The upper cuspids suffer most from environmental influences according to Dewel (1) and being the last anterior tooth to erupt it frequently has to provide part of the space for itself by a wedging action. Lingual or palatal impaction is common and hard to explain satisfactorily. Dewel recommends only the surgical dissection of overlying tissues in these cases and says that the tooth should be given the opportunity to erupt of its own accord in the first place. Four to six months may be necessary for the tooth to erupt but this is preferable to the destruction of tooth material in the preparation for a pin or inlay. When the tooth has erupted sufficiently a cast cap with staple is fitted to the crown and traction is applied. Palatally impacted cuspids occur more often than not in arches which are not crowded and are more common in females than males. The cuspids is second only to the third molar in frequency of impaction which is strange as it is possibly one of the most indispensable teeth both from the point of view of function and aesthetics.

A slight labial malposition and rotation of the lateral is symptomatic of canine impaction when any canine remains unerupted at the age of twelve. 

**ETIOLOGICAL FACTORS.**

The dense hard and soft tissues of the palate are the prime aetiological factor behind non-eruption. The long course pursued by these teeth gives great opportunity for deflection from a normal course during growth and eruption. The cuspids forms early and erupts late with a total length of time required greater than any other tooth and any factor which retards growth or development could be unfavourable to the cuspids. This article is short and to the point and gives an excellent exposition of the problem of the impacted cuspids which is an ever present situation to be faced up to in orthodontic practice.
Strang (2) traces the history of the expansion arch and its method of treatment which held sway for many years and for which all appliances were adapted.

Grieve and then Tweed were the first critics of the routine expansion of the dental arch. Tweed with his classical exhibit of clinical results in 100 consecutive cases finally convinced Strang that many of the failures in his practice were due to positioning teeth in unstable positions relative to the muscular forces.

Strang is quite definite "that denture expansion as a treatment procedure in the correction of malocclusion should be discarded and every effort should be directed toward preserving the muscular balance that is the most important factor in establishing and maintaining tooth positioning."

In this article Curran (3) shows a number of case histories in which relapse has followed treatment due to the eruptive forces of the maxillary third molars.

He suggests the removal of the second molar if the third molar is of good size, form and position.

In cases in which second molars have been extracted Curran considers that resistance to distal movement has been decreased.

Possibility of maxillary third molar impactions reduced or eliminated.

The correct normal buccal tooth relationships are more stable.

Wylie (4) in this article gives the impression that he is criticising for the sake of appearing in print.

Tweed in a previous article claims that by altering the inclination of the lower incisors to no less than 65 deg. angulation to the Frankfort horizontal plane he straightens up the profile and produces good to excellent facial aesthetics in 90% of cases.

Wylie measures the two variables, axial inclination of lower incisors and the soft tissue angle of convexity as follows
and applies them to Tweed's lateral head X-rays.

Depicting the manner in which the two variables were measured, axial inclination of the lower incisor and the 'soft tissue angle of convexity'.

Wylie admits that Tweed accomplishes his objective of up-righting incisors and straightening up the facial profile but because Wylie can derive no correlation between the two he will not accept them as a cause and effect.

Wylie agrees with Tweed that some natural growth of the mandible may be elicited by treatment which might not take place otherwise.

Tweed however goes further and claims that by up-righting the lower incisors he makes more room for the forward growth of the mandible. Tweed's skilful ability to produce mandibular growth is rather a cause of the improvement in facial profile rather than the establishment of the correct angulation of the lower incisors according to Wylie.

He also emphasises the great influence of Dr. Tweed's pains-taking clinical technique in producing good results.

Wylie's criticism in this article I think are rather hair-splitting and this article does not measure up to his contributions in the past.
Sved (5) divided this paper into two phases.

Part 1. Active phase of treatment or the mechanics of appliances.

Sved says that although he has changed from a labio-lingual technique to the use of the edgewise arch as developed by Angle he considers the forces applied to the teeth by the edgewise arch to be excessive. To counteract this factor he has developed a special bracket which obviates the rigid control of the arch wire in the channel of the edgewise arch bracket.

With the use of this bracket Sved claims that his appliance is the most gentle of all appliances in use at the time and will produce only one half the pressure exerted by the Johnson twin arch under similar circumstances.

Sved urges the need for a good knowledge of elementary mechanics solving orthodontic problems and goes so far as to suggest a full year course on the application of mechanics to orthodontics.


In this phase of treatment Sved deals with changes in arch relationship and in the occlusal level.

Most of this part of the article is concerned with a most irrational attack on Tweed's extraction treatment for bimaxillary protrusions. Sved even dismisses all X-ray diagnostic methods as being prone to so much error that the results obtained from them must always be questioned.

He shows models of a retracted (by Sved) bimaxillary protrusion case without extraction and the resulting occlusion looks more like that of an anthropoid ape than a human. This is his sole example and argument against extraction in these cases.

His sole worthwhile constructive contribution to treatment procedure is his use of the acrylic upper splint attached to a head cap with which to open the bite and obtain distal movement of the maxillary teeth in maxillary protrusions.

While the first part of the article contains some information of value I consider the second part a most illogical contrib-
uation to the literature and of very little value.

Jackson (6) says that success or failure in orthodontics depends on three major decisions.

1. Structural balance

"By this we mean the physical and aesthetic proportions desired between total tooth structure and total bone substance to establish mechanically stable machine."

There are two extremes, large teeth in a comparatively small amount of bone and very small teeth in a much larger amount of bone.

Extraction are necessary in "Some practices up to 90%, in ours 15 to 20%.

2. Functional efficiency "which is the mechanical economy making the masticatory system a satisfactory machine."

Problems involved include deep overbites, overjets, crossbites, open bites and those underjets not requiring surgical intervention.

3. Aesthetic harmony "meaning the artistic balance between the masticatory system and the surrounding structures."

Dr. Jackson requires a viewpoint to correlate the foregoing three problems in his analysis of a case to be treated and chooses Dr. Alfred P. Rogers term "position of mechanical advantage" which is apparently the bases of his father's and his treatment. Dr. Jackson then shows two technique.

models of his various appliances in which his main arch wires seem to be fairly passive and the teeth are activated by finger springs soldered to the arch wires or by coiled spring pressure. Provision is made for intermaxillary traction by the use of hooks on the maxillary arch wire.

"The appliances most commonly used by us are the simple labial arch with auxiliary springs of every description, the bite plane for vertical changes, the removable lingual arch and lastly the Johnson twin wire technique for alignment."

Jackson goes through several treatments of various cases with very good photographs of his appliances.
He favours the minimum of banding and his round arch wires seem to be mainly passive with most of movement being promoted by finger springs attached to the arch wires. The appliances shown are certainly neat in appearance and beautifully constructed and in the cases brought forward have produced a good result and if as he says he can get these results with the minimum of banding so much the better. He concludes that there is no direct relation between size of teeth and size of supporting structures. As the supporting structures cannot be altered by orthodontic means, the orthodontist is justified in extracting teeth to improve the structural balance, functional efficiency, and aesthetic harmony of an individual.

This article is a summary by Higley (7) of the benefits of cephalometry to orthodontic diagnosis. Cephalometric analysis had brought home to orthodontist the virtual impossibility of moving posterior teeth distally and also the failings of intra-oral anchorage. Higley shows his stabilising plate which when used as a source of anchorage and resistance has distinct advantage over the use of teeth alone. When constructed properly the plate combines both the teeth and the alveolar process into a unit of resistance and in the maxilla the palate also contributes to the anchorage resistance.

Higley claims that the use of the stabilising plate obviates the necessity for mandibular anchorage preparations and tip back bends and had made intra-oral anchorage adequate for most orthodontic purposes.

Buchner (8) believes in treating his cases in the permanent dentition and says that the ideal time as far as he is concerned is when the first permanent molars have erupted sufficiently to be banded and if possible before the maxillary canines and first premolars have erupted. He uses the mandibular arch on which is placed an 0.021X0.024 edgewise arch as anchorage for intermaxillary elastic traction.
If second deciduous molars are still present these are extract- 
ed before appliance is placed. 
In the maxilla bands are placed on the incisors and molars 
and either a 0.021 round arch or 0.021X0.024 edgewise arch 
is used. 
Buchner claims that it is not uncommon to have the relation- 
ship of the arches corrected in two months of intermaxillary 
traction. He then goes on to show some cases and results 
obtained. Although the views of the models are a little 
indistinct the majority of his cases look more like Class I 
cases than Class II Division I and this seems to be evident 
also in the profile photographs. 
The fact that just before intermaxillary force is applied 
he extracts the rather large mandibular second deciduous molar 
would account for the ease with which he corrects the distal 
position of the mandibular molar which in any case in several 
models is in a cusp to cusp arrangement normal at this stage. 
I would say that as far as one can judge from the evidence 
of models and profile photographs that these cases even if 
they could be classified as Class I Division 2 by the use of 
a great deal of wishful thinking are certainly hand picked 
to prove the efficiency of his treatment. 

that the resistance of the anchorage must be greater than 
that offered by the tooth or teeth to be moved, otherwise 
there will be displacement of the anchorage and failure in 
the movement of the teeth is the theme of an article by 
Strange(9). 
Anchorage must be secured from either the teeth or from 
 sources external to the teeth and may be classified as 
simple, stationary, reciprocal, intermaxillary and occipital. 
Selection of anchorage is one of the most important problems 
of orthodontic treatment particularly in Class II cases. 
In these cases failure to achieve stable anchorage can result 
in the following ill-effects.
Forward tipping of incisors can be accompanied by slipping of proximal contact points in the buccal segments. Strange advises against the inclusion of mandibular incisors in any scheme of anchorage and says that these teeth should be allowed to remain relatively free.

In Class II cases treated in the mixed dentition very slight elastic forces should be employed and preferably elastic force should not be used during the day.

Strange mentions the disturbance of the arch and undesirable drifting and shifting which must take place in separating the teeth in preparation for the placement of bands. Especially is this so in the cases in which large number of teeth are banded. This is a factor which has never been considered to any extent and in Strange's opinion will initiate considerable tissue disturbances and may produce slipping of all teeth in a forward direction with a consequent crowding or forward inclination of the incisor teeth.
In his discussion of the problem of slipping of the mandibular arch when used for anchorage Pressano (10) stresses the need for light elastics particularly at the commencement of treatment. Elastic force should never exceed 4 ounces. The lingual appliance is probably most common used as mandibular mechanical therapy in Class II cases. Either a fixed lingual or the mershon type of lingual appliance have their uses and advantages.

The use of the edgewise arch necessitates the banding of all the teeth and the preparation of teeth involved tends to affect all the periodontal fibres and therefore disturb the original stability of all these teeth.

Head caps or head gear would seem to be the best anchorage were it not for the necessity of depending on the co-operation of the patient which may not always be forthcoming.

Another means of assisting the stability of the mandibular arch is the use of a semi-fixed acrylic plate which throws some of the weight of anchorage on to the soft tissues. Preservation of anchorage will be assisted by not trying to move too many teeth at one time. The use of sectional arches to move premolars and molars and then anterior will obviate the necessity of pitting the whole maxillary arch against the whole mandibular arch.

To quote Prezzano "As we approach more nearly ideal anchorage we shall approach more nearly ideal orthodontic results."

The definition of anchorage by McCoy is quoted by Jerrold (11). "Anchorage consists in the selection of adequate and properly distributed resistance units for the control and direction of force."

Two types - intra-oral and extra-oral

Occipital and cervical anchorage was among the first to be used in orthodontic practice. Gunnell in 1822 and Angle in 1889 used it. Then it fell into disfavour.

Occipital apparatus should be fitted to the patient and should be comfortable when the patient is at rest.
Principal direction of movement upward and backward Jerrold says that occipital and cervical anchorage meets with the specifications of an efficient anchorage.

**APPLICATIONS**

1. Stabilising agent
2. Active unit of force
3. Means of retention

Tweed advocates the force for a stabilising unit in the treatment of Class II Division 1 cases.

Lewis used it for the preparation of mandibular anchorage.

Oppenheim and Atkinson have employed it for mesial and distal movement of teeth in Class II and Class III malocclusions.

Case has employed it for retention.

An appliance is an instrument having certain necessary requirement which are described by Atkinson as follows:

"It is our concern to select orthodontic appliances capable of delivering to the teeth the most nearly correct amount of controlled force capable of inciting proper cellular activity in a selected area of the anatomy of a particular individual."

Occipital and cervical anchorage meets with these requirements. This head gear being worn only at night, consequently the force exerted is an intermittent one as advocated by Oppenheim as the optimum.

Most efficient in moving maxillary molars distally.

During the distal movement of the buccal segments, the anterior segment usually follows due to these factors.

1. The pressure which originally displaced them has been relieved.
2. THE NATURAL DRIFT OF INCISORS, CUSPIDS, AND PREMOLARS IS TOWARD THE DISTAL, aided by lip pressure and the action of the orbicularis oris muscles.

An arch of 0.040" is recommended by the author with a further arch of 0.050" soldered to it to take No. 12 elastics which should exert 6 to 8 ounces of force.

In Class I cases where the buccal segments have moved forward, the author uses Class II elastics onto a sliding yoke to move
second maxillary molars distally during the day and the occipital force is used on the first molars at night. With blocked out canines due to forward movement of buccal segments this method is also successful.

In mixed dentition cases where anchorage is weak due to lack of approximal contact of teeth, occipital anchorage is useful. Distal movement of mandibular molars may be accomplished just as easily by this form of anchorage.

In bimaxillary protrusion cases, arch wire is used stopped at maxillary molars.

In mandible 0.040" arch is used stopped at mesial of first molar and winged arch is fitted to this to take elastic force from head gear.

Light Class I elastics are used from mandibular molars to hooks on maxillary arch wire.

Extra-oral elastics should exert 3 to four times more force than the intermaxillary.

In this way both arches are moved distally together.

The CHIN CAP as an auxiliary used with occipital anchorage has many practical used.

Occipital anchorage was widely used in the last century according to W.M. Thompson but with the advent of Angle’s appliances were largely superseded by intra-oral anchorage. Angle’s various appliances were gradually developed with the idea of providing more anchorage within the mouth.

The fact that correction of perverted axial inclination was being accomplished by root tipping instead of bodily movement in many cases led to the return to the more stable occipital anchorage. Thompson gives his treatment of bi-maxillary protrusion cases using the head cap.

Distal movement of the mandibular buccal segments is attempted first using Class III elastics in the daytime and occipital head cap and auxiliaries attached to a passive maxillary arch at night. When the mandibular denture position has been corrected the mandibular arch is then used as anchorage for Class II elastics to move the maxillary buccal segments.
distally. Occipital head cap and attachment are adjusted to
the hooks on the mandibular archwire. In an article that is
both brief and to the point Thompson points out that the
head gear must be comfortable for the patient to wear and
although he says tooth movement can be produced with the
occipital head cap without elastics, he considers that it is
best used in the form of subsidiary anchorage to relieve the
strain on the arch for twelve out of twenty four hours of
the day.

Kresnoff (13) given Strang the credit of being one of the
first to reintroduce occipital anchorage in 1924 in con-
junction with the ribbon arch.

As well as Thompson, Tweed used the occipital anchorage as
an integral part of his Class II treatment. The use of this
anchorage is once more on the increase as an active tooth
moving device, an auxiliary support against undesirable
effects of Class II and Class III elastics, as a retentive
device in Class II treatment.

Kresnoff has studied the results of both intermaxillary
elastics and occipital anchorage used independently and in
conjunction in a number of cases of which he has made
cephalometric tracings.

While admitting the small amount of data at his disposal
and a not very accurate control the conclusions he reaches
are:-

1. Occipital anchorage can stimulate tooth tipping
   movement although to a lesser degree than inter-
   maxillary elastics.

2. Occipital anchorage was found to be less effect-
   ive than intermaxillary elastics for activating
   the intracranial appliance for mass movement of
   buccal segments.

3. Occipital anchorage is much more stable than
   intermaxillary anchorage.

4. Since usually the head cap is worn only
at night occipital anchorage does not provide a continuous force but is most useful when used as an adjunct to maxillary elastics in preventing protrusive movement of the anchorage arch particularly in those cases showing a predisposition to protrusion.

Kresnoff's comments on occipital anchorage are very reasonable and he urges a more comprehensive evaluation of occipital anchorage especially with regard to the duration and intensity of the force, the mechanics of the intra-oral and extra-oral appliances and the potentialities of the tissues for reaction.

In extra-oral anchorage according to Nelson (14) the possibilities are far greater than the limitations. Limitation of this type of anchorage are the length of treatment time although the hours and degree of force are less than in inter-maxillary force. The only other limitation is that in some cases for unaccountable reasons the teeth just do not move even though the patient is co-operating. Intra-oral anchorage is the only true stationary anchorage and Nelson says that intra-oral force introduces reciprocal force no matter how carefully the anchorage preparation may be.

The influence of light intermittent force which may be adjusted to requirements will produce tooth movement that is least productive of pain and damage to the tissues.

Simplicity of appliance and a minimum of banding is a further advantage of the extra-oral anchorage.

Closson (15) reports that occipital anchorage which has been established once again in present day orthodontics can be used in combination with any of the more popular appliances, twin arch mechanism, universal appliance, labio-lingual technique and edgewise appliance. Occipital anchorage is particularly advantageous for treatment in the mixed dentition of Class II cases with severe maxillary protrusions. Distal movement of maxillary first molars which have drifted
Mesially following early loss of deciduous teeth is easily achieved and this type of force is particularly suitable if only unilateral movements are required. The amount of pressure applied varies with the case and the judgement of the operator, but Glosson recommends a light elastic with a long pull. The head gear seems to work best in Class II cases when the forces are applied only to the molar teeth except in deciduous dentition (four to six years.) The use of occipital anchorage allows early treatment of young patients without cumbersome intra-oral appliances and its use in older patients eliminates the necessity of wearing appliances by day.

Patient co-operation is important and this should be forthcoming particularly if the head cap is comfortable. Nelson (16) cites the fact that extra-oral anchorage is the only complete stationary anchorage and therefore does not produce reactionary movements of other teeth as a result of its action on the desired teeth. Five other uses and advantages are mentioned.

1. As a means of increasing or decreasing arch length.
2. As a means of changing mesio-distal relationship of upper and lower teeth.
3. As an auxiliary to intra-oral anchorage.
4. The advantages of applying gentle intermittent forces.

Nelson illustrates these points with case histories which show how valuable this type of gentle movement of teeth can be particularly in the appropriate cases. Interesting variations of the appliances are mentioned such as the use of elastics across the anterior teeth when the incisors are protrusive.

The main disadvantage and possibly the only one is the necessity for complete co-operation from the patient although as Nelson says it should be the responsibility of the orthodontist to create confidence and desire to co-operate in the patient.
As against this disadvantage this method of treatment largely
does away with conspicuous appliances, move teeth gently
without pain and soreness and must merit a high priority
when treatment of suitable cases is being planned.

The purpose of this article by Fischer (17) is:

1. To discuss the use of occipital anchorage in Class
   II Division I cases.
2. To show some results obtained by this method and
   a cephalometrical appraisal of the changes produced
   in the dento-facial complex.

**INTRODUCTION.**

Occipital anchorage was first used by Kingsley and then later
by Guildford, Farrar, Goddard and Angle, and others.
Calvin E. Case used occipital force extensively in treatment
for cases with blocked out canines.
Albin Oppenhein used it for posterior movement of maxillary
teeth and highly commends it in his 1956 paper.
It is used today in the preparation of mandibular anchorage
prior to the use of intermaxillary Class II elastics as advoc-
ated by Tweed in Class II Division I treatment.
Although occipital anchorage has been in use for about 100
years it is used less now than at the turn of the century.
These are two reasons.

1. Discomfort of apparatus
2. Adoption by Angle of intermaxillary forces.

in 1889 Angle used and advocating occipital anchorage in
maxillary protrusions.
But in 1907 he had changed over almost entirely to inter-
maxillary anchorage although still admitting the value of the
occipital force.
Fischer believes that Angle's changed attitude to occipital
anchorage was due to intermaxillary anchorage fitting in
better with his changed views on diagnosis, classification
and treatment of malocclusion.
Angle based his classification and treatment on two hypotheses.
1. That the maxillary first molar always erupts in the correct relationship to cranial anatomy.

2. That the best balance, the best harmony, the best proportions of the mouth in its relation to the other features require that there shall be the full compliment of teeth, and that each tooth shall be made to occupy its normal position - normal occlusion."

To move the maxillary molars posteriorly would not be consistent with these hypotheses so he abandoned this in favour of intermaxillary force.

Today when both Angle's hypotheses are open to serious doubt, we can open the discussion of the desirability of the use of occipital anchorage.

**THE OCCIPITAL APPARATUS.**

Head cap is similar to the one designed by Strang and the force is transmitted by double bow hooked on to the head cap with elastic bands. Outer or facial bow or inner or dental bow are used. With this form of occipital apparatus, force can be applied to the molar, the premolar or the cuspid area of the dental arch.

**ADVANTAGES:**

1. Sturdy, comfortable and efficient.

2. Force can be applied to any part of the arch.

3. By means of dental bow any undesirable expansion in the premolar and molar regions can be prevented.

4. Proved efficient not only in the preparation and reinforcing of anchorage but also in the posterior movement of the maxillary arch or its lateral segments without recourse to intermaxillary elastic.

**CASE REPORTS**

These six cases are part of a group characterised by the plan of treatment followed and were taken at random to test the efficiency of occipital force as a corrective measure in Class II Division 1 malocclusions.

**METHOD OF APPRAISAL**

Records from.
1. Oriented plaster casts by denta-phrase technique
2. Oriented facial photographs by cephalometric technique
3. Oriented mandibular X-rays

**SUMMARY.**

1. In all cases maxillary arch was moved posteriorly with the exception of the one where the occipital force was applied in the intercanine area.

2. This posterior movement brought about a correct occlusal relationship between the teeth of the two arches except in the one case quoted above.

3. Marked improvement in facial balance seems to have been due to a readjustment of the various component parts of the dento-facial complex.

The spaces caused by the absence of lateral incisors present rather a dilemma in orthodontic practice. Carlson (18) insists however that any canine next to a central incisor would be an improvement on the insertion of some prosthetic appliance or bridge in the space. Before making the decision to adopt a systematic procedure to close these spaces Carlson admits he would have preferred to dodge these treatments if possible.

He advises the use of the edgewise arch with every tooth banded in order to give the necessary control over the movements essential to the treatment. Movements which are essential are the bodily movement of the canines as any tipping of crowns would be followed by relapse.

It is most essential if possible to move the first bicuspids root into the area represented as the cuspid eminence for the sake of a pleasant appearance.

Lingual and incisal grinding of the canine is essential for the sake of occlusion and appearance when moved adjacent to the central.

Carlson discloses a very thorough and exact technique which
he says is essential for these cases in order to prevent relapse and produce a pleasing appearance and he concludes by saying that he will continue to close spaces until he sees better restorations made for missing lateral incisors. Carlson's definite attitude and approach to an orthodontic problem is refreshing in comparison to the many articles that beat around the bush and conclude in greater confusion than when they commenced.

The search for a method to change the relationship between mandibular and maxillary dentures by reciprocal force is as old as orthodontia. Breitner (19) claims in his experiments on monkeys using intermaxillary Class II rubber bands to have produced the following changes.

A. IN THE ALVEOLAR PROCESS The mandibular teeth including the alveolar process were moved forward and the maxillary teeth including the alveolar process were moved backward.

B. IN THE POSITION OF THE MANDIBLE. The glenoid fossa was displaced mesially by new growth and resorption of bone thereby creating a new more mesial position of the mandible.

C. IN THE SHAPE OF THE MANDIBLE Condyle and neck grew upward and in a dorsal direction and the angle of the mandible was widened.

Breitner considers from evidence in his previous study that the orthodontist is not limited only to changes in the alveolar process but that bone changes occur in the temporo-mandibular joint, gonial angle and ramus in orthodontic treatment. I have not read Breitner's previous article but I consider he is the victim of his own wishful thinking. In the thirteen pages of this rather verbose article he fails to put forward one definite fact in support of his theories but rather fully discusses a lot of suppositions which seem not to have much bearing on the subject of the article.
Deleterious forces created by the use of intermaxillary elastics are greater than the useful distal driving components in the distal movement of teeth according to Bien (20). This is particularly so when the jaws are open and in this position we have a force of 2.6 ozs acting to extrude the lower molar from its socket when the mouth is open against a tension of four ounces of intermaxillary elastic. With the jaws closed this extrusive force exerted on the lower molar is much smaller, 0.6 ounces.

The head gear exerts no deleterious force on the lower molar or other teeth. The absence of the mesial driving force and upward extrusive force exerted on the lower molar by intermaxillary elastics is a large factor in the arguments for extra-oral anchorage and forces. The head gear with spring traction bar exerts the smallest amount of undesirable force components according to Bien.

The most favourable combination of forces for the most efficient distal movement of teeth would be the use of very light intermaxillary elastics during the day when the mouth is open frequently and heavier elastics and/or head gear with spring traction bar during sleeping and quiet hours.

This article on treatment by Downs (21) is concerned mainly with those cases where there is crowding within an arch caused by buckling of the arch. Loss of interproximal contact is brought about by various causes, and collapse of the arch follows instigated by the anterior component of force which causes the buccal segments to move anteriorly. Downs maintains that it is possible to move the buccal segments posteriorly by his methods but that the greatest problem is anchorage. As he says, we have ample forces at our command but without a stable point from which to exert them they are useless. Where mesial drift can be definitely diagnosed he used the technique of moving the teeth distally one at a time, the second molar first and using the other teeth in the segment for anchorage. The stages of his technique can be best
shown by Downs' diagram of the succession of movements involved.

The technique is extremely exacting and generally requires from twelve to eighteen months to obtain ideal arch form. Downs also recommends occipital anchorage in the more obstinate cases when other anchorage may be insufficient. These cases under treatment by Downs were followed by lateral head plates and in fourteen cases the amount of arch length gained by the distal movement was between three to 7.5 mm. In summarising Downs says that an adequate case analysis will show whether the malocclusion has been caused by the mesial drifting of buccal segments in which case we have two alternatives.

Either the mesial drift can be halted while anterior segment moves forward or in other cases distal movement of the buccal teeth must be instituted.

Downs seems certain there is satisfactory clinical evidence that buccal teeth can be moved distally and that there is conclusive cephalometric evidence that it can be done.

In this study of variation within one class of malocclusion Fischer (22) divides the variable traits into three categories.
Dental, dento-facial, and facial.
Dental traits include overjet, overbite, axial inclination of incisors etc.
Dento-facial traits. Fischer claims to be able to recognise at least five distinct dento-facial relationships within Class II Division I.
Facial traits. Variation is found in these traits such as the divergence of the facial profile, lip position, lateral shift and facial asymmetrics.
According to their divergence he divided facial profile into two types.
Type I. Forward divergence
Type II. Backward divergence.
The manifold variation of these traits lead to an almost infinite diversity of dento-facial patterns.
Class II Division I cases in particular seem to have an enormous number and diversity of variables thus stressing the individuality of each case.
Fischer treats all these cases with occipital anchorage and elastic force applied only to the maxillary arch. The mandibular teeth are not touched and no inter-maxillary force whatever is used.
To add to the infinite variations in the various traits we find that similar traits may respond differently to treatment of the same kind.

DENTAL TRAITS.
In Fischer's treatment by occipital force he considered treatment in two stages.

1. An optimum arch relationship is produced by an over-corrected molar relationship where possible and a corrected overjet with sufficient space for all teeth. To produce this he uses the application of force to an edgewise arch adjusted to the four maxillary permanent incisors and the two maxillary first permanent molars.
Variation in response will be seen in the different
rate at which teeth will move.

2. attainment of a correct occlusion shows variation in the number of appliances necessary to produce correct interdigitation of the cusps of the bicuspid and cuspids.

OVERBITE AND OVERJETS.
Response to the application of occipital force of these two factors varies with the individual subject.

DENTO-FACIAL TRAITS.
According to Fischer depending on the forward and backward divergence of the profile these are either due to maxillary protrusions or structural mandibular retrusions respectively. He claims three responses to his treatment.
1. In a maxillary protrusion the maxillary arch moved posteriorly the whole distance.
2. In other cases the mandible is repositioned with the maxillary arch unchanged.
3. In some cases there is a combination of the above two movements.

FACIAL TRAITS.
Variations in response also takes place and changes in the facial profile must be attributed to
1. Posterior movement of the maxillary dental arch
2. Repositioning of the mandible
3. A combination of these two

It seems that while the distinctive features of the Class II Division 1 cases are plain there is a great variation of all the component parts of the dento-facial complex and their inter relationships.

Fischer emphasises the antagonism between the standards used in treatment and the individual which makes it impossible to compress an individual facial pattern into a preconceived mould by mechanical processes, if this mould would differ appreciably from that of the individual.

Dealing with successes and failures in his practice Fischer
admits that his successes in treatment of Class II Division 1 cases treated with intermaxillary force were invariably functional retrusions. Facial profile improvement being due to a repositioning of the mandible. Failures are due to the inadequacy of mechanical forces to reduce maxillary protrusions.

PROGNOSIS

Prognosis in treatment of these cases may be grouped under one word. - HAZARDS - which involve
1. Instability of the treated denture
2. Damage to the tissues involved in treatment

VARIATIONS OF END RESULTS

In an effort to minimise this variation Fischer advocates the following principles of treatment.

1. Slight variations of dental and dento-facial traits are accepted as natural phenomena and not interfered with.

2. Orthodontic correction is carried out with a minimum of disturbance of structural pattern of the individual.

3. The achievable optimum for the individual is aimed at.

4. Early treatment is advocated when tissue tolerance and adaptive capacity of structures are at their maximum.

This is a most interesting and thorough dissection of the many problems of analysis and treatment of Class II Division 1 cases and provided Fischer's cases are not picked to prove his points, his results in those shown certainly show the merits of occipital anchorage and force directed therefrom. His theory of individual variation seem to be recapitulation of ideas put forward by Brodie and Wylie. However his analysis of the many other variations in this particular type of malocclusion and in the response to treatment demand a change in our approach to case analysis and a more flexible and individualistic scheme of treatment.
Bull (23) claims that only about 5% of Class II Division 1 cases are successfully treated without recourse to the extraction of teeth. The remaining 95% according to Bull result in two conditions neither desirable.
1. The dual bite induced by the wearing of Class II elastics.
2. A double protrusion results from the tipping forward of mandibular teeth used as anchorage.

Bull's technique of treatment is first to upright the lower incisors. He first extracts the lower first bicuspids and then with a sectional steel arch on each side with a closed loop adjacent to the space moves the cuspids distally to make sufficient space to permit uprighting and correction of rotations.

A continuous arch wire is used to upright incisors over basal bone and then another arch wire with tip-back bends is fabricated to correct any mesial inclination in the buccal segments. This arch is then tied back.

The maxillary first bicuspids are then removed and sectional arches for the maxillary buccal teeth are made with closed loops as before. These loops are activated for the distal movement of the cuspids and Class II elastics are begun.

At this time a new mandibular arch wire is formed in such a way that the lower molars and bicuspids will be moved mesially to a Class I relation but the lower anterior will not be affected. A continuous arch is fitted to the upper teeth and the upper centrals and laterals are retracted by closed loops between the lateral and cuspids.

With the advent of Bull's technique the pendulum has certainly swung to its other limit in the matter of extractions. Apparently from Bull's article his sole reason for extraction lower first bicuspids is to enable him to position the anterior upright over basal bone. In cases of crowding this might be condoned but in numerous cases the mandibular teeth are fairly good alignment.
Lower anteriors are replaced posterior to their pre-treatment position and then eventually maxillary anteriors are placed in occlusion with them.

Some years after treatment Bull might regret his sacrifice of teeth when he sees the results in the profiles of the patients.

Particularly in the contour of the lips, this tendency for large reductions of tooth tissue may produce a worse result than if the malocclusion had been left alone.

Jarabak (24) discusses the treatment of five cases of Class II Division I malocclusions in which the maxillary protrusion has been satisfactorily reduced by means of his cervical elastic strap appliance. He believes the action of this strap on the upper anterior teeth stimulates a "reflex phenomenon" in which muscular action places position of the mandible forward and so tending to correct the distal position of the mandibular teeth.

His explanation of the neurological basis of the "reflex phenomenon" is given but I am inclined to think that it is rather a case of wishful thinking.

Terwilliger (25) traces the development of the edgewise arch by angle in his search for an efficient appliance which would control movement of teeth in all directions and with which bodily movement of teeth or groups of teeth would be possible. The soft bracket was first originated and gave way to the more rigid milled bracket. Freedom of the arch wire in the bracket channel was made possible by the use of round arches for commencement of treatment or rectangular arches of slightly smaller dimensions than the 0.022 inch channel. In the edgewise arch was incorporated all mechanical advantages of the E. arch, pin and tube and ribbon arch plus the advantage of being able to make use of bracket bands on all the teeth for increased stability and anchorage control. The author stresses the care that should be taken in the
the proper positioning of both hands and particularly brackets in order to obtain the maximum efficiency from the edgewise arch or for that matter any arch.

With the advent of technique of treatment involving extraction and space closing the edgewise arch has shown its superiority over other appliances in its control of bodily movement of teeth. Since its inception the edgewise arch has suffered no major modification and this speaks well for its efficiency especially in the hands of the experienced operator.

These cases of Class II Division 2 are characterised by distal occlusion in each lateral half of lower dental arch as indicated by the first permanent molar relation but with retrusion instead of protrusion of the upper incisors and their treatment is described by Barich (26).

Width of arches is more nearly normal and there is less abnormal overbite elevation of the lower incisors.

Marring effects on facial lines noticeable and characteristic the retreatting jaw and compressed upper lip alone making diagnosis easy.

One or all six incisors can be in lingual- or supra-version. Usually only centrals in lingual version.

The curve of Spee is exaggerated.

**TREATMENT OBJECTIVES**

1. Reduction of lingual and supraversion of upper anterior teeth.
2. Distal movement of upper buccal segments
3. Establishment of arch form in both arches.
4. Reduction of supra-version in lower anterior teeth.
5. Establishment of flat curve of Spee
6. Placement of mandibular denture upon maxillary denture.
7. Finishing
8. Retention after establishment of normal occlusion by various mechanisms.

**PLAN OF TREATMENT.**

Appliance used is a plain round labial arch with McCoy open
tube attachments and lingual extensions on the upper arch. Fixed removable lingual appliances and plain round labial arch with McCoy open tubes on mandibular arch.

**PHASE 1.**
Reduction of linguo- and supra-version of upper incisors 
Upper arch wire lengthened by opening spring loops and bent anteriorly to loops to adjust gingivally giving labial and depressing movements.

**PHASE 2.**
Class II rubbers, adjust labial arch further gingivally to prevent elongation of anteriors.

**PHASE 3.**
Establishment of arch form 
Bilateral expansion of upper arch 
Finger springs on lower lingual appliances.

**PHASE 4.**
Depression of lower anterior segment 
Intermaxillary force has a direct action which tends to depress lower anteriors. Also adjust lower arch gingivally.

**PHASE 5.**
Curve of Spee should have been taken care of by previous mechanisms

**PHASE 6.**
Adjustment of arches

**PHASE 7.**
Distal positioning of cuspids by direct pressure of the labial arch wire or finger springs attached to the arch wire.

**PHASE 8.**
Hawler retainer with or without labial bow with inclined plane to hold bite, and a fixed lingual appliance in the mandible.

**WARNING.**
Extraction of upper first premolars is contra-indicated in the Class II Division 2 case.
Sved (27) states that extractionist and non-extractionists have different sets of standards.

Tweed's standards.

1. Normally mandibular incisors are in upright position over basal bone.

2. Practically all malocclusions are characterised by a forward drift of the teeth in relation to basal bone.

3. If the mandibular anterior teeth are placed upright on basal bone result will be more stable.

4. In a large proportion of cases, facial balance cannot be obtained without resorting to extraction.

1. Tweed defined his upright incisors as being 90 deg. +5 to occlusal plane.

He claims support from Margolis who used mandibular plane. Both used the word upright, but used different points of reference. Tweed certainly positions his incisors in treatment at 90 deg. to occlusal plane.

According to Sved, Margolis' standard is nearer the truth.

2. Sved agrees with this standard of Tweeds but says that after correction natural processes very often reduce the maxillary protrusions.

Tweed in extracting in 75% of cases admits that extraction is practically essential in these cases.

Sved maintains that maxillary protrusions can be reduced by orthodontic means.

3. Extraction and bringing teeth over basal bone according to Sved results in a reduction of interproximal pressure and a loosening of interproximal contact.

Sved says that extractionists point of view is justifiable on the ground that we have never been able to move an entire dentition distally.

Uprighting of anterior teeth after extraction may produce a stable result but the loss of interproximal contact will take
its toll in the future.
With the movement of anteriors distally there is also move-
ment of posteriors mesially which means that the gap is only
partly closed by the anteriors. Sved infers from this that
only a small distal movement is necessary for the reduction
of a maxillary protrusion.
He says that most operators move posteriors distally first
then using the posteriors as anchorage move anteriors distally
so that the posteriors move mesially again.
Only solution to problem is mass movement of entire denture.
Therefore intra-oral anchorage cannot be used as with this
we get a reciprocal movement of teeth. Anteriors move dis-
tally and posteriors move mesially, and since mesial movement
is more easy this will predominate and increase the protrus-
ion.
Appliance for mass distal movement.
1. Must be capable of delivering a greater force than
   ever before used in moving teeth.
2. Must give no danger of devitalisation.
3. Appliance must be activated by extra-oral force.
4. Force must be delivered simultaneously to every
tooth in the jaw to produce mass movement.
The two parts of this appliance originated by Sved consists
of a head gear and an intra-oral acrylic splint.
Useful in Class II Division 1 and 2 cases as maxillary pro-
trusion can be reduced by this appliance.
Distocclusion is eliminated by the distal positioning of
the whole maxillary arch rather than by the forward position-
ing of the mandible.
In treatment of Class II Division 1 cases after arches are
equalised normal arch relationships can be permanently est-
ablished by the distal displacement of the maxillary arch.
In Class I cases if after treatment these teeth are protru-
sive, the mandibular teeth can be moved distally by Class III
elastics and then the maxillary teeth can be moved distally
by the use of the head gear and acrylic appliance.
Wright (28) advocates the return to earlier treatment of malocclusion and shows the use of a type of tube spring appliance for arch expansion in the correction of cross bites.

Early correction of these deformities before they become fully established will enable function to play its full part as a factor in development.

Bedell (29) says that only rarely is the labial frenum the cause of diastema of the centrals and in most cases the activating cause can be found.

The separation of the incisors from other causes is usually the reason why the frenum is still present between the teeth. When these causes are found and treated and the incisors moved together the frenum attachment will in most cases disappear without any surgical resection.

The results achieved in the surgical treatment of facial clefts are only made possible by the fullest co-operation of teams of specialists, surgeons, orthodontists, prosthodontists, speech therapists, anaesthetist and pediatrian.

The fact that one in every 770 births produces a problem in the form of some facial cleft makes us realise that this is not a rarity by any means but another deformity to be studied and about which something must be done.

In this article Slaughter and Brodie warn against radical surgery in early life as in this way damage is done to blood vessels and sites of growth with resultant much retarded development of the maxilla. Surgery to cleft lip must be carried out very carefully and in stages and the soft tissues must be handled with the greatest care. Bone must not be cut, fractured or moulded so as not to interfere with growth which will take place in these cases just as in normal ones.

The two authors who in previous five years have handled 1349 cases of this deformity show some good results of what can be achieved early in life in operations on the cleft lip using the most conservative surgery.

They conclude with the warning that surgery poorly executed
or poorly timed can do more damage than good in the long run. Thompson (31) emphasises the team work necessary between the many branches of medical and dental science involved in this problem.

Researches in growth have caused surgical methods to be refined to comply with and not inhibit the growth of the bony structures. Maxillary growth in particular must not be inhibited as this would produce the deformity that becomes progressively worse as the other parts of the face grow normally while the maxilla fails to develop.

Research in functional analysis has shown a very large freeway in many cases which must be taken up by the wearing of dentures over natural teeth.

If the difference between the rest vertical and the occlusal vertical dimensions is not great, orthodontic treatment can be implemented.

Loss of hearing which occurs in 50% of cases is preventable by proper care and regular examination.

The work of this group of specialists commences with the adjustment of the parents to the shock and disappointment and proceeds with the child under regular observation.

Lip surgery is the first treatment and after a few years the advisability of closing the palate is determined by group discussion.

Prosthetic and orthodontic treatment, speech therapy, pedodontia are available at the optimum time in the co-ordinated treatment program to try and relieve the effects of this deformity.

Eby (32) suggests that an orthodontist should be brought into consultation on cleft palate cases at about the age of three or four years.

During the deciduous dentition the upper arch should have a mild stimulus to increase arch width and to establish correct vertical occlusion and functional relationship if possible. When deciduous teeth are exfoliated it is necessary to suspend treatment and wait until the permanent dentition has completed. After the age of sixteen serious thought has to
given to three problems by the oral surgeon, the orthodontist and the prosthodontist.

1. Length, adhesions and need of support of the upper lip.

2. Presence, position and condition of upper incisors adjacent to the cleft.

3. Mandibular length.

At this age removal of any doubtful teeth must be considered to improve the aesthetics and function of the upper appliances. Lower premolars may have to be removed in order to retract the mandibular incisors.

Knyv quotes Parker who says he is not prepared to operate for a cleft palate closure on a patient before the age of three. Opportunity for a certain amount of growth and development is thus given.

Mandibular deformities which have a particular effect on the social and economic life of the patient should be eliminated or corrected if possible according to Parker (33).

In planning the treatment by surgical means many different factors have to be considered. The consideration of treatment steps demand accurate records of the patient particularly casts of the teeth, intra- and extra-oral X-rays and lateral head plates and profile photographs.

From the casts we can study the amount of posterior movement of the mandibular arch required also the types of splints or arches which will be most desirable for retention of the case after surgery.

There are two surgical techniques, osteotomy or ostectomy and each has certain advantages and disadvantages.

Osteotomy is the operation in which the ramus is severed usually above the entrance of the mandibular nerve and the body of the mandible carried back to the desired position. Parker describes the several techniques of different surgeons to accomplish this operation.

Ostectomy implies the surgical removal of part of the body of the mandible on each side equal to the distance that the
symphysis needs to be carried back. Interferences with the mandibular nerve is the chief disadvantage of this method but Dr. Dingman has evolved a surgical technique which precludes this possibility.

Micrognathia in which the mandible is undeveloped is a deformity particularly in some extreme cases. When orthodontic treatment has been completed the simplest way to restore fullness and contour of the chin is by graft or implants. Bone or cartilage is the best and vitallium and tantalum have been used for implants.

Another method of treating these cases of micrognathia is that of horizontal osteotomy through the ramus and in this case the reverse procedure to that of the prognathism is employed. This treatment is not altogether successful because of muscular tension produced. Correction of these deformities can change the whole outlook of the patient and should be attempted if he is going to take his place in society.

The need for team-work in treatment planning and treatment between the different specialists involved is important and with a co-operative patient much can be done.

This article is a clear and interesting summary of the problems involved in these cases, the treatment of which although most exacting and difficult must give great satisfaction when carried to a successful conclusion.

Types of cases successfully corrected by surgery are those too extreme to be managed by orthodontic therapy alone and include according to Barrow and Dingman (34).

1. Mandibular prognathism
2. Mandibular deficiency
3. Non-habit open bite
4. Lateral mandibular displacement
5. Various combinations of the above.

These writers have abandoned the method of sectioning the rami of the mandible and prefer the operation involving the body of the mandible.

The first essential is accurate models which are cut in the
first molar area and the parts of the mandibular model are moved to attain the best relationship with maxillary teeth. The size of the spaces between sections of model will give an indication of the amount of bone to be removed from the body of the mandible.
In extreme mandibular retrusion cases Dingman has found that it is possible to advance the anterior element 10 mm without causing injury to the inferior dental nerve.

Cases in which no teeth or very few are standing require great care in determination of amount of bone segments to be removed. Fixed appliances are used in which it is necessary to band all the existing teeth. A labial arch of 0.040"wire is used and this is soldered to the bands in sections with spurs for attachment of intermaxillary elastics. Acrylic splints are used in those cases with insufficient teeth with which to maintain stable relationships by a fixed appliance.

Splints are also used with fixed appliances in the maxilla being similar to a Hawley retainer.

The results shown in the cases treated by the writers certainly show what a great service can be rendered to the patients handicapped by these disfiguring deformities by surgery of this kind.

Co-operation between surgeon and orthodontist is most essential to a successful result. Surgery with adequate immobilization of the parts during healing by the orthodontist can, it seems produce the solution in these problem cases which are beyond normal orthodontic treatment.

Gold (35) in his summary of mandibular prognathism says that the majority of these cases are hereditary in origin although there is the type of Class III malocclusion which is brought about by the underdevelopment of the maxilla.

Glandular disorders, posture, premature bilateral loss of the six year molars and imitation may also produce prognathism. The time of treatment of Class III malocclusions is about the only subject in orthodontics about which there is general agreement. Treatment of some sort should be instituted as soon as the condition is noticed.

In treatment Gold uses the head gear and muslin chin cap with elastic traction. On the maxillary teeth he uses a Johnson twin arch to expand the anterior teeth labially.
A lingual arch is also used if the cross bite has to be corrected by lateral expansion.
A celluloid bite plane is used for one half hour daily. It is rhomboidal in shape and cut large enough to include the four maxillary anterior teeth. The mother presses the bite plane hard against the mandibular teeth while the child bites against the plane.
Gold has obtained good results in some of his cases with the bite plane and chin sling alone in placing of the maxillary anteriors in correct labial position to the mandibular anteriors.
In cases in which there is a protrusion of the mandibular anterior teeth a mandibular labial arch wire with occipital force applied is used to reduce the protrusion.
The classification of mandibular prognathism is so broad that much differentiation is necessary to distinguish between the many gradations both in mandibular prognathism and maxillary micrognathia.
Once these cases have been thoroughly analysed the correct treatment procedures should become evident.
Kloehn (36) urges treatment in the mixed dentition especially of Class II Division 1 cases. He quotes Oppenheim's plan of treatment which was to accept the position of the mandibular teeth and move the maxillary teeth distally into correct relationship by occipital anchorage.

By starting this treatment early it may be possible to stop the forward growth of the maxillary teeth and alveolar process until normal mandibular growth had advanced the mandibular arch forward sufficiently for normal relation of the teeth. The optimum time to start this treatment then would be when the first permanent molars are fully erupted.

In his treatment of Class II Division 1 cases in the mixed dentition Kloehn used the head cap and E. arch at night and avoided at all costs Class II elastics or any interference with the mandibular teeth.

With the occipital anchorage Kloehn uses elastic force to move the buccal segments distally and if anteriors have open contacts and severe labial inclination these are also brought into contact with the arch to tip them lingually.

This is most interesting article by Kloehn and revives hopes in the efficiency of mixed dentition treatment particularly the technique of occipital anchorage and elastic force applied to the maxillary teeth in Class II Division 1 malocclusion. Kloehn's belief that arch length in the mandibular arch can be increased by growth in many cases provided the mandibular teeth are not used for intermaxillary anchorage is worthy of note and extensive trial. His arguments for the guidance of eruption and alveolar growth cannot be ignored as it seems to be one of the few avenues of treatment we have left to try and obviate the need for extraction in the permanent dentition.
Principles can be defined for our guidance but not rules as orthodontia is an applied science with too many variables. Kloehn (37) applies the following principles in evaluating the best period for treatment.

1. When can the most stable result be obtained
2. When is it possible to correct the malocclusion with the least amount of disturbance and destruction of tooth tissue and alveolar bone.
3. When it is possible to have the shortest time of treatment.
4. When is it possible to use the least amount of appliances.
5. What is the psychological effect of the malocclusion on the patient.

Kloehn shows an interesting selection of cases treated in the mixed dentition. These include a pseudo-Class III malocclusion and some Class II malocclusions. His ideas seem to be that although we cannot increase growth and development in treatment, with mixed dentition treatment we can at least remove some of the anomalies of occlusion that might inhibit the growth potential of the individual concerned. This is shown particularly in the pseudo-Class III case in which if left untreated the maxilla would have very little change of development. Moving the anteriors at least gives the growth potential a chance.

Class II cases he treats in the one arch mainly with head cap for anchorage for distal movement of upper molars and bite planes to be worn in the daytime.

He advises the use of as little in the way of appliances as possible and to use them to direct alveolar growth and guide the teeth during eruption.

Treatment at the stage of the mixed dentition leaves us with a larger period of growth and development ahead and even if treatment is not completed at this stage at least it may prevent a much more severe malocclusion and reduce treatment time in the long run.
Lasher (38) agrees with Kloehn in the importance of treating Class III and pseudo-Class III malocclusions as early as possible even at the age of two with head gear and chin strap. All other cases with a rare exception Lasher and the group he is speaking for considers should be treated when the case has fulfilled its growth pattern. As he has found nearly every case has to retreated this increases the time element which the patient may be unwilling to pay for. The time element is also important for the patient who would prefer to have the bands on for only 15 to 18 months.

Biologically as well as hygenically one treatment would be more desirous.

Lasher considers that the child of 12 would be more appreciative of treatment and more co-operative than a younger child.

Bishop (39) will have none of mixed dentition treatment except in those cases of cross-bite or space maintainance or in cases where maxillary protrusions are having a bad psychological effect on the child.

He and the group he represents have had no success with Class I and Class II treatments and what is more he casts doubt on the results of those who do claim some success saying that they do not follow their cases for a long enough period. The distal movement of protrusive anterior is fraught with risk as they would tend then to impinge on the high unerupted cuspid. Certainly case analysis and treatment planning would be easier in the permanent dentition when some of the variable factors and potentialities confronting us in the mixed dentition have become stabilised.

The inaccuracy of diagnosis and the minimal treatment time involved is Bishop's main argument for delaying treatment.

Kelly (40) is also opposed to mixed dentition treatment by mechanical therapy except in Class III cases. However he
accepts minor mechanical therapy as desirable in some cases and states his treatment limitations as follows.

A. Early observation of cases and the procuring of sufficient data to obtain some idea of what the ultimate orthodontic problem may be.

B. The serial extraction of deciduous teeth in order to prevent and overcome rotation of the maxillary and mandibular incisors and to allow these teeth to assume their normal positions in the basal bones.

C. Early correction of individually malposed teeth, such as occurs in a scissors bite and severe cross-bites.

D. The use of bite-blocks, bites plates, lingual arches and head caps where advisable for minor movements or for short period of treatment.

E. Treating cases to relieve trauma which if left alone would produce lasting damage to the supporting tissues.

F. Gathering in and reducing the protrusion of maxillary incisors to lessen the possibility of fracture.

G. The early and prompt removal of any supernumery teeth and also the dissection of any abnormal frenum labii.

Terwilliger (41) presents a well thought out summary of some 23 orthodontists in his group. The general opinion among them is that some treatment in the mixed dentition is essential especially in certain cases. Anterior and posterior cross-bites and Class III cases must be treated.

A more cautious approach to Class I cases by most of them was evident and treatment was mainly limited to the Nance treatment and careful observation over the years. Severe Class II Division I cases should be treated in the opinion of the majority but the methods advised were different and varied from the bite plane and head gear on the upper
arch to full edgewise arch appliances.
Half thought Class II Division 2 should be treated to open the bite and Class II relation of molars reduced.
Treatment at this stage would benefit those cases in which the distal relation of the mandible was due to posterior displacement caused by the anterior locked bite.
Terwillinger's group were 75% of the opinion that secondary treatment was necessary and all individually were of the opinion that the two treatments were longer than one in the permanent dentition. Terwillinger averaged out their treatment times and found that treatment time was less divided into the two phases than in the one.

These articles by Kloehn, Lasher, Bishop, Kelly and Terwillinger are certainly a comprehensive summary of the desirability and limitations of this type of treatment. Opinions varied from some who would avoid the treatment like the plague to others who found they could get quite satisfactory results.
Lasher leads those who are not in favour of early treatment and his chief reason is the factor of retreatment.
This necessity of retreatment is accepted by all in the majority of cases. Lasher's chief objections do him no credit in this scientific discussion whether mixed dentition treatment is desirable. His opposition mainly seems to be the unpleasant task of collecting fees for the second treatment. Lasher says "By waiting until the second teeth have erupted, one knows exactly what is to be done. The case has gone its limits, has fulfilled its growth pattern." This statement to my mind just about represents the depths of defeatism. Although we cannot influence the directions of the growth pattern of the facial skeleton we can by early treatment modify beneficially some of its adverse effects on the teeth and the alveolar bone. To recognise a developing malocclusion at the age of about eight and stand by and watch until it has "gone its limit" in severity without any thought of interference seems to smack of malpractice.
Bishop is also pessimistic about the possibilities of mixed dentition treatment but the other three discussions are more positive in their approach to the question. The use of simple appliances seems to be most popular and most writers seem to be of the opinion that lengthy and complicated treatment should be avoided at this stage and that full band technique is better left until the permanent dentition if the case needs more extensive treatment. Most of the writers advise an approach to the problem not with any set rules for any class of malocclusion but with the evaluation of what can be done for the individual case, as there seems to be even more variation in factors at the mixed dentition stage than later. All are agreed on the necessity for treatment of cross bites and Class III and pseudo-Class III cases and this is the extent of the full agreement.

Class I cases should be carefully observed throughout growth and development and most of the writers seem to be favourably disposed to Nance's treatment in these cases with the judicious use of serial extractions. Class II Division I cases it seems should be attempted when extreme, particularly in an attempt to modify molar relationship by extra-oral force, increase vertical dimensions with bite plates and retract anteriors which otherwise might suffer from accidental fracture.

Class II Division 2 cases treatment is a contentious matter. Some won't touch them and other writers have found an advantage in releasing probable causes of displacement of mandible and in opening the bite to facilitate later treatment. Retreating was generally considered to be necessary in 75% to 90% of cases and to any of the orthodontists involved this was a major factor in their objections to early treatment. The laying down of the rigid rules on treatment according to classification of malocclusion has been one of the greatest handicaps of orthodontics. Standardisation of treatment is not possible and particularly is this true in an approach
to early treatment procedures.

Kloehn (42) says rules are prohibited but certain principles can be laid down as a guide to the mixed dentition treatment of malocclusion.

Treatment of Class II Division 1 cases in which the deformity is due to a maxillary protraction and in which the mandibular teeth are in good alignment is ideally carried out in the mixed dentition by means of occipital or cervical forces. At this stage of life we can expect to have all the growth processes as an ally in treatment.

Kloehn is opposed to any form of anchorage involving the mandibular teeth and the advantages of his system of treatment are obvious.

A simple appliance, worn only at night and needing few adjustments and more important the absence of any pain or irritation of tissues.

In a case with the characteristics of Class II Division 2 Kloehn uses a flat palatal bite plane with finger springs to tip the lateral incisors lingually.

The whole idea behind Kloehn's philosophy of treatment is that each case must be analysed and treated on its merits. The possibilities of guiding teeth and alveolar bone in their period of greatest change should be grasped as in this way we may be able to prevent many malocclusions and modify the severity of others thus making later treatment much simpler. It would appear that in a period of growth the forces that need be applied would be much smaller when used in guiding the changes in tooth and alveolar bone. Smaller forces plus simpler and fewer orthodontic appliances must be considered an outstanding argument for this phase of treatment.

The opinion of Barich (43) on mixed dentition treatment is that all types of cases may be treated during the mixed dentition period except those with inadequate arch length which are potential extraction cases and which should be left until the permanent dentition. All cases must be treated
individually and no hard and fast rules can be laid down as far as appliances and methods are concerned. Those cases in which the malocclusion is having a psychologic effect on the patient must be treated as soon as practicable. Those cases of malocclusion notably cross bites etc., in which the nature of the deformity is inhibiting growth, correction should be instituted as soon as possible to encourage maximum development.

The article by Battiste (44) is virtually a summary of previous work in this subject. He makes no observations or deductions of his own accord but presents the opinions of others in a brief and concise manner.

Among several hundred articles I have read this is the only one exclusively devoted to treatment of the adult. Goldstein (45) quotes the opinions of many eminent orthodontists on the question and the majority seem to favour some treatment but apparently have never had sufficient courage to venture into print on the subject.

Goldstein gives some of the indications for adult treatment as :-

1. Facial deformities
   (a) Protrusions of upper anterior teeth and or with protrusion of complete upper arch.
   (b) Protrusion of lower jaw
   (c) Severe lateral cross bite
   (d) Close-bite causing excessive grinding of teeth and loss of vertical dimensions.

2. Malfunction of teeth
   (a) Individual tooth cross bite
   (b) Spacing of teeth due to extraction, missing teeth or impactions.
   (c) Severe crowding causing periodontoclasia.
   (d) Traumatic occlusion
   (e) Mutilations due to neglect
Irregularity causing food-packs and caries.
3. Denture deformities without pathological sequelae
4. Psychosomatic considerations
5. Pain
   (a) Mandibular displacements
   (b) Temporo-mandibular joint disturbance.

Before treatment is commenced the patient must be given a thorough understanding of what is involved in treatment and also the possible lengthy nature of treatment. Adults are far more easily irritated by appliances than children.

A very thorough case analysis and treatment plan is essential as tooth movement must be positive and kept to a minimum. Extraction will usually be found necessary because these adult cases are usually suffering some form of crowding.

Adults will usually undertake treatment for a year and possibly two years and extraction in certain cases followed by proper treatment will enable the case to be completed more quickly and with less tooth movement.

In the treatment of the adult dentition the orthodontist will find absolute co-operation with the periodontist, prosthodontist, oral surgeon and general practitioner an essential for successful treatment.

According to Goldstein there is no age limit for orthodontics. The quality of the supporting bone and tissues and the judgement of the operator are the determining factors and not the chronological age.

It is essential to watch progress of treatment closely by frequent X-ray examinations and treatment must be more cautious than with children. Accurately diagnosed and properly treated cases will give satisfactory results and be rewarded by a most grateful patient.

As Goldstein says the awareness of the public to the benefits of orthodontic treatment is rapidly increasing and there is no reason why this treatment should not be available to adults when their condition demands it.
Porter (46) runs through the many appliances that have been brought forward over the years and points out their inadequacies and reminds us that we cannot sit back, as the ideal in appliances has certainly not been attained no matter how skilful the operator or how efficient the appliance he uses.

1. Angle-E. arch with ligature to each tooth and resulting in gingival troubles.
2. The Jackson removable appliance to avoid necessity of ligatures.
3. Pin and tube appliance is rather harsh in treatment and difficult to handle.
4. Mershon half round tube lingual appliance with delicate finger springs which exerted delicate pressure but lacked individual tooth control.
5. Ribbon arch was quite harsh and positive in action.
7. Lourie's high labial arch.
8. Twin arch of Johnson.

Porter then dissects the pros and cons of the extraction problem. He deals at length with Tweed's treatments and the result of his consecutively treated cases. He warns that in debating this question of extraction many factors must be considered such as

1. The possibility of further growth.
2. Which teeth to extract - perhaps second molars might be better than premolars in some cases.
3. Whether to extract in one arch or both.
4. Extraction does not always change facial profile for the better.
5. Most important, can spaces be closed and kept closed after extraction or will small spaces be left between cuspids and second premolars which may produce greater damage than had a few crowded teeth been left alone.
6. Can we move anterior teeth posteriorly and expect them to stay there in all cases.

The position of teeth must be mainly influenced by muscular balance, and if teeth are moved lingually the tongue pressure, because it is cramped for space, must be greater. This pressure could easily cause a relapse after retentive devices are removed. Porter says "I believe the tongue muscles are a powerful force in determining the stability of orthodontic changes in both extraction and non-extraction cases. I do not believe the uncontrollable tongue pressure has been emphasised to the degree to which lip and cheek pressures have been considered."

Tongue pressure without a compensating pressure from cheeks and lips is an uncontrollable force. This seems to be a very good argument for muscle therapy during and after treatment. It is most important to consider tongue size and pressure before extracting.

Porter describes his appliance the "side hook" which he uses with success to move buccal segments distally.

In distal occlusion cases he uses the "side hook" to correct mesio-distal relation first and then corrects positions of anterior teeth. Intermaxillary elastics are used with a lingual arch in the mandible.

Porter says the possible distal movement is dependant to a large extent on second and third molar pressure. One of these may have to be removed. Use of side hooks may aid in preventing bimaxillary protrusions during treatment.

The use of side hooks sometimes stimulates bite opening. Porter uses bite planes for bite opening and stresses the effect bite opening has on facial profile.

Retention is the problem after bite opening. Teeth may be depressed again by muscular action if bone structures have not developed sufficiently with the new positions of the teeth.

Porter emphasises the need to be proficient in the use of more than one appliance and to consider the patient when treatment is needed. Some patients may become over-sensitive and develop a complex if bulky appliances are used - hence the desire for
idealism must be modified in some cases to produce a greater service.

Halderson, Johns and Moyers(47) have made a study of various forces used for tooth movement. Forces at work on the dentition can be classified into two groups.

1. Natural or intrinsic.
2. Artificial or extrinsic which includes orthodontic force.

Forces applied by the various appliances of orthodontic treatment such as coiled springs and elastics were measured by the authors, and three of the most popular appliances were compared for the magnitude of forces applied and their relative efficiency.

LABIO-LINGUAL APPLIANCE.

With this appliance tooth movement is mainly limited to tipping although a wide range of forces is possible, and it can be adjusted to produce gentle continuous forces. The distance through which the force is acting is great and therefore there is not such control as in the multi banded appliances. Continuity of force application is possible with this appliance.

Because teeth are not held rigidly by an arch wire any beneficial effect from the tongue or lip muscles may be utilised.

EDGewise MECHaniSM.

A force may be applied to any tooth in any direction with this appliance, and although the weight of the force varies with the three orders of bends nearly all the forces applied are high. Success is due to the fact the distance of application of the force is small the movement is rigidly controlled.

TWIN-WIRE APPLIANCE.

Usefulness of this appliance is largely limited to tipping and rotary movements. It is most efficient for movement of anterior teeth but its action on posterior teeth is questionable. A wide range of force may be applied from the very lightest upwards. The greatest danger is the use of a prolonged force
however slight over too great a distance, and misused, this appliance can be the most harmful of all.

The appliance of choice for the case must be selected and applied so that it works with the periodontal membrane and does not attempt movements of teeth against the natural forces of the muscles.

In cases studied by the authors it was found that distal movement of first molars was possible slightly before the second molar impinged on the cervix of the first molar. After this any distal force applied would do no more than maintain the first molar in the same position.

The summary of this excellent article is worth recording here as it is a clear indication of the bounds and limits of forces to be used.

A. **NATURAL FORCES.**

1. As far as possible work in the same direction as the natural forces of the masticatory system.
2. Correct any imbalances within the inherent forces of the masticatory system as soon as possible.
3. Work within the limits of tissue tolerance.
4. Leave the case with all the natural forces well developed and in balance.

B. **ARTIFICIAL FORCES.**

1. Select those teeth needful of movement, then determine the direction and type of tooth movement involved.
2. Break down into groups the teeth which will be moved in a similar direction.
3. Decide the most logical sequence of tooth movement.
4. Choose the mechanism which will most efficiently allow each movement to be effected.
Tweed(48) divided treatment into two classes.

1. Primary or true orthodontic treatment which has for its object the guidance from the abnormal to the normal of growth and development processes occurring in the dentures of children.

2. Secondary or adult, orthodontic treatment or the amelioration of abnormalities of occlusion and the improvement of facial contour in the adult.

The basis of Tweed's treatment is the placement of the mandibular incisors upon the basal bone; he calls this phase anchorage preparation. He stresses that the establishment of a stable anchorage is a fundamental factor in successful orthodontic treatment and should be the initial concern of the operator.

Tweed's general plan of treatment is divided into three distinct steps.

1. Anchorage preparation in the mandibular arch in Class I, Class II and bi-maxillary protrusion cases, and when necessary the rearranging of axial inclinations in the maxillary arch particularly in Class II Division 1 incisors.

2. En Masse movements to correct jaw relationships.

3. Detailed tooth positioning preparatory to retention.

CLASS I TREATMENT.

1. All mesially inclined teeth in buccal mandibular segments must be uprighted and incisor teeth maintained on the basal bone.

2. Lower ideal arch wire is made of .021"X.025" steel with step back bends from molars to cuspids and slight torque, to torque the crowns of the incisors lingually. This arch is tied to molar sheaths and all teeth are bound together as one unit.
3. Maxillary arch is treated similarly and finally is fixed with a .021" X.028" steel arch wire with second order bands to prevent tipping forward of teeth when Class III elastic force is applied. Arch wire is ligated and tied to molar band sheaths.

4. Tweed then uses for his distal movements both a head gear with a distal pull on the maxillary arch, and Class III elastics for the distal pull on the mandibular arch. The pressure exerted by the headgear must be greater than that exerted by the Class III elastics.

5. By accentuating second order bends and lengthening mandibular arch wire the teeth in the buccal segments are made vertical and space has been developed to accommodate all irregular teeth. Thus anchorage preparation is completed.

**TREATMENT OF MIXED DENTITION.**

Tweed first X-Rays the teeth, determines amount of space in excess of that necessary to accommodate the permanent cuspid and first and second bicuspid teeth.

The deciduous cuspids are then either trimmed or extracted. The incisors are then moved back to a position that will allow just enough room for the permanent cuspid and first and second bicuspid teeth, and they are then held in this position.

In those cases suffering from premature loss of teeth and space first reduce the first deciduous molar or extract it and guide the cuspid back at the expense of the space for the first bicuspid. If necessary this process may be repeated and second deciduous molars extracted to allow space for first bicuspid.

These permanent teeth can then be used for anchorage and if intelligently used according to Tweed's methods the first permanent molar may be moved distally.
For opening spaces Tweed is very partial to the use of the Strang vertical loop but warns that every vestige of anchorage must be utilised in order to combat protrusive movements of the anteriors. Second order bands, head gear and Class III inter-maxillary forces must be employed to obtain maximum anchorage. Vertical loops are also utilised to make space for blocked out anteriors in narrow arches.

In high cuspid cases in which mesial drift of the buccal segments are responsible, Tweed first establishes mandibular anchorage and then use intermaxillary Class II elastic force plus head gear attached to mandibular arch wire.

In finishing cases for retention, spaces between teeth are closed by the use of the vertical spring loop. Vertical elastics are utilised when it is necessary to seat the cusps of the teeth into their proper positions.

CLASS II MALOCCLUSION.

The treatment of this type of malocclusion is divided into three stages.

1. LOWER ARCH—ANCHORAGE PREPARATION.

Anchorage is established similarly to Class I cases with second order bends, Class III elastics and head gear. When anchorage is complete, that is when mandibular teeth are positioned correctly to the mandibular base and toe hold has been obtained the stabilising arch wire .021" X .028" is placed.

In approximately four months anchorage should be complete and the maximum resistance to forward displacement from Class II inter-maxillary force should have been secured.

2. UPPER ARCH.

The upper arch is prepared similarly to the lower and excessive protrusion of the anteriors is corrected at this stage.

While the upper arch is being used to assist in anchorage preparation in the mandibular arch, Tweed advises against the
banding of the incisors. If they are banded and bracket engagement obtained before mandibular anchorage has been completely prepared they will force the mandibular teeth into protrusion with an end result of a Class I cuspal relationship and a Class II jaw relationship.

A. Arch wire in passive state. B. Correct co-ordinated second order bends with incisal torque. C. Illustrates action when intermaxillary force is applied to co-ordinated bends.

3. EN MASSE DISTAL MOVEMENT OF THE MAXILLARY TEETH.

Passive arch wire gives place to one with second order bends and masslingual torque in incisor segment. Class II elastics are worn. After two weeks second order bends and incisor torque are accentuated and intermaxillary pull is increased.

Every two or three weeks degree of the bends in the maxillary arch wire is increased until normal mesio-distal relationship of the teeth is obtained and until incisors present in edge to edge relationship.

Tweed stresses the importance of co-ordinating the second order bends and the incisal torque in order that they work together and not in opposition.
4. **CORRECTION OF ANTERIOR OVERTURN.**

Open bite can be corrected with vertical elastic rubbers. When at the end of treatment lack of vertical development is noticed Tweed leaves the arches in position and constructs a bite plate to open the bite on the anteriors and have the buccal segments separated by about¹⁄₄". Arch wires are cut between cuspids and laterals and ends turned and smoothed. A large elastic is run around the buccal segments in the form of an oblong. When bite has been opened on the buccal segments sufficiently, elastics are similarly run around the incisal segments.

**CLASS III MALOCLUSIONS.**

The treatment of Class III malocclusions presents no unusual problems, but the retention of these cases after treatment is all important. Treatment should begin as soon as the abnormality is noticed, and even in the second year a chin strap may be utilised to effect normal relationships.

The general plan of treatment in the permanent dentition is to correct the bucco-lingual axial inclinations of all the teeth in the buccal segments of both the maxillary and mandibular dental arches; constrict the mandibular arch and expand the maxillary arch and move the maxillary teeth forward en masse utilising the teeth in the mandibular arch as stationary anchorage.

All the teeth in both arches are banded as in Class I and Class II cases and hooks are soldered on to the lingual surface of the upper anchor bands. Ideal arch wires are fitted with the lower arch wire made narrower, the upper wider, and step forward bands are placed in the upper arch.

After ligaturing in place, cross-bite elastics are fitted to swing buccal segments of upper arch outward.

Class III elastics are also worn. When cross-bite condition has been relieved arch wires are then shaped to the ideal, and treatment is continued until maxillary teeth have been moved forward en masse into occlusion with the mandibular teeth.
Tweed admits that this treatment does not produce normal occlusion, but the result will be a vast improvement aesthetically and functionally with less tendency to relapse than if an attempt had been made to retract the mandible.

BIMAXILLARY OR DOUBLE PROTRUSION.

SECONDARY OR ADULT ORTHODONTICS.

In these cases both the maxillary and mandibular teeth are too far forward in relation to their respective bases. Tweed says that extraction should not be resorted to as long as growth and development processes are available to the patient. Never before the complete eruption of the second permanent molars or before every possible hope of conservative treatment is exhausted should extraction be resorted to.

We must then choose between retaining thirtytwo teeth all out of the line of occlusion or extracting four bicuspids placing the remaining twentyeight in the line of occlusion and in proper relation to the basal bone.

Tweed considers that there is no alternative in the patient sixteen to thirty years of age with a double protrusion to extraction as growth and development are complete and period left for treatment is short and not favourable.

He considers treatment in the mixed dentition stage, with guidance of occlusal and facial growth and development may be the means of eliminating the necessity for extractions in later life.

PLAN OF TREATMENT.

The general plan of treatment is the extraction of the four first bicuspids and then the retraction of the incisors by vertical spring loops into the space thus formed, and at the same time the buccal segments must be prevented from moving mesially.
If the buccal teeth are not mesially inclined then bicuspids are extracted at once. If they are mesially inclined arch wire must be fitted and by means of second order bends which are made progressively greater the buccal teeth are gradually uprighted. Eventually they must be sufficiently uprighted to afford toe hold or proper anchorage to move the incisal segments back without any forward movements.

Vertical loops are placed in the arch wire in the position of the missing bicuspids, and by the activation of these loops the incisal segments are moved.

Madden (49) gives the advantages of the Johnson Twin Arch appliance as follows.

1. Easy to use.
2. Simple parts which are easily kept clean and not often broken.
3. Light and constant pressure of twin wires continue to work long periods and will be as near to physiological force as possible.
4. All types of tooth movement can be accomplished without root resorption.
5. Particularly useful in that prevalent case of Class II Division I malocclusion.

In Johnson's (50) last 500 cases he has extracted in 65 or 13% of cases. He believes extraction is justified in the following cases.

1. Where the teeth are too large to be aligned on the bony base supporting them.
2. In bimaxillary protrusion.
3. Where there is a bimaxillary drift of a posterior tooth forward, the full width of a premolar due to the early loss of the deciduous teeth.
4. In adult cases where extensive tooth movement is not practical or advisable.

Barber (51) reminds us that success or failure is largely determined by the diagnosis, case analysis and treatment planning. Before using the Johnson twin-wire mechanism anchorage must be studied. Correction of molar rotations with a lingual arch and any buccal expansion with springs from this lingual arch is recommended. The amount of pressure hence the strain on anchorage must be carefully studied with inter-maxillary force. Elastics used should be measured for force exerted and not just guessed, as otherwise the lower arch will buckle.

Alignment of lower teeth, particularly the bicuspids, is an essential prerequisite to adequate anchorage. The correctly used Johnson appliance is most effective in the elimination of deep overbites in treatment.

Barber in this article puts forward a few points of interest in the application of this appliance in treatment but as a whole the article is disappointing.

In the American Journal of Orthodontics there have been only two articles on treatment of Class II, Division 2, Malocclusion in twenty years according to Joseph E. Johnson (52). Johnson's cases all suffered from a lack of face height indicating a lack of vertical growth in the molar and premolar regions. The anterior maxillary teeth are inclined lingually, especially the central. Normally the axial inclination of the mandibular incisors is lingual, and both sets of incisors may be somewhat extruded.

Most of these cases need slight expansion of 1/16" to 1/8". It is also necessary to depress the incisors and to develop vertical growth in the molar and premolar regions as well as to correct mesio-distal relations.
According to Johnson his appliances practically correct this condition automatically.

Bracket angulation is suggested by Holdaway (53) as a means of simplifying the use of the edgewise arch. This is particularly useful in the duplication of arch wires in that it obviates the difficult task of reproducing the same second order bends in the new arch wire.

The writer cites three main uses for this bracket angulation and says that the orthodontist should work with ideal arch wires which are either flat or with a mild curve of Spee.

A. Paralleling roots in extraction cases.
   Bracket angulation of three degrees is used in avoiding tipping movements and paralleling roots of teeth on either side of extraction gap.

B. Anchorage preparation.
   The advantages of this method is that bracket angulation eliminates the necessity of second order bends. Thus when arch wires are changed there is no "jiggling" of the anchor teeth by the slight differences in the new arch with consequent loss of anchorage.
   Maintenance of teeth in upright position needs only two or three degrees angulation of brackets but in bimaxillary protrusions or Class II cases ten to twelve degrees bracket angulation will be necessary.

C. Artistic Positioning.
   Anteriors may be positioned readily by this method especially lateral incisors, and the need for and angulation required in the anteriors should be ascertained at the commencement of treatment so that the alignment of these teeth may proceed with the rest of the treatment.
The aim of Laskin's (54) article is to discuss the treatment employing the adjustable bracket and to introduce a clamp for rectangular archwire therapy and a bracket bow string for the rotation of teeth.

The clamp for the arch wire will dispense with the necessity for soldering to the arch wire such auxiliaries as stops, spurs, staples, intermaxillary hooks, and auxiliary springs. The clamp can be placed anywhere on the arch wire ready for use. Vertical spring loops for the opening and closing of spaces are fashioned and bent to the desired shape and size. A clamp is soldered to each leg. The two clamps are fixed in position and the arch wire cut away between. The loop is incorporated without removing arch wire from mouth or forming a new arch wire. The bracket bow string would serve for rotations of teeth and takes the place of staples and springs soldered to the bands. The adjustable locking bracket does not need any ligature ties.

Laskin shows few changes from edgewise arch technique. Angulation of the brackets is only slight. A change in the angulation of the channels will produce a wave in the arch wire on insertion into the bracket channels. These have the equivalent effect apparently of the tip back bends of Tweed's technique.

The tip back action on the teeth should be gradual, and two or three slight adjustments of the brackets are better than one large one. The technique wherein a series of bends are placed in an archwire for tip back action produces a series of lever arms in the interbracket segment.

With the adjustable bracket, however, the position is reversed. With the use of the clamp the assembling of the arch wire becomes much simpler and in addition force can be exerted more readily on specific teeth.

The vertical loop has an inherent and potential source of power, a force which is most efficient and direct.
The adjustable cylinder of the bracket is a turntable and is perfected to carry pressures far beyond the pressures within orthodontic range. It is essential to have an ample margin of friction over the requirements. Clamps have been tested and retain their grip on the arch wire withstanding a direct pull of friction beyond normal requirements. These devices are presented to simplify a technique. They are refinements to the edgewise arch appliance wherein the greatest control of tooth movement and anchorage is available.

Nelson (55) has adopted the methods of Oppenheim in the use of the head cap. The value of this technique lies not only in the mode of anchorage but mainly in the fact that light intermittent elastic forces may be applied to the arch wire and Nelson advises the use of the appliance ten hours out of the twentyfour, and the optimum amount of elastic force for each patient to be determined by trial. A minimum of force is used at the commencement of treatment gradually working up to the threshold.

Force is adjusted by changing grades of elastic or length of the elastic stretch.

The writer shows five cases in which treatment is commenced at various ages, the youngest in the deciduous dentition at the age of five and a half years and the oldest at the age of fourteen.

In all cases treatment is limited to the maxillary teeth and consists of the use of occipital anchorage and elastic force on the molars using at 0.045" arch. Together with the distal movement intramaxillary rubber dam elastics are worn from canine to the molar on the opposite side, thus effecting a gentle retracting force on the anterior.

In the Class II Division 1 cases cited the writer by moving the maxillary teeth distally then relies on growth to carry the mandibular teeth forward into correct occlusion.
in Class I cases buccal segments which have drifted mesially are moved distally to make space for blocked out anterior teeth. Nelson's applied forces in treatment are certainly most gentle and the pressure created would be very easily tolerated by the periodontal tissues, but I consider that these advantages would be easily outweighed by the length of treatment time in each case shown at least three to four years.

A very long-suffering patient, parent, and an exceptional care of oral hygiene, as these appliances are worn at night, would be essential.

Bjork (56) in his study of the treatment results of the Andresen activator divides the malocclusions into five groups:

**Group I** Pronounced Maxillary Overjet in Combination with Normal Overbite, Normal Inclination of Incisors and Normal Spacing of the Teeth.

In the treatment of these cases there is no forward positioning of the mandible except in those cases in which the bite has suffered a functional backward displacement which may be shown by a functional analysis. Any effect on the growth of the jaws is so slight that it must not be reckoned on. The main effect in treatment is a distal movement of maxillary teeth and a mesial movement of mandibular teeth and alveolar bone. Treatment is most efficacious in the deciduous dentition and to a somewhat less extent in the mixed dentition, but its use is very limited in the permanent dentition.
Group I. Diagrammatic representation of activator treatment in the case of pronounced maxillary overjet in combination with normal overbite, normal inclination of incisors, and normal spacing of the teeth. The portions indicated by vertical lines in the left column indicate the dental and alveolar arches, while the horizontal lines denote the jaw bases.

Group II.

MAXILLARY OVERJET IN COMBINATION WITH DEEP VERTICAL OVERBITE.

In these cases it is necessary to reduce both the vertical overbite and the maxillary overjet. The appliance is similar to that used in the treatment of group I cases except that it is necessary to open the bite by the increased eruption of buccal teeth. The upper teeth are guided distally and buccally while the mandibular teeth are guided mesially and buccally.

Group II. Diagrammatic representation of the activator treatment in cases of maxillary overjet in combination with deep vertical overbite.
Group III

PRONOUNCED MAXILLARY OVERJET IN COMBINATION WITH SPACING OF THE UPPER INCISORS AND NORMAL OVERBITE.

In this type of case the arch wire is made active and treatment is directed to retract the maxillary anterior segment. If the bite is not deep all stages of the dentition may be treated fairly successfully.

Group III. Diagrammatic representation of the activator treatment applied in cases of pronounced maxillary overjet in combination with spacing of the upper incisors and vertical normal overbite.

Group IV MANDIBULAR OVERJET.

The activator is constructed in these cases with the arch wire engaging the mandibular incisors, and no portion of the appliance is in contact with the lingual of these incisors. Maximum results are obtained in the mixed dentition when the appliance is used at the same time as the teeth are erupting. Any changes are restricted to reshaping the alveolar arches during their vertical growth along with a raising of the bite.
Group IV. Diagrammatic representation of the activator treatment applied in cases of mandibular overjet.

Group V  TRANSVERSE OR LATERAL MALOCCLUSIONS.
Expansion of both the maxilla and mandible according to Bjork may be obtained with an appliance split in the mid-line and fitted with either a small screw or a Coffin spring. The Andresen appliance used in the hands of a capable orthodontist would be a useful adjunct to treatment but would necessitate intense patient cooperation over a long period. Its mass production in laboratories to cure the orthodontic ills of the populace would constitute a serious abuse of all the basic tenets of case analysis and treatment of malocclusion.

Robin of Paris and recently Andresen of Oslo has suggested a new principle incorporated in their device called the activator or the "monobloc". This device utilises short intermittent pressures produced by muscular function and directed by the appliance in such a way that the teeth are moved in the desired direction.

Wachsman (57) has modified the ideas of these two originators by incorporating elastic springs of thin wire and thus transforming Andresen's passive inelastic activator into
an elastic active appliance.

The writer gives rather vague details of his technique but his dissertation on the all embracing advantages of his appliance over all others would lead one to the conclusion that it is the ultimate in appliance therapy. With this appliance Wachsman can treat about one thousand patients simultaneously besides accepting two new ones daily.

This proud boast is enough to condemn not only the writer but also his appliance in my opinion.

I was most impressed with this appliance as described by W.H. Oliver (58). His article is brief and to the point, and the main features of the labio-lingual appliance are excellently illustrated with well chosen photographs.

The neatness of this appliance and the minimum of banding which apparently does not prejudice the movement of the teeth is an object lesson to those using the multi-banding appliances. One of the main features is the occlusal guide plane which, as the author says, has many advantages over the more conventional acrylic bite plate.

It is a fixed-removable appliance which cannot be removed by the patient and this is a chief reason for better results as compared with the acrylic removable bite plate.

The occlusal guide plane will allow of one occlusion, and one only, whereas the bite plate can easily produce a dual bite being much more bulky.

I consider that Oliver is a little optimistic in his theories of the changes in mandibular position that the occlusal guide plane will produce in Class II Division 1 cases, however, an appliance of this type would be most useful in cases which showed a tendency to caries or in those patients who desired a less conspicuous appliance.
This article by Neimlich (59) is one of the few in the literature to have pointed out the need for selective occlusal spot grinding in such detail.

Teeth moved into good occlusion from malocclusion would no longer have use for the facets of wear which developed in the malocclusion. They should be carved to obviate occlusal trauma. Occlusal trauma, especially when teeth are in retention, would be most detrimental to the new supporting tissue formed, and this condition must be relieved. Occlusal interference can cause the movement of teeth by nature to lessen the forces, and thus cause a relapse. Grinding should be done at several settings over a period of time as some of the interference will be self adjusted by the teeth if they are given time. Great care must be exercised, however, as tooth structure once removed is lost forever.

An excellent set of photographic illustrations show methods used by the author and emphasise the place of this treatment as an adjunct to orthodontic therapy. A little extra time spent in this operation can produce a more stable result and obviate possible damage to the investing tissues of the teeth.

Coleman (60) defines an equilibrated occlusion as "that normal balanced occlusion of the natural dentition in which each and every individual tooth unit of the maxillary and mandibular dentures make continuous and occluding contact with at least one and no more than two opposing units through every functional occluding range of denture relationships."

Each and every tooth in the natural dentition is capable of being so placed as to withstand normal occlusal forces and because of its shape to perform a definite function in mastication. When the occlusal force applied is in equilibrium with the resistant forces of the periodental tissues a physiological occlusion exists. Local factors which may upset the ideal occlusion may be eradicated by spot-grinding.
A tooth which may be in good position in centric occlusion may be in trauma during lateral movements of the mandible. Coleman lists the methods of attaining an equilibrated occlusion as follows:

1. Detailed positioning of individual teeth. The proper use of orthodontic appliances plus the rubber positioner formed on the ideal set up is suggested by Coleman.
2. Selective spot grinding in an effort to spread the load over all of the teeth both in centric and lateral and protrusive movements.

Seven ideals to be aimed for:

(1) Maximum distribution of stress in centric relation.
(2) Retention of the maxillo-mandibular opening.
(3) Harmony of the grinding inclines.
(4) Reduction of the inclines of grinding tooth surfaces that occlusal stresses may be more favourable applied to the supporting tissues.
(5) Retention of sharpness of cutting cusps.
(6) Increase of food exists.
(7) Decrease of contact surfaces.

**PREREQUISITES TO SPOT GRINDING.**

1. Radiographs.
2. Study models.
3. Study of patients chewing habits.
4. A plan of procedure.

Coleman gives a detailed procedure for the actual operation of spot grinding and goes through the various positions and movements of:

1. Centric occlusion.
2. Protrusive position.
3. Protrusive excursion.
4. Lateral excursion.

This is a most comprehensive article by Coleman and shows the importance of occlusal equilibration as an adjunct to the
retention of the teeth after orthodontic treatment.

In my opinion certain paths of mandibular movement
must be established by muscular actions over the years when
the teeth are in malocclusion, and we cannot expect these
muscles to adapt themselves immediately and entirely to the
new positions of the teeth. This factor would make selective
grinding an indispensable part of treatment.

Kesling's (61) tooth positioning appliance was the
product of a desire to create some simple appliance that
would

1. Influence all teeth to flow into best possible position
without bands or wires.
2. Be effective under functional stress.
3. Produce arch form in accordance with type.
4. Attain desired harmony between facial features and tooth
arrangement.
5. Would later serve as a retainer.

The appliance was developed finally to serve as a final
positioner after basic treatment. Kesling says that the best
method of diagnosis and treatment planning is to accept our
limitations of bone development and leave in each arch only
those teeth that can be properly positioned with relation to
basal bone in an upright fashion and properly rotated in
correct approximal contact. Then mechanically we can place
the maxillary denture in proper relation to the mandibular.
The Tooth Positioning Appliance allows the teeth to flow into
their final ideal positions without interference from bands,
caps, or wires.

It has proved practical for final positioning and retention
of teeth that have already had their basic treatment completed
with a conventional appliance.
STEPS.
Arch form need not be ideal, slight spaces, overbites may remain, mesio-distal or bucco-lingual relationships of maxillary teeth to the mandibular need not be perfect as long as the cusps are starting into their proper inclined plane relationships.

1. All bands etc. are removed and impressions are taken, and two sets of models made.
2. One model as set-up model, the other as control.
3. Dissect teeth from set-up model and arrange in wax on these bases.
4. Set up models are articulated and bite is opened to physiological rest position.
5. Positioner is made of one piece pliable rubber which completely fills the freeway space and covers labial buccal and lingual surfaces of both maxillary and mandibular teeth. The teeth are most susceptible to its gentle forces when the positioner is used at the end of major teeth movements.

The positioner will stabilise teeth after treatment. By its use period of retention treatment can be cut down four to six months. When worn each tooth is being gently forced towards its optimum position. It can close slight spaces, correct small rotations, and overbites can be reduced by depression of anteriors.

Sved (62) is one of the main opponents of extraction in orthodontic treatment. In this article he tries to disprove Lundstrom's theory of the apical base and its limiting effect on the number of dental units.

While, as Sved says, Lundstrom has never proved his apical base theory, it seems to be based on much more logical hypotheses and deductions than Sved's arguments against it.
Sved has apparently abandoned altogether his acrylic splint appliance for moving the maxillary teeth distally which treatment he regarded a few years before as the important factor in his treatment procedures. Sved to my mind is so biassed and one sided in his unqualified opposition to extraction in any case, that it seems to have affected his ability to produce an article to scientific value. His whole reasoning and arguments seem too affected by an obsession which regards extraction as almost criminal.

Sved has evolved what is in his opinion the ultimate in retentive appliances - the adjuster. This is a modification of the Kesling positioner and is made in one part to fit over mandibular and maxillary teeth and so not only correct minor discrepancies in tooth relation but also maintain any new jaw relation attained during treatment. It takes the form of a Vitallium framework in which is inserted soft acrylic to activate and retain teeth.

Retention depends on good function, and McCauley (63) says "Forget aesthetics, if function is optimum, aesthetics will be the best possible for that case."

Thoughts on retention should start with the process of treatment planning. It is important to look for any factors that which will affect a perfect arch form or a perfect function and to check all anomalies. Study mandibular structure as a whole, and particularly
a. Width at six year molar - molar width.
b. Lower six anteriors - cuspid width.

Use these two widths, and starting with the mandibular measurements work the maxillary dimensions to it.

McCauley while admitting that the first molar relationship is most important enters a plea for the consideration of the cuspids, particularly their correct positioning in the completed case so that they do not interfere with the lateral movements of the mandible in function. Within certain limits the entire mandibular joint and its separate parts are subject
to alteration under function and dysfunction and under the normal process of growth. Head of the mandible establishes a compensating change in its path over the eminentia to originate a new path of lateral excursion of the mandible. In other words we have a definite case of alteration under function.

It is necessary to study mandibular movements as treatment proceeds, and McCauley says that the primary factor in permanence of the result is proper cuspal relation during function of upper and lower cuspids and then secondarily the classic cuspal relation of the first molars.

Retention says Webster (64) is one of the least written about and the least talked about subjects in orthodontia mainly because of the many embarrassing experiences it conjures up. Although little is written on this subject it is just as important as other treatment procedures as the end of retention determines the degree of success attained.

Treatment in deciduous and mixed dentition cases should be undertaken to remove any interferences to growth and development, and once these are successfully treated natural stability will provide retention.

In cases treated in the permanent dentition muscular balance must be maintained and stability brought about. This idea precludes much arch expansion, and very little added arch length or width should be attempted if retention is to be successful.

Factors which tend to make prognosis unfavourable are:

a. Sucking habits.
b. Tongue habits.
c. Hypertrophied tongue.
d. Flat cusps of buccal teeth.
e. Tight lip muscles.
f. Short upper lips.
g. Upper anterior rotations when corrected are hard to hold.
h. Lack of harmony in the size of the teeth interfering with occlusal relationships.

i. Deep overbite conditions.

Corrected Class II cases are most stable in cases in which the mandibular anteriors were not crowded. Corrected overbite may need long retention, the final result depending on the possibility of vertical growth taking place in sufficient amount. Class III cases also need long retention. Retaining appliances should in all cases allow functional occlusal freedom of the teeth, and their length of employment must be suited to the individual case.

Webster favours the removal type of retainer such as an acrylic plate for retention since it allows freedom of occlusal movement of the teeth, and its use can be regulated, and it may be gradually discontinued toward the end of retention. The fixed retainer is a little too rigid, although these are not lost or broken as are the removable appliances.

Webster considers the Kesling tooth positioner to have no advantage over the well constructed acrylic plate and in addition he says it will interfere somewhat with the occlusion.

This is a good article by Webster on a much avoided subject and seems to emphasise that with modern methods of treatment, retention has become more successful and less of a problem which may arise to haunt many an orthodontist.

Grieve (65) has championed Sim Wallace's theory of "forward translation of the teeth." Grieve says that if treatment is skilfully carried out, the problem of retention is a minor one, the real problem being that of anchorage. Extra-oral anchorage must be resorted to, to bring the teeth back that have been driven forward. Most malocclusions are complicated by this forward translation. Grieve says "Notwithstanding the opinion of Hellman and Brodie increase in the length of the maxilla and mandible can be brought about
by proper mechanical stimulation."

OVERBITE.
More or less excessive overbite is an almost constant problem associated with malocclusion. Normal overbite according to Orton and Lischer is approximate 1.5 mm and not greater than 2mm. Grieve is in favour of intrusion of the anteriors as treatment for overbite.

POSITION OF TEETH IN ARCH.
Teeth do not occupy position distal to normal in the bone in which they are located. Teeth are always mesial to normal and some more mesial than others. Grieve says that for years he sought to move buccal segments posteriorly irrespective of effect on third molars, but in 1926 considered that in some cases extraction of four first premolars would be a better procedure. Impaction of third molars particularly the lower ones will menace stability. Grieve uses in Class II cases where the mandible is definitely short, the buccal plane, to jump the mandible forward. He leaves plane on for a year although in many cases jump has taken place in six months. Where extraction is decided upon, the first premolars are the teeth of choice although perfectly sound teeth are not necessarily extracted and bad ones left.

One case is shown where because of caries six year molars were removed and occipital anchorage used for distal movements. In this case, Grieve claims increase in the forward growth of the mandible was brought about by buccal planes.

RETENTION AND STABILITY.
Forward translated teeth must be carried back into normal relation to basal bone and retention will not be necessary in a large number of cases.
FORWARD GROWTH OF THE MANDIBLE.

Buccal planes initiate the stimulation to bring about the necessary growth. Grieve says that he believes that the change which takes place is not a forward placement of the mandible but actual interstitial growth in the rami.

It would appear to me that the movement is a bodily movement of the mandible with changes taking place perhaps in the temporomandibular articulation.

Sicker has denied all interstitial growth in the mandible.


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Pringle (1) gives his explanation of differing results in orthodontic treatment:

Stimulus → Basis for response → Response.

Basis for response is varied by hereditary, pathological condition and constantly changes with age. To quote Arey "The growth of the body, its parts, organs and functional systems is a pulsating process which shows marked changes in rate from time to time". Many of these definite periods of alternate acceleration and slowing have been determined and commonly designated as a "Stretching and filling". Growth rate is never of an even nature, and alternate periods of acceleration and retardation are different with each organ of the body. Although these growth periods are independent for each part or organ of the body there is an important interrelation between the growth cycles of adjacent parts.

ORTHODONTIC TREATMENT OR STIMULUS.

Reaction to same force differs with individuals and age. Some factors against a good result are enumerated.

1. Lack of growth, loss of space and movements of the teeth due to early extractions.

2. Inability of the patient to understand what is meant by biting forward.

3. A considerable lack of occlusion when the mandible is placed forward.

4. Family or personal history of bad luck, illness and accidents.

5. Boarding school and evacuation.

A study by Cole (2) was an effort to determine what changes occurred in the position of the incisors and molar teeth, following the removal of all retention in cases treated after the extraction of four first bicuspids. The following planes were established and studied:
Cole throws light in his results on the limitation of tooth movement after extraction. Closure of the space is accomplished by both posterior movement of the incisors and anterior movement of the molars, and the posterior movement of the incisors can involve either the crown alone or the whole tooth. There is a strong tendency for the axial inclination of the incisors to return to that appertaining before treatment after retention has been removed.

If the mandibular molar crown is tipped distally in treatment it shows a strong tendency to mesial movement following retention, and this will increase the procumbency of the anteriors.

Extractions tend to increase the overbite due to the molars controlling the overbite being further forward in each jaw. Overbites reduced by treatment tend to return, and this involves a decrease in the mandibular plane angle.
Walter (3) reviews the current literature on the subject of arch length and comes to the opinion that
1. Our knowledge concerning changes in arch width and length as a consequence of normal growth is incomplete.
2. Various investigators do not agree regarding the possibilities of maintaining altered arch form which is produced by orthodontic treatment.

The measurements used in this study of 102 patients are as follows:

In these cases of increased arch dimension by treatment no extractions were used as a therapeutic measure, and the sole criterion for the selection of cases was the availability of adequate before and after treatment and retention records.

Although Walter has apparently put a lot of work into gathering his measurements he does not seem to be able to come to any more definite conclusions than many other investigators in previous surveys of this problem. The mean changes in arch length and width found by Walter do not allow him to make any original or valuable contribution to the controversy over arch expansion except the very vague
statement that the findings of his investigation seem to indicate that the statement that the dental arch can not be permanently widened or lengthened is incorrect.

A cephalometric investigation by Litowitz (4) attempted to record movement of the mandibular incisors and the maxillary and mandibular first permanent molars during and after treatment and subsequent to the removal of all retention.

The lines and planes used in this study are as follows:

Litowitz found that mandibular molars may be moved either distally or mesially in treatment by either tipping or bodily movements, but after retention they have a strong tendency to return to their previous position.

Maxillary molars moved distally show even stronger tendency to drift mesially to original position after retention. Mandibular incisors after treatment showed less tendency than molars to regain their previous position; but if the root apex had been moved these teeth without exception returned to their former position.
by Donovan.

By a knowledge of apical base relation, large minus readings indicate extremely unfavourable relations and extremely favourable small minus readings indicate extremely favourable relations. Large plus readings indicate extremely unfavourable small plus readings indicate extremely favourable relations. Large minus readings indicate a very unfavourable small minus readings indicate a very favourable relation between the apical base and the occlusal plane of the side involved.
In the vertical dimensions teeth depressed by treatment not only regained their pretreatment height but in some cases exceeded it. Therefore the correction of overbite had a strong tendency toward relapse after retention in some cases. Increase in lower arch length gained during treatment tended to decrease after retention, and that arch expansion gained by treatment similarly showed a loss after retention. Cases which exhibited the greatest amount of growth during treatment showed the least relapse subsequently. Some of the increase in arch length and arch width appears to hold especially the arch length between the first bicuspids.

Donovan (5) has made a study of serial tracings of cases of malocclusion under treatment and after treatment. The cases fell into a range of ages nine to sixteen years in which there can be expected a large amount of growth and development of the face. Although the cases were very much varied in the types of malocclusion, success was achieved in those cases with favourable growth behaviour, while in those cases of failure there was either extreme apical base disharmony or unfavourable growth trends.

Prognosis of Class II cases seems to depend to a large extent on the SNA and SNB difference. If a large value either positive or negative be found prognosis is not good.

Treatment of Class II malocclusion seems to depend to a great extent on inhibiting forces applied to the maxillary arch in order to restrain the point A from a forward movement and if possible to decrease the angle SNA.

**Inhibiting forces to be utilised are:**

1. Class II elastics.
2. Cervical or occipital appliances.
3. Bite plates.
4. Oral shields.
5. Muscle therapy
   a. Coordination of bone, tooth, and muscle development.
   b. Elimination of bad habits.
   c. Improvement of functional habits.

A. With cervical or occipital anchorage and in the presence of considerable maxillary horizontal growth it seems possible to
1. Inhibit somewhat the forward path of the maxillary dental arch in correction of Class II arch relation.
2. Inhibit somewhat the forward path of the maxillary molar so as to attain an adequate arch length.
3. A combination of the above.

B. With equalised horizontal and vertical growth pattern of the maxilla, the same three combinations are possible but not as successful.

C. If maxillary growth is mainly vertical in direction the above possibilities are not often successful and extensive tipping and extraction must be resorted to often.

This is most interesting analysis of treatment changes by Donovan and shows that although cephalometrics in case analysis can be most useful for prognosis, we still must rely on adequate growth for success in treatment. There is no method of predicting what growth if any, or in what direction it will take place. However, the serial study of cases under treatment will yield much interesting data which may be applied to other cases and enable us to predict more accurately the treatment changes which may take place.

In this study Silverstein (6) compared treated Class II Division 1 cases with a control group of normal occlusions and Class II Division 1 cases which had never had any treatment.
The points used are as shown in illustration:

The only significant difference in the morphology of treated and untreated males and females was in the relation of the bony profile points to each other (AB to facial plane). The effect of treatment became more marked as the distance from nasion downward increased. Treatment inhibited the decrease of the mandibular plane angle (as it is related to the cranium base line S-N) and reversed the normal growth tendency in the females by increasing instead of decreasing the angle. The forward movement of pogonion was inhibited in males and females so that the expected growth potential was not attained according to Silverstein. The angles S-N-B and S-N-ANS were not affected by treatment, while SN-A tended to decrease in males with the females unaffected.

The conclusions of this study seem to be based on too few cases, and most of Silverstein's findings seem to have been produced from feeding his data into the statistical mill. Valuable information can be gained by statistical methods only
when sufficient and large amounts of data are available. The smaller the number of cases the less reliable the statistical findings in my opinion.

Silverstein admits at the end of his article that the way to uncover real individual differences in morphology or growth trends in treatment and treatment cases would be longitudinal and paired comparison studies.

The writer seems to have dodged the real objective of his study and produced something of little practical or theoretical value by taking the easy methods of investigation.

Howes (7) presents two cases in which he claims the mandible has been repositioned in treatment. One is a Class II Division 1 case and the other a Class II Division 2 case. In both he has removed occlusal interferences and says that this removal has allowed the mandible to take up a normal antero-posterior relation.

The evidence that Howes puts forward is based only on models and profile photographs which is not enough in the light of present knowledge to claim alteration in mandibular position during treatment. In the Class II Division 2 case particularly, the forward position of the mandible at the conclusion of treatment could be due to growth which has taken place after Howes has released the restraining influence of the typical incisor relation of the Class II Division 2 case.

Howes, however, is most conservative in his summary and says that it could be possible to reposition the mandible when by removal of occlusal interferences the condyles are allowed to move backward and forward as the case may be from abnormal position into normal positions.

Hedges (8) in a cephalometric appraisal of Class II Division 1 cases treated by the edgewise arch found that in the majority of cases the relation of the maxillary first permanent molar showed a constant relation to the line S - Gn. In the majority of cases the lower first permanent molar shows
a forward positioning in relation to the line S–on and mandibular growth accounts for the major amount of this change. Treatment which is accompanied by little or no growth appears to cause a change in facial pattern as observed in a tipping of the occlusal plane.

This study by Epstein (9) shows the possibilities of treatment in the mixed dentition and although the research was carried out on only twelve individuals they were in the age group of six to ten years. Epstein although admitting the small sample considers he derived enough evidence from his cephalometric studies to be able to say that posterior movement of the maxillary molars is possible by means of treatment by the head cap method as advocated by Oppenheim.

In some cases there is a posterior movement of the maxillary molars while in others the maxillary first permanent molars are held stationary while the maxilla as a whole grows forward. Either of these results in conjunction with the growth forward of the mandible will correct antero-posterior relationship of the molars in Class II Division 1 malocclusion. Epstein says that this method of correcting Class II malocclusions approaches an ideal which has long been sought. Forward tipping movement of the mandibular molars is not apparent, the occlusal plane remains unchanged and changes in the position of the mandible are the result of growth and development only.

Success, however, in this method depends largely on the necessary growth and development occurring in the individual and the cooperation of the patient in wearing the appliances.

A preliminary report on the efficacy of the cervical gear therapy in treatment of Class II Division 1 cases is given by Graber (10). Of a survey of 150 cases 65 have been completed and the results are most interesting and encouraging.
1. It is possible to change maxillo-mandibular apical base relationships by cervical gear therapy. This is the rule rather than the exception.

2. In fifty-four of the 65 cases the Class II tooth interdigitation was eliminated.

3. Tendency for molars to tip under cervical traction was lessened by permitting the arch wire to maintain positive pressure on the maxillary incisor segments.

4. In severe, basal dysplasias it was necessary to incline the maxillary incisors excessively to the lingual in order to reduce the incisal overjet.

5. Where overbite was deep a bite plate appliance was placed to reduce overbite and to obtain clearance to retract the maxillary incisors.

6. There was no significant change in mandibular incisor inclination except in those cases when the bite plate was used.

7. In six cases of severe basal malrelation maxillary second permanent molar teeth were removed prior to treatment. In all cases a complete reduction of Class II tooth relation was obtained by moving the maxillary denture posteriorly.

Goldstein(11) defines the part played by the orthodontist in this treatment of surgical correction of Class III malocclusions as pre-operative and post-operative.

**PREOPERATIVE**

A. Complete records for study and consultation with the surgeon.

1. Impressions and wax bite.
2. Lateral head X-rays and lateral jaw X-rays.
3. Intra-oral X-rays.
4. Photographs both frontal and lateral.

b. Study of records.

1. Possibility of placing casts in good relation by straight forward and backward shifting.
2. Changes necessary in the arches to ensure good
interdigation of the teeth.

C. Appliance therapy. Consists of banding all teeth with the insertion of arches for the fixation of the jaws.

SURGERY.
The surgical methods employed are either a horizontal or ramus section or a condylar cut.

POST-OPERATIVE.
All cases were wired together for at least six weeks and as soon as possible elastic traction should be substituted for wiring.

Orthodontic treatment for correcting alignment and occlusion is necessary.

This is a most interesting article on a controversial subject but the results in the adult cases are certainly very good.

Goldstein emphasises that this treatment if carried out during the growth period will probably be unsuccessful. A rigid, multiple band technique such as the edgewise arch should be employed to distribute the load of retention over as many teeth as possible. As he says, the surgical treatment of mandibular position is not difficult, the maintenance of the new position presents the major problem. Bone union is obtained over a varying period and depends on the surface contact obtained and the amount of displacement.

Of the two surgical methods Goldstein says that the condylar cut technique seems to produce better results. Improvement of facial lines takes place in practically all cases and in nearly all cases the patients are extremely grateful.

Oppenheim (12) continued his work begun in 1911, and this article in 1944 is a contribution of new findings made over the ensuing years.
FINDINGS.

Mature monkeys (Macaca rhesus) were used in the experiments which were carried out on the four incisors. Forces used were provided by coiled springs furnishing continuous force and the elasticity of the labial arch alone, provided intermittent pressure in the second experiment. The movement of teeth, some with coiled springs and others with ligatures were performed to test the contention that continuous force give results different from and more injurious than intermittent forces. Directly, this attempt failed, because ligatures were removed too often (every other day) thus making this force too strong also.

However in cases where the ligatures became loose more quickly or where force became reduced the difference showed up.

After the use of strong forces we see the familiar picture of a crushed periodontal membrane, the apastic bone surface and undermining resorption from either the periodontal or periosteal surface of the bone and the narrow spaces. Quite often a disintegration or disappearance of the osteophytes occur and occasionally of the cementum corpuscles also.

Where light forces are used, osteoclastic activity takes place only on the periodontal surface, leaving there the signs of this activity.

However in the present material even under the application of supposedly light forces, undermining resorption starts on the periosteal side, and the osteocytes also are attacked.

PERIODONTAL MEMBRANE

Degree of recovery of the periodontal tissues depends on degree of alteration during original movement which in turn is dependent on the duration and amount of force applied. Recovery proceeds at a quicker rate in the apex region than at the crest, apparently because of better nourishing conditions. According to Marshall recovery of the periodontal
membrane in man would take 20 days at the apex and somewhat longer at the crest.

As regards the completion of undermining resorption when Marshall's rule is applied to Oppenheim's findings it would appear that 30 months would not be sufficient time for bone to return to normal in man.

Soreness and looseness of teeth due to non-physiological movement may easily be attributed to these two factors - the alteration and destruction partial or entire of periodontal tissues and the great increase in periodontal width on the traction side compared with that on the pressure side.

**OSTEOCYTES**

The compression of the periodontal membrane beyond a certain limit affects the osteocytes whose very existence and survival depend, wholly or in part on this source of nourishment. Once the osteocytes, which develop the matrix, are gone and the lacunae are found empty the bone must be regarded as "dead".

Once gone they cannot be replaced.

The dead bone must then be presumably resorbed by osteoclastic activity.

The causitive factors of bone necrosis gleaned from the field of general bone pathology may be applied to the periodontal tissues.

Bone is a fibrous tissue which differs from ordinary connective tissue only in that calcium salts are deposited in the ground matrix.

A crushed periodontal membrane brings about inflammation which is bound to spread into the bone.

Inflammation brings osteoclasts which resorb and rarify the bone. Cutting of the blood supply is the one common reason for the death of bone. The disappearance of osteocytes from their lacunae and their subsequent necrosis of the bone has been demonstrated now by Orban, Weinman, Sicher and Oppenheim to take place in dogs, monkeys and humans.

What is of great consequence to orthodontists is the uncert-
ainty of whether the periodontal membrane, which recovers quickly will lay down osteoid on "dead" bone. Perhaps the embedding and reattachment of suspensory fibres cannot take place until this "dead" bone is eliminated.

OSTEOCLASTS.

In the course of these experiments three types of osteoclasts were distinguished.

(a) Where no crushing and devitilisation of tissues has taken place primary osteoclasts were brought into being and act on the lacunar surface producing a uniform lacunar resorption, the ideal reaction.

In his experiments Schwarz found that the most favourable treatment is that which works with forces not greater than the pressure of the blood capillaries. This pressure in man is 15 to 20 mm. Hg; it is about 20 to 26 grams to one square centimetre of surface - such a pressure is so intensive that a continuous more or less lively resorption takes place in the alveolar bone at the region of pressure."

Osteoclastic activity and tooth movement will continue even after the stimulus of tooth movement has ceased, the duration of this continued activity however is not known.

(b) Where the periodontal tissues have changed in a pathological way and where osteocytes are disintegrating and disappearing the dying bone is attacked from all sides by osteoclasts which because of their prolonged presence in the area are called secondary osteoclasts.

Secondary osteoclasts on the periodontal side may appear in less than one day in order to remove the affected bone as rapidly as possible.

When nature through this osteoclastic activity has removed the "dead" bone and crushed tissues
the tooth once again makes a movement and if the same force is acting or has been renewed the same process starts again. Thus the tooth moved by fits and starts. It is essential to realise that if no movement is noticed for a few weeks this may be a recovery period, that the solution is not to increase the force but rather to allow adequate time for the tissues to recover. To quote Oppenheim "In encountering greater resistance, the right procedure should be to double the time not the force."

(c) Tertiary osteoclasts on the traction side.

1. With the use of light forces with no fibres torn we find a smooth even layer of osteoid.

2. With stronger forces and a few fibres torn the bone follows in elongated spicules.

3. With strong forces, most of fibres are broken and only a trace of osteoid formation is evident.

Vessels are ruptured and haemorrhages are found everywhere. Severence of vessels interferes with nourishment of bone and its vitality is reduced.

Toxins from decomposition of the red blood cells and the lowering of the vitality of the bone are responsible for the mobilisation of what Oppenheim calls tertiary osteoclasts which resorb the bone by surface resorption.

**INTERMITTENT LIGHT FORCES, AND OSTEOID.**

The use of these forces particularly in extra-oral anchorage used only at night means considerably less strain on the tissues and therefore better chances for repair and restoration.

In the light of the new knowledge of osteoid tissues Oppenheim has modified his definition of "intermittent force."

From his monkey experimental findings he recommends.

(a) Use of a stimulus for a short time (one day or one night only) followed by an intermission of the same duration or slightly longer.
(b) A new stimulus should not be applied as long as the primary osteoclasts mobilised by the preceding stimulus are at work. The only difficulty remaining and a major one, is to find a method of using these light forces in practical cases.

To evolve mechanisms meeting some of these requirements is the responsibility of the orthodontist. All destruction areas even those which are the result of strong forces will be for the most part repaired back to normal with the exception of one part which is never restored to its original height, that is the buccal or labial alveolar crest. This loss must be minimised to prevent undue gingival recession and exposure of root in later years.

OSTEOPHYTES.
Osteophytes have been found to develop very slowly in man and need considerable time for their formation. This is another reason for advocating the slow movement of teeth.

CEMENTUM
In places where the periodontal membrane has been crushed we find the cementum surface aplastic, like the bone surface. There is a disposition to resorption even though the cementoid seems to be a protection against quick resorption.

Impaired nourishment of the superficial layers due to pressure causes a decrease of vitality of the cells and a consequent disintegration resulting in eventual cementum resorption.

PULP
Remarkable changes were found in the pulp by Oppenheim and the pulp tissue is transformed into a striuctive more like connective tissue.

RELAPSE AND SELF-ALIGNMENT OF TEETH.
The quicker the original movement, the quicker and more forcible the relapse.

With slow movement osteoid tissue forms on the traction side after twelve hours and continues to build up and forms an even layer all along the bone surface.

With strong forces applied we not only get no osteoid form-
ation but also have resorption on the traction side so the space available for relapse is greater.
Added to this the fact that osteoid tissue is more resistant to resorption would minimise the tendency for relapse.
In treatment we must constantly keep in mind the fact that the normal approximate width of the periodontal membrane is 0.2 mm of soft and easily compressible tissue.

In this portion of his work Oppenheim (13) deals with the practical application of his histological researches.
An analysis of elastic force of rubber bands is given and it is stressed that these bands gradually decrease in the force they exert especially used intra-orally. He suggests changing intra-oral bands every day and extra-oral bands every fifth day approximately.
Elastics stamped out of rubber dam are the most preferable but in most cases any mechanical obstacles of the occlusion should be eliminated by a bite plate for instance, although in some cases this is not necessary for successful results.
Elastic force is used only during the night with all or most of the appliances removed in the day time.
The head cap was revived by Oppenheim and he advocates that the force be applied only to the molars and says that the other teeth will move because of tension set up in the transseptal fibres provided that the force is not so great as to sever these fibres.
It is only by the preservation of these transeptal fibres intact, that the contact points between the teeth will remain tightly closed.
The use of intermittent elastic force is particularly effective in the following types of cases.
1. Class II cases with the chin in normal relation to the skull and the maxillary teeth in protrusion or rather maxillary protrusions.
2. Class III cases in patients from 10 to 40 years of age where maxillary teeth and alveolar process as a whole have to be brought forward.
3. Class I cases with a high canine where the buccal segments have moved mesially.

Oppenheim shows cases which he and other operators have treated successfully. In all cases the force used was necessarily gentle, and usually rubber dam elastics were the choice. They were worn at night only. Head gear is not used for anchorage in all cases and he instances one Class II case in which no bands were used but only mandibular and maxillary plates were employed with intermaxillary elastics worn at night.

The active treatment should pass into the retention period marked only by a gradual reduction in the number of nights per week the elastics were worn, until they are discarded altogether.

In Class III cases in advanced age the only result obtainable is a forward movement of the maxillary alveolar process and teeth. Anchorage is obtained for this movement from attachments on a chin cap. Although this method is not always successful it is preferable to try it before surgical treatment is employed.

Two upper molar bands are fitted with a well fitting lingual arch supported by spurs on the canine bands.

The chin cap is fitted with rods pointing upward to the angles of the mouth. Rubber dam elastics are stretched between the rods and hooks on the molar bands.

Oppenheim emphasises that although the duration of treatment is rather lengthy the actual time during which force is delivered is not much more in intermittent pressure treatment than in continuous treatment.

"Depression may be defined as the process of changing the relation of a tooth to the surrounding bone by causing its retraction into the alveolus." To quote Lefkowitz and Waugh. (14)

Depression of a tooth in its alveolus results in tension on all the periodontal membrane fibres except those at the apex
ant the bifurcation in multi-rooted teeth.

Tension causes bone formation but as depression would have to be accompanied by bone resorption then resorption must occur under tension.

Gottlieb and Orban suggest that depression is possible although it has never been satisfactorily demonstrated.

Lefkowitz and Waugh established the following facts:

1. Teeth may be depressed.
2. Under tension of the periodontal fibres resorption occurs and periodontal membrane re-establishes its physiological width after compression.
3. Findings suggest that mild continuous force is better than an intermittent force which may cause resorption of cementum and dentine.

The authors, Erickson, Kaplan and Aisenburg set out to find the effect on the transeptal fibres of bringing teeth into approximation by force and also widening the space between teeth.

With extraction of first premolars becoming prevalent these fibres must have some effect on the stability of the completed case.

They found:

1. Transeptal fibres are very constant even when much alveolar bone is lost and are being continually renewed.
2. When teeth drift apart the transeptal fibres elongate as also when teeth are extracted.

3. When teeth are moved together after extraction of intervening teeth, fibres contract and coil into hard mass which resembles scar tissue.

4. It does not diminish in size and pressure from the mass, may cause injury to the periodontal membrane and alveolar bone.

5. With this mass between the roots it is biologically unsound to expect good approximal contact between teeth moved together after an intervening extraction.

6. There is always a tendency for contacts to reopen after they have been closed by mechanical force.

This article is concise and to the point and their conclusions seem to be borne out and admirably illustrated by excellent microscopic sections which have been well reproduced.

Gottlieb (16) urges us to consider both sides of tooth in application of orthodontic forces, the side of pressure and the side of traction.

The width of the periodontal membrane is the limit of primary movement of the tooth as the two hard surfaces of tooth and bone will be in contact.

The theoretical ideal of tooth movement is the compression of the periodontal membrane to such a degree that it can perform frontal resorption of bone and furnish space for further movement without damaging the connective tissue of the periodontal membrane.

No technique can produce this throughout entire treatment however.

If we start moving a tooth with a certain force so that compression of periodontal membrane produces a stimulus for resorption, the same force applied again will have greater effect and may produce contact of tooth and bone.
NO FORCE CAN ACHIEVE MORE THAN CONTACT BETWEEN TOOTH AND BONE 
AND NO TECHNIQUE CAN AVOID IT.
The side of traction had also to be considered. In the case 
quoted, periodontal fibres are stretched considerably, but 
one are torn and there is no bleeding.
Contact between tooth and bone on other side prevents further 
traction.
In next case we see on the side of traction after forty eight 
hours:
1. Considerable widening of membrane
2. Formation of new bone in several places
3. Denser accumulation of cells indicate where bone 
is going to be formed.
No sign of damage after very strong traction only ideal 
response to stimulus is evident by formation of new bone 
trabeculae.
There is no damage on the side of traction.

ANKLYOSIS IN ORTHODONTICS.
Impacted teeth without pathology may remain without anklyosis 
permanently while overloaded teeth as in orthodontics may 
develop it.
First molars used for anchorage are often affected.
Gottlieb produced experimental anklyoses in dogs after 6 
months and 12 days.
Resorption into dentine preceded the anklyosis with the bone. 
Once the coat of uncalcified cementum is lost no one can tell 
when resorption of the dentine and deposition of bone will 
start.
An uncalcified matrix is resistant to resorption and that is 
what makes the presence of an uncalcified cementum coat on 
the root surface so important.
There are three possibilities for bone resorption. Orthodont-
ically with the compression of connective tissue, this tissue 
tries to gain back the old amount of occupied space. This is 
reclaimed from the bone, since the tooth is protected by a 
layer of uncalcified cementum.
Contact of resorbed dentine with bone is one condition which favours anklyosis. If a resorbed area of dentine is brought into contact with the bone, before new cementum is deposited, that may represent a predisposition to anklyosis. If, however after resorption the relationship between tooth and bone remains stable until a new cementum coating is formed anklyosis may be prevented.

APICES OF ORTHODONTICALLY MOVED TEETH MAY PERFORATE THE BONE.
If the apex is moved a considerable distance and the formation of osteophytic bone on the outside is poorly developed, apex may become situated under the mucous membrane. Additional bone formation at a later time of rest is possible but immediate cessation of additional movement is indicated.

ORTHODONTICS AND PYORRHEA.
Gottlieb says that "traumatic occlusion" does not produce pyorrhea.
Faulty orthodontics can produce anklyosis but not pyorrhea and long orthodontic treatment may favour resorption of roots.

CONTINUOUS ACTIVE TOOTH ERUPTION AND IMPACTION.
Teeth have a tendency to move in the direction of the enamel covered crown. When the crown has erupted, active eruption is more favoured and more rapid until occlusion takes place. Tendency to erupt still exists but occlusion is the counteracting factor in continuous eruption.
Aisenberg (17) says that both bone and cementum may be resorbed but that cementum is much more resistant to resorption. To prevent resorption of cementum teeth should be moved realising the limits of the periodontal space.
He divides the fibres of the periodontal membrane into 2 types one attaching tooth to bone and the other attaching tooth to tooth or tooth to sub-epithelial connective tissue. The latter attachments are more difficult to recognise in treatment and may thus be a cause of relapse.
Reorganisation and reconstruction of bone is done in two stages, first bundle bone is formed and this is later replaced with the more permanent lamellated bone.
LOCATION OF FULCRUM.

When a tooth is tipped horizontal stress Aisenbärg maintains that the fulcrum lies just below the alveolus for strong forces but with lighter forces the fulcrum is closer to the apex. Varying degrees of force range from the use of strong forces resulting in a crushing and necrosis of the periodontal membrane with cessation of tooth movement until the injured tissues are removed by resorption to light forces which are ideal according to Aisenbärg as they stimulate both bundle and lamellated bone. He says that following light forces the period of retention is lessened.

The six kinds of tooth movement are listed by Aisenburg as tipping, bodily movement, elongation, depression, rotation, and the closure of a space following tooth removal.

Bodily movement and tipping are comparable movements while elongation according to the author is a simple easy movement.

Depression is doubtful of attainment from evidence in the literature. Rotation and the closing of spaces after extraction are the two movements most fraught with the danger of relapse.

Although this article is mainly a summary of work of various research workers on the subject it gives an interesting and concise review of some of the problems of tooth movement in its effect on the tissues.

All appliances are limited by the reactions of the periodontal membrane—according to Moyers (18). This membrane is made of the connective tissue from which are generated the cells which make tooth movement possible—osteoblasts and osteoclasts.

Adequate blood supply is essential for the genesis of the osteoblasts and osteoclasts.

Sequence of happenings when light force is exerted on tooth.
1. Straightening of fibres on opposite side
2. Some lessening of blood supply on tension side
of tooth.

3. Same occurs on pressure side only more so with stasis in some cases.

With stasis a portion of the membrane must undergo strangulation necrosis and regeneration before tooth movement will be started. When a tooth is tipped blood supply is endangered but rich anastomoses comes to help. Membrane is crushed at alveolar crest and just above apex of root on opposite side. However regeneration with collateral circulation is soon begun.

With bodily movement more damage is done to blood supply and the consequent regeneration takes longer. Therefore bodily movements must be approached with great care and caution.

The oral mucosa should be scrutinized as also the other soft tissues of mouth, and the condition of bone and cementum in X-rays to try and get some idea of the health status of the periodontal membrane itself.

The membrane determines whether tooth movement is possible and to what extent and whether the tooth will remain in its new position after movement.

"Whatever the appliance or technique of the operator they are all limited to one factor the response of the periodontal membrane to pressure." Moyers and Bauer (19).

Pressure exerted on the tooth is transmitted through the membrane to the alveolar bone.

The response of both the periodontal membrane and the bony alveolus is determined by the blood supply to the area. Therefore although all forces in excess of normal capillary blood pressure 25 gm./Sq.cm will diminish blood supply, care must be taken that the force is not so excessive as to cut off all blood supply to the area. Tipping movements of the teeth, besides being the most common and the easiest are the least injurious to the tissues while bodily movement
unless carefully controlled is fraught with danger. The writers of this article favour the gentle controlled action of the well fitted arch wire to systems of loose, dangling finger springs which may easily produce a jiggling effect on the tooth and tissues.

The round arch wire produces a quicker osseous response than square or rectangular rigid arches with less danger to the tissues. While certain movements may be carried out more efficiently with the rigid arch it also requires the greater care and caution to avoid making a haemorrhagic mass of the membrane.

Root resorption is more prevalent with the square and rectangular arches and it is advised to always commence treatment with a round arch.

Of the appliances tested the twin arch wire was found to be nearest the ideal of desired force application. The danger in this appliance is the tendency to let forces act over a long expense.

Distance and time can do damage as well as sheer weight. The ideal appliance would operate over a distance of less than 0.2 mm. with a force of between 15 to 25 gm which weight to be intermittent allowing time for the periodontal tissues to recover. Such an appliance does not exist therefore we must still search for more effective and efficient appliances which will treat the delicate periodontal tissues with more respect than they now receive.

The purpose of this study on early changes following tooth movement in rats is threefold and were investigated by three workers. (20)

1. To explore the suitability of the rat dentition for studying tissue changes following tooth movement.

2. To establish a base line for further investigations on the effect of pathological systemic conditions on these changes.
3. To concentrate on the early changes from 1 to 72 hours following tooth movement. The rat molars which resemble human molars were found to be too small to fit any appliance however movement could be induced by placing rubber bands between the teeth. The result of this pressure on the multi-rooted-teeth of the rat was a tipping or rotatory movement rather than a bodily movement with the greatest pressure at the cervical part of the root and the least at the apex.

**Changes in the Periodontal Membrane**

1. Amount of force used was dependent on the rubber sheet 300 micra thick being wider than the combined widths of the periodontal spaces distal to the first molar and mesial to the second molar.

2. Damage to the periodontal membrane was first evidenced by hyalinisation of the membrane as early as three hours after the application of pressure.

On the side of tension the fibres of the membrane are stretched and unravelled.

This enlargement of space led to mitotic activity and cellular proliferation after 15 to 18 hours.

3. Appositional and resorptive changes in the alveolar bone takes place after about 12 hours. Aplastic resorption lines were noted after 12 hours and 24 - 36 hours after movement was begun apposition of bone was seen.

Not only osteoblasts and osteoclasts are active in repair following tooth movement but also fibroblasts. The increased mitotic activity of the fibroblasts in the periodontal membrane is part of the process by which the fibre bundles of the widened periodontal spaces are repaired and re-adapted to the changed relations between tooth and bone.
Five methods of study were followed by Phillips (21) and the data was obtained from before and after treatment intra-oral X-rays on the subject of apical root resorption during orthodontic therapy.

Lateral cephalometric head films were used to relate resorption to sex, age and length of treatment. They were also used to evaluate the effects of apical root loss of the different types of tooth movement.

Extracted teeth were used and ground to simulate resorption areas.

1. Before and after treatment intra-oral X-rays of orthodontic cases.

Sixty nine sets of these X-rays were used of which forty three were bicuspid extraction cases. Resorption was classified according to degree into

(a) Slight
(b) Moderate
(c) Excessive
(d) Questionable

II. Linear measurements of apical root loss from before and after treatment lateral cephalometric head films.

Sixty two lateral head films were used and as the lateral and central teeth were found to be most affected by resorption, the upper central incisor was chosen as it was more readily visible in the X-rays for measurements.

Amount of loss was then compared to attempt correlation in three separate categories.

1. Sex differences
2. Age of patient at inception of treatment

III. Measurements of angular change from before and after treatment lateral cephalometric head films.

Sixty one films were used and tracings made using the line from P.N.S. to the A.N.S. as base line and a line through the long axis of the central incisor. Three different types of tooth movements were found to occur.
1. Apical tippings
2. Anterior or posterior apical displacement
3. Lingual bodily movement

IV. Linear measurement of the movement of apices of the teeth typed "lingual bodily movement" from before and after treatment lateral cephalometric head films.

V. Surface area studies

The amount of retentive surface area of a tooth lost by resorption was simulated by grinding extracted teeth and measuring the amount of area lost.

RESULTS.

1. Of a total of 1745 teeth
   61.1% showed no loss
   7.4% were questionable
   26.8% showed moderate loss
   0.3% or five teeth were classified as excessive.

11. The mean loss between sexes was the same and no correlation was found between either the age of the patient or the length of treatment and the amount of root resorption.

111. Type of tooth movement was divided as follows.
1. Apical tipping - 33 cases showed no correlation with root resorption

2. Apical displacement - 13 cases contained the highest correlation with root resorption of the groups but Phillips says this is not significant. Therefore the amount of apical root loss again is not relative to the amount of tooth movement.

3. Lingual bodily movement included 15 cases and the results showed no correlation between this movement and root loss.

IV. The distance a tooth is moved during treatment could not be correlated with the amount of apical root resorption.

V. Surface area studies showed the following loss of area of attachment in the teeth studied. These figures are approximate.

<table>
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<tr>
<th>TOOTH</th>
<th>2 mm.</th>
<th>4 mm.</th>
<th>6 mm.</th>
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<tr>
<td>1/1</td>
<td>8%</td>
<td>20%</td>
<td>36%</td>
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<tr>
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<td>8%</td>
<td>23%</td>
<td>35%</td>
</tr>
<tr>
<td>1/1</td>
<td>7%</td>
<td>18%</td>
<td>32%</td>
</tr>
<tr>
<td>2/2</td>
<td>6%</td>
<td>18%</td>
<td>28%</td>
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</tbody>
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Phillips gives a very informative survey of other work in the field of root resorption and his findings are at variance with many previous writers on the subject.

His subjects however were treated under different circumstances than those in many previous studies. Phillips' analysis of this problem can be summarised that although tooth resorption is caused by orthodontic treatment this resorption except in rare cases can be regarded as clinically insignificant and not endangering the life or function of the teeth.

It would appear that far more damage to the teeth and surrounding tissues could eventuate if the malocclusion were left untreated, than has been shown by Phillips to take place with orthodontic treatment. Phillips' evidence although
of a macroscopic character has been carefully collected and seems to give cause for optimism in the consideration of a very real problem to the orthodontist.

The appearance, structural characteristics, and degree of opacity of the lamina dura in an X-ray correlates exactly with the state of eruption of the teeth, reports Massler (22). During active eruption the density of the lamina dura was greatest and then decreases until as the tooth achieves full clinical occlusion and the rate of eruption flows down the lamina dura becomes thinner and much less radiopaque. During orthodontic tooth movements the lamina dura became much thicker and more radiopaque on the side of tension and new bone formation.

On the side of pressure the lamina dura became thin, irregular and finally disappeared as a result of resorption. During retention a new lamina dura appeared on this resorbed surface. The thickness and radiopacity of the lamina dura indicates the area and amount of new bone formation and the direction and amount of tooth movement.

An investigation by four workers (23) found that cement etched all enamel surfaces exposed to its influence and that surfaces which had been ground and polished were more effect-ed than unground surfaces. This seems to indicate along with past investigations that the enamel is covered with some kind of membrane. Cement liquid alone etched the enamel most markedly. When the cement was completely set the amount of etching did not seem to increase.

Sved (24) discusses decalcification of the enamel which is one of the undesirable results of orthodontic treatment. The public and the general practitioner blame the orthodontist and when studied it becomes apparent that the orthodontist must carry some responsibility but the major share is the
patients.
As bands cover the middle third of the teeth, the incisal third is seldom affected. The middle third and the gingival third are most often affected.
On the lingual part covered by band and on proximal, decalcification occurs only under loose bands left on for long periods. Decalcification during treatment may be divided into eight classes.

Class I. Occurs on gingival third of labial or buccal surfaces. Patient should be able to keep clean.

Class II. Occurs under bands. Loose bands, leaky cement or food forced under bands are causative factors and the orthodontist has the responsibility.

Class III. Occurs under bands. Caused by chemical action of phosphoric acid in cement on enamel. Very seldom seen and beyond our control.

Class IV. Occurs under bands on lingual surfaces of maxillary teeth. Force of mastication crushes cement and leaks develop. Elimination of masticating stresses on bands is the treatment.

Class V. Etchings occur at cervical edges of bands, poor bands or too thick material the cause.

Class VI. Occurs on lingual surface of the maxillary molars and labial surfaces of mandibular molars. Crushing of cement and leakage. The linguo-occlusal edge of the maxillary molar band and the labio-occlusal edge of the mandibular molar band must be trimmed clear of the bite.

Class VII. Occurs along cervical and occlusal edges of bands receiving meticulous care. Similar to erosions from vigorous brushing and rarely seen.
Class III. Occurs under various kinds of removable bite plates and retaining appliances. Class I is preventable by educating the patient in brushing, in Class II effects bands must be checked and recemented if necessary. At least once a year at outside and for this purpose the orthodontist must record dates of cementing of bands.

It is extremely important to record all areas of decalcification present on the teeth before treatment. The dental profession must be fully informed of the fact that orthodontic appliances do not cause decalcification of the teeth and that the greatest percentage of decalcification is caused by accumulation of food particles on surfaces not covered by bands, the care of these areas being the patient's responsibility.


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