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DIAGNOSIS and TREATMENT of OCCLUSAL RELATIONS of the TEETH

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Diagnostic Instrument: To make an accurate diagnosis of the occlusal relations of a patient's teeth we must have an accurate relational duplication of his oral mechanism. This dimensional copy is made in four steps: (1) recording the mandibular movements of the patient; (2) mounting the recordings on an articulator that is capable of duplicating jaw movements; (3) adjusting the articulator to retrace the recordings made by the patient; and (4) mounting accurate casts of the patient on the duplicating articulator.*

It should be emphasized that a set articulator is not a metal mouth. It is only an instrument that has recorded in it the gauged distances of each lower tooth from the three mandibular axes located in the condyles: (1) the opening-closing; (2) the right lateral, and (3) the left lateral rotation axes.

It also has recorded in it the paths in which these axes travel. These paths are accurately and constantly gauged in position and inclination respectively to the upper teeth. In other words, the axes remain in fixed relations to the lower teeth in all their movements, but the paths in which the axes travel remain constant to the upper teeth. The courses in which the opening-closing axis runs reciprocally down-and-forward and then upward-and-backward are commonly called the condyle paths. The courses in which the lateral rotation axes run outward-and-inward are called the Bennett paths, side shift, or lateral condyle paths. By mounting the upper cast in vertical relation to a horizontal reference plane (the axis-orbital: a modified Frankfort plane) we can incorporate the third dimension into the articulated casts.

Diagnostic Data: There are many intermaxillary and condylar relations concerned in an oral functional diagnosis. They involve both occlusal and condylar positions. We can have no full appreciation of the intermaxillary dental relations if we dismiss from our diagnostic studies the corresponding relations of the condyles to their fossae and their eminences.

In models correctly mounted upon the set articulator we have "tied" together the teeth and the condylar axes and paths. In any relative movement between the opposing teeth we can see how the condyles behave

*This technique is best demonstrated in a cinematic film.

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with respect to their fossae and eminences. This behavior cannot be seen at all by studying the occlusal relations directly in the mouth. Hand-held casts give us no information whatsoever about condylar relations and only untrustworthy information about the occlusal relations.

Incorrectly mounted casts or casts mounted on an articulator that does not reproduce mandibular movements can only misinform us, if we are lulled into believing whatever relations they do show. What we want in a mounting is true information about the harmony or conflict between occlusal relations and the corresponding condylar fossa-eminence relations.

In our experience, the joints can readily make painless temporary positionings to compelling tooth interdigitations if in the paths of normal condylar movements, but they will painfully refuse to make permanent adaptations to any changes in path directions or axes positions. However, if the joints accommodate by positioning to an eccentric intercuspation, the teeth suffer in wear and periodontal strain; hence, for both teeth and condyles it is better to have easy cooperation between them than a conflict which will require calling into action the defensive mechanism of the neuromuscular system.

Abnormal Occlusal Positions: The simplest, yet perhaps the most important, relationship to diagnose in the mounted casts is the occlusal interdigitative position of the mandible. It is often abnormal by being out of centric relation. By centric relation we mean that position of the mandible in which its opening-closing axis is rearmost and the condyles are fully retracted in fossal position. The occlusal interdigitative position of the mandible should be in centric relation. If it is, mouth closure can be made without tooth interferences and on the articulator the interdigitation of the teeth can be made without drawing the condyles forward.

If the occlusal interdigitative position is abnormal, interfering teeth strike first then guide the mandible bodily either forward or forward-and-laterally until an interdigitation is reached as the jaws are closed. In such closures, the condyles of the articulator are drawn forward and downward, usually unequally. In other abnormal closures, one condyle is shifted laterally and the other

inwardly-and-forward. The teeth causing the interferences are said to make premature closure contacts. These contacts are called prematurities. The teeth having premature contacts should be examined for facets of wear and their x-ray records should be closely studied.

Lateral and Balance Prematurities: If the teeth being examined have a semblance of bilateral balance or have been previously restored or ground into balanced occlusion, the diagnostician should put the mounted casts in lateral closure and observe how much the rotating condyle needs to advance to accommodate the acquired lateral interdigitations. At the same time he should examine the balancing side to ascertain if excessive balance affects the positions of the condyles. In such conditions the condyles may have to drop below the eminences to accommodate the closures.

Extreme Conditions: The overall diagnosis of a wrecked mouth requiring total rehabilitation is complex. Diagnoses leading to rational treatments of long neglected dentitions are made difficult by: (1) teeth being absent, or spaced, or irregularly extruded, or tilted, or worn off, or partly destroyed by caries, or improperly restored; (2) malocclusions in which the opposing arches are mismatched in dimensions and facial positions; (3) partly closed spaces caused by extractions or congenital deficiencies; (4) serious periodontal destruction; (5) open bites or deep overbites; and (6) mandibular joint disturbances. Any mouth afflicted by several such categories of ills demands a careful study not only of the individual teeth but also of their possible hindrance to good treatment. A dimensional survey of the mounted casts on an articulator will show the relation of the above mentioned difficulties in their perspective to the condylar movements and may indicate the plan of treatment.

Cuspids and Molars: In less extreme oral conditions it is essential to give added diagnostic attention to the restorative occlusal possibilities of the cuspids and molars. The conditions and the positions of the cuspids merit much more consideration than has been given them heretofore. How well their crowns can be restored into proper and esthetic antagonism should be thoroughly investigated.

Current Methods: Occlusal malrelations may be treated: (1) by orthodontic methods; (2) by equilibrations; (3) by restorative procedures; and, (4) by partial or total prosthesis.

Orthodontics is best applied to growing children whose teeth have cusps undefiled by wear and caries, whose peridontiums are healthy, and whose alveolar bone is immature.

Equilibration is applied to remove permuturities and thus to abate the conflict between condylar and dental relations. In adventurous hands it has been applied to establish bilaterally balanced occlusion, or a semblance of it.

Restorative procedures are commonly used to build the occlusal surfaces of the injured teeth to whatever unanatomic or unphysiologic occlusion that the opposing teeth may indicate. Such is a form of dental opportunism, for the restorations are made and inserted without regard to the principles of dynamic occlusion or to the consequences they may cause to the oral organ. If, however, restorative treatment is based upon a functional diagnosis of the oral organ, if the posterior teeth are resupplied with the cuspal elements of articulation, and if the ridges of the cusps are arranged to cooperate with the movements prescribed by the condylar motions, then the oral organ will become capable of functioning physiologically without hastening its own destruction. This recapitulation of the oral organ has been dignified by the term "rehabilitation." It is a requalification of the whole stomatognathic system.

If all or nearly all the teeth have been lost, an artificial occlusion is instituted. Even this occlusion requires and merits attentive professional care. It must be such that it does not dislodge the bases upon which it is installed. It should not transmit injury to the mucosa of the ridges. It should be created of lasting materials, for wear is always irregular and unbalancing.

Prosthetic Influence: Whether dentists have treated occlusal relations by moving them, or reshaping them, or by recusping them, or by replacing them, they have all been influenced by principles evolved by prosthetists. As is well known, the complete denture prosthetists have long emphasized the importance of interdigitating the teeth

in centric relations. They were first to recognize in a general way how variations in condyle paths affected occlusion. They have given much attention to the importance of the overjet and overbite. Even though they never obtain the degree of accuracy they desire in transferring patient-relationships to an articulator, they approximate it well enough to make use of such instruments. They worked out a therapeutic occlusion which has been applied in various degrees to natural teeth by the other specialists who deal with occlusal relations.

Balanced Occlusion: Balanced occlusion is a treatment of teeth invented by the prosthodontists. It is an arrangement of the cusps and blades of the teeth which permits most of them to have occlusal contacts no matter how or where they may close. If lateral closure is made, all the teeth on that side occlude and so do some on the other side of the mouth. If protrusive closures are made, most of the teeth make occlusal contacts. If test glides are made on an articulator, or in the mouth, balanced teeth can maintain occlusal contacts all the way from a lateral position to centric.

Such glides in no way represent chewing strokes. They are simply tests made to show that the teeth can have occlusion in all closure positions between the lateral stations and centric, or between a protrusive posture and centric. Balanced occlusion is not an arrangement of teeth which evolution has selected out of a multitude of trials as the best adaptation for natural teeth. It does not occur in the dentitions of young adults, but is mimicked in mouths whose upper cuspids became shortened by wear or were tardy in erupting. Calling bilaterally balanced occlusion a therapeutic arrangement of teeth does not necessarily discredit it, for often man's treatments improve the functions of organs.

Indications for Balance: In treating the edentulous, balanced occlusion, even though never accurately attained, is indicated. It is sometimes indicated in tooth replacements by partial dentures. In patients who have fairly healthy rooted remnants of most of their teeth but have cuspids so far out of position that they cannot be restored into proper antagonisms, the principles of balanced occlusion are applicable in rehabilitating their oral organs. A wide range of

balance that allows lateral enmeshments of the buccal cusps is the tooth arrangement of compulsory choice in these instances.

Contraindications for Wide Balance: For some time operators have been restoring natural teeth in wide balanced occlusal relations to a degree of accuracy that is impossible to attain in complete denture prosthesis. We have had enough experience so that we can now appraise the efficacy of such occlusal therapy. We base the appraisal upon the reactions of the patients and upon the fateful decline of the restorations inserted.

Patients' Reactions: Many patients accepted the balanced restorations with little expressed discomfort. At first they may have bitten the cheeks and the tongue severely because the edges of the cusps could enmesh upon them, but they learned to avoid such accidents. A number of patients complained that the long lingual lower cusps hindered their chewing. Operators would have to reduce the heights of these cusps enough to take them out of working balance in order to free lateral chewing. Some patients objected to the balancing contacts, stating that it disturbed their chewing. If they were chewing small particles on the right side of the mouth, they saw no reason why the teeth on the left side had to be colliding. If they were biting thin foods with the front teeth, they disliked having the posterior teeth interfering.

The posterior and the lateral balancing contacts may be called cross-mouth balance. Simultaneous occlusal contacts of the buccal and lingual cusps of opposing molars or bicuspid may be called cross-tooth balance. Patients felt that cross-tooth and cross-mouth balance robbed them of chewing freedom. Those patients who kept testing their occlusal relations by glides were conscious of friction. One patient stated graphically a complaint that others vaguely hinted at by saying that she felt as though she had lost her lower jaw. She could put so many teeth together in so many closures that it was hard to distinguish centric from other closures. A few patients, after wearing the restorations a few months, had maddeningly painful joints.

Fate of the Balanced Restorations: Balanced occlusions may not long remain balanced. They may wear out in a few years.

The tips of the cusps wear off; the curved sides of the cusps become faceted, then flat; the buccal edges of the lower buccal cusps become dulled, then broadly blunted. Many of the important transverse ridges are ground out of existence. The edges of the incisors also wear off. Remountings of worn restorations on an articulator usually show that the centric closure is lost. They also disclose that, if the casts are put into lateral closure, the rotating condyle will have to be advanced to suit the worn-in grooves.

Sometimes the mountings show that the balancing contacts wear at a slower pace than the working contacts, which is probably responsible for some of the joint pains, since the unworn or less-worn set up an imbalance that strains the condylar capsular ligament. The attempt to retard the rate of wear by creating curved surfaces on the occlusal sides of the cusps has failed. It is thought that this wearing is due not so much to chewing as to induced bruxism.

Cuspid-Protected Occlusion: The type of human dental occlusion which has the slowest rate of wear is that found in good natural dentitions—where teeth interdigitate in centric relation but have no cross-tooth and cross-mouth balance. In such dentitions, when the mandible is deflected laterally, the opposing cuspids are the only teeth that maintain a gliding contact; all the other teeth are held out of occlusion. And, when the mandible slides straight forward the only teeth maintaining gliding contacts are the lower six anterior ones against the upper incisors. In edge-to-edge incisal relations all posterior teeth are out of occlusion. In this natural tooth arrangement, if the patient should try to make the upper cuspid pass through the occlusal embrasure between the lower cuspid and the first bicuspid, he could not succeed. The lower cuspid would slide downward, outward and backward against the concave surface of the mesial half of the lingual surface of the upper. This action would separate the other teeth from occlusion and this action would prevent the cross-scraping of the buccal marginal ridges of the buccal cusps and the ruinous cross-scraping of the incisor blades. This seems to be a natural plan evolved to protect the ridges and the blades of the teeth. Since the cuspids perform this role, such occlusion we call "cuspid-protected."

Authorities: It is interesting that this natural arrangement, seen so often by observant practitioners, has never been suggested as a treatment goal for rehabilitating the occlusal relations. Those who have extensively studied good young mouths (Shaw¹, Jones², and D'Amico³) report that such dentitions do not have balance until deteriorated by wear.

Commenting upon the widely balanced occlusions of worn dentitions, Shaw states that the picture they present would be "a beautiful one if the prime function of the teeth were but to grind and deface one another and if the efficient comminution of food were a merely secondary function." He declares that "the supposed kinematic condition of extensive contact areas does not normally exist" and says that where it does the dentition has deteriorated. He stresses the importance of the "shearing" as opposed to trituration, saying: "It should be quite obvious that any masticating work done by two opposed surfaces must take place and be quite finished before these surfaces come in contact with each other. In the working of any such machine, natural or man-made, the contact and attrition of the tool surface is not in itself an end or a functional aim, but is merely one of the unavoidable results of the constructive limitations and restraints imposed by mechanical or physical laws. And if anyone seeks for beauty in design or a real cause for admiration, he will find it, not in Nature's supposed attempts to multiply contact areas, but in the wonderfully simple and effective arrangements by which useless contacts are avoided or kept down towards a minimum." Shaw did not state that the peculiar natural antagonism of the cuspids which he described protected the other teeth.

In 1925 in a display of skulls at the Southern California State Dental Association Meeting Spencer R. Atkinson showed in a mature dog's skull how, during its known puppyhood, the loss of an upper cuspid led, he thought, to the destruction of the cusps behind it. He propounded that cuspids give extended life to the other cusps by preventing their lateral enmeshments. Dr. D'Amico has recently repeated and extended the studies of Shaw and confirmed his opinions and findings.

Authors' Studies: About ten years ago we, independent of previous observations on

cuspid antagonisms, reached the mature opinion that cuspids are too important to be neglected in rehabilitations or be given the common ranking of other cusps. We had noticed in the good middle-aged mouths which had minimal cusp-wear that the cuspids had undergone little or no destruction. We had found in those mouths in which the cuspids had been cut off by wear or otherwise deprived of antagonism that the other cusps had been destroyed. We had long observed in the better dentitions that the cuspids prevent general intercuspatations in the lateral mandibular deflections. We concluded that cuspids are guard teeth that protect other teeth from self-destruction during gnashings or in lateral mastications.

To test these conclusions, we (Stuart) started restoring the crowns of the cuspids into natural antagonisms in patients who were beginning to have general attrition and saw that the cuspid "lift" halted the rate of wear. This treatment has had good patient acceptance and there has been no evidence that such restorations are injurious to the peridontium of the cuspids.

In rehabilitation work, whenever it is at all possible, we (Stuart) restore natural cuspid antagonism or their equivalents in order to protect the painstakingly reconstructed anatomy of the teeth.

Importance of Accurately Recorded Relations: Rehabilitating dentitions into a cuspid-protected occlusion requires more accurately recorded occlusal and condylar relations in the articulator upon which to fabricate the restorations than has been possible in previously used instruments. However, with the new recording instruments and duplicating articulators, we can overcome the inaccuracies of the past.

Centric occlusion is the cardinal principle of all total restorations. It has target attention because all cyclic chewing is directed towards it. Each chewing stroke should be unhindered or unhindered by tooth guidance. No cuspids, no incisors and no cusps should collide with, or rub, or touch opponents in these free cyclic strokes until near-centric is reached. The muscles, the condyles and the teeth should be so coordinated that freedom in mastication is possible.

The out-of-cycle articulative glides of the cuspids are important because they guard the other teeth when, for any reason, the

patient attempts to make extracyclic closures. The extracyclic protrusive glides of the incisors are also important because they take the other teeth out of occlusion. The incisors and the cuspids must participate in centric closure, have freedom to bite off food and at the same time act as barricades to extracyclic closures. This coordination is obtained by co-relating the cuspids and the incisors precisely with the lateral and the protrusive movements, respectively, recorded in the condylar controls. The lateral movement of the tip of the lower cuspid has incorporated in it the Bennett movement.

Since there is considerable opening involved in the cuspid glide, the Bennett control must be put upon the upper frame of the articulator to prevent an error. Since the straight protrusive path of the condyle often differs from the forward-downward-mesial condyle path, it must be recorded in the mounting if we are to properly relate the glides of the incisors. Because the heaviest occlusal pressures are exerted on the molars and bicuspid near centric, it is of utmost importance to have mandibular movements accurately reproduced in the articulator.

Important Details of Centric Occlusion: Since centric occlusion is all-important, certain details of it should be emphasized in restorations. Many of these details can only be instituted in cuspid-protected occlusion. Most upper lingual cusps should have fossa occlusion; even the lingual cusps of each upper bicuspid should occlude in the distal fossa of its lower opponent. Likewise, many of the lower buccal cusps should have fossa occlusion*. Fibers held firmly by two adjacent teeth are stretched across the transverse marginal ridges. These ridges, working with an opposing triangular ridge, can easily cut the fibers in two or mangle them. The way in which an opposing triangular ridge strikes the transverse marginal ridges not only cuts the food but prevents wadding of fibers between the adjacent teeth.

The amount of overlap of the restored upper cuspids will depend upon how much "lift" is required to clear the other teeth from occlusion in the lateral mandibular deflections. The amount of the overlap of the

*Shaw estimates that the area of the total intermaxillary contact in occlusion need not exceed more than four square millimeters.

upper incisors is a compromise; it must not be so much that they scrape edges with the lower incisors in the lateral cuspid glide. It must be enough so that they can "lift" all posterior teeth out of occlusion when edge-to-edge. The surface of the mesial half of the lingual surface of the upper cuspid restoration must be concave from tip to cingulum so that it is outside the lateral boundary of the chewing-cycle path of the tip of the lower cuspid in free mastication.

The lingual surfaces of the restored upper incisors also should be concave from edges to cingulum, so that they are out of the way of contact with the lower incisors in the free chewing cycles. In free chewing the buccal marginal ridges of the buccal cusps should not contact opponents but each lower cusp should shear past its opponents close enough to cut the food. This clearance can be determined during the fabrication of the cusps by using the restored cuspids in the gliding tests. The gliding of the molars and bicuspid is restricted to between one and two millimeters. These and many other important details of dental anatomy and natural occlusal physiology can be utilized in cuspid-protected occlusion but not in balanced restorations.

As before stated, the occlusal interdigitative position of the mandible should agree with the terminal hinge position and lateral interdigitation of the teeth should not cause the rotating condyle to advance from its posterior fossal position. If these conditions are not satisfied the teeth will guide the mandible into undesired closures and cause wearing off of tooth structure or degeneration of the periodontium, or both.

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