# Review of Current Literature

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## Experimental Change of the Mesio-Distal Relations of the Upper and Lower Dental Arches

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Part I

### Mesial Displacement of the Lower Jaw by Means of Intermaxillary Rubber Bands

Experiments were carried out to determine, if possible, which of the various methods, used to correct faulty mesio-distal relations of the denture units, was the best or most feasible and to locate the changes occurring in the bones during the corrective movements.

Breitner recognizes the following variations from normal as possibilities in effecting changes in the mesio-distal relation of the teeth.

1. A distal displacement of the dental arch.
2. A mesial displacement of the dental arch.
   a. Due to a forward movement of the teeth in the jaw bone.
   b. Due to a forward movement of the whole mandible. (Movement of the joint.)
   c. Due to an artificial increase in the growth of the lower jaw (opposition at the head of the condyle, flattening of the angle, etc.)
3. A combination of several of these mentioned movements.

He claims that anyone of these movements is possible and the one chosen depends upon the cause. He refers to Grünberg's treatment of Class II, where extra-oral anchorage is used instead of anchorage on the maxillary teeth, and claims that the followers of Angle used this as an argument that the deformity in Class II lies in an under-developed (called distally displaced) mandible. He states that this does not necessarily follow since it has not been proved that this bone can be influenced only toward normal development.

Macacus Rhesus were used for the experiments because of the similarity in the structure of the joint and pattern of the teeth with the corresponding structures in man. The apparatus was made as similar as possible to that

used in clinical practice. The first experiment was performed with the teeth held "en bloc" during the movement, using light intermaxillary rubbers as the power.

By "en bloc", Breitner means a stationary fixation or anchorage whereby the teeth are so immobilized that they cannot change the relations existing between them. They cannot tip, in other words. Such fixation, however, does not mean that the teeth do not change in their relation to their bony base. In short, merely because the teeth change their relation with the opposing jaw is no sign that the jaw has moved or developed.

The appliance used was as follows: In the mandibular denture, thin metal caps were cemented on the teeth of both buccal segments, from first molar to canine. To the metal caps, buccal tubes were soldered to support an archwire which touched the incisors and was ligated to them. Small hooks, for the rubber bands, were soldered to the sides of the metal caps in the region of the first molars.

In the maxillary denture, cast metal caps were cemented on all buccal teeth, in a similar way. Buccal tubes were placed on the caps to support an archwire which, however, did not touch the front teeth. Hooks were placed in the cuspid region of this archwire but the incisors were not attached to it in any way.

This appliance naturally opened the bite slightly but Breitner placed caps on his control so that the two animals started alike. It was shown, however, that the raising of the bite *did* cause changes in the joint.

The animals wore this apparatus, together with light rubber bands (rings cut from rubber dam), the stress of which was too slight to cause a shifting of the mandible, for 82 days. The bands were removed only during feeding and were renewed daily. A muzzle was used to prevent the animals from removing the rings. After 82 days there was a noticeable mesial occlusion of the mandible (Class III relation) and the animal was killed, perfused with Kollmer's liquid and all teeth, upper and lower, and also both mandibular joints, were examined histologically. (Pp. 11.)

Preceding the recital of the findings, Breitner explains the form of the head of the condyle and the articular cavity in Macacus Rhesus in order to eliminate any false readings in the experimental material. Then he declares that there is no appreciable bone activity in either the head of the condyle or the floor of the cavity under normal conditions.

### Findings in the Experimental Material

A—Head of the Condyle and the Articular Cavity.

A sagittal cut of the joint shows new spicules of bone on the distal side

of the cavity and also on the ascending head and these spicules are laid down mesio-distally or in line with the pulling force. This, Breitner takes as a sign of active opposition of new bone.

The same section shows an active resorption on the mesial wall of the articular cavity and the corresponding side of the condyle.

(Note: In the illustrations shown, the area of deposition is considerably more widespread than the area of resorption and, what is more peculiar, all of the resorption and most of the deposition, is above the level of the top of the condyle, in line with the meniscus.)

The control animal shows no resorption on either condyle or cavity wall and the bone spicules are nearly vertical, with an absence of abnormal deposition.

The first conclusion drawn is based on the picture presented by the bone activity in the cavity and absorption in front; there must be a migration of the cavity forward. Since the head of the condyle does not change in relation to the fossa, the mandible must be displaced forward, en toto, and in this way a change would be seen in the relations of the teeth.

The activities going on in the condyle head, deposition behind and absorption anteriorly, caused the jaw to become longer, literally by a setting back of the head of the condyle on the neck of the mandible as this bone moves forward. This would be classified under changes in the form of the jaw.

B—The Angle of the Mandible. (Pg. 18.)

Here, again, processes are found in activity that would end in a change in the form of the mandible. Heavy resorption is shown at the posterior edge which would result in the angle becoming more obtuse. Breitner's idea of this change is that the bone is literally straightened out between the condyle and mentone by an opening of the angle. And, since the condyle retains its position in the fossa, the body must go forward. He shows no pictures of the inner angle or the symphysis. He claims, at this point, that such a flattening of the angle is desirable since Hellman, Sicher and Krause found that in Class II, division 1 cases the angle of the mandible was sharper than in the normal.

C—Changes around the Mandibular Teeth

Here just as definite changes took place as in the sites formerly studied. All of the teeth upon which attachments were placed show osteoblastic lines on the side of pull while the side of pressure shows heavy resorption all along the root.

A very interesting thing, also seen in these pictures, is the fact that the bone spicules are not lined up horizontally but have a slightly mesio-apical direction. Breitner claims this is due to the fact that occlusal stress was increased, due to the raising of the bite through the wearing of the caps, so that the teeth were not only moved mesially but were depressed as well.

The marked amount of movement that has taken place is shown, so Breitner claims, by the fact that only new bone can be seen in the septa between the teeth. This indicates how effective was the light force in spite of the stationary anchorage obtained in the jaw. He draws the conclusion, therefore, that only the strongest of stationary anchorage should be used on the mandible if it is our object to bring this jaw forward. Any mesial tipping of these teeth leads to a premature gaining of correct cusp relationship without a corresponding change in the body of the bone.

He claims that the danger of causing a direct movement of the teeth without a corresponding movement of the jaw is increased by adding to the stress of the rubber bands but he does not tell how he reaches this conclusion. He states that the great thing to be careful about is not to overstep the threshold of stimulation that will give a favorable response to *all* the parts which we wish to influence. Hence the length of treatment should never be a determining factor in regulating the degree of force.

D—Changes around the Maxillary Teeth

Here he could find some evidence that these teeth had been moved distally but this evidence was not strong enough to convince him that this was surely the case. None of the pictures were analagous to that showing mesial movement of the mandibular teeth.

## Summary of Part I

1. Intermaxillary rubber bands, acting to influence a mesial movement of the mandibular dental arch, do cause a mesial displacement of this dental arch.
   a. By immediate mesial movement of all mandibular teeth used for the fixation.
   b. By longitudinal growth of the mandible caused by osseous changes in the ascending ramus, the angle of the jaw and the head or condyle of the jaw.
   c. By anterior displacement of the mandible caused by a mesial migration of the articular cavities.
2. Not any of the osseous changes just described can be produced in isolated form at any one of the above mentioned locations by means of intermaxillary rubbers nor can a single one of them be completely excluded.

3. However, it is possible to emphasize the change of the bone at one or the other point by means of a suitable arrangement of the apparatus. The relation of the used force and the strength of the fixation is of importance.

4. The action of the intermaxillary rubber bands is independent of the etiology and the conditions of the case. The acting force causes the same reactions whether the jaw is in a normal or pathological position.

5. In treatment, points 3 and 4 are the most important for obtaining cosmetically optimal results.

## Part II—Jumping the Bite

The purpose of this experiment was to settle the question as to whether there are variations resulting from the use of different therapeutic means for effecting the mentioned change and what these differences are, if any do occur. In this experiment the effort was made to move the lower jaw forward by means of an endogenous instead of an exogenous force, i.e., by muscular force instead of rubber bands. Such a possibility lies in the therapy of "Jumping the Bite" as introduced by Kingsley.

Breitner prefaces the experiment with a discussion as to the validity of comparing experimental work done on animals to therapy done on man and recalls, for the reader, the work done along these lines by Oppenheim, Johnson, Appleton, Rittershofer, Schwartz, etc.

He claims that the results are analogous in every respect with the possible exception of intensity or response. He goes on to say, however, that we note this difference of response between various patients and hence there is no reason why we should not expect it in experimental work. (Pg. 5.)

When we cause the structures to be artificially stimulated by endogenous forces most of the objective (intensity) is removed, for it is generally conceded that muscular and osseous tissues in any given individual are designed and balanced with each other. In other words, the teeth and jaws of any individual will stand the full load of his musculature.

### The Experiment

Bite raising caps were cemented upon all of the buccal teeth of the mandible and maxilla of a young Rhesus monkey. These caps eliminated the normal inclined planes of the teeth and substituted others which made it possible to bring the lower jaws into occlusion only by carrying it mesially. No other force was used on this animal and the animal was killed 46 days after the caps were cemented. All lateral (buccal) teeth, both maxillary joints and the angles were subjected to histological examination.

A—Changes in the Fossa.

Here, as in the former experiment, we find deposition of the bone at the distal side of the articular cavity and resorption at the mesial.

B—Changes at the Condyle.

Here, also, we find the same picture as before, i.e., a deposition on the distal side and resorption on the mesial. In this slide, on the other side of each lamella from the resorption side there is present a larger amount of new bone which Breitner claims to be an effort of the organism to preserve the static structure of the mandible.

Thus it can be stated that this form of therapy had the same end-result as the wearing of intermaxillary rubbers, which has been stated to be a change of relation between joint and cranium. All of these changes were less in amount however.

C—Changes at the Angle.

Here again we see changes analogous to those shown in the former experiment, namely resorption at the apex of the angle.

From all of these things the conclusion is drawn that any change in the bite can cause changes of the bone of different types and at different points.

D—Changes around the Teeth.

In these areas we do not have an analogous picture to the one in the former experiment. In the mandibular segment heavy destructions have taken place at the bifurcations of the molars and the permanent teeth, as well as the deciduous, show a break-down of the peridontium along nearly half of the distal root so that tooth and bone touch each other without any intermediate tissue. Any biological process is impossible at such a point. It is an extreme picture of traumatic occlusion. Many hemorrhages are present at this area and further apically, where the connective tissue is not yet destroyed, we find extensive resorptions of the bone and cementum on the distal root. There is no desposition on the other side to offset these changes.

Thus the force acting on these teeth, although derived only from within the organism, was far beyond physiological limits.

Another slide shows the interdental septum of two teeth of the opposite side and here we see a marked destruction of the crest of the process, from the depressing action of the caps. The septum, instead of yielding, as in Oppenheim's experiment, is being destroyed without reorganization.

The slides of the maxillary teeth show entirely analogous pictures at the root bifurcations of the animal which wore caps and the one that was subjected to intermaxillary rubbers. Both show a balance between deposition and absorption.

## Summary of Part II

1. In animal experiments it was shown that "Jumping the Bite" can cause a modification in the form of the cranium or of the maxillary joints, just as the intermaxillary rubber bands do.

2. The forces, however, caused by "Jumping the Bite" are much too strong for the fixation (anchorage) and produce the severest lesions of the teeth and especially of the surrounding bone. They also effect a strong immediate movement of the teeth.

3. The results of this experiment are valuable for human therapy. They can be applied to man because no outside forces are working but forces within the organism itself.

## Part III—Distal Displacement of the Mandible by Means of Intermaxillary Rubber Bands

The purpose of this last experiment was to remove certain objections that might have arisen in regard to the first two. Breitner realized that the deposition and resorption of bone, as shown in the former slides, might be laid to normal growth changes. In order to disprove this he completely reverses the mechanics of his treatment in an effort to show that teeth and bone must behave in an analogous manner during the action of forces running counter to the directions of growth.

Analogous to the first experiment, cast metal caps were cemented on all lateral (buccal) teeth, including the cuspids, of a young Rhesus monkey. In the maxilla these caps were connected by a wire of 1 mm. diameter which closely fitted the front teeth. Tubes soldered to the caps in the region of the canines received this wire, (½ round, within ½ round tubes) so that the entire arch was included in the anchorage which, in the buccal segments, was stationary, and in the anteriors was simple. Hooks were placed at the molar region.

In the mandible an outside arch was fixed to the caps in buccal tubes at the molar region. This had hooks at the canine areas. The incisors were not included in this arch adjustment. Light rubber dam rings were used and the animal was killed after 72 days, perfused with Kollmer's solution and the same areas as before were examined histologically.

A roentgen picture of the animal's head at the end of treatment shows the macroscopic results of the experiment.

A. There is a clear cut disto-occlusion of the mandible in the canine region as well as in the molar areas.

B. The disto-occlusion is much stronger on the left side (about the width of one cusp). This side wore two elastics instead of one.

## Histological Picture

A—Changes in the Glenoid Fossa and Condyle.

On the distal side there is no parallel arrangement of fibres so clearly shown in the former experiments. To the contrary we find giant cells present, lying in lacunae, and indicating resorption while, at the other end of the spicule, is seen the typical picture of bone deposition, osteoblastic lines and uncalcified osseous substance. From this picture Breitner concludes that the cavity here is in distal migration and that this would tend to bring the teeth and jaw (lower) distally.

It is pointed out that if this amount of force is sufficient to bring about such changes it is permissible to assume that power derived from a head cap would have the same effect.

In this connection, Breitner says that it is not surprising that the visible effect appears after a much longer time, if this therapy is used exclusively, since, when we use rubber bands, we have at least three processes contributing to the repositioning of the jaw instead of just the one. However, the same point makes it possible to move the whole jaw back without any secondary changes. Apparently here he forgot the changes at the angle of the jaw.

Analogous to the former picture, we find bone deposition on the forward wall of the fossa and on the forward surface of the condyle.

As a result of all this we have the opposite effect on the mandible from that shown formerly, i.e., this jaw is getting shorter for the condyle is approaching the mental eminence and this leads to a change in occlusion.

B—Changes at the Angle.

Here we find deposition going on instead of absorption as in the former experiments. There are present new osseous spicules, in parallel arrangement, and considerable absorption at the opposite side of the spicules (towards the inner side of the angle). The conclusion is reached that with this therapy the angle of the jaw becomes more acute.

C—Changes around the Teeth.

In the lower jaw at the first molar region the following changes are noticeable:

There are absorptions of the root itself which Breitner claims are probably due to the trauma occasioned by raising the bite with the caps. At the same time the root has been depressed into compact bone nearly a fifth of its length without doing any appreciable damage.

At the bifurcation and at the interdental septum the distal movement of the teeth is very evident as shown by the sites of deposition and absorp-

tion and by the arrangement of the fibres. Thus we see that the tooth movement here is exactly analogous to that of mesial movement.

In the maxillary teeth the same general changes are seen but, of course, in a mesial direction. It seems that this movement is faster than the distal movement below. The changes at the bifurcation and interdental septum are the same.

## Summary of Part III

I—The described findings, from the experiment, confirm the results obtained, macroscopically, i.e., that it is possible to produce a change of the occlusion, in the form of a distal displacement of the lower jaw, by means of intermaxillary rubber bands.

II—They show that the osseous changes are analogous to those which we find in the mesial displacement of the lower jaw which we described in the previous experiments.

III—It has been found that forces act always proportionately to their strength upon the bone and are never lost (difference between right and left).

The fundamental laws derived from the findings of the first and second experiment, dealing especially with mesial displacement of the lower jaw and reported in the respective summaries, are confirmed and generalized also for other movements of the jaw and teeth and may be outlined as follows:

1. Intermaxillary rubber bands or endogenous forces produced by changes of the bite conditions (Jumping of the Bite), cause a change of the occlusion:
   a. By an immediate movement of all teeth upon which the forces act.
   b. By changing the form of the mandible (enlargement or reduction), due to an osseous change in the ascending branch, angle of the jaw and head of the jaw.
   c. By a displacement of the mandible in relation to the cranium, due to a migration of the articular cavity.

2. The intensity of the osseous changes is absolutely dependent on the strength of the force used.

3. Only a force acting upon an extra oral point (chin cap) can affect the joint and the jaw separately. If the force acts upon the teeth, these, in the first place, are immediately moved in the jaw. The relation between the force that is applied and the strength of the fixation that is used is important in determining the predominating localization of the affected osseous changes.

4. The effect of the therapy that is used is entirely independent of the etiology and the condition of the case.

5. The endogenous forces caused by the jumping of the bite are much too strong for the possible fixation. Therefore, this method of therapy is not advisable, at least with regard to the permanent teeth. Intermaxillary rubber bands seem advisable for the production of any change of occlusion, as their force can be regulated individually and any traumatic damage can be excluded.

The mentioned results of our experiments have, of course, influenced the human therapy. Knowing the mechanism of the processes, one can use more suitable machines, simplifying and improving many orthodontic methods of treatment and sometimes obtaining reduction of the time of treatment.