The Function of Mastication: Implications for Occlusal Therapy

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A theoretical discussion of mandibular kinetics during incision and mastication has been previously presented.[1] The observations detailed in the aforementioned study should initiate critical discussion of occlusal treatment based only on the patient's execution of protrusion and lateral movements. The clinical differences between the classical and the functional occlusal approaches are compared to assess their impact on the occlusal equilibrium and the treatment of temporomandibular disorders.

DEGLUTITION

If the intercuspal position of the patient is unsteady or disrupted by a dental interference on the closure path, the neuromuscular system is compelled to address the disruption in order to function. The system adapts a path of closure to avoid the obstacle and establishes a steady functional intercuspal position, or the mandibular rest position is modified in accordance with the new intercuspal position. If these adjustments exceed the adaptive threshold of the masticatory system, a craniomandibular disorder may result.

While the premature contacts may be "hidden" by the patient as he or she avoids the antagonizing movement, several techniques can be utilized to detect their presence. Manipulation and swift, repetitive movements are often used in this manner, although the authors prefer to utilize an anterior deprogramming device. Interposing a jig along the closure path for several minutes allows the clinician to cancel avoidance and adaptive reactions generated by the central nervous system (CNS) of the patient.[2,3] The jig, which is fabricated of resin, promotes the symmetric relaxation of the patient's masticatory muscles.

Once the patient has been relaxed and deprogrammed with the jig, he or she occludes directly against the premature contact that was previously "hidden."[3] Following the completion of occlusal correction using progressive subtraction, the dental contacts must be reestablished to reflect simultaneous and equal balance on a maximum of teeth during deglutition.

MASTICATION

Incision versus Protrusion

During the process of mastication, several dissimilarities are evident between the incision and protrusion movements. Due to the activity of the elevator muscles, the occlusal contacts and guidance are significantly more important during incision than protrusion. When exposed to the activity of the antagonist muscular groups,[1] the spatial

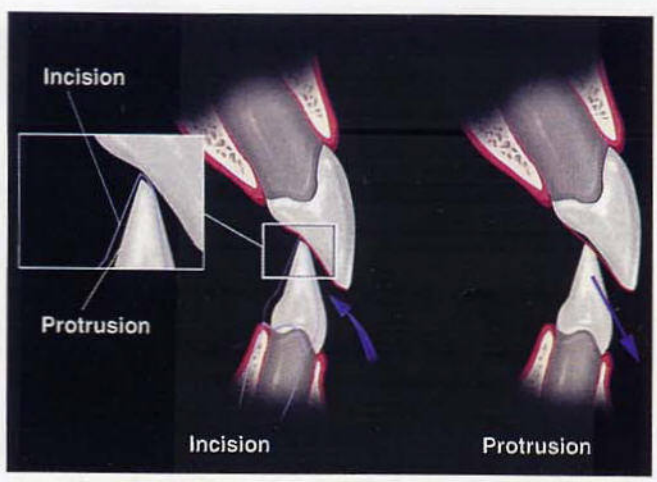

Figure 1. While the inferior incisors seem to pass over the palatal concavity of the superior incisors during protrusion, a well-marked guidance is present during incision.

Figure 2. Buccal view of 3 rigidly connected ceramometal crowns, placed on implant-supported restorations (TPS Cylinder, Steri-Oss, Yorba Linda, CA) at sites #7 through #9.

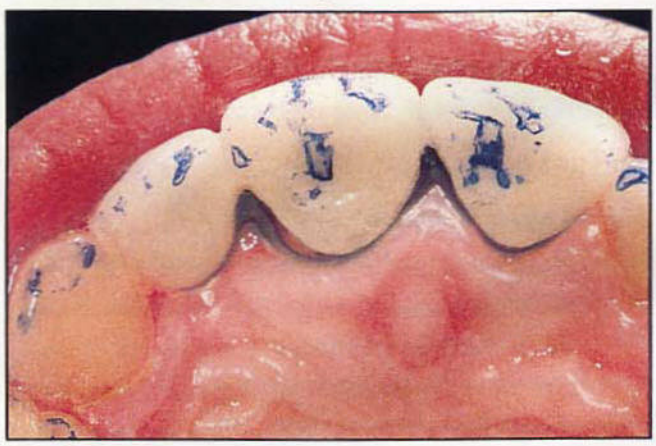

Figure 3. Following equilibration in maximum intercuspation, protrusion movement is effected on articulating paper; the guidance appears to be poised on the two central incisors.

position of the mandible is slightly different and the dental paths of the two movements are different:

- During incision, the contacts and guidance are well marked between the edge of the mandibular incisors and the palatal concavity and cingulum of the maxillary incisors, whereas during protrusion they seem to "fly over" the anatomical landmarks (Figure 1).
- During incision, the posterior maxillary and mandibular teeth are in closer proximity, while they are well separated during protrusion. The posterior inferior teeth slightly contact the superior teeth for the majority of the incision process in order to provide proprioceptive information to the CNS.

When utilizing solely protrusion movement to examine functional anterior guidance, the clinician may neglect the overguidance contacts on the functional path of incision, since they are often not evident during protrusion. In the natural dentition, this phenomenon may be compensated for in part by the slight displacement of the incisors, due to their extensive physiological mobility. Conversely, lateral and/or axial mobility is reduced with conventional bridges and implant-supported restorations (Figures 2 through 5). As a consequence, overguidance contacts may become significantly more important,[4] as

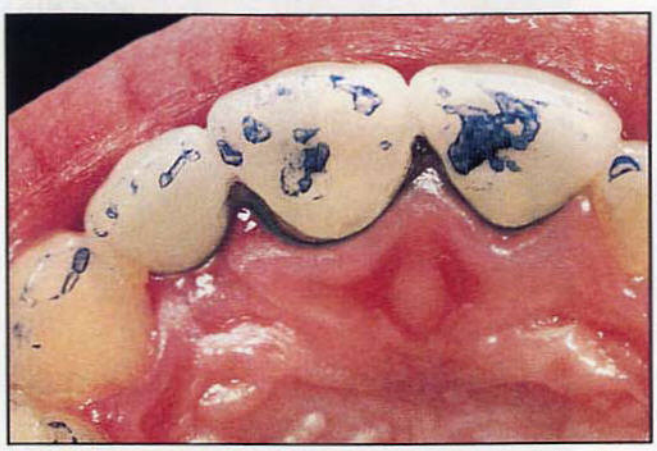

Figure 4. The incision functional movement is then effected on the same articulating paper: overguidance is evident on the palatal aspect of #9.

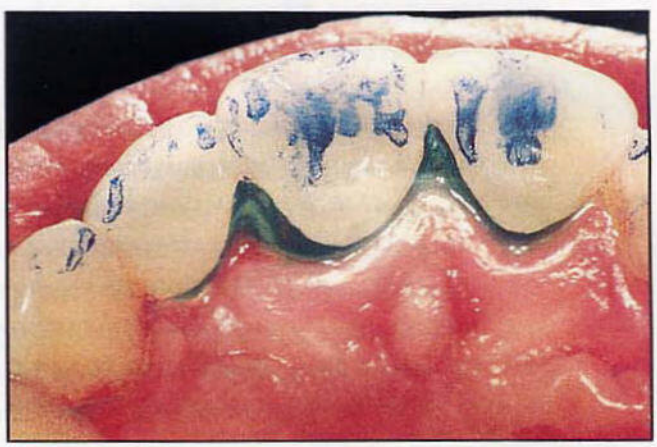

Figure 5. Following correction by subtraction, the incision movement is now harmonious and well shared on the palatal aspect of the two central incisors.

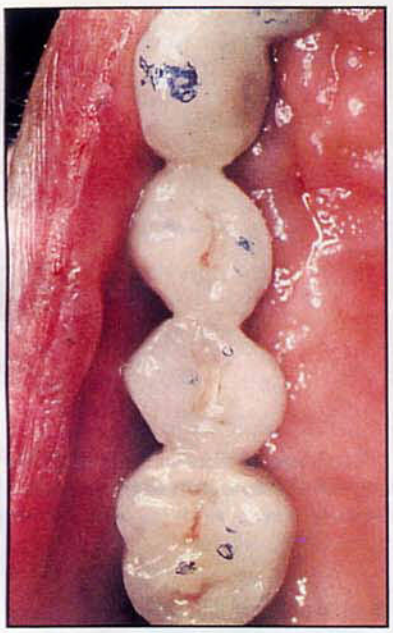

Figure 6. Equilibration of a fixed prosthesis supported by 4 natural teeth and 5 implants. Intercuspation contacts have been established and lateral movement has been effected. The cuspid guides the movement.

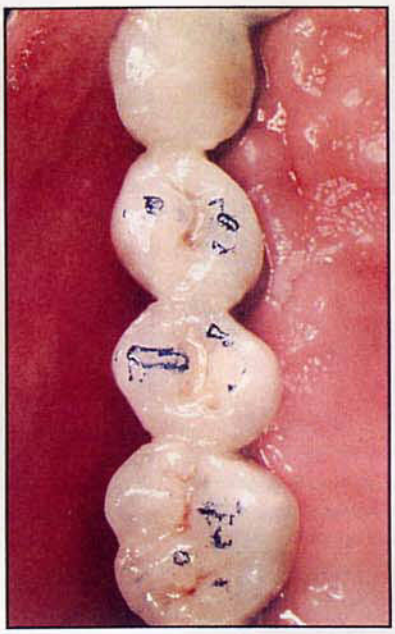

Figure 7. Simulation of mastication on articulating paper is requested of the patient. During "cycle in," overguidance appears on buccal cusp of tooth #4. Note the absence of guidance on tooth #6.

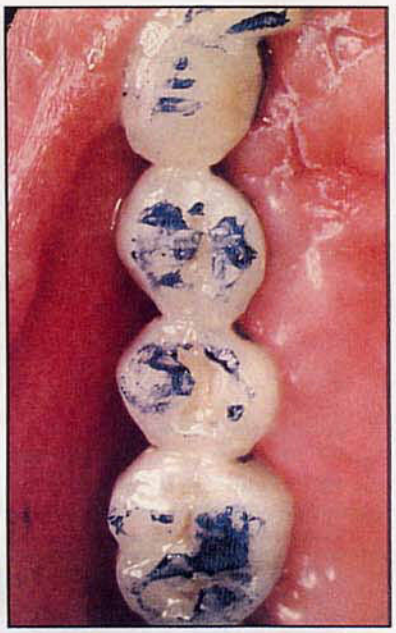

Figure 8. Following subtractive adjustment, mastication pathways appear balanced. Note an anterior overguidance that may be diminished on tooth #7 and #8 to ensure anterior functional interplay.

the mechanisms of avoidance can be impeded or canceled. At each incision or cycle of mastication, the teeth collide on the overguidance contacts. This collision occurs without the awareness of the patient and is consequently unavoidable.

Additional concerns must be addressed when examining functional anterior guidance. The attending clinician must provide sufficient anteroposterior functional freedom in the area of the maximum intercuspation contacts. This freedom is necessary to allow posterior trituration without anterior interferences or overguidance on the anterior teeth. Furthermore, a posterior interference may be evident during incision that cannot be detected by protrusive movement.

Dilaceration and Trituration Versus Lateral Movement

Lateral movement is generally guided by the cuspids on the corresponding side. During the mastication cycle, the spatial position of the mandible is slightly different in centripetal orientation, and the dental guidance is harmoniously distributed on the entire occlusal faces of the cuspidated teeth. Performing the lateral movement only to check the posterior functional equilibrium results in the following complications:

- The clinician is not able to determine functional posterior contacts and guidance during the dental entry ("cycle in") and the dental exit ("cycle out").[1]
- Detection of important interferences and overguidance contacts is possible; however, the functional guidance may be compromised. Overguidance, underguidance, or insufficient functional freedom may result from this complication (Figures 6 through 8).

If the classical concept locating maximum intercuspation in centric relation is rigorously applied, the retrusion movement can be suppressed. On the masticating side, however, the "centripetal return movement" from a lateral retrusive position is a kinetic component of the dental

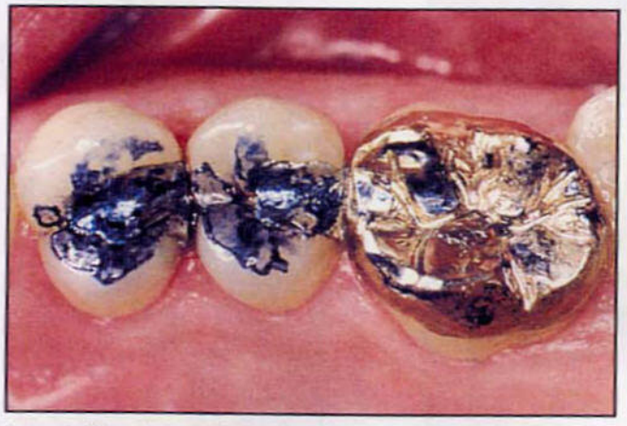

Figure 9. Flat palatine table developed for crown of tooth #14. Abnormal contacts are induced on buccal cusps of teeth #3 through #8 (on nonmasticating side) explaining patient's pain when masticating on the crown.

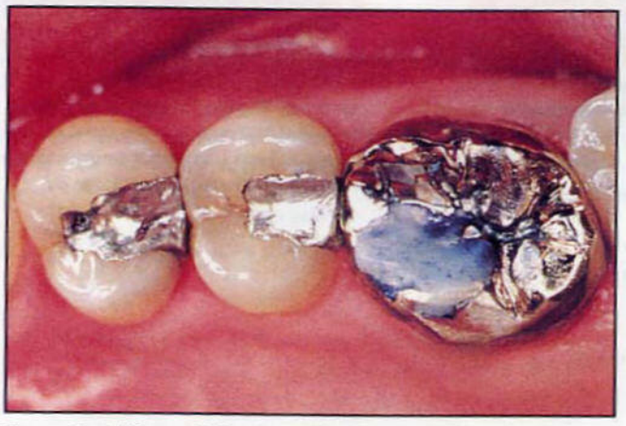

Figure 10. Adding and chewing self-curing composite resin allows the rehabilitation of the cusp slope of tooth #14 as a test and to suppress the nonfunctional contacts on the opposite side.

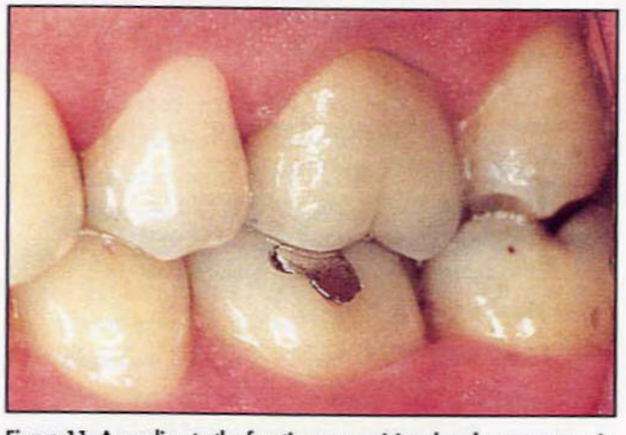

Figure 11. According to the function, a provisional and a new ceramic crown restoration have been fabricated. Note the physiological low position of the buccodistal cusp.

Figure 12. Occlusal view of the balanced mastication guidance of the new crown. On the opposite side, the contacts induced by the previous underguiding crown have disappeared.

"cycle in."[1] To deprive a patient of a part of this functional limit may cause the muscular pathways to alter the masticating cycle mesially to restore functional centric freedom. If the intercuspation contacts are too rigidly engaged, they may become overguidance contacts or functional interferences. Bruxism may result from the elimination of these complications.

CLINICAL CONSEQUENCES

Occlusal Equilibration

The identification and the restoration of functional contacts and occlusal guidance have become the principal objectives of the clinician; consequently, a modification of conventional diagnosis and treatment is necessary. Functional movements must be prioritized by the clinician. The topography of the functional dental guidance and contacts must be integrated into the identification of the occlusal anatomy. The terminology utilized to describe the mastication cycle must include the existence of slopes guiding the "cycle in," as well as the existence of tables guiding the "cycle out." In addition, the occlusal subtractive or additive techniques must be evaluated. These procedures must address:

- The excessive functional guidance or overguidance corrected by subtraction.
- The lack or the insufficient functional guidance or underguidance corrected by addition.

- The existence of interferences, which prevent functional contacts and/or guidance, generally corrected by subtraction.

Prosthetic Reconstruction at the Laboratory and in Clinical Situations

In order to allow adequate reproduction of mastication pathways, articulator setting must be determined by utilizing recordings of the functional movements and, as required, the articular cases modified for the same purpose. Advances in prosthetic rebuilding of occlusal surfaces, as well as improvements in the functional simulation capacity of the articulators, allow the clinician to go beyond anterior protective concepts and to ensure functional equilibrated posterior sectors.

Diagnosis and Treatment of Temporomandibular Disorders

The classical treatment of temporomandibular joint dysfunction requires the use of an occlusal splint to sedate muscle pain and spasms or to recapture the articular disk prior to the completion of an occlusal equilibration. Classical anterior guidance is rendered without addressing the effective guidance of the posterior teeth. The results of these treatments, however, range from unpredictable to poor (from 45% to 64% failure).[5] Thus, one should carefully reconsider the role of occlusion in temporomandibular joint dysfunction.

While the majority of these techniques consider the maximum intercuspation contacts (swallowing functional contacts), none of the techniques addresses the importance of the posterior dental guidance of mastication. Therefore, the assessment of the pathological consequences of a modification of posterior dental guidance provides several benefits. During mastication cycle, the patient experiences indirect and then direct guidance. An excess of guidance, considered as an interference by conventional techniques, causes muscle spasms and pain. It is frequently corrected by selective grinding, and the treatment is generally successful. Alternately, insufficient guidance — especially in the first molar area — induces a less promising clinical result. It generally induces a widening of the cycle, and this expansion may result in several bilateral consequences:

- On the triturant side, the disharmony between the dental and articular guidance may dislocate the disk by excessive contraction of the superior aspect of the lateral pterygoid muscle, with muscular pain or without.
- On the nontriturant side, the expanding cycle may provoke interdental contacts, which may be confused with nonworking interferences when applying classical treatment concepts.

A new treatment modality may then be proposed, addressing the lack of posterior guidance and suggesting its therapeutic rehabilitation, either by the addition of composite resin material on the occlusal slopes of natural teeth or by provisional modification of the existing prosthetic teeth (Figures 9 through 12). The material must be shaped prior to hardening and carefully equilibrated thereafter by simulation of mastication. Completion of this procedure allows the clinician to restore the functional equilibrium of the masticatory system and results in the achievement of definitive prosthetic restorations according to these principles.

CONCLUSION

An occlusal adjustment is not achieved by the blind application of a dogma or a corrective rule. Occlusal therapy must be initiated with a complete understanding of the peculiarities of the case and their consequences. Accurate evaluation of these consequences is essential. Comprehensive knowledge of the determining factors of the masticatory system (CNS, teeth, muscles, joints) must be obtained prior to the initiation of every occlusal procedure. The successful integration of kinetic principles to the understanding of the masticatory process and the restoration of occlusion has become a challenge for the clinician.

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