Occlusion: Understanding or Misunderstanding

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Often the matter of communication between an orthodontist and his referring colleagues seems lacking. In this era of heavy emphasis on occlusion, philosophies differ and misunderstandings result. The orthodontist has received criticisms by some facets of the profession for practicing iatrogenic dentistry resulting in dysfunctional symptoms in the patient. These accusations may at times have foundation but many other times they may not. In the absence of organic pathology, overt TMJ syndromes seem to develop in the presence of deflective malocclusion, particularly balancing contacts.[1,2] The patient may have a Class I occlusion in maximum intercuspal position and concomitantly have functional deflections resulting in neuromuscular accommodation. This may well result in clicking, pain, periodontal problems, etc. When the orthodontist examines a patient with a malocclusion, his objective in treatment is to correct it. Due to the malrelationship of teeth, incipient dysfunction of the TMJ and associated muscles may have begun prior to the first examination while the patient was completely asymptomatic. If the patient is finished with deflections remaining, he may develop acute symptoms that are then attributed to orthodontic therapy. This would be a case in which criticisms could find foundation.

To mitigate these pathologies and the accusations precipitated by them, it becomes imperative that the orthodontist be aware of a functional goal for which he wishes to treat attendant with the static one. Throughout treatment he should routinely test the functional positions of articulation as he does centric relation occlusion to assure proper treatment, i.e., working, balancing and protrusive. Mounting of diagnostic models on a semi- or fully adjustable articulator might be required, particularly prior to posttreatment equilibration. Assumptions that "settling in" will solve functional deflections should not be made. Special attention must be given erupting second molars since it is here that many destructive contacts are seen. Banding of these teeth to correct axial inclination may be mandatory.

Angle is credited with making the profession most aware of occlusion by presenting standards whereby a malocclusion could be compared with a normal. His classifications have been used as guides of orthodontic therapy since 1887.[3] Another excellent contribution has been made by Andrews.[4] His six keys give a well-delineated prescription for an ideal intercuspation of the teeth. However, these descriptions define only a static relationship and tend to ignore eccentric functional positions. Hence, the orthodontist tends to appraise the occlusion of a patient from a static viewpoint. He then utilizes this stationary position as his objective and may erroneously assume that ideal function will automatically follow.

It is the intent of this paper to present the current philosophies of function or articulation. Hopefully, they may be used as a reference to eradicate misunderstanding and enhance communication between orthodontists and referring colleagues.

There are essentially three concepts of functional articulation.[5] Each will be presented with a brief history of its development.

Bilateral Balanced Occlusion

Apparently the conjectures of the anatomist, von Spee, were passed down from generation to generation and accepted as truth. In a paper published in 1890 he portrayed the teeth of dry skull specimens to remain in contact throughout all excursions of the mandible. To do so he selected examples showing extensive attrition of the occlusal surfaces.[6] In the early part of this century, research in functional occlusion was done primarily by complete denture prosthodontists. Since it was possible to dislodge a denture if tooth contact was too heavy on one side during function, a balancing contact between upper and lower dentures seemed indicated. This conformed to von Spee's inferences. The idea of balancing contact was subsequently applied to the treatment of natural dentitions. The influence of this concept prevailed with most leaders in the field of restorative dentistry until about 1950.[7] However, many failures occurred when this technique was utilized in dentulous mouths.[2,8] The shortcomings may be due to the flexure of the mandible on the balancing side. As the condyle leaves its centric position and slides down the eminence, it is no longer braced by the temporomandibular ligament. The force of the muscles may then cause a slight flexure of the bone which results in an occlusion which is extremely difficult to keep in balance. Periodontal sequelae and bruxism are then the consequence. It is now generally accepted that bilateral balanced occlusion should be used primarily for complete denture prosthetics.

The requirements of bilateral balanced occlusion are as follows:

1. *Centric position:* All the teeth contact evenly when closed into centric relation. The anterior teeth contact lightly.

2. *Working side:* The maxillary buccal cusp inclines are in even contact with the mandibular buccal cusp inclines.

3. *Balancing side:* The teeth opposite the working side shall have a balancing contact between the lingual cusps of the maxillary teeth and the buccal cusps of the mandibular teeth.

4. *Protrusive:* Incisal edges of the maxillary six anteriors are in contact with the incisal edges of the mandibular eight most anterior teeth. There should be a balancing contact between the maxillary and mandibular last molars.

Unilateral Balanced Occlusion, or Group Function

About 1950 this philosophy was born out of restorative dentistry by Pankey, Mann and Schuyler,[5,9,10] and the periodontists who began equilibration by this technique.[2] This has become the basis for the restorative technique referred to as P-M-S. The elimination of balancing contacts from the bilateral balanced philosophy resulted in a unilateral balanced occlusion.

The requirements of unilateral balanced occlusion are as follows:

1. *Centric position:* All teeth contact evenly when closed into centric relation. The anterior teeth contact very lightly. The concept of long centric has been introduced which is a freedom of the mandible to move in *one* plane of space from its most retruded position to a point approximately .2-.5 mm anterior. The anterior point is delimited by a simple movement of the mandible from rest position to intercuspal position.[11]

2. *Working side:* The maxillary buccal cusp inclines are in even contact with the mandibular buccal cusp inclines.

3. *Balancing side:* There shall be no tooth contacts on the side opposite the working side.

4. *Protrusive:* The maxillary six anteriors shall contact the mandibular eight most anterior teeth in an edge to edge relationship. There shall be no contacts of any teeth posterior to the above-mentioned ones.

Disclusion or Mutually Protective Occlusion

Disclusion was formulated by McCollum, Stallard and Stuart from their gnathological society which began in 1926. The word gnathology was coined by Stallard, an orthodontist, to describe the study of the entire oral mechanism as a functioning unit. Their study group noticed the prominence of the canine in meat-eating animals and concluded that one purpose of the canine was to disclude or separate the posterior teeth during eccentric movements.[12,13] However, this group and their progeny of restorative dentists rebuilt mouths to a bilaterally balanced occlusion until approximately 1950.[7] The years around this date seem critical to the development of the two popular concepts, group function and cuspid disclusion.

The requirements of disclusion are as follows:

1. *Centric position:* All the teeth contact evenly when the jaws are closed in centric relation, also called the terminal-hinge position. The anterior teeth miss contact by a very small amount. Two thicknesses of .0005 mylar paper should meet some resistance when pulled from between the incisors at centric relation occlusion.

2. *Working side:* The maxillary canine should contact the mandibular canine. *No* posterior teeth shall contact at any point once the jaw leaves the immediate centric position. The objective is for the posterior teeth to disclude by .5 to 1 mm.

3. *Balancing side:* There shall be no tooth contact on the balancing side.

4. *Protrusive:* There shall be no posterior tooth contact when the maxillary six anterior teeth contact the eight most anterior mandibular teeth in an edge to edge position.

It should be pointed out that in each of these concepts, the maximum intercuspal position assumes the condyles of the mandible to be in a rearmost, uppermost, and midmost position in the glenoid fossae or centric relation occlusion. The ideally occurring intercuspal position seen naturally is one termed a cusp-embrasure relationship. This is slightly misleading since it connotes each mandibular buccal cusp and each maxillary lingual cusp of the premolars to occlude in an opposing embrasure. In reality, a cusp-embrasure relationship ideally places the mandibular premolar buccal cusps in opposing embrasures but the maxillary premolar lingual cusps are in the distal fossae of the mandibular premolars.[4] The mandibular first and second molars have the mesiobuccal cusps in embrasures and the distobuccal cusps in opposing fossae. The maxillary first and second molars have the mesiolingual cusps in fossae and the distolingual cusps in embrasures. The second intercuspal concept is called a cusp-fossa occlusion. Ideally, it is used by restorative dentists and places each mandibular buccal cusp and each maxillary lingual cusp in an opposing fossa, or a one tooth to one tooth ratio. This includes the molars and is said to insure stability of the rebuilt occlusion. However, to achieve this phenomenon, it places the molars in an end-to-end relationship resulting in a varying amount of anterior overjet. The restorative dentist would have only the canine contacting in disclusion due to the resulting overjet by building to a cusp-fossa concept. If the orthodontist utilizes disclusion, he may well have the incisors contacting also

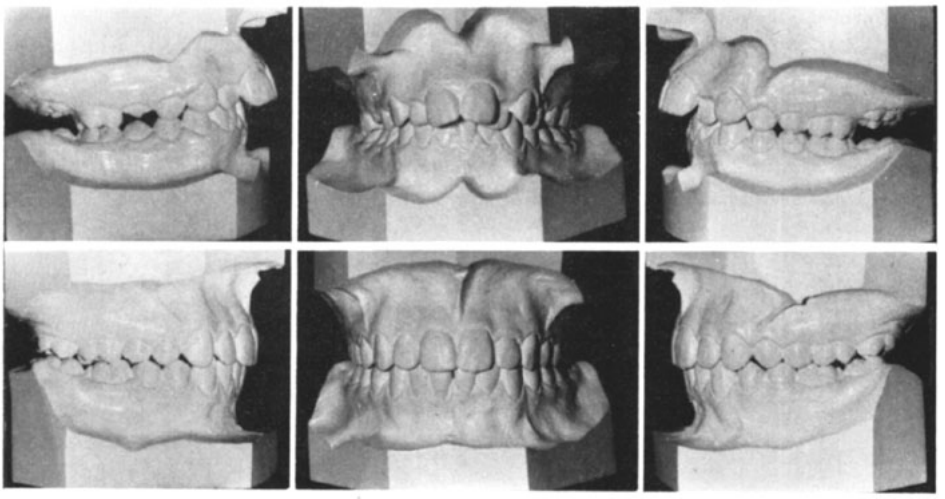

Fig. 1

in function because of his fully corrected Class I molar position.

It is beyond the scope of this paper to argue the pros and cons of the preceding philosophies since the purpose here is to present the current available concepts. Let it merely be said that cuspid disclusion is the one most often seen in today's naturally occurring young adult dentition.[14] Problems are ambient in the treatment of an orthodontic case. To attack the problem effectively, there is a need to know where we are going before we begin. It is for this reason that growth predictions are needed in planning treatment. It is also for this reason that a functional goal, and testing procedures for it, are needed concomitantly with the static goal. It seems the only logical method the orthodontist may use in the thorough treatment of his patients and in vindicating himself in the eyes of his colleagues.

A clinical example follows which is typical of the patients seen in our clinic and emphasizes a need for more critical evaluation of functional movements throughout treatment. The pursuant symptoms described were caused by subtleties in the articulation which require an integrated insight to function prior to correction. They also exemplify treatment which we as orthodontists should be able to render for our treated patients. It is our responsibility, in this era of expanded knowledge, to thoroughly treat the patient rather than sending him back to the referring dentist unaware of potential occlusal disharmony.

A tweny-one year old female was referred to the orthodontic clinic by her private orthodontist. Her chief complaint was clicking in both temporomandibular joints, very limited opening and soreness around the ears. The duration of her symptoms was two years. At age eleven she had received headgear and full-banded treatment which lasted three years. Her case was diagnosed as Class II, Division 1 with ten millimeters of overjet (Fig. 1). Treatment was nonextraction except for third molars which were extracted following therapy. A thorough history was taken which revealed no complications from trauma or systematic disease. Radiographic examination showed no pathologies and no severe asymme-

tries. A muscle palpation test indicated the right lateral pterygoid muscle to be hypersensitive. The left masseter and medial pterygoids bilaterally were slightly sensitive. Clinically, the occlusion revealed a very slight deflection from centric relation to maximum intercuspation.

The patient was diagnosed as having a dysfunction syndrome and a full coverage, acrylic maxillary bite plane was constructed. It was made so that all mandibular teeth contacted in centric relation occlusion and the anterior teeth immediately discluded all posteriors coincident with mandibular movement away from the aforementioned position. She was instructed to wear the bite plane at all times except when eating. All clinical patients with obvious dysfunctional symptoms wear the bite plane 4 to 6 weeks prior to occlusal analysis. This insures muscle relaxation and irradication of detrimental neuromuscular reflexes. It also acts as a differential diagnostic tool. For example, if the appliance alleviates pain and discomfort, malocclusion is probably the primary etiology and can therefore be treated by the orthodontist.

One week later the patient returned and was examined. More anterior deflection was noted indicating some immediate muscle relaxation. Clicking in the joints had decreased and the muscle palpation test resulted in marked improvement. She was seen weekly for four weeks. All tests were negative at this time with the exception of minor clicking upon opening. At the next appointment the patient was pantographed using a Denar pantograph and an interocclusal record was made using zinc oxide eugenol paste and utilizing a small acrylic anterior guide. This method tripodizes the mandible on its two condyles and the acrylic between an upper and lower incisor. The condyles are therefore seated upward and posteriorly in the fossae by the muscles themselves. The anterior acrylic was adjusted so that the vertical dimension was closed to a maximum with no tooth contact. The models were mounted on a Stuart fully adjustable articulator and an occlusal analysis was done. An equilibration of the models was completed by finding the deflections in a sequential manner using .0005 inch shim stock material and then marked with articulating ribbon. A step-by-step list of corrections was made which could be correlated with the deflections found in the patient's mouth at the time of clinical treatment. The accuracy of the mounting could be tested in this manner. It was discovered that the patient needed a small amount of occlusal adjustment. The primary prematurities occurred on the balancing side second molars during mandibular excursions. These deflections were observed to be on the mandibular molars just lateral to centric relation occlusion and were the result of a more than average immediate side shift of the mandible. This enigmatic movement occurs as the mandible makes a bodily motion prior to the beginning of translation of the balancing condyle on the posterior surface of its eminentia. If the lingual cusps of the maxillary posterior teeth are firmly seated in the fossae of the mandibular teeth, and if the inclines of the mandibular cusps are steep, a collision will result with movement in the presence of an immediate side shift of the condyles. This occurs if there is no anterior guidance to disclude the posterior teeth (Fig. 2). However, the anterior guidance itself must also be in harmony with the immediate side movement of the mandible. When it is not, the muscles may overpower the anterior teeth and force the mandibular cuspid lingually to cause crowding or periodontally loosen the maxillary cuspid with bone loss

Fig. 2 Indicates the immediate movement of the right balancing condyle from A to A' prior to any translation down the eminentia. At A', translation begins. Correspondingly, the effect of this motion at the molar tooth position is nearly a one to one ratio from A to A' on the mandibular right molars as they move lingually. This occurs before the teeth are lifted apart by translation of the balancing condyle. The darkened area schematically represents an area of potential interference which precipiated dysfunctional symptoms in the patient. This malarticulation would have been virtually impossible to diagnose without a properly mounted set of models.

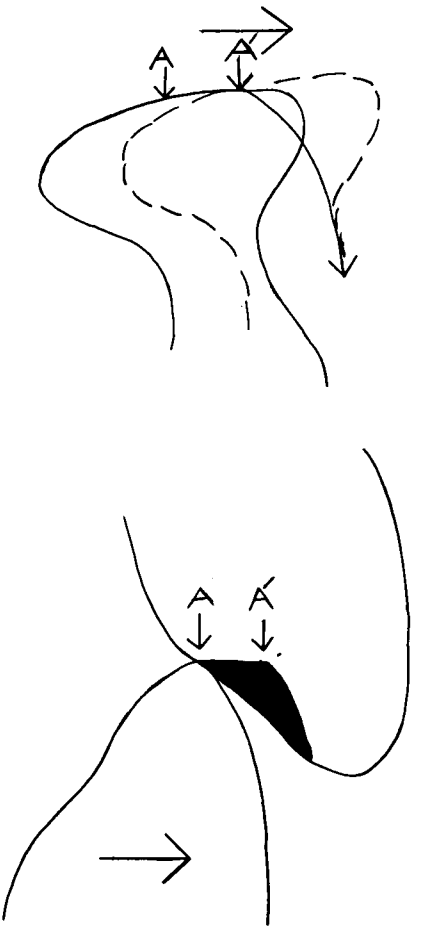

Fig. 3 Represents the immediate movement of the right balancing condyle from A to A' prior to any translation down the eminentia. Correspondingly, the effect of this motion on the opposite side or left cuspid is indicated from A to A'. The left cuspid and incisors act as the discluding factors when the mandible executes a left working movement. The darkened area depicts tooth structure which may require adjustment to prevent crowding of lower anteriors or looseness of the maxillary cuspid.

(Fig. 3). Clearance must, therefore, be made by means of equilibration.

Side shift can only be programmed into a fully adjustable articulator and subsequently, using the mounted models as a guide, accurately equilibrated in the patient's mouth. The clinical symptoms of this patient may be explained in the following manner. To prevent collision of the teeth due to the large side shift, the muscles were required to slightly open the mandible. Since the lateral pterygoids are the muscles most active in the initial opening, they became fatigued by overwork, hence, spasm and ischemia.[14] The spasm caused the limited opening and ischemia. The blockage of venous flow did not allow the by-products of muscle metabolism to be carried away and, specifically, potassium ions accumulated which irritated free nerve endings.[15] Muscle pain ensued. Clicking in the joint was subsequent to asymmetric contraction of the two heads of the lateral pterygoid muscle causing the meniscus and the condyle to move with incoordination. The clicking, therefore, was a product of the condyle sliding over the edge of the disc.

The patient was equilibrated to a disclusion philosophy making allowances for the side shift on both the posterior and anterior teeth. The same procedure outlined for the adjustments on the mounted models was followed clinically. Centric was adjusted first; however, some knowledgeable practitioners equilibrate the lateral excursions before doing centric. In this case it was decided to approach the problem contrarily due to the large amount of side shift present. When all stamp or centric holding cusps (lingual of the maxillary teeth and buccal of the mandibular ones) would hold the .0005″ shim stock material and the vertical dimension was closed so that centric relation and centric occlusion were concurrent, the initial phase was considered complete. Blue articulating ribbon was used to mark all centric stops and the subject was not allowed to move into eccentric positions at this time. Next, red ribbon was utilized to re-mark the same holding cusps superimposing the blue marks. Then with an operator-guided movement the patient was assisted into a left working and right balancing position, the red ribbon being placed on the right side. Since the philosophy of disclusion prefers no contact of posterior teeth on any eccentric movement, any marking of red in the fossa of the mandibular teeth not coincident with the blue centric mark indicated a deflection outside of centric relation occlusion. It was removed using a fissure bur and high speed air rotor. The procedure had been done on the diagnostic models and, hence, was a simple matter to duplicate clinically. The fossa of the mandibular tooth was widened to allow for the side shift. As the right balancing condyle moved down the eminentia, the teeth began to move apart. This demonstrated the progressive side shift or Bennett movement. At this stage the supplemental or developmental grooves on the inclines of the cusps were deepened and improved as an escapeway for the maxillary lingual cusp. Centric holding cusps are never shortened.

The anterior teeth are considered a critical guiding factor. They must work in harmony with the movements dictated by the condyles. The canines and incisors are in ideal position to undertake this assignment. They are the farthest forward from the fulcrum of the muscles. A similar adjustment for side shift was made on the lingual surface of the maxillary canines and incisors. They were evaluated digitally for movement eccentrically and tested with shim stock and marking ribbon. Their adjustment was judged complete when

they slightly contacted in centric relation and continued their contact on the working side to disclude all posterior teeth eccentrically without apparent movement in the alveolus. The patient was finished with an occlusion which was stable in centric relation but free in all excursions guided by the anterior teeth. She was seen routinely for one month, the casts remounted, and slight final adjustments were completed. All symptoms remained in remission.

Even though this subject would be considered a good orthodontic result from traditional static models (Fig. 1), dysfunction developed. Roth[1] has emphasized the importance of second molar deflections from his studies. The patients seen routinely in our clinic with these symptoms seem to reemphasize this area of neglected treatment. This clinical example points out the subtleties of minor deflections that may cause dysfunction in a patient with low tolerance.[2] It also indicates a need for critical understanding of functional movements by the orthodontist and continued observation throughout treatment. The majority of these problems may then be corrected by archwire adjustments or banding of additional teeth, i.e., second molars. A quick mounting on a simple articulator midway through treatment for assessment, or a change in treatment plan may also be required. Each patient's models need not be mounted on a fully adjustable articulator at the end of treatment if functional goals are well understood, employed, and tests made to insure these ideals with the first band placement.

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