which relationship assumes important diagnostic significance. Of course these types observed by Dewey are basic and we may see many variations of them, but to me the important thing is the characteristic skeletal pattern of the class III case.

Writing further of class III (Angle) malocclusion, Salzman⁶ states that this malocclusion expresses itself in mesiocclusion (pre-normal relation) of the mandibular molars, premolars and incisors. He, significantly, and apparently in contradiction to his former words, states that the relationship may be confined to the teeth, while the basal arches may not show abnormal relationship. That there may be mesiocclusion in the premolar and molar relationship, or these segments may be normal as in pseudo class III, is also stated.

Further, the body of the maxilla may be undersized in relation to the mandible, or the maxilla may be in normal relationship to the base of the cranium, while the mandible is either overgrown or bodily displaced in a forward direction. This seems to be a good expression of the

variations that may be seen as part of the recognised class III pattern.

Salzman also speaks of "actual" and "apparent" class III (Angle) malocclusions and mentions that there are two types of "mesiocclusion which have been promiscuously described as class III (Angle). (1) True class III.

(2) Apparent class III, where one or more of the following factors are present -

(a) normally developed mandibular arch in normal relation to the cranium with the maxillary arch shortened in its antero-posterior direction.

(b) normal occlusal relationship of the molars but a labial relationship of the mandibular incisors in association with a fairly normal profile.

(c) labial or edge to edge occlusion of the incisors.

(d) the mandible can be retracted forcibly to a normal relationship with the maxilla by asking the patient to raise the head as far as possible and applying pressure with the palm of the hand to the chin in a backward and upward direction until the teeth are approximated. Correct placement of the mandible will bring the teeth into a normal relationship."

It is further stated that many cases of self-correction of linguoversion of the maxillary incisors have been reported, when the mandible does not show the true class III (Angle) nature.

Writing of the causes of incisor malrelationship, Salzman enumerates (i) Extraction of maxillary teeth and subsequent collapse of the dental arch and change in the occlusal relationship. With mandibular extractions, an assumed prenatal position of the mandible may be acquired, in order for the patient to obtain better occlusion of the remaining teeth.

The patient, whose models are pictured in Fig. 3. has had an unfortunate dental history - premature extraction of

deciduous teeth, maxillary crowding, accidental and unreplaced loss of a maxillary central incisor, and the extraction of a premolar tooth from each arch segment. The facial appearance would cause one to assume that this is a class III malocclusion, yet there is no family history of

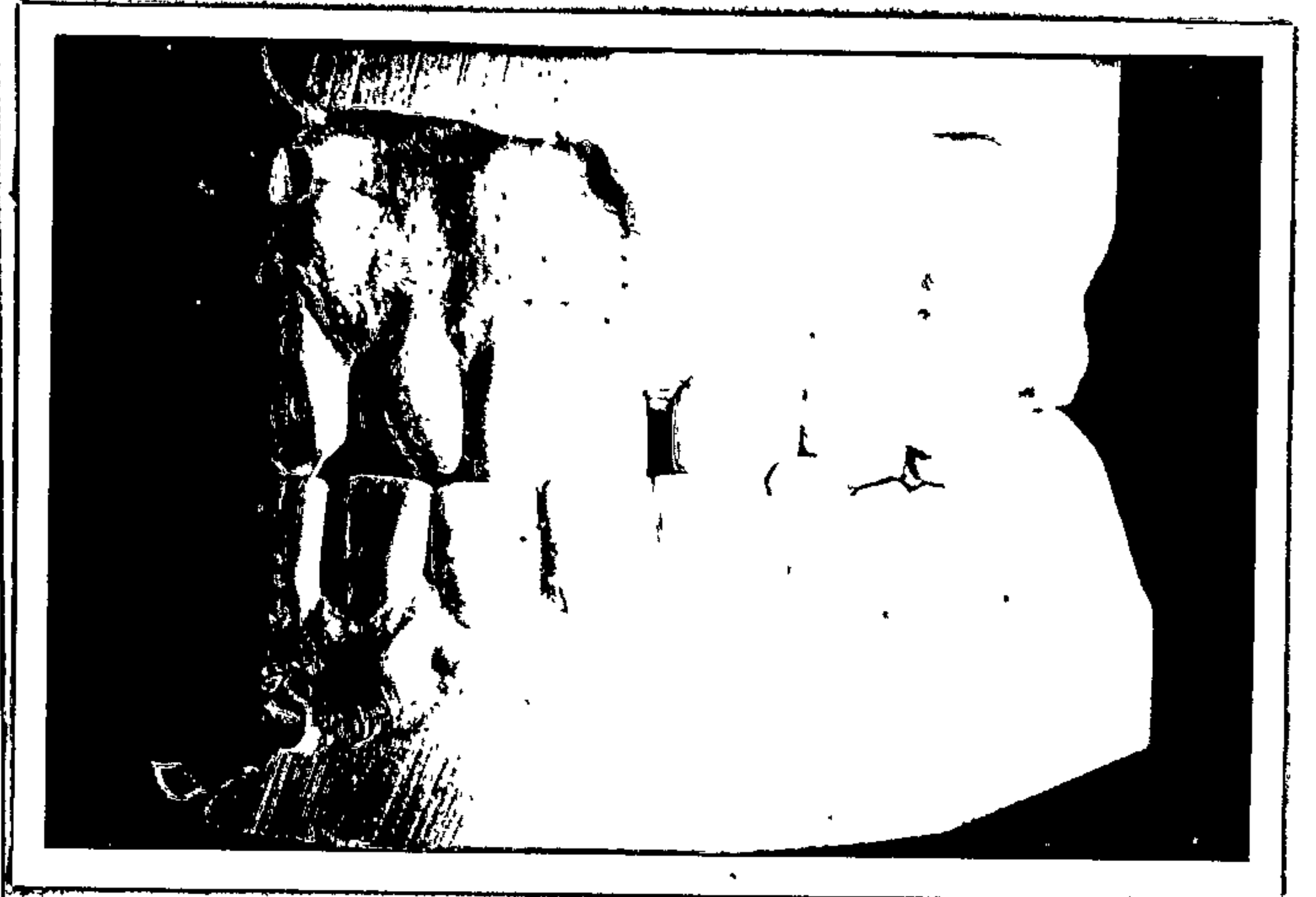


Fig. 3.

this deformity. All of the occurrences in the patient's dental history, have led to the resultant occlusal and facial deformity.

Fig. 4. shows the result of an attempt to improve the aesthetics of this case, the means being purely conservative --- the placement of a porcelain jacket crown on the left lateral incisor. How much better it would have been to attempt the redemption of the lost space by orthodontic means and provide a prosthetic restoration? Yet, in this case does a pattern of skeletal deformity impose restrictions on such an attempt? Here, cephalometric evaluation could be useful.



Fig. 4.

(ii) Retention of the maxillary deciduous teeth beyond the physiologic age when they should be shed; this may cause the permanent incisors to occlude lingually to the mandibular incisors.

(iii) The habit of thrusting the jaw forward and holding it in the prenatal position.

(iv) Sucking habits where the lower jaw is pulled forward by the fingers, have also been known to produce the defect.

Salzman makes a significant observation concerning differential diagnosis, stating that in apparent mesiocclusion the erupting second permanent molars are shown, in the roentgenogram, to be lying close against the distal

root of the first permanent molar. In true class III cases there is usually a space seen in the roentgenogram, between the first and second molars.

This is well illustrated in Fig. 5., which shows X-Ray photographs of the mandibular molar areas of two children aged ten years. One was a class I malocclusion case, while the second showed class III characteristics.

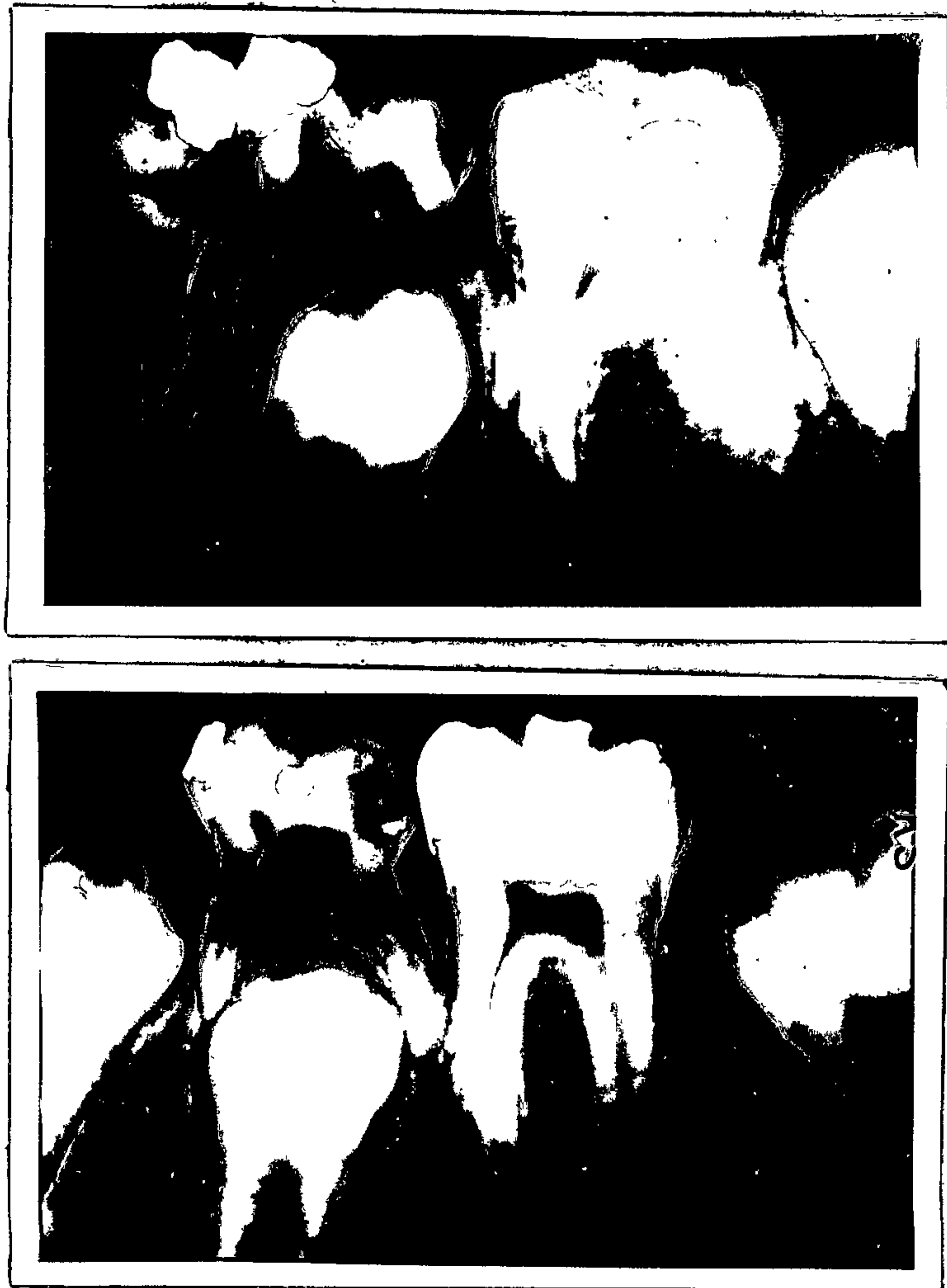


Fig. 5.

Prognosis is stated to be markedly more favourable in apparent than in true mesiocclusion.

Class III malocclusion is defined by Strang⁷ to be simply "cases of malocclusion in which the body of the mandible and its superimposed dental arch are in mesial relationship to the cranial anatomy." He declares that class III cases are usually readily analysed, because of the great changes that take place in the body of the mandible as a result of inherent abnormal forward growth; further, that in advanced cases the growth pattern of this bone is tremendously modified, so much so, in fact, that the results

of treatment are far from satisfactory, and the prognosis is quite unfavourable.

Strang states that in early stages the mesial relationship of the inclined planes of the mandibular molars and the lingual inclination of the mandibular incisors, which nature tries to keep in occlusal contact with the maxillary incisors, are important differential signs. He regards this faulty inclined plane adjustment as an important secondary aetiological factor in aggravating the abnormal mandibular relationship. He says "it is also to be expected that the maxillary dental arch and alveolar process will be constricted in its growth in class III malocclusion, because the lines of masticatory stress produce a backward and lingual pounding on the teeth in this dental arch. Hence the apices of the roots of these dental units, together with their alveolar process, move lingually to adjust themselves to this constricting force."

Broadbent's findings concerning changes noted as a result of class III malocclusion are reported by Strang, as being excessive forward positioning of the symphysis of the mandible, a reduction in the vertical growth of the rami, with a resulting forward movement of gonion, and retardation of the forward and downward growth of the maxillae, and, there is reported, no forward displacement of the condyles. Hence, it is stated that such extensive variations can hardly be attributed to the action of the perverted functional forces alone, but are much more likely to be the result of disturbance of the growth pattern from over-stimulation by inherited factors of control; furthermore, inherited tendencies to this deformity are quite in evidence, and abnormal stress forces probably aggravate the deformity, because treatment at an early age has proved to be exceedingly beneficial in many cases.

Strang too, feels that practically all class III cases exhibit a perverted swallowing habit and that during this

abnormal functional action, the tongue is pressed forcibly against the front section of the mandible below the incisor roots; this oft repeated pressure tends to force the mandible further forward and to narrow the maxillary denture.

From the remarks of these notable authors I would deduce that the major aspects of class III malocclusion are inherited, and that aggravation may result from perverted function as a result of the inherent pattern, or from additional functional abnormalities. I believe their assessment to be most logical.

Further opinion concerning the diagnosis of Angle's class III malocclusion is given by McCallin,⁸ who emphasises the importance of recognising that skeletal morphology dictates the dental base relationship, and that the dento-alveolar structures, as they grow from the dental base to meet across the intermaxillary space, are moulded by pressures exerted by soft tissue posture and behaviour, to bring the teeth into either normal occlusion, or variations from normal. Both factors are stated to be responsible for either normal or abnormal occlusion.

He emphasises his discussion through describing two extremes of morphological types, also pointing out that there is a smooth distribution of variations between the two extremes.

Type 1. is described as having a long mandible, with above average gonial angle, and short antero-posterior and laterally contracted maxilla. Usually there is a large inter-maxillary space anteriorly, and as a result, a long face with a concave middle third profile. Occlusal variations of this type relate to various soft tissue pressures - tongue position, lip competence or incompetence, hanging away of the lower lip, position of tongue in swallow, etc.

Tongue position may separate the labial segment from the buccal, in a long mandible, while a normal dental base

relationship may have a class III incisor relationship through the forward position of the tongue.

Alternatively, a high gonial angle class III dental base may have a fairly normal occlusion through soft tissue pressures of the lower lip, and balanced by the tongue holding the lower labial segment lingually inclined.

The position of the tongue may cause an anterior open bite.

Mesial displacement of the mandible from the premature contact between the incisors from rest position to occlusion is less common in this type than in the other extreme type.

Type 2. The body of the mandible is long, with the gonial angle average or below average; the maxilla is of average length and not contracted laterally. The mandibular prognathism is less marked than in Type 1., with inter-maxillary space average, and the face round or square in shape.

No typical postural or behaviour soft tissue patterns are manifest.

Commonly there is incisor interference between rest and occlusion, with resultant over-eruption of the lower incisors, giving the ability to overclose.

Between these two types, there are infinite variations and the bulk of Class III malocclusions fall between these two extremes.

McCallin states that he and his co-workers have not been able to confirm the words of many text books, wherein it is stated that the rate of growth of the mandibular bone exceeds that of the maxilla in cases of class III malocclusion.

It seems that McCallin observes as principal differentiating features of the two named types, the widely varying gonial angle, the variation in inter-maxillary space (perhaps this relates to the gonial angle), and the variation in morphology of the maxilla; and yet both types have the common feature of a long mandible.

Of what practical significance are McCallin's observations? This, I believe, is limited to recognising the variations that can exist in class III malocclusions, and recognising that in many cases treatment is limited by soft tissue patterns and behaviour, as much as by the inherent skeletal pattern.

Further reference to the association of soft tissue with tooth position is made by Tulley,⁹ who states that in cases of Angle class III malocclusion where the apical base relationship is class III, the skeletal pattern dominates the clinical picture. The teeth are apart in swallowing, and Rix is quoted in describing in normal cases, the tongue to be cushioned between all of the teeth at the mylo-hyoid phase. The morphology and function of the tongue, although not a primary aetiological factor, will dictate the degree to which the lower incisors can be collapsed lingually during orthodontic treatment. Concerning the influence of the tongue, Tulley further cites Rix in describing the separation of the cheek teeth during swallowing as sufficient to cancel out the reverse overbite; the tongue tends to set between the cheek^{teeth} and the incisors are placed in light edge to edge contact.

The importance of the tongue in the function of swallowing is not always evident in casual clinical examination, and so Tulley's appraisal is a useful reminder to consider this aspect when considering treatment.

Brodie¹⁰ also relates musculature to the malocclusion, and states that lack of harmony between the position of the two arches leads to a superimposing of muscular factors on the skeletal disharmony, and that this often occurs in class III malocclusions. Such malocclusions necessitate muscular adaptations, of various sorts, which aggravate the condition.

He records that class III malocclusion comprises a malrelation of the arches and jaws that is opposite of class II, but in addition, often, it is found that this accompanied by certain differences in development. Furthermore,

statistics of the morphology of class III patterns have shown that the angle of the body and ramus of the mandible is strikingly larger than in class I or class II cases. This leads to an increase in the effective length of the mandible, causing the characteristic protrusion; this is often accompanied by a lack of maxillary development of varying degree, which accentuates the discrepancy. Brodie has found it useless to treat a class III malocclusion orthodontically, unless the tongue position can be simultaneously corrected.

The question, of course, is how can correction of the tongue position be maintained to effect stability of the orthodontic correction? No doubt, sustained voluntary endeavour is the answer. Ballard, Gwynne-Evans, Tulley, Rix and others would not agree, however, that tongue control is possible, for swallowing is regarded as half involuntary, and moreover Ballard¹¹ believes that the abnormal swallowing action is present at birth and probably inherited.

Three main causes of mandibular overjet are cited by Bjork¹² - (1) Relative difference in basal prognathisms, with the lower jaw, as a whole, protruding in relation to the upper jaw.

(2) Relative difference in alveolar prognathism, with the lower alveolar arch protruding in relation to the upper, but the jaw bases in normal relation.

(3) Proclination of the lower incisors with or retroclination of the maxillary incisors.

What a splendid summary of basically agreed facts!

Concerning cases where the diagnosis of true class III malocclusion is in doubt, Hopper¹³ has made an examination of patients with prenatal mandibular incisor relation, excluding those with prenatal mandibular base relations. He records that most patients could achieve edge to edge incisor relations, a characteristic often ascribed to what he terms class III postural cases.

In most cases examined temporo-mandibular X-rays showed little or no difference in the position of the condyle at rest or in occlusion.

Morphologically, many of the cases were described as class I (Angle) but cephalometric analyses showed them really to be mild cases of mandibular prenormality. A large number showed an increase in freeway space, due to faulty muscle patterns or overloading of the buccal segments.

If the upper incisors were moved labially, in treatment, even to a small extent, the condyle is shown to be displaced anteriorly, and if no retention followed active treatment, a relapse resulted till equilibrium was established in the original incisor relation, and the condyle displacement lost.

Cephalometric examination of the treated cases showed static condyle-glenoid relation, but equilibrium was reached through the labial tipping of the upper incisors, together with lingual inclination of the anterior displacement of the mandible, with over-rotation of the condyle.

It is interesting to note that, in these cases, proclination of the maxillary incisors alone, to "jump the bite," is inadequate, and results in a state of lack of equilibrium, doomed to relapse.

In the matter of diagnosis and making a reasonable prognosis Spring¹⁴ warns "if we accept the work of Brodie on the constancy of the facial pattern, we must assume that it is genetically determined. In other words, a malrelationship of the jaws, as seen in class II and class III cases, can be, and very probably is, a genetic variable, the pattern of the malocclusion having been established by an unfortunate combination of genes. This pattern, once established, cannot be changed unless an active growth centre is eliminated."

No doubt, this statement assumes new significance, when one considers the cases described by Hopper.

However, Salzman¹⁵ writes that favourable genetic

influences lead to normal growth and development. When they are unfavourable, they may lead to abnormalities of the dento-maxillo-facial area. Environment is frequently the deciding factor, states Salzman, in the extent of the manifestation of abnormalities of genetic origin. "Although the genetic growth pattern tends to manifest itself during growth and development, it can nevertheless, be favourably modified, by present orthodontic methods. Congenital abnormalities may or may not be of genetic origin. They may be due to an abnormal state of the pregnant mother or to deficiencies in the foetus."

Salzman states further that class III (Angle) malocclusions, together with class II, have muscular adaptations which aggravate the condition. The tongue position in class III is in the mandibular space, and the body of the mandible is not usually longer than a normal or class II (Angle) malocclusion, but the gonial angle is greater, giving a greater overall length to the mandible.

It is interesting to compare this statement concerning the length of the body of the mandible, the gonial angle and the overall effective length of the mandible with the findings of Brodie,¹⁰ who would agree, and with those of Parker³ and McCallin,⁸ who would not generalise in the same terms.

Further enlightenment on aetiology is given by Ballard¹⁶ who emphasises that the dental arches whether normal or abnormal, are in a position that is in balance in soft tissue morphology and behaviour; further, that the mandible has a postural relationship to the maxilla which is endogenously determined, mature at birth, and probably remains stable throughout life. This view seems to conform with the basic conclusions of Brodie and Hopper.

Ballard enlarges by saying that the position of the dento-alveolar structures developing from the dental bases, and their occlusal levels, is determined by the posture

and activity of the oro-facial and masticatory muscles; significantly too, the dento-alveolar structures grow vertically into a genetically determined inter-maxillary space, until their inherent power of growth is balanced, physiologically, by masticatory or other muscular activities; a special note is made that the forces involved must be very light, because two teeth in contact are sufficient to maintain normal inter-occlusal clearance, and a conclusion reached that a reflex mechanism is almost certainly involved.

Ballard mentions the finding of Hopper, mentioned earlier, that the condyle is not displaced forward in class III malocclusions, which have a postural element, saying that this is easily explained on the basis of the physiology of the deviations from the normal path of closure. Furthermore, the aetiology of these cases is that, morphologically, they are class III but to a lesser degree, so that when the mandible moves through a normal path of closure the first contact is an incisor edge to edge contact. This, reflexly and sub-consciously, is not tolerated, and the mandible makes an avoiding action which is the apparent forward positioning. This physiological mechanism also accounts for the constant finding of an excessive interocclusal clearance and over-closure in these cases.

"With a normal path of closure, the occlusal level of the cheek teeth would be at about the level of the incisor edge to edge contact, but the normal pattern of activity, which determines the occlusal level, is reflexly disturbed. That is, there is muscle activity to produce the deviation, when there should be relaxation."

This effect is illustrated in the case pictured below: this case is, of course, complicated by the mutilation of extractions in the deciduous dentition and of the permanent first molars, and the premolar teeth are only recently erupted, but the point is clear.

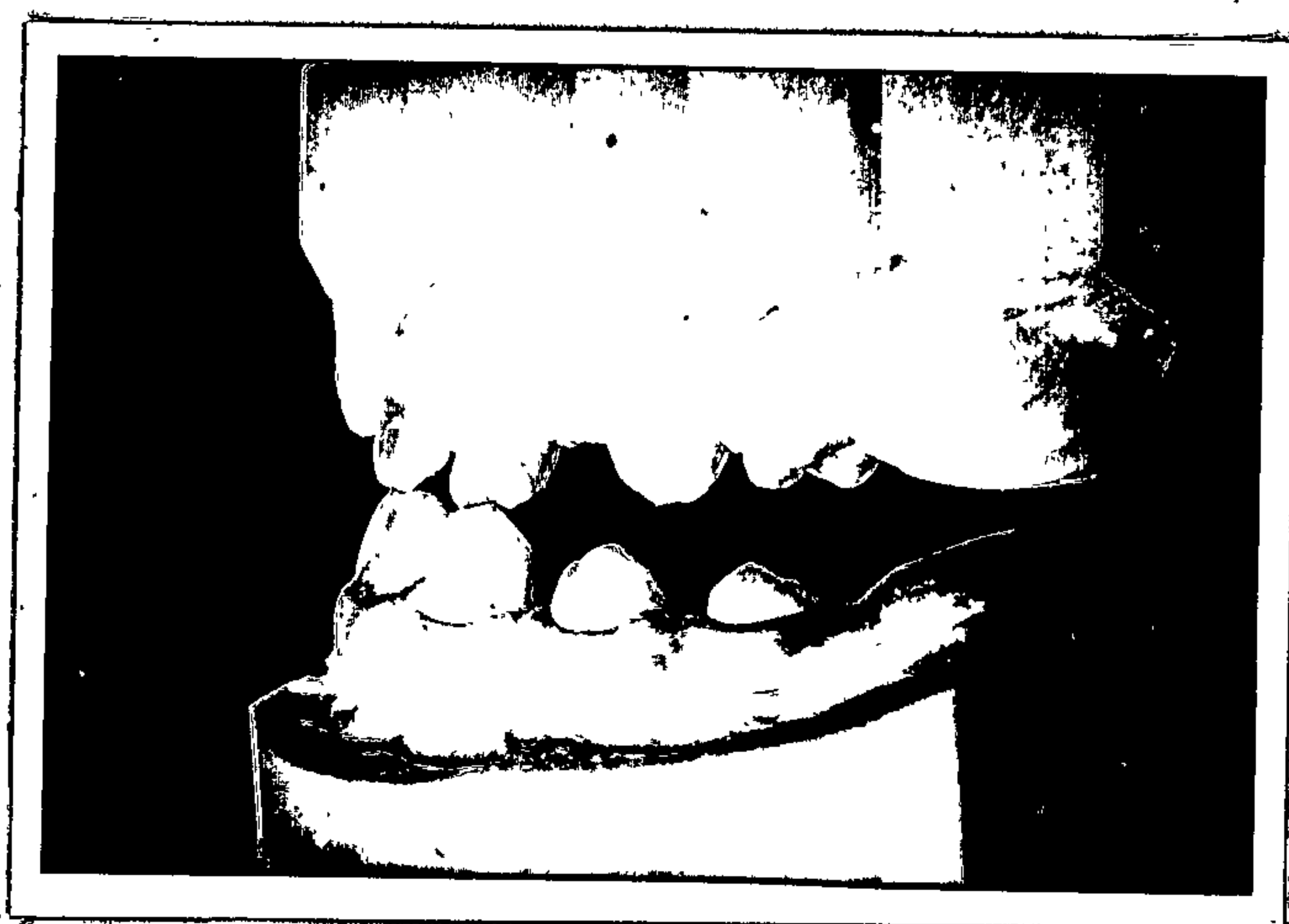


Fig. 6. Rest position

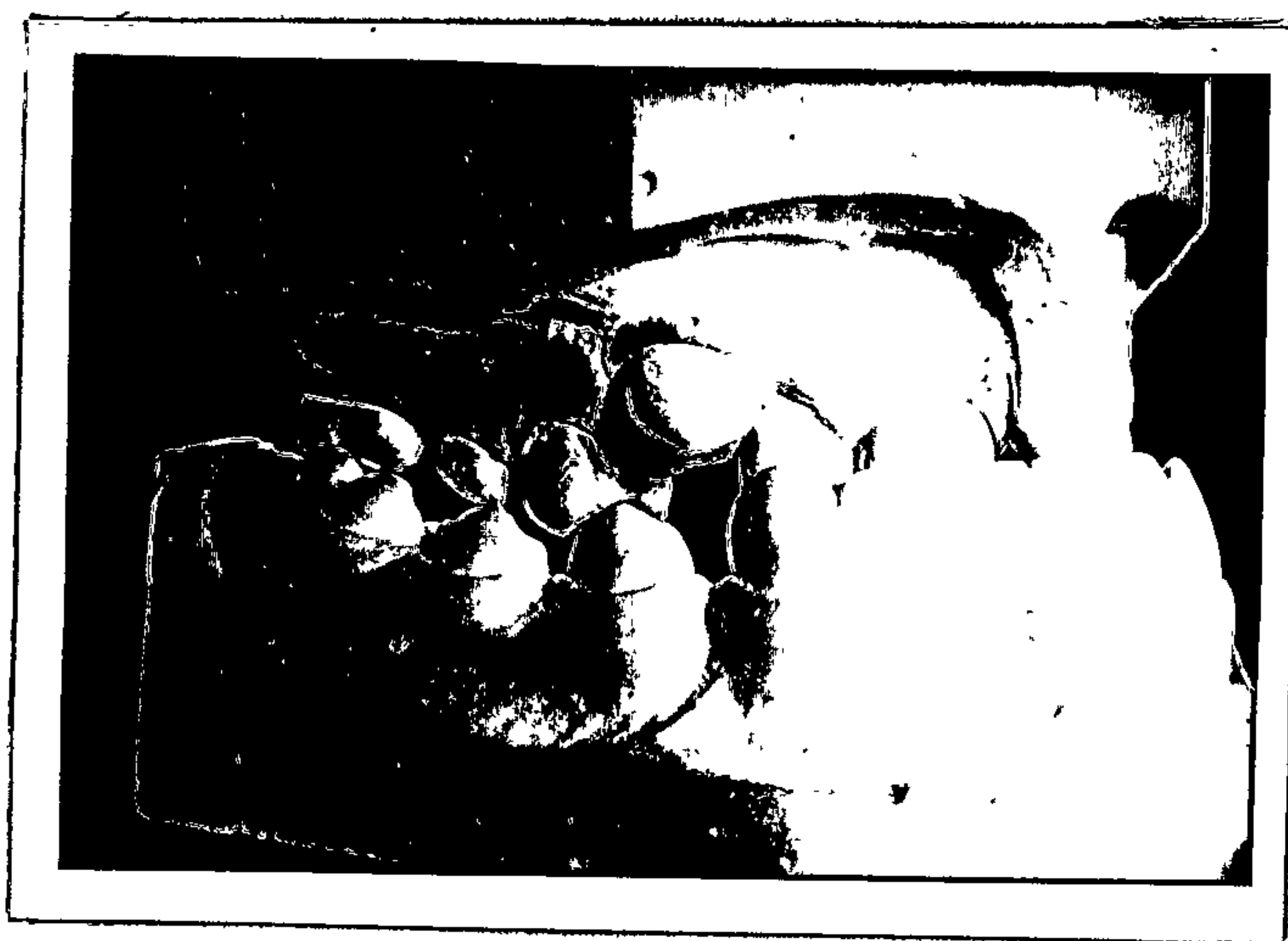


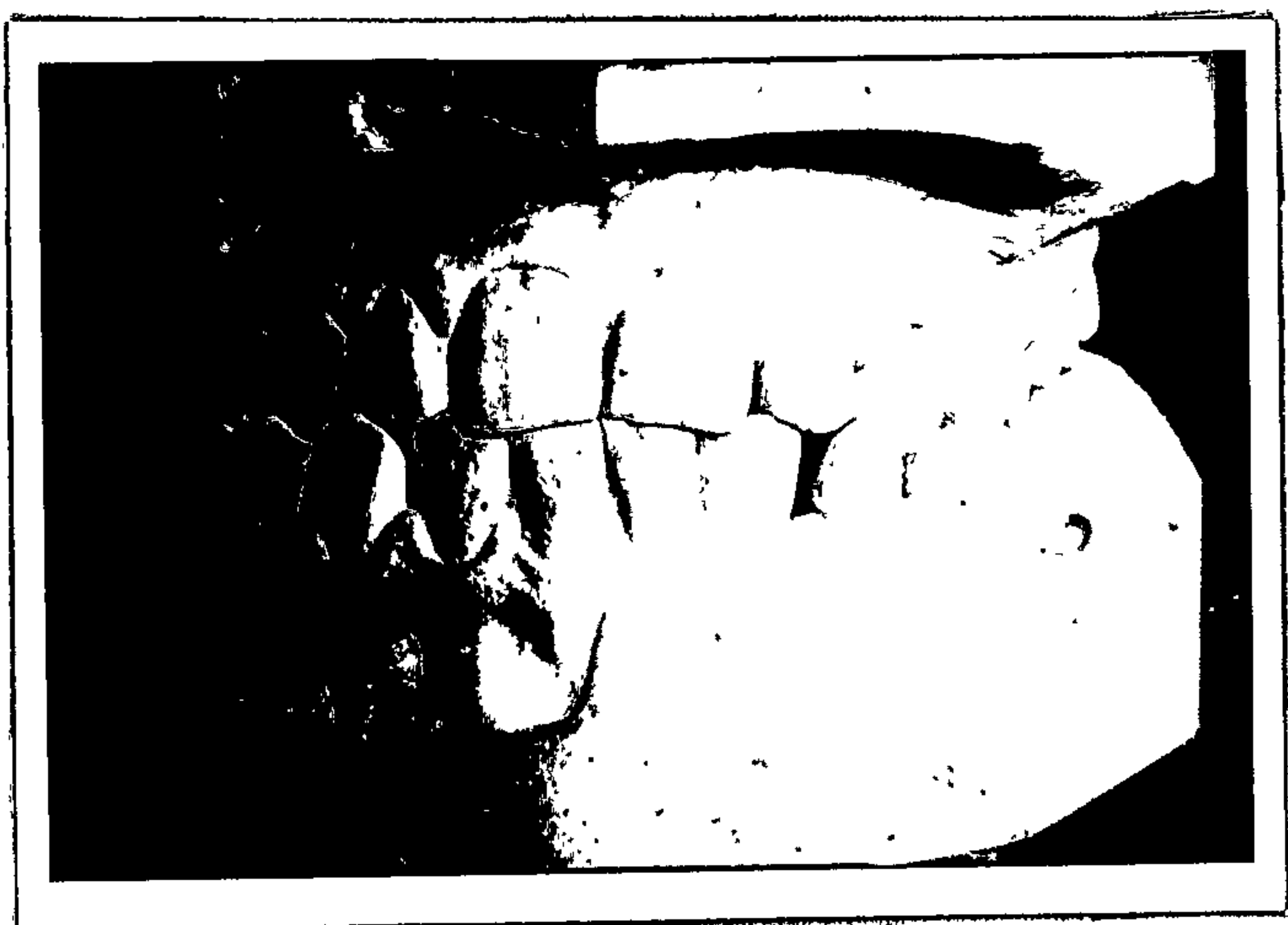
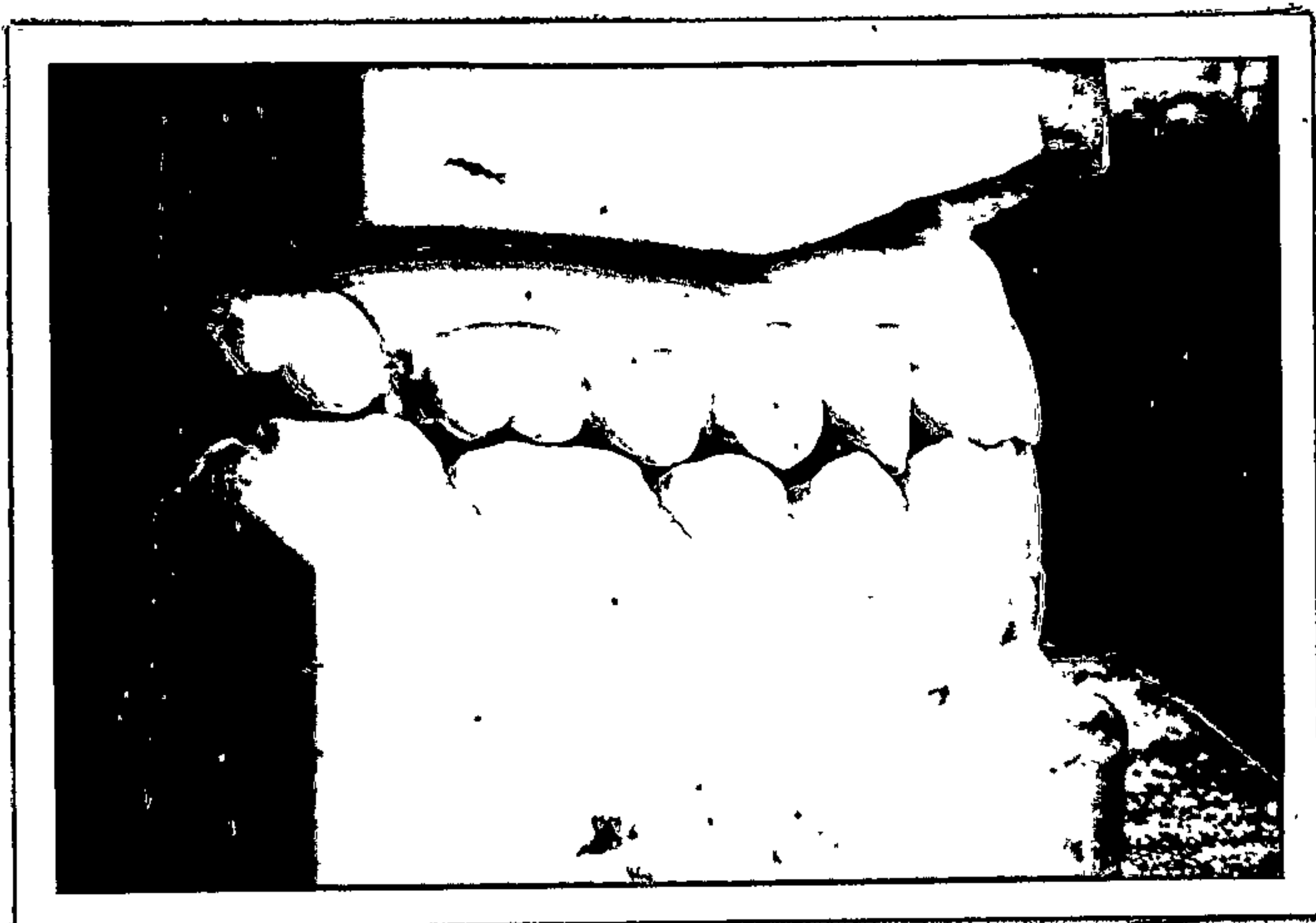
Fig. 7. Functional overclosure.

Further mention of this physiology is given by Grewcock,¹⁷ who states that in some cases of apparent class III malocclusion, the forward positioning of the mandible is the result of premature cusp contact during the normal path of closure. He adds that retrusion in centric can often be maintained by suitable overlays.

In the same discussion Ballard,¹⁷ speaking of the physiological reflex mechanism of avoiding abnormal contacts by mandibular displacement, shows the case of a treated class III malocclusion, in which the upper incisors had been pushed over the lower incisors, so that the incisor overbite was the factor holding them forward against the lip action. He records that the patient could only close his back teeth if he applied sufficient pressure to push his incisor teeth forward out of the way. This, obviously, is the result of the position of balance, at rest, that is, between the lips and tongue, not being the same as that in the occlusal position. The result is, of course, excessive absorption of the upper incisor roots and permanent thickening of the periodontal membrane.

This is in accord with the findings of Hopper mentioned earlier, pointing out that stability and equilibrium is reached only if there is an accompanying lingual inclination of the lower incisors, when the upper incisors are pushed forward over the lowers during treatment.

The case illustrated on the next page received limited elementary treatment in which the upper incisors were proclined and the lower incisors given a degree of lingual inclination. The result, although not ideal, shows that some equilibrium has been reached and a functional occlusion of the posterior teeth attained, through the dual avenues of tooth movement.



Fig, 8.

In another discussion relating to diagnosis, Ballard¹⁸ states that inherited variations are the causes of the majority of malocclusions, and there is no evidence that the individual is as plastic in its environment as many text book aetiological factors require. He says, also, that it is more evident than ever that malocclusions are not the result of environmental factors acting post-natally. Therefore, he states, it is not possible, by controlling environment, to prevent malocclusions. Even more dogmatically, he states "malocclusions are the result of inherited variations, the details of which we must be able to assess in our diagnosis."

If we are to accept the theory of Ballard we must reject the clinical evidence amassed by numerous authors concerning habits in particular, or must we assume that the habits do not contribute to the malocclusions? Or perhaps we must regard the habits themselves, in a sense, part of the malocclusion and therefore inherited!

Concerning the discrepancies of jaw size which may be found in malocclusion, Dixon¹⁹ relates that it has been shown that the teeth are supported by alveolar bone, which develops expressly for this purpose. In orthodontic practice, he states that alterations in pressure upon teeth promote "cellular modulations in the labile alveolar bone which consequently adjusts itself readily to the altered tooth positions, a modification most easily carried out during the growth period." On the other hand, Dixon recalls that the basic neural element develops for quite a different purpose - to support nervous tissue - and "we would not expect this part of the jaws to respond to tooth movement." He states that the critical region of dento-facial development seems, therefore, to be between the alveolar bone and the basal bone which supports it. Then, significantly, "the greater dependence of the mandible on growth by cartilage replacement accounts for the overgrowth of the lower jaw compared with

the upper facial skeleton, in acromegaly. Conversely, the dystrophy affecting membrane bones which are not dependent on cartilage replacement, namely cleidocranial dysotosis, principally affects the maxillary region.

While these are extreme and pathologic states, the mechanism of bone growth is of interest when considering class III malocclusions, when, so often, we have a combination of an overly large mandible and an unusually small maxilla.

Salzman⁶ also speaks of acromegaly "the pathognomonic facial changes of which are, enlargement of the supra-orbital ridges and changes in the jaws especially the mandible. The mandibular change is not confined to an increase in mandibular prognathism alone, although this type of malocclusion predominates; there may be edge to edge or even normal occlusion. Pathogenic changes in acromegaly are not to be confused with normal facial prognathism or alveolo-dental prognathism; the maxillary dental arch also shows enlargement, and there is tooth spacing. Both jaws show increased labial inclination of the incisor teeth." He illustrates the progress of mandibular prognathism to a pathologic extent, with photographs of twin brothers, both of whom had slightly protruded lower jaws at six years, but one boy has had a steady progression of mandibular prognathism associated with a pluriglandular syndrome, with marked transient hyperpituitrism.

A distinctive type of class III malocclusion is mentioned by Blyth,²⁰ who uses seven cases of this type for his analysis.

In this type, the clinical picture shows a postural component, but additionally, a failure of vertical development in the buccal segments is significant. There is an increased inter-occlusal clearance which appears to be due to a primary failure of vertical development, and not secondary to that produced by a displacing activity of the mandible. With a mild class III dental base relationship,

there is solid incisor contact and the mandible does not normally move forward as a habit-avoiding activity in speech. The incisors may meet edge to edge without displacement being induced. To achieve occlusion there is a conscious disengaging movement of the mandible (as distinct from the reflex avoiding activity). It is possible, states Blyth, that the developmental failure has, to some extent, included the labial segments so that in these cases the rest position is open from the initial incisor contact; this is in contrast to the true postural class III case, where the rest position may be somewhere closed from the initial incisor contact. Most of the cases have marked wear facets on the occlusal surfaces of the molars, and there is a history of bruxism.

Radiographically, Blyth notes a class III dental base relationship and often a short maxillary apical base with over-crowding and little depth to the maxilla in the premolar and molar areas and the curve of Spee is reversed: with the teeth in occlusion, there is increased inter-occlusal clearance, coupled with a low mandibular plane angle; the gonial angle is not necessarily low, and in proportions of facial height there is subnasal insufficiency.

Blyth considers that aetiology of this type is obscure, but it could be genetic or merely a morphological pattern. There could be a failure of vertical development as in cleft palate cases.

That this particular series of cases should be differentiated as a special type, appears rather open to question. Surely every variation from the basic features of an accepted clinical type, cannot be regarded, in itself, a separate type - and Ballard¹⁶ has already described a basic clinical type displaying the postural element, excessive inter-occlusal clearance, and muscle activity on overclosure. I believe that Blyth's cases represent the same type, but with minor variations occasioned by more marked micro-development of the maxilla.

Sanborn²¹ concludes - (1). A class III malocclusion does not imply a typical facial pattern, and the various types of skeletal profiles may be grouped according to similarities in the amount of maxillary and mandibular prognathism.

(2). The most striking difference between the class III facial pattern and the normal, is the angle of convexity (Downs) which is a measure of protrusion of the maxillary part of the face to the total profile.

(3). The maxilla of the class III with its alveolar process tends to be less prognathic than normal, while the mandible tends to be more so.

(4). The ramus of the class III mandible forms a more acute angle with the cranial base and the upper face than does the normal, and the gonial angle is more obtuse, while the lower border of the mandible is more steeply inclined than in the normal.

(5). The upper incisors are inclined further labially, in relation to the palatal planes in class III malocclusions, while the lower incisors are inclined further lingually, relative to the lower mandibular border and occlusal plane.

(6). There is no significant difference between class III and normal occlusions, in the length of the body of the mandible from gonion to gnathion, and there is no significant difference in the length of the ramus between the points articulare and gonion, but point gonion is further forward in relation to the cranium and upper face.

To summarise Sanborn's findings, we may conclude that the class III deformity is due to a combination of factors involving malformation and malrelation of the parts that go to make up the dento-facial complex. On the average, the class III facial skeletal pattern shows a middle face deficiency and a more prognathous mandible than normal,

resulting in a concave profile, which is the most striking feature of the class III deformity.

These seem to be logical conclusions and in conformity with those of Brodie, Salzman, McCallin, Parker, etc.

McCormick²² compared the lateral X-rays of the heads of 35 cases of class III malocclusion with those of 34 class II div. 2 cases and found no essential differences in the relationships of the structures of the upper face to each other or the cranial base. He concludes, therefore that the abnormality is limited to the lower jaw. It is interesting to compare this conclusion with that of Sanborn, who emphasises the concavity of the middle face. It is further interesting to note the findings of certain continental investigators.

Luzj,²³ Maj,²⁴ Luzj,²⁵ Miotti²⁶ and others recognise two different types of normal construction of the skull - that represented by the angular profile and that by the rectilinear profile, the assessment being made in respect of the basic form of the facial profile from forehead to chin; these two extremes represent definite constitutional types and between them is a graduating scale of profile forms. The facial angle formed by connecting soft tissue points, Frontalis-Nasion-Gnathion is used as a guide for determining the angularity of the profile.

An observation frequently made, is that with the rectilinear profile, the cervical vertebrae is a straight section, while the angular profile types possess a twisted cervical section.

It is declared that a strict relation exists between the conformation of the head and body constitution. The "brachytype" or "brevilinear" form represents one end of the scale, and with this constitutional "entognathic" type one finds a "tendentially rectilinear" profile.

Now it is the constitutional type possessing the rectilinear profile which tends to exhibit the class III malocclusion, and the term "prosopontasy" has been applied to

this anomaly.

Prosopontasy may result from (a) anomalies of position of the jaw with respect to the individual cranio-facial frame, and (b) anomalies due to altered development of the jaws, and the distinction is emphasised.

With the former type of anomaly we see analogy to the type of malocclusion referred to by many, as pseudo-class III, and with the rectilinear profile, deviations to produce a prosopontasy may be (i) a slight tipping of the dental axes, or (ii) mesial position of the first molars of both arches or excessive size of the teeth. Both of these dental deviations produce a forward displacement of the mandible.

The most typical form of prosopontasy is (iii) that in which the only producing element seems to be the constitutional type. It is particularly emphasised that this form should be distinguished from those cases mentioned above. This constitutional type is characterised by the fact that the two arches are each of normal shape and size, but abnormally adapted to each other, owing to a too advanced position of the mandible. There is superimposed a further tendency for forward positioning of the mandible due to the natural early childhood impulse to thrust the mandible more and more forward, when there is no barrier imposed by the upper anterior teeth.

"The possibility of correction of this anomaly is eminently related to the mobility of the mandible with respect to the cranio-facial block. Correction depends further on a displacement of the teeth and on a modification of the axial tipping of the teeth, and by a bodily movement of the mandible downward and backward without any change in shape."

"That is to say, a movement of rotation around an axis passing through the head of the condyles. From the aesthetic point of view, the results are less remarkable, because the modifications of the profile line are localised and consist

in the abolition of that element that made the profile disharmonic, which profile, nevertheless, remains constitutionally extremely rectilinear." ²⁴

The distinction between the above anomalies and those cases of prosopontasy produced by excessive development of the mandible or by underdevelopment of the maxilla, is re-emphasised.

Treatment of the hyper-developed mandible is directed towards surgical reduction of the bony base, following completion of the normal growth period.

The term "micrognathic sintostasy" has been applied where there is crowding of the teeth in too small a bony base, and in the maxilla, this condition with a normal or over-developed mandible, produces an inferior protrusion. Treatment aims to expand the maxillary apical arch and despite controversy, success is declared to be real, and not related to a mere tipping of the teeth. In this regard Thörne relates satisfactory results from attempts at widening the median maxillary suture.

In the typical constitutional type of this form of prosopontasy, the mandibular hypertrophy is generally associated with reduction of the development of the maxilla, so that the relative difference of basal prognathism of the two jaws becomes worse.

Berger²⁷ favours the constitutional classification according to Kretschmer's types and records the "athletic" type is the one which is disposed towards class III malocclusion (cf. "Leptosomic" and "Pyknic" or "Eurysonic"). Separately,²⁸ he warns of the need for keeping in mind the certain maturation changes common to all types: these changes may vary in degree in certain types, and be most pronounced in, the athletic. They consist essentially of a flattening or a kind of backward sweeping of the forehead, and a forward growth of the lower part of the mandible. The mental prominence comes into existence and gets its proper shape. This is a timely warning, especially when considering the

usefulness of orthodontic treatment of a developing progenia.

Hovell²⁹ writes of the genetically imposed limits of orthodontic treatment, and states that true class III malocclusions are based upon class III skeletal patterns, and the majority of the so-called postural class III cases are initiated because of the presence of a mild class III skeletal pattern. This is in accord with the constitutionalists mode of thinking but more broadly stated.

I am greatly impressed by the profoundly analytical approach of the European authors, though rather overwhelmed by their extreme and heavy verbosity. The specialised results and groupings which come from their analyses, seem to be of value in calculating a fair prognosis, which may be in doubt if estimated from broader evidence. It is interesting to compare this constitutional analysis with the just as specialised cephalometric appraisal, which tends to be rather mathematically dogmatic.

Concerning cephalometric evidence in making a diagnosis and estimating prognosis, Graber³⁰ warns of the definite limitations and circumscribed areas of this field. The use of cephalometric radiograms in the study of cranio-facial abnormalities, and in the longitudinal appraisal of orthodontic therapy, during and after treatment, is unchallenged. He states that "the infinite variability of cranio-facial morphology and the complexities of function do not lend themselves to group standards, however, mathematical expressions of facial and dental relations have tended to over-simplify some of the problems." He does agree, however, that cephalometrics does provide a diagnostic aid.

This is an honest appraisal and worth remembering and considering where cephalometric measurements are quoted in works relating to diagnosis.

Marshall³¹ considers prognathism to be one of the most mis-understood words in the dental and medical literature. He regards the measurement of the facial angle, formed by the

intersection of the Frankfort Horizontal Plane and the Nasion-Prosthion Plane, significant for determination of maxillary prognathism. Mandibular prognathism, he relates, can be measured by the facial angle formed by the intersection of the Frankfort Plane and the Nasion-Infradental Plane. He regards bimaxillary protrusion to be established if both angles are less than 83° . Individually, this is regarded as the critical angle, and below this figure prognathism is assumed.

These precise angular measurements seem rather critical, and perhaps we should observe Graber's warning here.

Marshall also records that aetiology is difficult to recognise, but broadly states that growth and development interferences of either maxilla or mandible results in disproportion. This is a most obvious observation.

In analysing mandibular growth, Benson³² records that in twenty-one class III cases, the mean incisor angle was $77.71^{\circ} \pm 9.72^{\circ}$, while the mean gonial angle was $135.52^{\circ} \pm 5.72^{\circ}$. In giving these figures, Benson, like Graber, warns about angular measurements resulting from cephalometric radiograms and states that other factors may influence these angles - muscle habits, for instance. He emphasises the need for the supportive evidence of cuspal relations, and, that the two angles need to be related.

INCIDENCE

Various authors have given figures of incidence and these vary greatly.

Gardiner³³ classified the antero-posterior oral relationships according to Angle's system - that is whether the lower arch lay more than one half cusp unit mesial or distal to the upper arch. This analysis was made by visual examination only, no models or X-rays being used. The figure for class III was given as 0.6% and this is subdivided as follows:- bilateral 66.66%, unilateral 33.33%, and further with open bite 33.33%, with closed bite 66.66%.

Salzman² quotes Huber and Reynolds who examined 500 students of the 18-22 years age group and found that class III malocclusions comprise 12.2% of the malocclusions present.

In 1925 Ainsworth³⁴ examined 4,170 children from 36 schools and found 23.2% to have malocclusions, and of these, 1.35% were classified as Angle class III.

Angle¹ publishes a table showing that an investigation of 1,000 cases revealed 4.2% to be class III malocclusions.

In an examination of 3,355 children of the 6 to 14 age group, Newman³⁵ records that of the malocclusions, 0.15% had class III "preventable" malocclusions and 0.33% had class III "correctable" malocclusions.

In this regard, the work of Korkhaus³⁶ is significant. He notes a significant difference in the prevalence of progenia and edge to edge bite at the ages of six years and fourteen years and quotes an illustrating example, when in a study, 26 children at six years had a progenia, and at fourteen years only 5 exhibited this anomaly. For edge to edge bite the corresponding figures were 56 and 4, a notable reduction. The explanation is in the natural process of growth and development of both jaws.

We may accept Korkhaus' report as a warning for hasty conclusions concerning diagnosis.

Moore³⁷ examined 800 children of the fifteen to eighteen age group, which appears reliable investigating material, and found that less than 1% exhibited class III malocclusions. This is more in agreement with Gardiner's findings on a smaller group of children.

McKeag and Scott³⁸ conclude, naturally, that there is considerable variation in the figures concerning the incidence of the various forms of malocclusion. A more useful conclusion is reached, however, in that class III (prenormal) malocclusion is rare in the deciduous dentition. Overall figures are interpreted to mean that variation is between 0.0% and 12% but the majority of investigators report figures

ranging between 1.0% and 3.0%.

These figures do appear rather low, but, no doubt, they hinge around what one does consider a class III malocclusion, especially in the light of Gardiner's findings, wherein the percentage of class I malocclusions was found to be 88.5%, and the remaining 10.9% to be class II.

A really large group of cases must surely be necessary for an accurate assessment; the fallacy of concluding on the basis of limited material is obvious to me, for in my own practice, of the seven new cases presented during the past two weeks, three have I classified as class III malocclusions. Certainly, no conclusion or inference can be deduced from this random occurrence.

When it is considered, of what value is statistical information concerning incidence, anyway? The most significant information appears to relate to racial differences and distribution of the malocclusion. Incidence varies with race; class III malocclusion occurs to a high degree in Japan, while the incidence is low in U.S.A. and in the United Kingdom.

Kjellgren³⁹ finds that progressive progenia is more common in the Northern European countries than in central and southern countries.

Bjork⁴⁰ also finds that prognathism may express itself differently in different races, and that the correlation between maxillary and mandibular prognathism appears to diminish as a result of racial mixture.

Brash⁴¹ reports the best known examples of inheritance of malocclusion, i.e. mandibular prognathism, and the peculiar incidence in the Hapsburg and other dynasties.

Rubbrecht⁴² recognises that both class II and class III malocclusions can have local causes such ^{as} habits, premature loss of deciduous teeth etc., but through a study of generations of class III malocclusions, concludes that the frequency and distribution of class III malocclusion over a large number of families prove it to be dependent on heredity, and shows the pattern of irregular dominance.

INDICATIONS FOR TREATMENT, PROGNOSIS, AND EARLY TREATMENT.

Outlining what factors are useful in deciding what is of immediate concern to the orthodontist, from the point of view of a handicap to health, Waldo⁴³ emphasises that not all malocclusions which detract from the appearance of the patient constitute a handicap to mental health. In a person with an assured aggressive personality and a satisfactory adjustment to his environment, even a severe deformity may be well tolerated. On the other hand, the importance of a trivial irregularity should not be under-estimated, if it is a real source of worry to a timid, insecure person. Naturally, will treatment be more definitely indicated for a girl than for a boy, when the malocclusion is a progenia.

Of course, where physiologic symptoms are superimposed, the challenge is definite. On this basis, Campbell⁴⁴ reports cases where facial neuralgia cease following orthodontic correction of incisor relationships in postural class III cases.

Hellman⁴⁵ writes that "attempts in orthodontic procedure, to be fully justified, depend entirely on a clear understanding of the goal to be attained, and of the impediments interfering with its attainment."

That no set plan of treatment is possible, is emphasised by Marshall³¹ who states that compromise is necessary to obtain a balanced proportion. Surgery is not the only answer, nor is orthodontic mechano-therapy, through which some correction may be obtained - for example, by condensation of the mandibular elements and producing distal movement using intermaxillary elastic traction, expansion of the maxilla may be necessary together with the use of partial dentures to fill the resultant spaces. Obviously, the compromise comes from the alliance with a prosthetic appliance, which functions as a retainer to obtain the balanced proportion alluded to.

Writing of the extreme cases, Lefton-Jacobs⁴⁶ tells us

that orthodontics alone cannot accomplish satisfactory results in the case of the ultra-prognathous mandible. The alternate or associated surgical approach involves deliberate fracture of the mandible, either by removing sections of bone from the body of the mandible, or by fracture of both rami, placing the mandible into a neutro--occlusal relation to the maxilla, and treating the fracture as a compound multiple fracture. If the protrusion results from endocrine disturbances and is an early sign of acromegaly, it is stated that jaw resection is contra-indicated.

More concerning the surgical approach will be mentioned later.

Korkhaus³⁶ makes a plea for early treatment, with a view to "guiding" to normality, by simple measures, even though some successful cases of early treatment may have to be controlled for several years beyond the second dentition; - but such control will be a small burden compared with total treatment later on. The purposeful use of natural forces is an essential part of early treatment, in orthodontics.

He states that "various clinical observations have shown that, apart from a considerable endogenous component, the growth of the jaw is, to a large degree, under the influence of the developing teeth, requiring space, and in particular, the dynamic thrust of the eruption of the last molars. This mesial shifting of the teeth, which at times, may be connected with a lateral movement (growth in width) and a vertical movement (growth in height), is accomplished by bone apposition on the outer surface of the alveolar process, and a corresponding resorption on the inner side." The old idea that the germs of the permanent teeth which succeed the deciduous teeth, move vertically into the same position, is not correct. They not only move vertically during eruption, but also horizontally forwards and outwards and take up positions different, not only in height, but also mesially and laterally, as compared with the positions of the previous deciduous arcade."

So it is seen that a clear understanding of these facts is essential when considering the occlusal pattern of the deciduous dentition and the transition from deciduous to permanent dentition. The expectancy for self-correction, with simple interceptive measures may be assessed through such appreciation, or the need for more active early measures may be gauged and the appropriate treatment instituted in time.

Korkhaus' high figures for spontaneous correction in cases of deciduous teeth progenia are illustrated, and all the cases show a similar course of development. The typical case results from forced occlusion or "bite accommodation," mostly due to elongated deciduous canine teeth; when these teeth are shed in the natural way through resorption at the age of eight or nine, the lower jaw, now freed from forced occlusion, may regain its position. In some cases, the physiological opening of the bite, usually connected with the eruption of the first permanent molars, may counter forced occlusion. It is stated that correction of progenia is brought about only in a small measure by the lower jaw regaining position, however much greater correction results from the marked growth in the length of the upper jaw, as compared with the lower jaw at the time of the changeover to permanent incisors. The enlargement of the anterior segment of the upper arch, especially in the sagittal direction, brings the upper incisors into vertical overbite.

Korkhaus states that "by initiating the natural process of correction, early treatment must seek to adjust the bite by eliminating all disturbing protruberances and edges of the controlling teeth. Sometimes it is sufficient to grind the deciduous teeth in question as well as the cheek teeth. If the change-over to the permanent incisors is too far advanced, the bite will have to be freed by caps on the lower deciduous molars."

No mention is made of the situation where the upper

permanent incisors erupt in retroclined direction, and often crossed, when the state of mild progenia exists. In these cases, elimination of occlusal interferences alone cannot hope to produce enlargement of the anterior segment of the upper arch; no doubt, attention to the possibility of prolonged retention of the deciduous incisors being a causative factor has, to be given, and when the anomaly does arise, appropriate simple mechanical correction may aid premaxillary development, when instituted early enough. It is appreciated, however, that Korkhaus seeks, principally, for a better understanding of the effect of occlusal interferences, in the deciduous dentition, on the ultimate occlusion of the permanent teeth, and his approach is very sound.

Keeping this in mind, we may read further, that as a result of eliminating occlusal interferences, the lower jaw will sink back to the edge to edge bite if the incisors, and the upper jaw, now freed, can make up for its impeded growth, and when the permanent incisors erupt they will take up the correct vertical overbite.

Korkhaus states that approximately 15% to 20% of progenia in the deciduous teeth belong to this group which is amenable to treatment, and that the best time for treatment is five to seven years, when the permanent incisors begin to erupt, and when help thus given makes for free operation of the natural forces of development.

The qualification is given in the statement that in all other forms of deciduous teeth progenia, in which there are already definite deviations in the upper and lower dental arch, or perhaps even a protrusion of the lower jaw, a self-correction is not possible. Here, besides adjusting the bite, the different deviations will have to be eliminated and the compressed upper jaw enlarged by early expansion. It is presumed that due consideration is given to the inherited pattern of base bone size and form, even though development may not be complete.

Most authors advocate early treatment of prenatal mandibular occlusion, and various forms of treatment are suggested.

Cheney^{47,48}, calls for early correction of "cross bite" and suggests the use of the tongue blade, grinding of the deciduous incisors, and the fabrication and placement of a mandibular incline splint.

Concerning the timing of orthodontic treatment, Carey⁴⁹ states that orthodontic treatment in the deciduous dentition should be limited to class III cases, after the age of two years.

Another proponent of early treatment is Hahn,⁵⁰ who says that all class III malocclusions, in the deciduous dentition, should be treated as soon as recognised, if the fontanells have closed; he adds that failure of permanency of result often may be traced to factors of hereditary or glandular imbalance. Correction in these cases is more difficult than in those that have been produced artificially.

In treatment of all deciduous dentitions with forward positioning of the lower anterior teeth in labiolingual relationship to the upper teeth, whether class I or class III, Hahn uses the following procedure - Johnson headcap and chincup, constructed over a stone model of the chin area, and rubber ligatures connecting the two elements of the apparatus. He states that, except in cases of continuing mandibular growth, retention is no problem, as the normal dental relationship maintains the teeth and jaws in their new positions. Such a view seems rather optimistic in those cases where the normal development of the mandible occurs to completion, and yet with an underdeveloped maxilla - here retention is of little value if the maxillary teeth and their supporting teeth are perpetually traumatised by the result of imbalance.

That the true class III condition should be treated very early, is also advocated by Johnson,⁵¹ who prescribes

the chin-occipital traction apparatus and a simple plate to unlock the bite, and says that these are so easily fitted that the opportunity of using this form of treatment should not be missed, as the patient is then at an age when the parent is more likely to help, by insisting on the continued use of the appliances, day and night. Johnson has seen a number of apparently true class III cases, aged between three and seven years, successfully treated in this way, but in others, at ten years and upwards, there is the suspicion that when success is attained, the degree of improvement is in direct proportion to the postural pre-normality that has contributed to the deformity. He warns that in older children with prenatal occlusion, solely genetic in origin, improvement is limited to what can be accomplished by changing the inclination of the upper and lower incisors - inclining the uppers more labially and the lowers more lingually - but unless a satisfactory vertical overbite of the upper incisors in their new positions, over the lower incisors, is established, relapse is inevitable. Permanent retention by a plate worn at night is possibly justifiable in some such circumstances.

Johnson shows a case at 11 years, 14 years and 15½ years, and relapse is experienced, when vertical overbite of the upper incisors over the lower incisors does not develop during the course of the treatment.

Salzman⁶ also states that class III cases should be treated very early, before root resorption of the deciduous incisors in the mandible becomes manifest.

Early treatment of class III malocclusion is also requested by Adamson,⁵² who suggests that the very young child may use the headcap and chincup, together with a wooden tongue spatula, which is bitten on for ten minutes per day. He considers it advisable to use fixed appliances even in the early stages, if other methods prove unsatisfactory.

Adamson⁵³ makes a further plea for the use of the chincup and headgear in early treatment of class III malocclusions. He prescribes that the direction of elastic pull is essentially parallel to the lower border of the mandible, and that the amount of tension should be just sufficient to have the chincup snap smartly when pulled away.

He then makes the important statement, which I have tried to emphasise earlier, that there is a limit to the amount of labial movement of the upper anterior teeth possible without denuding the upper incisors of the labial plate of bone. So then, anything which will keep the mandible in its most retrusive position, must, of necessity, reduce the amount of forward movement needed in the maxilla. Therefore, it is a great asset to use the chincup in early treatment, and later it provides the only necessary form of retention. In this matter, Adamson places special emphasis on the need for retention for a considerable time, following the removal of bands.

Colyer and Sprawson cite a rare case of untreated correction of a class III malocclusion, between the ages of five and sixteen years. They note, however, the maintenance of the class III molar relationship, and state that correction seems to have been obtained by pure correction of the incisor relationship, with the eruption of the permanent teeth. They too, advocate the use of the headcap and chincup.

The case illustrated in Figure 9 has no recordable history, for it was not observed prior to the eruption of the permanent teeth, but possibly was a case of self-correction of a developing progenia.

The face is distinctly rectilinear in profile, but well proportioned and aesthetically pleasant. If there is a tendency to vertical insufficiency of the maxilla, this is compensated by harmonious vertical excess of the mandible,

which is very well developed antero-posteriorly.

There is no crowding in either arch, but the maxillary left deciduous canine remains in position, for the permanent tooth is impacted obliquely in the palate.

The mandibular incisors have a decided lingual inclination, while the maxillary incisors are inclined slightly labially and a small diastema persists between the central incisor teeth.

On the right side there is a marked class III molar relationship, while on the left molar relationship is almost normal.

There is no history of any treatment having been performed.



Fig. 9.

Kantorowicz⁵⁴ has also reported self-correction of Angle Class III cases in the deciduous dentition; he relates that this may be brought about when the deciduous maxillary incisors are lost and the permanent maxillary incisors erupt into more anterior positions. He makes the significant statement that the maxilla may show acceleration of growth when the maxillary deciduous incisors are lost and the permanent incisors erupt over the mandibular incisors; however, where there is a definite macro-mandibular development, the tendency to self-correction does not manifest itself, and treatment should be instituted as early as possible.

Early treatment of class III cases is also advocated by Chapman.⁵⁵ He suggests that up to six or seven years, headcap and chincup be used and connected with rubber bands exerting a backward pull of two ounces on the chin. The overbite is eliminated by a lower plate covering the occlusal surfaces of the posterior teeth; this also depresses the molars temporarily and so increases the ultimate overbite, a factor which favours retention, and the plate is discarded when the upper and lower incisors are in correct relation. He adds that a useful variation is to make the lower plate with an incline on which the upper incisors bite; there is a reciprocal action of labial tipping of the upper incisors, and a lingual tipping of the lower incisors, and this may be used if the deciduous incisors are firm. If the overbite is slight it is not recommended, as it tends to be reduced further and the natural retention from overbite is eliminated.

Chapman prescribes that the headcap and chincup be worn at all times and that treatment be not commenced till full co-operation is obtained, and then he would expect its use for two or three months. He has also found grinding of the incisal edges of the deciduous teeth in slight class III cases helpful.

Apparently, Chapman has great faith in the retention gained from establishment of a reasonable overbite. We note that Adamson feels the need for prolonged retention with the head-gear. It seems reasonable to suppose that retention, only by means of the newly established overbite, would impose the same trauma to the upper incisors as is produced by excessive labial tipping of these teeth. I therefore feel that extended retention, partial at least, is indicated, and especially in view of the growth spurt evident at the time of puberty.

Another proponent of the chincup is Gold,⁵⁶ who suggests the standard headcap plus a muslin, well-fitting chincup, with four hooks for interconnection by elastics. He also recommends a celluloid bite plate 0.020" thick, which is bitten upon for two fifteen minutes periods per day, and immediately followed by the headgear and chincup. Between the ages of four and eight years, treatment is said to be rapid, a view inferred by Chapman.

Chapman⁵⁷ describes five successfully treated cases; three were treated by means of the apparatus described earlier (chincup and lower plate), the ages of commencement being 1 year, 5 months; 2 years, 3 months; and 6 years, 4 months. The other two cases were treated with fixed appliances and intra-oral inter-maxillary traction, again with a lower plate to eliminate the overbite; supplemental use was made of the extra-oral head-gear. One of these latter cases was commenced at 13 years, 2 months; and continued for four years, with the lower appliance removed at the end of two years. The upper appliance was removed at 17 years, 4 months; and followed by the use of headcap and chincup. Models at 23 years, 8 months; show no relapses, despite the inherited factors.

The other case was treated at 13 years, 11 months; and both upper first permanent molars were absent. Fixed appliances with inter-maxillary traction were used, plus

supplemental use of the head-gear worn occasionally, and at 14 years, 8 months all lower appliances were discarded. Treatment was continued to move the upper premolars distally to provide room for the canines and was completed at 15 years, 8 months.

It would be interesting to have the histories of some cases not so successfully treated; yet we know of the difficulty of successful treatment of class III malocclusion, and recognise the limitations imposed by the genetic status of skeletal and soft tissue morphology.

Strang⁷ also advocated very early treatment of class III malocclusion, because at the insipient stage, the perverted growth forces have not produced appreciable modification of form in the body of the mandible. By the time the premolars and permanent second molars have erupted, there is usually a very definite change in the architectural pattern of the mandible, which can never be appreciably improved by treatment. Untreated cases, almost invariably, show marked progression of the deformity, manifest between the ages of fourteen and thirty years. Even when early treatment is instituted, Strang has found the need for continued observation until the age of puberty, for at this age there may be a recurrence due to excessive forward growth of the mandible at this time. This is a very important point, whatever the philosophy of treatment and especially in regard to adequate retention of treated cases.

Strang states earlier that in class III malocclusions, the degree of aesthetic correction, gained by treatment, depends greatly upon the age of the patient - the younger the patient, the more satisfactory the result. With the very young child, the chincup is used in conjunction with exercises, till the second deciduous molars erupt. Upon eruption of these teeth, Strang places upper and lower bands on canines and first and second deciduous molars: class III elastics are used, after levelling off with a 0.020" arch

wire, to produce slight flattening of the incisal area of the mandibular arch, and also strong maxillary expansion.

When the first permanent molars have erupted, an exaggerated Curve of Spee is given to the lower molars and a decided backward inclination of the maxillary molars - this is to produce a backward drive on the mandibular teeth. At this stage, night-time elastics are used for one month only, and retention follows.

Of course, the ability to alter to inclinations of the molar teeth will relate to the technical efficiency of the operator and his appliances, and necessarily involves the use of the rectangular archwire. In Strang's hands, no doubt, this is unquestioned. The value of this reorientation, in checking or retarding the tendencies to further deformity and in stabilising the result of treatment, appears to be excellent.

However, Adamson⁵⁸ reports that he questioned Strang concerning this alteration to the curve of Spee and the altering of the inclination of the molars, and, in fact, suggested that it was technically impossible. Strang had to admit that he had never performed this task, and when he did try was forced to agree with Adamson!

The results of examining 5,275 patients were assessed by Nord,⁵⁹ who found that 5.5% represented class III (Angle) malocclusion and 1.1% were inherited. He recognises three types: (a) prognathic compulsive bite through involuntary forward thrust of the mandible.

(b) deviation in either jaw.

(c) deviation in both jaws, with prominence of the mandible.

All three types respond well to treatment, states Nord, providing it commences at an early age. The compulsive bite cases, he feels, can be successfully treated in a few weeks, by means of an inclined lower plastic bite plane. If the resultant occlusion is not good, he uses the chincup

at night, as an aid and to prevent recurrence.

With the case of developmental prominence of the mandible, he uses the chincup over a long period - at least, till the permanent dentition is completely erupted, or even into adulthood.

Prognathism, states Nord, is the result not only of inherited predisposition, but also may result from digital habits or intra-uterine conditions.

He states further that a clear distinction should be made between true and false mandibular prognathism. In both instances, however, he regards the chincup to be the best curative procedure, and should be commenced as early as possible, for neglect may cause severe aggravation.

Nevertheless, is there any real evidence that the chincup can prevent mandibular growth? Is it possible that the only proper use of this appliance is in the treatment of functional class III malocclusions, together with or following correction of the causative dental deviations? I have not encountered any evidence to support the rationale of the use of the chincup to prevent mandibular growth, yet I recognise its value for supporting the mandible, in the correction^{of} functional class III malocclusions.

Here we may recall the words of Maj concerning the mobility of the mandible, and recognise the value of its distal positioning to permit reinclination of the faulty dental elements, in the postural case, and note that the force from the chincup provides this repositioning to advantage.

Kjellgren³⁹ does not share Nord's optimism and states that genuine class III cases have a very uncertain prognosis. He feels that the backward displacement of the lower jaw to a normal relation is seldom possible by orthodontic means, so the more severe postural defect constitutes a problem. These cases can develop into a real progenia, when surgery is the only answer, as it is for the genuine progenia,

characterised by a normal sized upper jaw and a more or less protruded or over-sized lower jaw. Such surgery, however, should not be performed before completion of jaw development and not until the third molars have erupted or been extracted.

Kjellgren also recognises that many false class III cases are due to forced occlusion of the mandible, which is displaced forward through incisal cross-bite, and this in turn, caused primarily by a somewhat contracted or under-developed upper jaw. With these cases, however, the prognosis is good, providing a normal deep overbite can be created by expansion of the maxilla. He recognises, also, the moderately over-sized mandible together with some contraction of the upper arch, and the case showing slight crowding in the lower arch and more severe contraction of the upper arch. Here he recommends extraction of some lower premolars, and the lingual inclining of the lower incisors to meet the expanded upper arch; with such treatment some mesio-occlusal molar relationship will persist. Naturally, one would have to consider the possible effect of greater prominence of the chin resulting from the lingual tipping of the lower incisors.

Where progression seems obvious it is better to abandon complex orthodontic procedures, rather than to fruitlessly fatigue the young patient. At 18 to 20 years surgery should be of value.

Several cases illustrating the need for careful diagnosis are described by Shehan⁶⁰. One case, in particular, is significant, for in it was exhibited the great strength of growth and heredity. Early suspicions led to a long period of observation to confirm the tentative diagnosis of inherited mandibular prognathism, and Shehan states that "any treatment instituted prior to knowing the true nature of this case, would have been doomed to failure, and would have been very detrimental - not only to the well-being of the patient, but also to the status of Orthodontics as a

profession". I believe such a cautious approach to be completely justified, yet we must not ignore the frequent need for early interception of tendency to progenia; hence the need for accurate investigation of case history.

THE QUESTION OF EXTRACTION.

The serial extraction of teeth in the mandibular arch in class III malocclusion is reported by Kjellgren⁶¹ as being of value, when there is a crowding of the lower incisors. This, however, is contrary to the experience of others, especially Salzman⁶ who declines to accept this as satisfactory, because the extraction of the first premolars in the class III mandible, where the basal arch is ample in proportion, is followed by space opening and a tendency for the class III malocclusion to reassert itself; he says further, that in the class III mandible the teeth are usually upright or lingually inclined in relation to the mandibular plane (the plane tangent to the base of the mandible) and extraction is of little or no avail in bringing the incisors more lingually.

Colyer and Sprawson⁴ hint that diagnosis must be carefully made before extractions are considered, especially in "bite of convenience" cases. They warn that it may be better to limit treatment to forward positioning of the maxillary teeth.

Salzman also writes that loss of the maxillary permanent first molars in class III cases increases the malocclusion; also, extraction of mandibular permanent first molars, without subsequent treatment, does not benefit class III cases, because of the tendency of the mandibular premolars to shift singly and create inter-dental spacing, this in addition to other factors present, including a large basal arch.

Writing at length on extraction in orthodontic therapy, Salzman says that when the anterior and/or posterior teeth

are crowded with or without procumbency of the lower incisors, and the basal arch shows the presence of the Simian Shelf (i.e. there is an extreme subalveolar constriction), extraction is indicated. Attempts to arrange the teeth in normal occlusion by "rounding out" the arch will result in an increase in the size of the Simian Shelf, and in the procumbency of the incisor teeth in relation to the mandibular base, bringing about a dento-alveolar protrusion. In these cases it is stated that extraction should be resorted to if a favourable termination of orthodontic mechano-therapy is desired, furthermore, orthodontic therapy without extraction in this type of case, results in the positioning of the incisors and other teeth in conflict with the inherent lines of stress of the jaws and with its closed functional system. When these stresses exert themselves, there is a tendency to the re-establishment of the state of equilibrium in the malocclusion which existed before treatment and relapse follows, regardless of how long retaining appliances are worn. Salzman continues that procumbency of the mandibular incisor teeth in relation to the mandibular plane, in itself, is not to be accepted as a sole criterion for extraction - it is frequently a minor factor only, there being other important associated factors. It is possible to have procumbency of the mandibular incisor teeth, without a constricted or deficient basal arch, when facial and masticatory muscles are underdeveloped or of poor tonicity, while the tongue is large and vigorous.

These facts and their interpretation are not necessarily specific for class III malocclusion, but their understanding is desirable when considering extraction in class III cases, or those cases which have a class III occlusal pattern, if only in the anterior segment.

Another important factor in determining the need for extraction, where facial aesthetics are concerned, is said by Salzman to be the relationship of the mandibular dental

arch to the base of the body of the mandible. He describes a case with an Angle class III tendency and having a constricted basal arch in the maxilla. The mandibular first premolars were extracted and the mandibular incisors moved lingually and the canines distally. In this case the mandibular incisors were procumbent and the maxilla underdeveloped, and the treatment eliminated the class III tendency.

In direct contrast to this case, Salzman describes another case with a large mandibular basal arch and classified as a true class III (Angle) malocclusion, with the incisors and other teeth in lingual inclination to the mandibular plane. Here the practice of extraction as an adjunct to orthodontic therapy is of questionable value, for there could be a tendency for space opening. Rather is successful treatment, in the permanent dentition, accomplished by bodily distal positioning of the mandible or by increasing the degree of axial inclination of the maxillary incisors, through a forward and outward movement of the maxillary teeth, bringing the incisal edges of the maxillary incisors labial to the mandibular incisors, or by a combination of both procedures.

It would seem that it is a matter of assessing the relative positions of the upper and lower basal arches, and the relation of the alveolar arch to the basal arch as well as considering the actual size of the basal arch.

Strang⁷ notes that cases of class III malocclusion where the buccal teeth over-ride the incisor areas are uncommon, but in such instances in the mandible, extraction of the first premolars is permissible.

Strang also finds that in those cases where there is insufficient bulk of alveolar process on the lingual side of the mandibular incisor roots, a favourable improvement may result from the extraction of a central incisor. The decision to do this could hardly be taken lightly, and

special consideration of basic arch form would have to be made.

MECHANICAL TREATMENT AND ADJUNCTS.

Many descriptions of treatment procedures have been written but there seems to be little variation from one or two basic principles for treating class III malocclusions.

Steinvorth⁶² reports a case with a class III relationship and exhibiting a path of closure of the mandible markedly forward and upward. The second premolars of the mandible were extracted and full banding executed. In the upper arch, a light alignment arch was used and a similar arch wire placed in the lower arch, but with a reverse curve adjustment for the correction of the excessive Curve of Spee. Closing loops between the mandibular first premolars and first molars were used, and inter-maxillary elastic traction was made to a semi-passive rectangular upper arch wire. The molar cross bite was corrected by cross elastics and the tension to reduce the Curve of Spee and reduce the bicuspid space, retained till the very end of treatment. No retaining devices were used, and the case appears to have been treated successfully and without signs of relapse.

Apart from suggested inherited factors, the forward drift of the molars is said to have complicated the case, and no doubt the premolar extractions were important in relieving the resultant crowding: it is important to note that the patient was able to bring the incisors into edge to edge relation prior to treatment, at fourteen years of age. No doubt the postural element was strong in this case, and probably early interception would have provided an adequate answer, especially if space had not been lost through the premature loss of deciduous teeth. Yet Steinvorth states that the malocclusion was mainly the result of skeletal disharmony, and his treatment of the case is interesting.

Another case, in which the mandibular second premolars

were extracted, is described by McGonagle,⁶³ who expands the upper arch with an expansion arch wire and criss-cross elastics. Following extraction of the lower second premolars, the lower first premolars were moved distally until there was sufficient space to realign the anterior segment. With the lower dental arch established as a unit, and the cross bite corrected, class III elastics were used, and the case completed with the placement of correlated ideal arch wires, and throughout the procedure edgewise appliances were used.

In this case the class III relationship was due to a severe lack of development of the maxilla coupled with a long, wide, yet crowded mandible. The molars were in bilateral class III relationship, but the upper central incisors and left lateral incisor not in this relationship.

It is interesting to note different basic reasons for extraction of the second premolars, in the two cases mentioned. In the first, the premolar crowding was relieved together with some distal movement of the anterior segment, and mesial movement of the molars. In the second, the extreme crowding of the anterior teeth was relieved by moving the canines distally, and, of course, the molars moved mesially. In both cases, the expansion of the upper arch was an important factor in treatment; in this respect, McGonagle relates of the considerable loss of labial alveolar process, which would be expected with expansion of a considerably contracted arch.

A method applicable to those cases where there is mild yet definite inferior basal prenormality, in addition to the occlusal malrelation, is described by Briggs.⁶⁴ The mutilation of the dental arches by extraction is not a barrier to the use of this method; however, it is stated that it is helpful to deal with local irregularities before applying this method of treatment.

An essential part of the treatment is assumed to be the

extraction of the mandibular first premolars, unless there is spacing between the lower teeth. The maxillary first permanent molars are banded, these bands having buccal hooks and united with a soldered palatal arch wire. A removable lower appliance is constructed, and this consists essentially of a bilateral cast silver splint, covering the occlusal surfaces of the posterior teeth and united to a plastic base, in which is incorporated 0.8" steel tubing on each buccal surface. A sliding wire bow is adapted around the lower incisor teeth, and has hooks in the region of each lower canine. The silver gags are just sufficiently thick to free the adverse incisor relation, and are correctly orientated to each other. Inter-maxillary elastics connect between the upper molar hooks and the hooks on the lower labial bow.

Briggs reports two cases treated by the apparatus described, and each is said to have been treated in three to four months. No retention is described. He found, on completion of this treatment, that some degree of posterior or lateral open bite may be present, however, his experience showed that gradual reduction in the height of the gags, followed by their removal, resulted in spontaneous closure of the bite.

This is a novel method, but it seeks to correct only the anterior malrelationship, apparently, by distal tipping of the lower incisors and contracting the canine width; it is difficult to see how the extraction spaces may be adequately closed, even if permitted by soft tissue morphology, with this apparatus. The proclination of the anterior teeth, through the force on the palatal wire and the mesial movement of the upper molars, is conventional.

What Briggs regards as an advantage in the use of a removable lower appliances, would be interesting to know, for I feel that the young patient would handle a similar fixed appliance more capably, especially when inter-maxillary traction is involved.

McCallin's⁸ basis of treatment is that orthodontic treatment does not change the dental base relationship and that soft tissue patterning is somewhat unpredictable, and may or may not be modified from treatment. He cannot demonstrate that it is possible to move a mandible mesially or distally, as a result of orthodontic interference.

We recall McCallin's description of the two extreme types of class III malocclusion, and note that he treats type I (long mandible, above average gonial angle, short antero-posterior and laterally contracted maxilla, and usually large anterior inter-maxillary space) first by reducing the maxillary crowding, and then placing the lower labial segment lingually to the normal relationship with the upper labial segment. He states that seldom is stability achieved in attempts to expand the maxilla and procline the upper, labial segment with class III traction, for there is no soft tissue balance; further, maxillary crowding can only be successfully treated by extraction, and very slight lingual movement of the lower incisors can only be achieved by extraction; however, the tongue frequently restricts this lingual movement. Other points made by this author are that traumatic incisor relationship between the arches must be avoided, and the lower labial segment must be supported by the buccal, for extraction in this arch to be of value; also the lingual tipping of the lower labial segment does leave the chin rather prominent, and this should be considered carefully, in evaluating the worth of treatment.

McCallin also states that where a space exists between the lower labial and buccal segments, surgical interference is indicated; however, this often results in a somewhat chinless appearance, if the incisor relationship is to be corrected adequately, since the middle third of the face is depressed, through the small maxilla.

Where soft tissue patterning imposes a limitation on

stability, it is often necessary to establish voluntary corrective habits of the lips or tongue, or both, to make collapse less likely. To do this, I believe the operator must possess exceptional ability as a "gainer" of interest and co-operation, and as a teacher.

McCallin advocates the use of the chinstrap designed to exert force through the lower lip, against the labial segment, at an early stage, especially with the extraction of the lower first deciduous molars, and be followed by subsequent extraction of the lower first premolars. The direction of force and its point of application is specially emphasised.

With the pure type 2 case (long mandible, gonial angle average or below average, maxilla average length and width, and often over-eruption of the lower incisors), prognosis is very poor, when there is marked anterior placement of the lower incisors - surgery is stated to be the only answer. However, if the mesial placement is due to incisor interference, slight proclination of the upper incisors may be attempted, together with maximum lingual movement of the lower incisors, to avoid traumatic relationship. He states that fortunately, many of these displacement cases have relatively normal basal relationships, and a very slight upper incisor proclination is all that is required for improvement.

McCallin's article gives a very good account of broad treatment principles of class III malocclusion, and while we may not agree with everything he says, his consideration of the physiology of both hard and soft tissues is entirely sound. The importance of assessing the aesthetic result in the light of the size of the maxilla, is a note worth resounding, as much as his inferred warning concerning the need for balance between tooth position and tongue and lip musculature.

Blyth,²⁰ who writes on class III cases with failure of vertical development, states that his treatment principle

is to eliminate the displacement and build the level of occlusion to a position which would be normal in relation to the rest position of the mandible. His objects are to improve appearance, improve functional occlusion, and eliminate the possibility of future temporo-mandibular joint disturbances, and are attained by - (1) eliminating the over-crowding by extraction, (2) altering the incisor relationship, principally by retraction of the lower incisors, (3) determining whether the buccal segments will close or not by prolonged retention of the altered incisor relationship, (4) placing an overlay splint to support the proclined upper incisors and to bring about full occlusal contact.

Once again we see the difficulties or impossibilities associated with conditions of lack of development, and in this case, inadequacy of vertical development, and inadequacy in size of the maxilla, and the need for prostheses to attain function.

Tweed's philosophy and treatment is reported by Salzman,⁶ and again we are implored to treat class III malocclusion cases in early childhood, by means of the chin-strap which should be worn at night, during the entire period of growth, and following other active orthodontic treatment, or in conjunction with it.

The technique used by Tweed is to correct the abnormal bucco-lingual axial inclinations of all the teeth in the buccal segments, of both maxillary and mandibular dental arches; the too broad mandibular arch is constricted and the too narrow maxillary arch is expanded; the maxillary teeth are moved forward "en masse" utilising the teeth in the mandibular arch as stationary anchorage. Tweed believes that extraction of first or second premolars in the mandible is permissible, especially in older patients, when the maxillary basal bone is beyond appreciable further development.

Tweed recognises the difficulties in securing stability, but aims to provide it by altering the axial inclinations of the posterior teeth, and this brought about, of course, by the application of torque force through rectangular arch wires.

We may go back and look at Angle's advice for the treatment of class III malocclusion, and see that he recognised the limitations of his suggested inter-maxillary traction, in the well-defined case. He states that, if we do not gain the influence and full support of the inclined planes, failure is, in most instances, an ultimate result. Angle even suggests that these well-defined cases are good cases for the orthodontist to avoid and that his energies would be better expended on those cases where success is at least probable, surgery is suggested as a possible satisfactory avenue for treatment. I think most of us would agree with Angle, when the condition is well established, but when the child presents early in life, I believe any attempted measure is justified and possibly worthwhile, especially if the co-operation of an endocrinologist is gained.

Strang⁷ indicates that treatment, in the early stages, should be directed towards restoring, at the earliest possible moment, the normal inclined plane relationship, and gain such axial positions of the teeth, without disturbing the natural location of the condyles in their mandibular fossae, that the growth of the basal bone will, at least, be encouraged.

Concerning advanced cases, Strang, too, is pessimistic, and states that the best one can hope for, is to camouflage the abnormality, by moving the maxillary teeth forward.

The stability of results achieved from treatment, is the theme of Pringle's⁶⁵ record of a case, classified as class I, but probably skeletal III, and exhibiting a hereditary pattern. The treatment was simple enough, with the principle of advancing the upper incisors over the bite at

eight years, and expanding the upper arch with expansion plates from the ninth year. The appliances were used till a good occlusion was achieved, and models made at the age of twenty-nine years showed that the result had been maintained.

This is a very isolated case, and no doubt many such cases have been treated satisfactorily, and with stability, by Pringle and others; but many others which were not quite so favourable in their pattern must surely have relapsed or else a state of occlusal trauma achieved, following similar plans of treatment. I feel that we could learn more from published reports of failures in orthodontic treatment, either alone or preferably supplementary to reports of successful treatment, and especially in respect to those instances where the doubtful endeavour of expansion is employed.

For proper treatment to be instituted, Gold and Gilbert⁶⁶ emphasise the need for careful analysis, at the outset, in order to determine the relative degrees of prognathism of the maxilla and mandible. They recommend very early treatment, the optimum time being before the eruption of the first permanent molars, and state that very rapid results accrue from the use of extra-oral anchorage.

The customary head-cap is used, together with a muslin chincup, which is more hygienic than metal (can be laundered daily) and does not irritate. The two elements are connected via four hooks, four pieces of elastic webbing and eyelets, with the lower elastic strap following the lower border of the mandible, and the upper at an angle to prevent the chincup from slipping under the chin.

The apparatus is worn at night-time only, but when treatment has progressed to the stage of edge to edge bite, an additional chincup is issued, this for use during meal-times.

In conjunction, a rhomboidal shaped celluloid bite plane, 0.020" thick and wide enough to include four maxillary

incisors is used for a total of thirty to sixty minutes daily. The method is for the mother to hold the plane against the mandibular incisors, while the child closes against it; it is suggested that each session be of ten minutes duration, the final application being made at bedtime.

When co-operation in the use of the celluloid bite-plane is questionable, a reverse bite-plane is suggested, this being a removable lower plastic plate, with a reverse inclined platform. This may be used also at meal-times, when additional assistance is required.

Another auxiliary aid is the stainless steel labial arch-wire, used to drive the mandibular molars distally, through force via traction hooks sewed to the chincup. A similar wire, with an anterior inferior section, may be used for condensation of the labial section, when spacing exists between the teeth.

Gold and Gilbert are most enthusiastic about the quality and stability of the results achieved by their method of treatment. It would seem that this hinges on a mechanically sound apparatus used in the very early stages of the deformity, which, according to statistics, would be, in most instances, rarely a true mandibular over-growth of the progressing variety.

Brodie summarizes the results achieved by treating class III malocclusion cases, and Salzman⁶ quotes him by reporting that, in all cases the occlusal plane is distorted, with the posterior end going downwards, and, in the adult, the anterior end goes slightly upwards. No definite conclusion is reached, except that there is no effect on any structure other than the alveolar process. He may recall that Strang does, in fact, attempt to encourage growth of the basal bones, but this is essentially with early treatment, and where the process of growth and development would normally still be in motion, and no pressure that Strang attempts only to stimulate the natural process to its normal completion.

Concerning speech and the malocclusion of the prognathic mandible, both Salzman and Wray⁶⁷ mention that the chief difficulties of adjustment are experienced with the sounds of S, Z, Sh, Ch, F, V, and Th.

Barnett⁶⁸ explains that in attempting to produce an "S" sound, an effort is made to retract the mandible to give an edge to edge incisor relationship. Being unsuccessful, the person tries to substitute by placing the tongue against the incisal edges of the upper anterior teeth, and this results in a lisp. The difficulties with the other sounds may be explained similarly, keeping in mind the disproportion of position of the incisor teeth of both arches, and the resultant relative position of the lips.

Wray suggests that orthodontic treatment should precede any special plan of speech therapy, but emphasises that early habit training is desirable before the commencement of treatment. The presence of orthodontic appliances during treatment from the very moment of their placement, imposes speech difficulties, and the need for flexibility of adjusting to these artificial impediments is obvious. It seems to me, that adjustment to a corrected occlusion would be very readily attained and would be a very minor worry compared to adaptation to the physical presence of appliances.

The use of the Norsk appliance in the treatment of class III malocclusion is described by Lawes,⁶⁹ who states that, with practice, nearly everyone can get the mandible into a position which is definitely distal to the normal resting position; this will not be very much, but it will be sufficient, when the appliance is inserted, to exert a distal pressure on all the lower teeth and a mesial pressure on the upper teeth. The appliance is made very close fitting on the lingual surfaces of the teeth, and there is, as a result, increased pressure on the lingual side and reduced pressure on the labial. Labial wires are used on both arches, the lower to produce the distal force on the mandibular incisors, and the upper, loose-fitting arch wire will keep

the lips from exerting a distal pressure on the maxillary anterior teeth.

This appliance may have produced correction in some cases of a benign nature, but such correction may have been equally or better obtained with more conventional means, and without the traumatic and damaging effect of the plastic base on the soft tissues.

Grossman⁷⁰ states that "the main difficulty in the treatment of lower protrusion, by means of an activator, is the fact that it is usually impossible to obtain a satisfactory working bite. As a rule, the patient cannot move his lower jaw more than 1 to 2 millimetres distally, and this proves too weak an activator of the masticatory and facial muscles to lead to satisfactory tooth movement and changes in the temporo-mandibular joint.

He describes a new modification of the Norwegian plate to combine the advantages of both active and passive appliances. This is in the form of a screw for labial movement of the maxillary incisor teeth and distal movement of the lower incisor teeth and jaw. The upper and lower sections are left separate and an expansion screw inserted into the upper, behind the central incisors and parallel with the occlusal surfaces of the teeth. Following the processing of the separate parts, a plastic bridge to the expansion screw unites the two sections, and a window is provided in the palatal acrylic for adjustment of the screw.

Grossman believes that most of the movement results from changes in joint, as no individual tooth movement is provided for in the appliance.

He suggests care in the selection of cases for treatment with this appliance, and explains that where expansion of the upper arch is needed, this must be done first; also where loss of premolar space has occurred, this must be reopened first.

The appliance is worn for one hour during the day, and

for the whole of the night, and the screw turned one quarter of a turn each week: the more frequently is the appliance worn, the more the screw may be turned. After three or four weeks a new working bite is recorded and imposed by renewing the bridge: more frequent changes in the working bite are required than with the normal activator.

This is a novel appliance, and where one chooses to use a removable unit, it should provide more definite activation than would the conventional activator. Perhaps, however, this force on the condyles may provoke an intolerable discomfort - and who has assessed the effect of this force on the elements of the mandibular joint? Also, if the effect is confined to changes in the mandibular joint, would not mandibular repositioning be more comfortably and just as effectively attained by use of the nocturnal chin cup?

Due consideration to the surrounding musculature when treating class III malocclusions is of great importance, and Brodie¹⁰ has found it useless to treat a class III malocclusion orthodontically unless the tongue position can be simultaneously corrected. He describes the use of a small object (celluloid disk) detectable by both tongue and palate, to make the patient aware of the differences between habitual and proper tongue positions. The disk is placed well back on the tongue and the patient closes the mouth and raises the tongue until the disk is felt by the palate. This movement puts considerable strain on the superior posterior suspenders of the tongue, and constitutes the prescribed exercise, which Brodie considers valuable.

Brodie does not indicate the age group of the patients capable of performing this exercise, but no doubt the very young patient would be a very poor risk for its safe and satisfactory performance.

Webb⁷¹ also describes an exercise said to be useful in Angle class III cases, or those cases that are developing class III characteristics. He calls the exercise the

mandible restraining exercise or Platysma exercise. The patient stands with the back against a wall, and with a mirror (which may be discarded when the exercise is mastered), he checks that the teeth are in contact, and bends the head back as far as possible, throwing the shoulders well back, then opens the lips slightly so that the teeth are visible, and brings the teeth gently together again; the mandible is pulled backwards as far as possible without losing tooth contact and held in this position for five seconds; the muscles are relaxed and the exercise is repeated three times during each of the first two days, and gradually increased up to ten times for each session. The entire exercise is performed at least three times daily and as many times as possible.

When evaluating the factors revealed in diagnosis, and planning orthodontic treatment, we must, at all times, take into consideration the influence of the soft tissues. However, it is not always possible to avoid their undesirable influence in the ultimate result, and this is especially so in class III cases - and it is here that voluntary education of the muscles may be a worthwhile endeavour.

Webb has described an exercise which may help to keep the lower jaw in the most retrusive position possible; its performance may impose an onerous discipline, and its value may never be measured, but in treating the unsightly deformity of a class III malocclusion, one must seek every possible aid to maintain the result of treatment or to minimise advance of the deformity through postural habits.

Brodie seeks to negate the adverse forward thrust of the tongue, and this is highly desirable.

I believe that to seek the co-operation of the patient in performing these exercises is not impracticable, and not to attempt to do so is to deny the patient of a useful part of treatment, whether success be attained or not.

THE USE OF SURGERY AS A MEANS OF TREATMENT.

The use of surgery in the correction of mandibular prognathism dates back to 1848, and Hinds⁷² lists eleven operations devised and performed between this date and 1952, giving a brief historical review of the development of the surgical management of class III cases. He lays stress on the importance of the experience and ability of the operator, as well as the needs of the particular case, in considering the procedure to be adopted.

In evaluating the need for surgery or not, as an aid to orthodontic treatment, Crain⁷³ summarises his investigation that "in orthodontics, an error in diagnosis of class III cases of macrognathia with excessive mandibular prognathism, may mean an error in the attainment of a favourable prognosis. A thorough analysis and appraisal of all familial, physiologic and radiologic data related in the case, should be made before arriving at a conclusion in diagnosis." This is rather an obvious statement of facts, for no diagnosis or treatment plan, in respect of any medical or dental anomaly, would be committed by any conscientious clinician. Nevertheless, we may regard Crain's words as a timely reminder when contemplating the aid of surgery.

The literature contains various descriptions of techniques, and their modifications for surgical treatment of the prognathic mandible. Eubanks⁷⁴ describes a two stage operation for the accurate removal of a section of bone from the body of the mandible.

Lindsay⁷⁵ also describes an extreme case, in which two operations were performed; the first for the extraction of teeth and the removal of alveolar bone to the apices of the tooth sockets, and the second for resection of the body of the mandible and basal bone - this is followed by wiring of the lower border, and the use of metal inter-maxillary splints. A good result was attained in this case.

Hovell⁷⁶ describes good results achieved from the

correction of a case of extreme mandibular prognathism by surgical resection. The malocclusion of this case was so severe that the lower third molars just occluded with the maxillary incisors during lateral excursions of the mandible. As it was necessary to reduce the length of both the body and the ramus, angular resection was performed, a little over an inch of bone being removed on each side. The approach was extra-oral, and union was hastened by the use of iliac crest chips of bone. A corresponding wedge of skin, subcutaneous tissue and platysma was excised to eliminate the double chin that would otherwise have resulted.

A combination of orthodontic and surgical procedures in the correction of class III malocclusion in young adults is described by Lubowitz⁷⁷ and separately by Adelstein⁷⁸ and the usefulness of the combined procedures emphasised.

For the surgical correction of mandibular prognathism, Skaggs⁷⁹ explains that there are basically two methods - "ostectomy" (removal of a section of bone) and "osteomy^{Jo}" (sectioning of the bone): both may be achieved by surgical opening, and the latter also by a closed method.

In Skaggs' opinion there is no best method, but the surgeon should be familiar with at least three of the diverse basic techniques, to prevent the tendency to fit every case to a single mastered technique. In particular, for ostectomy, he considers valuable:-

1. The technique of Smith and Robinson, this being a subsigmoid ostectomy of the ascending ramus.
2. The technique of Blair, modified by Dingman, and this being a two stage ostectomy of the body of the mandible in the first molar region.
3. The technique of Pankow, which involves the removal of a horizontal triangular portion of bone from the anterior border of the ascending ramus, the base of the triangle being forward. This method is especially valuable when there is marked opening of the bite.

Osteomy concerns a sectioning of the ramus, and the minimum age for its performance, states Skaggs, is fourteen years, presumably following puberty. He emphasises the need for perfect understanding and co-operation of the patient, when this or any other operation is considered.

Gerlach⁸⁰ describes a case of bilateral osteomy with a boy of only eleven years. Prior to the operation, complete orthodontic therapy was performed to widen the maxilla and to retrude the mandibular incisors as far as possible.

A method of fixation for the surgical reduction of the prognathous mandible is described by Cohen⁸¹. He uses orthodontic bands, united by soldered arch wires, which bear hooks and spurs, and cemented in three sections (two posterior and one anterior). The sections are ultimately united with self-curing acrylic, the reduction being effected earlier by intra-maxillary traction.

This method of fixation seems more reliable than with cast splints cemented at the time of operation, for the appliances may be secured effectively before the operation, and guess-work of relationships of the fragments is eliminated.

It would seem that the danger of any jaw resection in the body of the mandible is that the size of the tongue will always cause a relapse. Sectioning of the ramus, however, takes the tongue attachment along the mylo-hyoid ridge, with it, and as a result the tongue drops back too. With this, we would expect no relapse in the incisor region.

Kjellgren³⁹ prefers the horizontal cutting of the ascending rami, above the mandibular foramen, parallel to the occlusal plane, but inclining to cut upward or downward may help in shortening or lengthening the ramus, as required. He prescribes rigid fixation for two months, followed by movable fixation, using rubbers for one month. Sometimes, a chincup is used in after-treatment, presumably for muscle

support and re-education.

With these cases, Kjellgren, prescribes carefully designed occlusal grinding, according to prepared models, before the operation.

He states that the inevitable tipping forward and upward of the upper (condylar) fragment is of little consequence, and describes four typical and successful cases.

Successful treatment of a severe deformity and with a stable end-result is also described by Bowdler-Henry⁸², who uses Kostecka's basic technique of sliding osteomy of the ascending rami.

Many accounts of preferred surgical procedures for the reduction of mandibular prognathism have been written, and details of approach, surgical management, fixation, and retention, soft tissue repair, etc., expounded, but such particular information is of special interest to the oral surgeon. What is important to the orthodontist is the recognition of the need for complete co-operation with the surgeon in respect to all phases, from diagnosis to post-operative care and re-education, whether orthodontic mechanotherapy is used or not.

SUMMARY AND CONCLUSIONS.

An attempt has been made, as a result of a review of sundry dental text books and periodic literature, to collate the resultant information as it concerns class III malocclusion.

The basic classification of Edward Angle has been used as a starting point, and the interpretation of various authors given. Various divergences from the basic clinical type have been given mention, together with the apparent difficulties in classification; hand in hand, is mentioned the factors which lead to a diagnosis, and the aetiological influences, as far as they concern prognosis and treatment.

Proper classification, alone, seems to be of minor

importance but diagnosis properly related to a study of aetiology, recognises the possibilities and limitations of treatment and hence prognosis.

Statistical information concerning incidence is recounted, but its main theme of importance relates to a consideration of self-correction and treatment of early anomalies.

The views of various authors concerning extraction in class III malocclusion is given and especially as it applies to active orthodontic treatment. Concerning the latter, some cases are reported in so far as they illustrate what may be involved in treatment. Regardless of the method used in treatment, the question of stability and possible tissue damage is given special emphasis, and the methods to attain stability outlined.

The use of surgery as a means, or associated aid, in treatment is mentioned briefly and some illustrative cases described.

Class III Malocclusion exhibits a typical facial pattern of mandibular prenormality and of varying degrees, but treatment cannot be designed through a standard pattern of principles and techniques.

We recognise that, generally, there is a need to reduce the prenormality of the mandible or of its dental elements, and often, at the same time, to increase the prominence of the maxilla or its dental elements. These things constitute the basic need for treatment of class III cases of malocclusion. However, the attainment of a satisfactory result and the methods employed, hinge on a recognition of the elements involved in the deformity - base bone, alveolar bone, jaw and cranial anatomy and relationships, soft tissue pattern and habits, habits of posture, tooth size and abnormalities of dentition, endocrine disturbances, are some of the elements that may separately or severally be of diagnostic significance -

and above all, how much of the deformity is inherited and how inherited influences may or may not be controlled or corrected to the functional and psychologic benefit of the patient.

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