Clinical Implications of Mandibular Repositioning and the Concept of an Alterable Centric Relation in Dentistry

Philip H. Levy, DDS

Philip H. Levy, DDS
1359 Bellmore Avenue
North Bellmore, NY 11710

Graduate New York University College of Dentistry 1953

Former Assistant Professor Fixed Partial Prosthesis New York University College of Dentistry

Exclusive limitation of practice to Orthodontics, Temporomandibular Joint and Associated Neuromuscular Disorders

Assistant Professor Boston University College of Dentistry Department of Continuing Education

Charter Member: American Academy of Cranio-Mandibular Disorders

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Clinical Implications of Mandibular Repositioning and the Concept of an Alterable Centric Relation in Dentistry*

Current laboratory and clinical research provides dentistry with solutions to problems that have eluded solution in the past. It has become apparent that a unified system of harmonious interrelationships involving the dentition, opposing jaws, connecting and associated muscles and ligaments, and the temporomandibular articulation must exist to produce a healthy stomotognathic apparatus.

A malfunction, excessive or prolonged stress acting upon any of the components, inevitably is reflected to other components. The dentition is clearly identifiable as the foremost disrupting element to the system's homeostasis. The teeth and periodontal membrane normally provide proprioceptive guidance around which the other elements function. Dental malocclusion, because of its potential to create an adverse and stressed mandibular posture, causes a wide range of associated disabilities. An imbalance to the system's equilibrium commonly gives rise to pain and debilitation in regions far removed from the inciting factor, such as the head, neck or upper torso.

Historical Development

The retruded mandibular posture originally served dentistry as a useful method for obtaining duplicable interocclusal jaw relationships for the edentulous patient. Matching spatial approximation of the jaws, facial symmetry, closely related neuromuscular balance and temporomandibular joint considerations generally were not appreciated or given consideration in this approach. The retruded mandibular positional concept later was adopted for patients having their own teeth. Most such patients seemed to be **at** or **near** the retruded position when occluding their teeth. Dentists came to consider this relation a **physiologic** starting point.[12] The terms habitual, functional, convenience, or accommodated occlusion have been utilized to describe an intercuspation or mandibular position that was at odds with the retruded position. Patients whose intercuspation (centric occlusion) coincided with the retruded mandibular position before intercuspation (centric relation) were said to be in the **terminal hinge position.** The terminal hinge position of the mandible — and hence the condyles — enables opening and closing of the jaws in a repeatable rotary arch which has obvious value in recording a bite (Fig. 1). It also derives value by allowing laboratory articulator changes of the interdental space without the incorporation of anteroposterior occluding discrepancies (assuming the axis is transferred accurately from the patient to the laboratory instrument). Ultimately, efforts were made to measure and record all mandibular movements which an individual was capable of producing, and to utilize those measurements in dental or reconstruction procedures "as a means of establishing a balanced and atraumatic dental occlusion" (Figs. 2A and B).

Orthodontic Classification of Edward Angle

In 1899, Dr. Edward Angle established a system of orthodontic classification based on an **assumed** fixed relationship of the permanent maxillary first molar to the maxilla. The mandibular dental arch could occupy one of

*This paper updates a 1975 report from the **Dental Clinics of North America** entitled "Clinical Implications of Mandibular Repositioning and the Concept of an Alterable Centric Relation."[23] It incorporates additional information and emphasis regarding opportunities to *resolve* temporomandibular joint and myofascial pain dysfunction rather than providing palliative help. Long term clinical treatment results are presented for a number of patients presented earlier. Historic background is provided regarding commonly held views in dentistry in order to establish a perspective and background.

three possible anteroposterior positions in relation to the maxillary arch.

It should be emphasized that each of Angle's classifications also was determined with the teeth in centric occlusion and the condyles of the mandible in a **retruded** position.[6] Those who had normally matched maxillary and mandibular teeth and jaws (usually leading to a good facial profile) were designated by Angle as Class I (Fig. 3). Patients having a distoclusal relationship of their maxillary and mandibular arches (thus generally having retrognathic profiles) were classified as having one of several types of Class II malocclusion (Fig. 4). (Patients with Class II malocclusions often have been characterized as having underdeveloped mandibles). Those with an anterior crossbite or tending to have one, were given Class III designations (Fig. 5). Angle also described another type of malocclusion in which one side was in a Class I relation and the other side in Class II relation. He called these Class II subdivision cases. Interestingly, the Class II subdivision cases frequently have mandibular jaw midline discrepancies which are almost always accompanied by facial asymmetry (Figs. 6 and 7).

Thus we may see a disparity of jaws or of teeth, anteroposteriorly, transversely, and in varying combinations. In each classification, patients generally have individual centric occlusions which coincide with, or are reasonably near, their centric relations. Thus, it appears that each of us tends to have a particular centric relation at any given

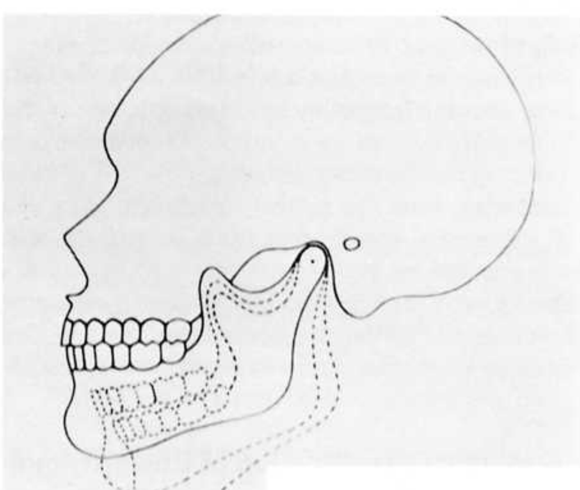


Fig. 1. Mandibular rotation in the terminal hinge position (Figs. 1 and 2 are reproduced from Lucia, V.O., **Modern Gnathological Concepts**, St. Louis, C.V. Mosby Co., 1961, pp. 41-56, with permission).

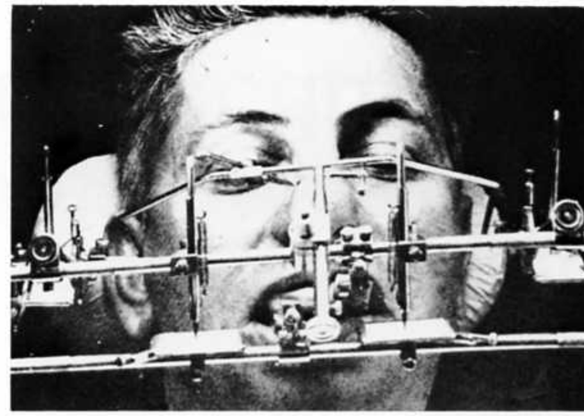


Fig. 2A.

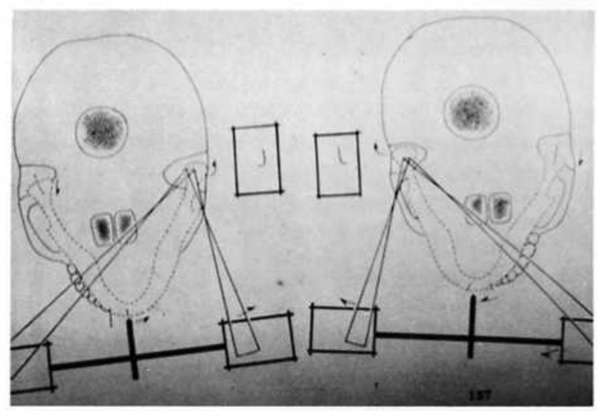


Fig. 2B. Pantographic tracings purport to "record a fixed envelope of motion characteristic of each individual which reflects the condylar path."

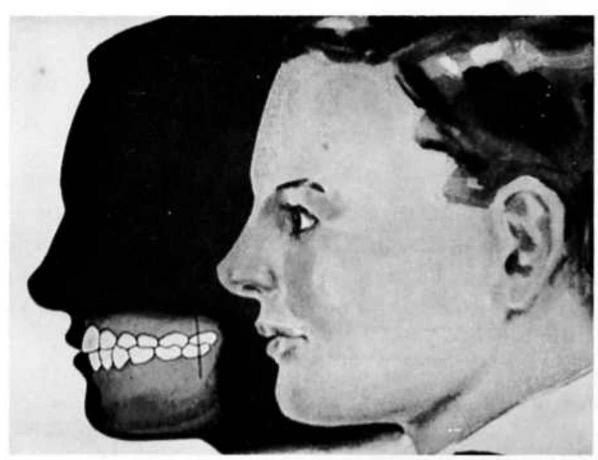


Fig. 3. Angle Class I occlusion displaying normal facial profile. (Figs. 3, 4 and 5 are reproduced from Best, E.J. (ed.). Visual education in dentistry. **Dental Dig**, 1964, with permission).

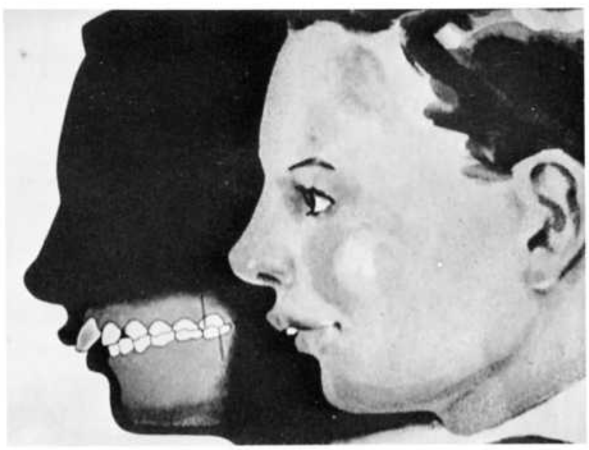


Fig. 4. Angle Class II, division 1 malocclusion showing distocclusal relationship of teeth and a retrognathic profile.

Fig. 5. Class III malocclusion with characteristic prognathic profile.

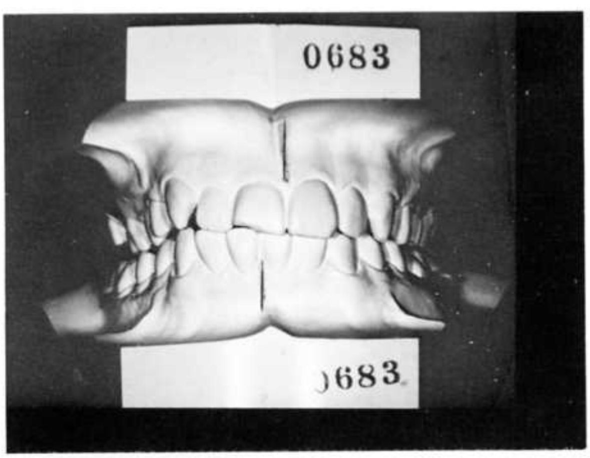


Fig. 6A

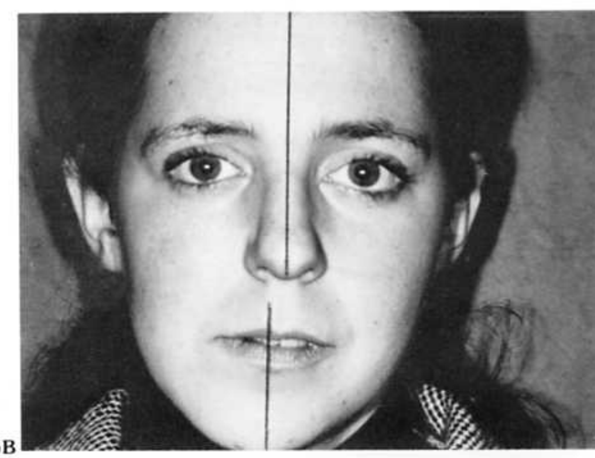


Fig. 6B

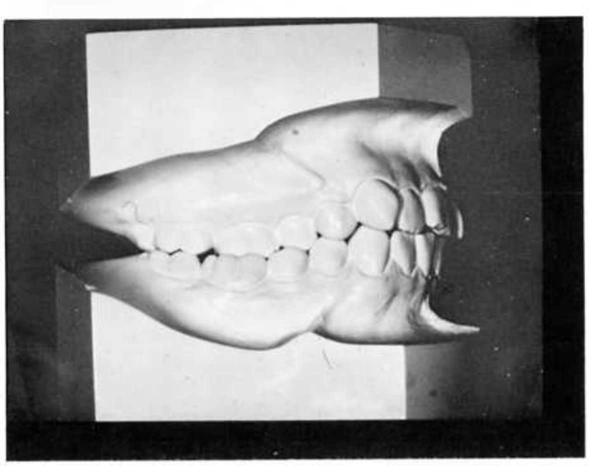


Fig. 6C

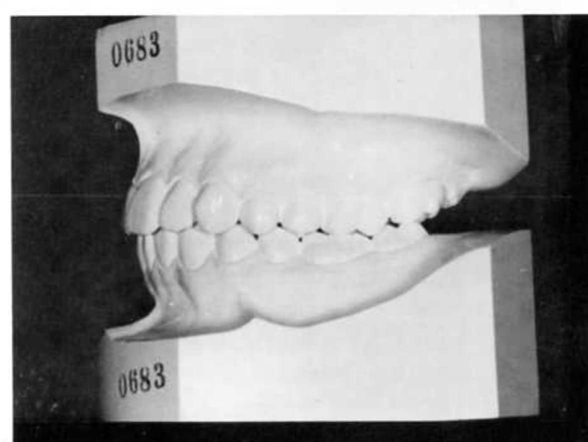


Fig. 6D

Fig. 6A. Class II subdivision example, displaying a jaw midline discrepancy to the right. Note that the maxillary and mandibular frena and central incisor teeth are not in alignment. **B:** Facial asymmetry common to many subdivision cases. **C.** Right posteriors in Class II position (and crossbite). **D:** Left side in Class I posterior position.

time. A key assumption in the history of dental practice has been the inherent nature and constancy of the condyle-glenoid fossa relationship and thus the constancy of the centric relation and the near constant centric occlusive position. **The assumption that each individual's centric relation had been derived and predetermined genetically marks the direction from which dentistry has evolved, and toward which diagnosis and treatment have been directed.**

Teeth, Neuromusculature, and the Temporomandibular Joints

Physiologically, the mandible is held in a sling of cradling musculature and ligaments (Fig. 8). It can be demonstrated that the developmental meeting of the maxilla and mandible that normally occurs **through tooth intercuspation** (Fig. 9) is readily influenced by local interference factors such as tooth malposition, narrowed arches, deviate habits of tongue, lips, etc. (Fig. 10). The condyles find their positions in the temporomandibular joint relationship as a result of the above. Centric relation develops as a temporary quasi-fixed position of the musculature in the **aftermath** of the determining occlusion. As such, each of us has a unique centric jaw relation that normally undergoes change throughout life and can be made to change radically if given the correct impetus. Further, the temporomandibular joints are universal joints which adapt and remodel readily over a broad area. Temporomandibular problems of various kinds frequently become evident when functional adaptability for the individual and physiologic form limits of the joints have been exceeded. (Figs. 19, 20, 23, 26, 27, 30).

The joints are thus the receptors of the mandibular positional determinants and not the initiating determinants of mandibular movements. Evidence is at hand to suggest that the concept of "centric jaw relation" (which has generally been regarded in rigid and fixed terms) will continue to serve the needs of dentistry, but in a broader perspective.

In view of the foregoing it is obvious that previously held views regarding occlusion, and derived assessments affecting diagnosis and treatment, require revision. It is necessary frequently to establish a provisionally correct matching of the jaws and teeth by means of a trial (As If) posture of the mandible while ignoring the occluding dictates of the teeth **per se.**

Fig. 7. When the interdigitation of posterior teeth (in the untreated case previously shown) is bypassed momentarily and the patient is guided to align upper and lower anterior teeth and frena in an "As If" corrected upper to lower jaw posture, the Class I side tends to pivot and remain Class I whereas the Class II side swings around to assume a potential Class I intermaxillary relationship (often with an open bite for that side). Utilization of an "As If" hypothesis helps to point the correct direction of treatment.

The **As If** hypothesis (Fig. 7) is of primary importance in diagnosis and treatment of conditions involving malrelated jaws in order to:

1. Pin-point the specific intermaxillary tooth contacts or arch form abnormality responsible for determining the existing centric jaw relation.
2. Identify the nature, regions and extent of tooth, arch form and mandibular postural changes required to bring about a cosmetically enhanced, stable and symptom-free resolution of the problem.

Begg's Investigation of Australia's Stone Age Man

Begg has shown that as Stone Age Man's dentition was reduced by attrition because of the abrasive nature of his diet, a compensatory mesial tooth migration as well as a continuous eruptive process maintained tooth to tooth contact and the intermaxillary distance.[1] Newly erupted permanent adolescent dentitions commonly display vertical and horizontal overlap anteriorly regarded as normal, and Angle Class I intercuspation; these tend to be transitionally replaced in the adult with occlusally flat and proximally narrower dentitions; the adult anterior tooth relationships changing to edge to edge and the arch to arch designation becoming Angle's Class III.

A less known study was done in 1930 by Begg on 834 aborigines' skulls. He measured the anteroposterior size of the specimen mandibles. Those having Class II, division 1 and Class II, division 2 designations were found to be not significantly different in size from those with Class I relationships (Fig. 11).[1]

The results of Begg's work with the dentitions of Stone Age Man are most valuable and illuminating, not as a rationale for the orthodontic sacrifice of teeth, but rather as an affirmation of the adaptive and changing nature of the temporomandibular articulation. Ironically, at first Begg did not recognize this fact, apparently believing the temporomandibular joint relationship to be static and fixed. He did not acknowledge that the mandibles of his specimens had migrated mesially together with the tooth to tooth migration, and that mandibular migration became possible only after the keyed intercuspation of the teeth had been eliminated thru occlusal wear. Were this not the case, we would not observe the adult Class III arch to arch relation-ship that had changed from adolescent Class I.

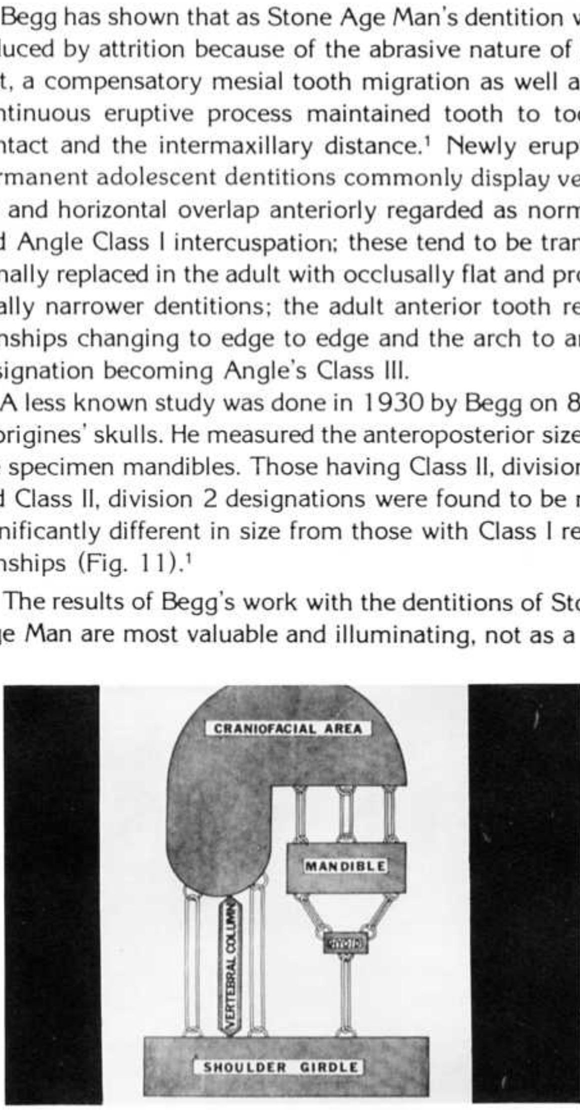


Fig. 8. Cradling or suspended representation of the mandible held to position by muscles and ligaments. (From Graber, T.M., Overbite — the dentist's challenge. **JADA** 79:1135-1145, 1969, with permission).

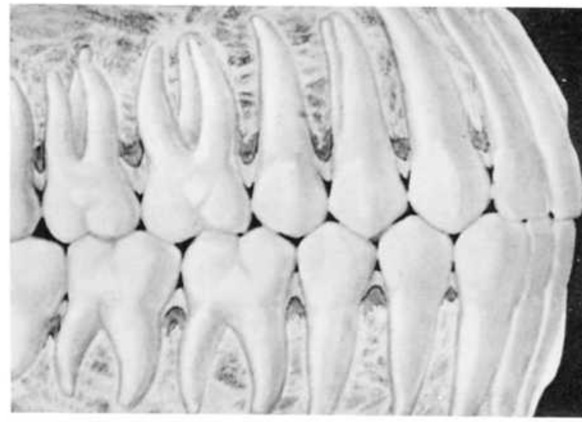


Fig. 9. Normally, tooth intercuspation and its interplay with the neuromusculature determines mandibular and condylar position.

Many dentists have had the experience of inserting satisfactory dentures which provided the ideal horizontal overlap for denture construction. Seen some years later, some of these patients were observed to be functioning in a protrusive relationship not explained on basis of ridge resorption and loss of vertical dimension. When the dentist tried to retrude the mandible to the "correct centric," he found that he could not do so. Close inspection usually would reveal that such patient's dentures had teeth with flat cusps that were not keyed to any specific bite. Adaptive changes had occurred in the temporomandibular joints, resulting in a new balance of the neuromusculature and a new maxillo-mandibular relationship similar to that noted in Begg's Stone Age Man.

Other Studies

In 1966, Blackwood observed, "Through a process of remodeling, the mandibular joint can and does adapt to

Fig. A

Fig. B

Fig. C

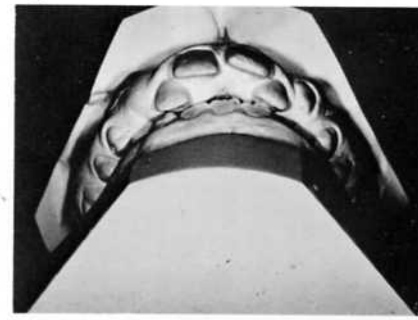


Fig. D

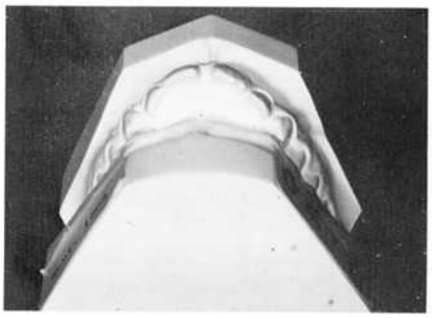


Fig. E.

Fig. F

Fig. G

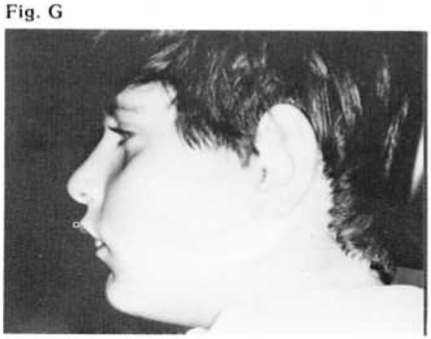


Fig. H

Fig. I

Fig. J

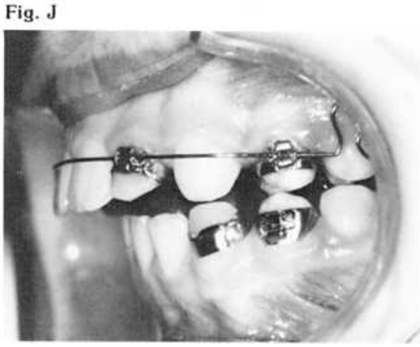


Fig. K

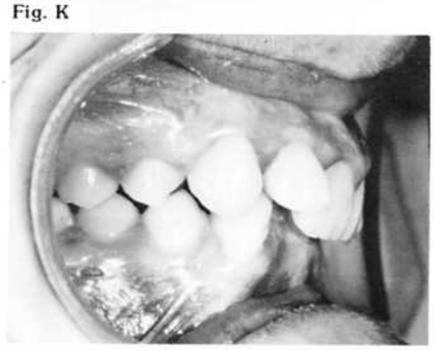


Fig. L

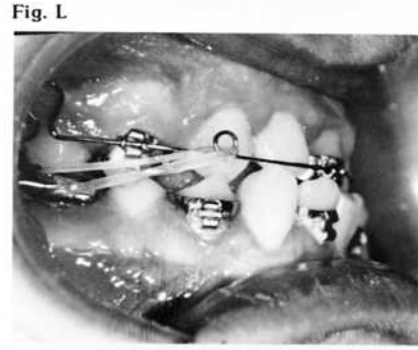


Fig. 10. Malocclusions. A. Class II division 2. Lingually tipped maxillary central incisor teeth have trapped the mandible in a dysfunctionally retruded position. **B.** Psuedo Class III. Lingually tipped maxillary central incisor teeth have trapped the mandible in a dysfunctionally protrusive position (typical midface deficiency type). **C** and **D:** Class II division 1. Narrowed maxillary arch usually in the canine and/or premolar areas or other obstruction will have caused the patient to shift the mandible into a dysfunctionally retruded position in his search for occlusive comfort and masticatory capability. **E:** Class II division 1. Finger habit associated with flaring maxillary incisor teeth, open bite, and retruded mandible. **F** and **G:** Class II division 1. Lip interposed between maxillary and mandibular anterior teeth has flared the maxillary teeth and caused the mandible to move distally. **H:** Typical instance of subdivision malocclusion in which the mandible has been deflected transversely by occlusive dicates. **I:** Girl, age 11.5 years, with Class I malocclusion at the start of orthodontic treatment. **J:** In midtreatment patient shown in **I** has assumed an unfavorable Class II maxillo-mandibular relationship resulting from her search to find a comfortable occlusion, thus illustrating an altered occlusive proprioception, neuromuscular balance, and a change of centric relation. **K:** Boy, age 12, with Class II division 2 malocclusion at the start of orthodontic treatment. **L:** In midtreatment patient shown in **K** had assumed an unfavorable Class III maxillomandibular relation due to the diligent use of Class II elastics and extraoral headgear.

changing functional requirements throughout life. From the dental standpoint, it is important therefore, when considering denture construction and rehabilitation, to bear in mind the remodeling activity of which the joint is capable. It is a frequent practice to construct complete dentures to a fully retruded position of the mandible and it would appear from these studies that this position may not be desirable if the optimal structure and function of the joint is to be maintained."[2]

In two independent articles appearing almost simultaneously, investigators have verified earlier findings of the adaptive and remodeling capacity of the temporomandibular joints in experimental animals by inducing malocclusions through forced abnormal maxillo-mandibular relationships.[8,20] (Fig. 10 I to L).

Many others since have successfully repeated these experiments. Rankow and Moss[15] have stated that the mandible is a combination of relatively independent functional cranial components, each composed of a functional matrix and a skeletal unit. Normal bone growth as well as the maintenance of osseous form are primarily a reflection of the mechanical requirements of the matrix. Briefly, the associated facial viscera, ligaments and muscles of the temporomandibular joint comprise the matrix required to carry out the function of mastication. The condylar process exists only as a skeletal unit supporting this functional matrix. The growth of any skeletal unit is secondary and adaptive to changes in the functional matrix.

Other investigators[3,5,10,13,14,22-32] have done important work in this subject. The foregoing has affected diagnosis and treatment planning significantly in almost all of the disciplines of dentistry.

Implications of a Fixed Centric Relation Concept in Orthodontics

In orthodontics, the philosophy of extraction therapy in Class II cases (that is, the extraction of premolars) is a direct outgrowth of a static representation of centric jaw relation. (Traditional orthodontics as it has been practiced in the United States in the past generally limited itself to treatment involving tooth movement exclusively). The orthopedic concept of a dysfunctionally retruded mandible capable of reorientation with a new centric jaw relation (and without the formation of a dual bite) has only recently been given somewhat more acceptance among American orthodontists.

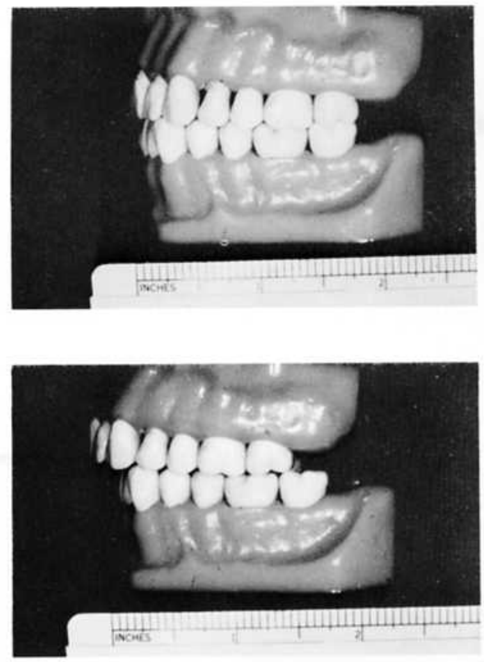


Fig. 11. Positional variance of the same set of models to establish a Class I or II maxillo-mandibular relationship.

It is a common practice in the treatment of Class II, division 1 malocclusions to extract a maxillary premolar on each side and to move the six maxillary anterior teeth back in order to "achieve an improved cosmetic appearance" (thereby maintaining the posterior Class II tooth relation and, of course, the Class II retrognathic facial form) or to extract four premolars, one in each quadrant. In this instance, by moving the six maxillary anterior teeth back as previously described and moving the lower posterior teeth forward, a Class I posterior intercuspation of teeth **may be** achieved. However, in both instances the mandible is treated as a fixed entity incapable of reorientation (Fig. 12). The result of treatment directed in this manner is a compromise, at times resulting in dished-in facial contour, unclosed spaces between teeth, possible future periodontal complications or temporomandibular joint problems, deepened bite with attendant recrowding of mandibular anteriors, root resorption from the torquing of roots, or open bite brought about by encroachment of the tongue volume space.

Adherents to a fixed centric relation concept in orthodontics, when discussing a successfully treated Class II malocclusion without recourse to extractions, have usually attributed such results to a large growth spurt, allowing

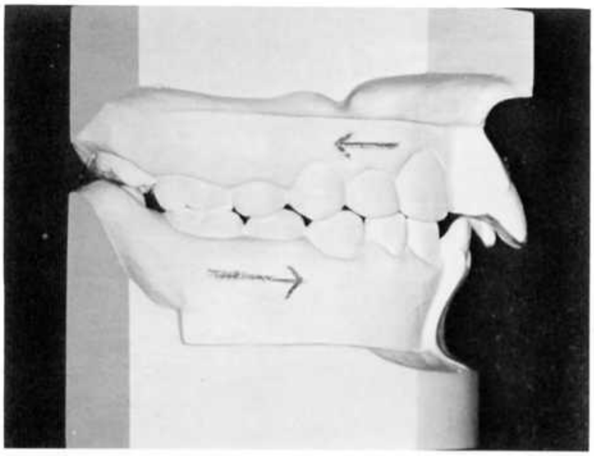


Fig. 12. Common orthodontic method of treating Class II division 1 patients involving the removal of four premolar teeth.

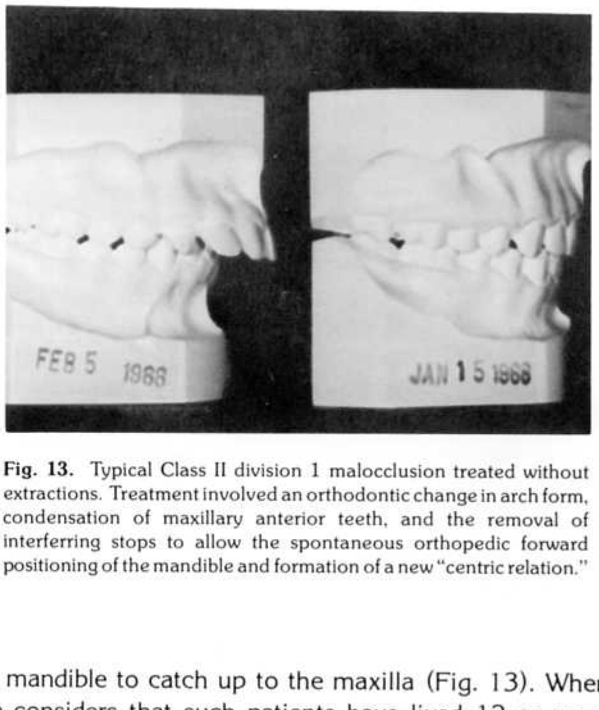


Fig. 13. Typical Class II division 1 malocclusion treated without extractions. Treatment involved an orthodontic change in arch form, condensation of maxillary anterior teeth, and the removal of interferring stops to allow the spontaneous orthopedic forward positioning of the mandible and formation of a new "centric relation."

Figs. 14A, B and **C**

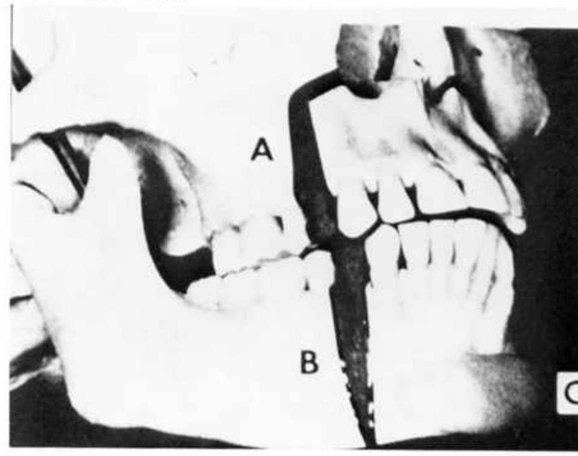


Fig. 14D

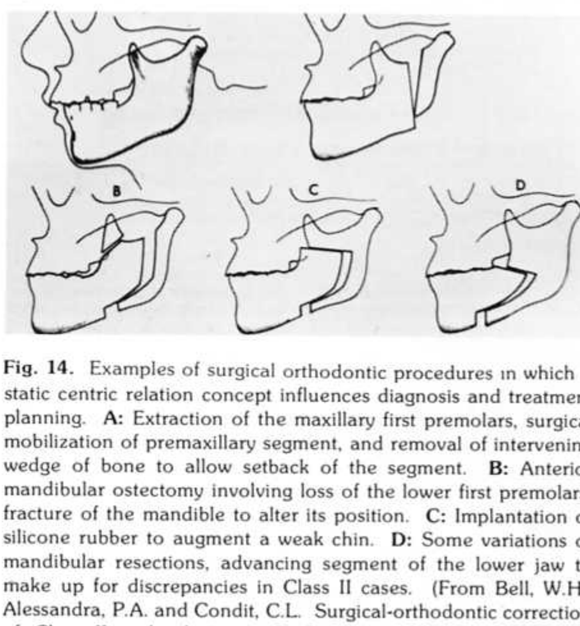


Fig. 14. Examples of surgical orthodontic procedures in which a static centric relation concept influences diagnosis and treatment planning. **A:** Extraction of the maxillary first premolars, surgical mobilization of premaxillary segment, and removal of intervening wedge of bone to allow setback of the segment. **B:** Anterior mandibular ostectomy involving loss of the lower first premolars, fracture of the mandible to alter its position. **C:** Implantation of silicone rubber to augment a weak chin. **D:** Some variations of mandibular resections, advancing segment of the lower jaw to make up for discrepancies in Class II cases. (From Bell, W.H., Alessandra, P.A. and Condit, C.L. Surgical-orthodontic correction of Class II malocclusion. **Oral Surg**. 26:265, 1968, with permission).

the mandible to catch up to the maxilla (Fig. 13). When one considers that such patients have lived 12 or more years with a gross malrelation of the jaws, and that major maxillo-mandibular relationship changes frequently occur in as little as three to four months of treatment, one must conclude that traditional concepts of growth do not appear applicable. Similar results can also be demonstrated in patients well beyond the normal growth years. (See Figs. 20-33).

Surgical Orthodontics

Surgical orthodontics has evolved principally under the influence of the Swiss surgeon, Obwegeser, who has devised techniques for moving about sections of either jaw surgically.[17,18] In patients with severe skeletal Class III caused by mandibular prognathism and in certain other limited conditions, orthodontics or dento-facial orthopedics may be of little help; for these patients the team effort of orthodontist and oral surgeon have provided satisfactory results when planned carefully.

In the situation involving a Class II or Class II subdivision malocclusion, however, the oral surgeon frequently holds views similar to those of many orthodontists about a fixed mandibular position, and develops procedures accordingly. He may also extract two maxillary premolars, surgically mobilize a segment of bone containing the six maxillary anterior teeth, and set the segment back after removing a wedge of intervening bone (Fig. 14A). The implantation of silicone to augment a weak chin is done (Fig. 14C). He may rotate anterior segments in open bite cases. He may elect to advance as well as retract a segment of the mandible in order to make up the discrepancy of jaw parts (Figs. 14B and D).

These procedures, in addition to entailing the risks of avascular necrosis, nonunion, devitalization of teeth, poor occlusion, open bite, temporomandibular joint involvement and postoperative relapse, are generally contraindicated on the basis of improper understanding of etiology. Most patients could and should have been treated orthodontically, including the functional orthopedic reorientation and development of the maxilla and mandible.

Lateral displacements of the mandible giving rise to facial asymmetry often may be caused by abnormal intercuspation (Fig. 6B). Such conditions may be misdiagnosed as condylar hypertrophy or hypotrophy affecting one side or the other. The retruded centric position forms a basic aspect of the diagnosis, and surgery may be selected as a means of correction, where it is not warranted. Of course there are instances of arrested or hypercondylar growth, just as there are true examples of micrognathia, but in the majority the abnormalities are postural and functional rather than skeletal.

Implications of a Static Centric Relation Concept in Crown and Bridge Reconstruction

An important subject worthy of review involves extensive prosthetic rebuilding of the dental arches. The Class II orthodontically neglected patient requiring full mouth reconstruction therapy represents a good case in point (Fig. 15). Such patients often have problems involving the temporomandibular joints or associated neuromusculature, or both. They may have other problems as well, such as reduced intermaxillary space accompanied by a deepened bite, or the lower anterior teeth may be hitting the soft tissue behind the maxillary incisor teeth inciting periodontal destruction. Significant overjet, retruded profile, and open mouth posture are frequent findings.

It is well known that grinding of the mandibular incisors to prevent them from traumatizing the maxillary lingual tissue is an expediency of temporary success as the teeth continue to erupt until they establish contact again.

Fig. 15. Mutilated dentition involving overclosure of the interdental space, dysfunctional retrusion of the mandible, and overeruption of the lower anterior teeth.

Increasing the vertical dimension with posterior crowns or onlays does not solve the inherent problems, although frequently it does **temporarily** allay discomfort in temporomandibular joints by placing the condyles in a more favorable position and achieving improved muscle balance. Raising the bite however, alters the crown; root ratio unfavorably from the periodontal viewpoint; equally important, the intrusive force of the musculature will usually assert itself to return the maxillo-mandibular distance to its original state (onlays and all). (See discussion page 115). Esthetics is likewise a problem in terms of the vertical and horizontal overlap as well as a continuance of the retrognathic profile. In the past, dentists have often extracted good maxillary incisor teeth and performed an alveolectomy, followed by the construction of a fixed anterior partial denture (set back to approximate the mandibular anteriors) in an attempt to "improve esthetics" (Fig. 16).

Reposturing the mandible to a clinically favored **as if** position determined by the anatomic factors present as an integral aspect of the reconstruction procedure, solves most problems posed by these conditions (Figs. 17A, B). If

Fig. 16A

Fig. 16B

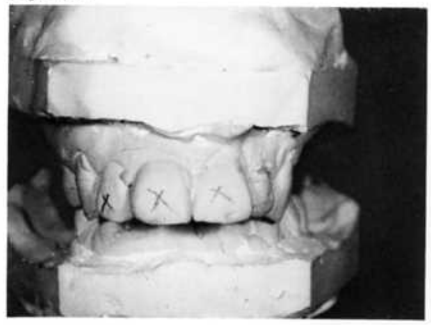


Fig. 16C

Fig. 16D

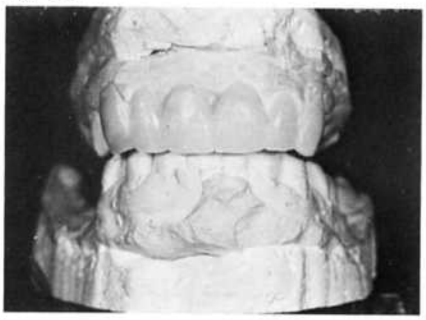


Fig. 16. Conceptually erroneous early attempts by the author to treat the patient shown in Fig. 15. Healthy teeth were extracted, an alveolectomy was done, and the wax-up of a fixed partial denture was set back to reduce the overjet and enhance anterior esthetics.

contact can be established with the cinguli of the maxillary anterior teeth with proper axial inclinations (usually possible unless the maxillary anterior teeth have flared abnormally), the following positive aspects may be realized (Fig. 17B):

1. Further extrusion of the mandibular anterior teeth will be arrested.
2. The maxillo-mandibular distance will be increased and stabilized as a result of two factors: more teeth present to resist the intrusive muscular force and — specifically — **anterior teeth** (those furthest from the lever fulcrum) are placed in a position to contact opposing teeth. Stated differently, an individual is capable of exerting approximately three times as much closing or intrusive pressure in the molar region than in the incisal. If one is capable of developing 15 lbs. of closing pressure in the masseter region, this is reduced to about 5 lbs. in the incisal. Here is found the basis for the dentist's ability to maintain occlusal vertical dimension prosthetically and to attain a nonmechanical and stable leveling of the occlusion orthodontically as well (See problem Fig. 18).

With the mandible repostured, the retrognathic profile obviously is improved, as are the conditions of vertical and horizontal overlap. Clear improvement or total elimination of temporomandibular joint and associated muscle problems are common. These patients of course retain their ability to retrude the mandible for a considerable time, as might be expected. Control of the situation requires that the newly established intercuspation be **definitely keyed** to allow the patient's musculature to establish a new balance and equilibrium, and time for the condyles and their fossae to readapt and remodel their relationships. The patient usually is more comfortable with the altered posture of his mandible. **(See discussion concerning The Levy Lingual Shelf**, pages 115 and 116).

Implications of the Static Centric Jaw Relation in the Treatment of Temporomandibular Joint (T.M.J.) and the Myofascial Pain Dysfunction (M.P.D.) Syndrome

Etiologic identification and treatment for a variety of seemingly unrelated facial, head, T.M.J., neck and upper torso disorders have been hampered by the traditional fixed jaw to jaw concept. A number of treatment modalities currently in use attain **symptomatic** relief for sufferers.

In our view, most temporomandibular joint or associated myofascial dysfunctions stem from dental malocclusion, the definition of which must not be limited to consideration of crowded, malaligned teeth or occluding premature contacts **per se.** Normal occlusion of teeth and healthy temporomandibular joints together establish a stabilized platform for the essentially free standing or floating mandible cradled in a sling of muscles and ligaments. It is reasonable to assume that a malrelationship of occluding teeth can direct the mandibular stance negatively for an in-

Fig. A

Fig. B

Fig. 17. A: Mandible tentatively advanced to effect anterior contact in a mutilated dentition displaying marked overclosure of the interdental space due to intrusion of remaining posterior teeth. Note open bite posteriorly as anteriors are brought into contact. **B: Reconstruction of the dentition of the patient shown in Fig. A by posturing the mandible forward and placing the uncrowned lower anterior teeth in contact with the exaggerated cinguli or lingual shelf of the crowned maxillary incisor teeth.**

dividual; this then subjects muscles or the T.M.J. (or both) to abnormal, unequal and sustained stresses. **Dental malocclusion, therefore, encompasses — and must be evaluated in terms of — the dentition, mandibular posture, neuromusculature and joints.** A further consideration is that an abnormal mandibular stance may be present in many planes, e.g., overclosed, retruded, transversely shifted, protruded, canted from side to side, antero-posteriorly rotated, or any combination of these.

Delineating T.M.J. disturbances with or without injury to the articular disc, associated with or apart from M.P.D., often has been uncertain. Diagnostic confusion may be heightened by symptom mimicry to many other conditions producing pain and occurring in the same regions, such as trigeminal neuralgia, atypical facial neuralgia, sinusitis, migraine headache, mandibular fracture, dislocation or subluxation, ocular and auricular involvement, rheumatoid arthritis, whiplash, ankylosis of the T.M.J., neoplastic disease, congenital and developmental anomalies, etc.

Treatment bias for T.M.J. and/or M.P.D. generally has reflected the orientation or specialization of the particular practitioner. Intentional, surgically induced permanent paresthesia has been used in cases of long standing pain effecting areas of the face, neck or back. Gold, steroids or alcohol also have been injected into the T.M.J. as treatment modalities. Local anesthetics have been introduced into the lateral pterygoid and other affected muscles. The use of analgesics, Valium, muscle relaxants, anti-inflammatory drugs, ethyl chloride spray, exercise, warm moist packs, occlusal grinding and increase in the vertical dimension with or without the prosthetic build-up of the posterior occlusal segments with crowns or onlays all have enjoyed favor and have their advocates. A mix of currently favored modalities, together with some of those listed above include: biofeedback, psychotherapy, chiropractic, acupuncture, applied kinesiology, electro-galvanic stimulation, ultrasound, and bite-plate and bite-plane therapy.

Fig. 18. Prominent curve of Spee results when the intrusive muscular force is greater than the eruptive force of the teeth posteriorly while the anterior teeth, lacking incisal contact, extrude. (Rather than a reflection of the condylar path).

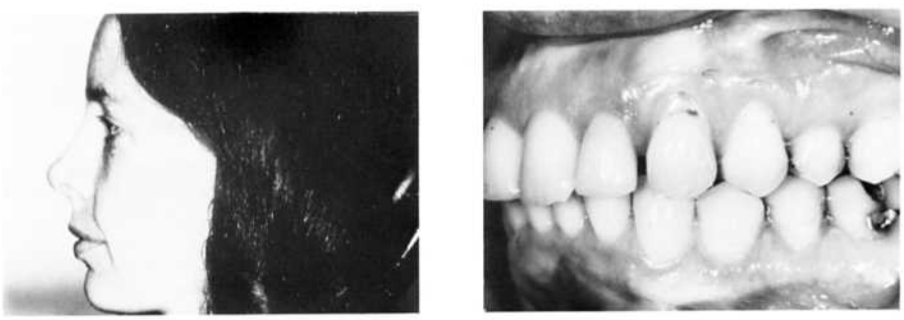
Figs. 19A and **B.** Pretreatment photographs (November 1979) of a 50-year old woman with an Angle Class II occlusion and overclosed interdental height. When examined, she gave a history of severe temporomandibular joint and myofascial pain dysfunction of eight years duration. She suffered almost constant frontal and occipital headaches. Pain radiated from her T.M.J. bilaterally but especially on the right side to the border of the mandible. Her inter-incisal opening was limited to 23mm. with reported progressive limitation. Severe muscle spasm involved areas of the neck and upper back. The patient suffered progressive hearing loss. Vertigo and numbness of her finger tips were additional complaints.

Fig. 19C. The patient had been fitted with an acrylic bite plate resting on the mandibular posterior teeth to increase vertical dimension. Appliance therapy was supplemented three times weekly for three weeks with physiotherapy, including electrogalvanic stimulation and ultrasound to all involved areas of the head, neck and back. Hot moist packs were also prescribed and a soft diet. The patient had been essentially symptom-free for 9 weeks when this photograph was taken. Her interincisal opening capability had almost doubled to 44mm. She had no vertigo or finger numbness. Referred to her dentist, the patient elected to defer extensive required restoration of her teeth.

Fig. 19D: Photograph made 12 weeks later. **The patient reported feeling that her bite was closing.** She had been wearing the appliance constantly and was still symptom free. The posterior acrylic onlaying appliance was removed at this time When the patient occluded her natural teeth, she was found to be further overclosed than when examined initially in November, and had become appliance dependent.

Figs. 19E and **F:** A maxillary lingual acrylic replacement appliance has been worn for 18 weeks. It incorporates an inclined plane, establishing anterior tooth contact. The appliance is held in place with lingual interproximal Dunn clasps which do not inhibit the possibilities of passive tooth eruption to correct the posterior open bite (in situations where bridges or splinted teeth are not present). **An acid etch composite bonded *Levy Lingual Shelf* works synergistically with the inclined plane to load the anterior teeth and reduce the effective closing muscular force.** The patient continued to be symptom-free but still requires extensive restorations of her dentition to the re-established mandibular posture and interdental height.

Figs. 20A and **B:** Pretreatment photographs of a 34-year old female taken in September 1971. The patient exhibits a severe Class II Division 1 malocclusion characterized by retrognathia and overclosure of the interdental space. She had for a number of years experienced crepitus in both temporomandibular joints. Additional complaints were frequent temporal and frontal headaches, neck and shoulder pain and a constant feeling of ear "stuffiness."



Figs. 21A and **B:** Post-treatment photographs obtained in October 1974. Dento-facial orthopedic treatment had been completed in October 1973 without tooth extractions. Patient symptoms subsided rapidly in the early months of treatment as the patient's mandibular posture, facial profile and dental occlusion normalized. A slight residual crepitus was still palpable for the right T.M.J. upon jaw opening.

Figs. 22 and **B:** Post-treatment photographs obtained in April 1980. Active treatment had been completed seven years earlier. The patient has remained symptom-free except for a slightly palpable crepitus on the right side. It is diagnostically significant that when the patient protrudes her mandible by several millimeters, opening and closing jaw movements are entirely free of any joint noise indicating the direction of further treatment potential.

Assuming an accurate differential diagnosis to have eliminated causality other than T.M.J. or M.P.D., a review of the varied treatments cited above (not nearly complete) indicates essentially that symptoms have been addressed, rather than the basic problem or problems. Relief, when attained, tends to be of limited duration or the result of symptom masking.

Bite plate or occlusal splint therapy has enjoyed moderate to excellent success in the elimination of muscle spasm, associated T.M.J. symptoms, or both. Utilization of the bite plate increases the interdental height and also tends to free the mandible from its habitual occlusal relationship. A postural change is frequently brought about for the mandible and condylar position, together with a rebalance of the associated neuromusculature.

As has been noted, "raising the bite" with posterior onlays does not solve the **basic** difficulty. Actually, it may worsen the original problem, often ironically, while relieving symptoms of T.M.J. and M.P.D. This **apparent** contradiction is explained in the section dealing with crown and bridge reconstruction. It is necessary to understand the capacity of the masticatory muscles to intrude posterior tooth segments with or without onlays to a point of equilibrium consistent with skeletal resistance or the eruptive force of the teeth; as a result, any increase in vertical dimension greater than that attained through a physiologic balance of those forces usually will result in **further** intrusion of the posterior teeth and a greater closure of the interdental height than was originally the case (Figs. 19 A to D).

Patients wearing posterior onlay bite plates over a period of months usually become dependent on the appliance and find that they cannot remain symptom-free without it.[21] (Fig. 19D).

A successful alternate approach to the problem cited utilizes a maxillary palatal acrylic appliance incorporating an anterior inclined plane. The mandible is guided to a forward position, enabling the mandibular incisor teeth to make contact with the lingual surface of the maxillary anterior teeth, thereby reducing the **effective** muscular force (Fig. 19F). Lingually-placed interproximal Dunn clasps do not inhibit discluded posterior teeth from erupting into a physiologically stable and normal dental occlusion. Long-term documentation of symptom-free patients attests to the success of this approach. **It should be understood that in addition to the achievement of increased interdental height, mandibular postural change, and anterior tooth guidance, changes in both upper and lower arch configuration often are necessary in order to effect the improved and *stable* intermaxillary relationship.**

In more recent years, the *Levy Lingual Shelf,* an acid-etched light cured composite stop bonded to the lingual surfaces of the maxillary anterior teeth, has greatly augmented treatment potentials and ease. The device is applicable for T.M.J./M.P.D. patients as well as for those orthodontic cases requiring increase of the interdental height and/or the establishment of a forward mandibular posture. [33] (Fig. 25B.)

The lingual shelf, while often used alone, may be employed synergestically with the aforementioned inclined plane for those patients capable of retruding their lower jaw behind the shelf and thereby cancelling its purpose and value; when such patients are no longer able to frustrate the shelf, the removable inclined plane may be eliminated totally.

Considered collectively, treatment involving complete dentitions are best carried out by an orthodontist with a **dentofacial orthopedic** orientation, while mutilated dentitions may be treated best by the general dentist or prosthodontist having a similar multi-dimensional concept. The patient with a full complement of relatively sound teeth is ill-served in many situations by prosthetically "shoeing" all the posterior teeth with crowns or onlays in order to open the bite.

Figs. 23A and **B:** Pretreatment views (November 1966) of a 32-year old woman who complained of progressive pain, limited mandibular opening and tinnitus in her temporomandibular articulation. Radiating discomfort was present for the right temporal region, right splenus capitis and supraspinatus muscles. The patient had been undiagnosed for eight years. The Angle classification was Class II division 2. A barrier imposed by the maxillary anterior teeth has forced the mandible into a retruded position and is responsible for the deep bite and loss of intermaxillary height brought about by the uninhibited intrusive effect of the strong masseter musculature. These factors are reflected by a posterior superior positioning of the condylar heads in deepened fossae. See Fig. 26B.

Figs. 24A and **B:** Post-treatment photographs (May 1969). The patient was symptom-free several months after the start of treatment. As the maxillary incisor teeth were moved labially and the mandible encouraged to move forward with the aid of an inclined plane, improvement was evident for the facial profile, tooth to tooth (Class I) relationship, excessively deep bite, increase of interdental height, and total cessation of T.M.J. and myofascial symptoms.

Figs. 25A and **B:** Post-treatment photographs made in May 1981. This patient has been seen at regular intervals and has remained symptom-free for 11 years. Two years prior to these photographs a lingual shelf was bonded to the maxillary central incissors. Its placement has eliminated the need for *any* removable retention device.

Condyle and Fossa Relationships

Frequent reference has been made to the position of the condyles in the fossae, despite evidence that the condyles of a normal individual do not bear deeply into the fossa in centric occlusive contact. However, in masticatory movements, the condyles — in concert with their menisci — function along the posterior slope of the articular eminence. To describe the position of the condyle as being in the fossa (often interpreted as found in the dry skull) is misleading and confusing. Indeed, the patient whose occlusion has locked the mandible into a dysfunctionally retruded position may truly represent the case in which the condyles **are** found bearing posteriorly and superiorly **into** the fossae. (Figs. 26A, B). These patients often have deep anatomic fossae and steep eminentia slopes. A forced mandibular position will have worn ever deeper the condylar fossae approximation: a clear and obvious example of form following function. Such patients frequently have symptoms that relate to the temporomandibular joints.

Fig. 26A. Typical Class II division 2 malocclusion reflecting a loss of interdental height and mandibular retrusion due to the proprioceptive guidance of the lingually tipped maxillary anterior teeth

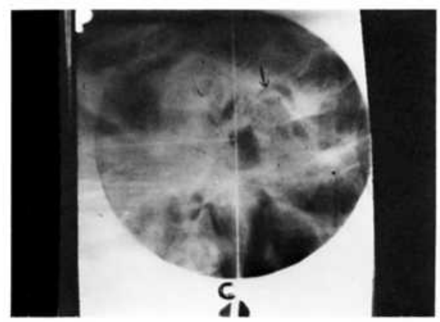
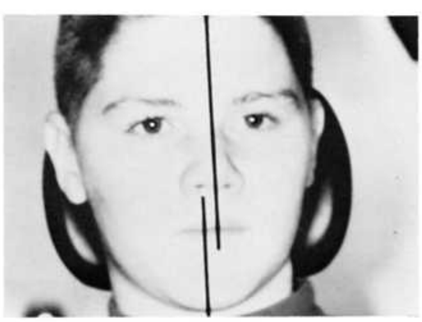


Fig. 26B. Deep anatomic fossa common to many Class II division 2 patients. Concomittant anterior disc displacement and neuromuscular imbalance make this group of patients highly prone to T.M.J./M.D.P. symptoms.



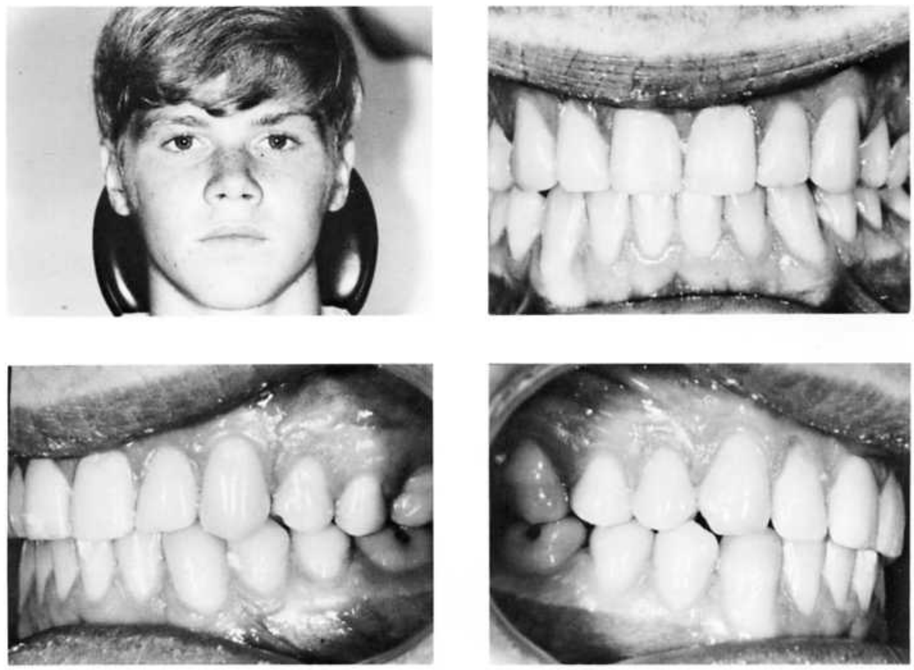
Figs. 27A to D: Pre-treatment photographs obtained in February 1968 of a 14-year old boy exhibiting a Class II subdivision malocclusion. The patient's chief complaint was of recurrent episodes of trismus and facial soreness. Note the facial asymmetry when patient is occluding in a retruded centric relation hinge axis position. Intraorally, the lower jaw midline is to the right of the maxillary midline. The left posterior tooth relationship is angle Class III, while the right posterior occlusion is edge-to-edge Class II.

Mandibular Function Following Condylectomy

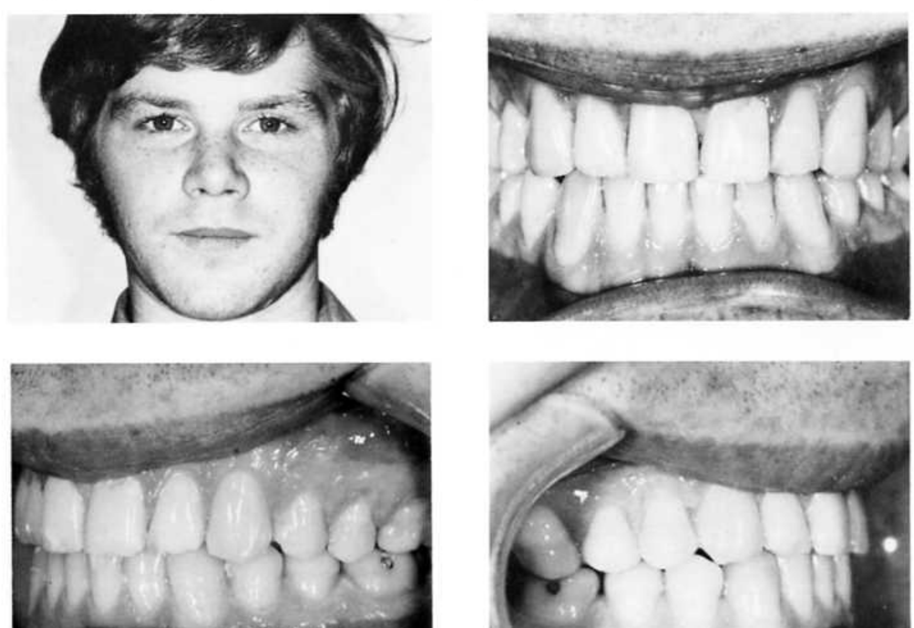
In the treatment of ankylosis of the temporomandibular joints and in certain types of fractures of the condyle or articular capsule, unilateral or bilateral condylectomy may be indicated. In these cases, patients are retaught the use of their muscles of mastication and function to a limited degree without benefit of the temporomandibular joints. Such examples illustrate that movements of the mandible are initiated and controlled by the interaction of the teeth and neuromusculature, and that the joints take their position as resultants of such action and operate essentially as weight-bearing stabilizers.

The Displaced Mandible

It has been noted above that Class II division 2 subjects have the mandible forced back into a dysfunctionally retruded position as a result of the barrier imposed by maxillary anterior teeth. In Class II division 1 instances, a narrowing of the maxillary arch (usually in the canine-premolar regions), or any other stop or impediment directed to the lower arch will have caused the mandible to shift back for convenience and comfort; whereas in Class II subdivision cases, occluding teeth will have forced the mandible into an abnormal lateral position. In all of these conditions it should be stressed that orthodontic (tooth moving) correction of the etiologic factor should precede any orthopedic (jaw moving) correction. The orthodontist cannot reposition mandibles successfully while ignoring arch form, tooth stops, noxious habits of lip, tongue, etc. In prosthetics, of course, this may often be done when the



Figs. 28A to **D:** Post-treatment records, August 1970. By means of orthodontic movement of the teeth to normalize the arch form and orthopedic pivoting of the mandible to the left (dento-facial orthopedics), facial symmetry and jaw midlines are improved. The patient's new centric occlusion and centric relation place both sides in a Class I relation. Obviously, the temporomandibular articulation has been altered. The patient has not experienced a return of his symptoms.



Figs. 29 A to **D:** Photographs made in March 1977. The patient's occlusion had been stable for almost seven years when last seen and he had remained symptom free.

Figs. 30A to **D:** Pre-treatment photographs (November 1969) of a 60-year old woman with severe and progressive facial and neck pain which had been continuous and unresolved over a four-year period. Discomfort was centered under the left eye and temporomandibular joint. The patient reported episodes of swelling and parasthesia in the area of the left zygoma and masseter muscle. Vertigo and gait unsteadiness were also reported.

Outworn fixed partials were in place in all quadrants except the mandibular anterior region, where natural teeth are present, and the edentulous mandibular right posterior region. A mandibular shift to the left was evident, as was a reduction in facial and interdental height resulting from posterior tooth loss and mandibular retrusion.

Figs. 31A to **D**: Post-treatment photographs of the patent in Fig. 30, made six months following the insertion of new dental restorations. The appliances consisted of full mouth fixed partials and a unilateral precision attachment partial denture for the mandibular right posterior quadrant. The reconstructed arches and mandibular stance were keyed to the most favorable compromise (**As If**) position suggested by the existing anatomy.




Figs. 32A to **D:** Post-treatment photographs of the same patient, made one year following the reconstruction. The patient had been free of symptoms of her previous temporomandibular discomfort from the time of appliance insertion. She functions comfortably and has a reduced ability to retrude her mandible by an estimated 50 to 60%. (The patient now resides in Florida. The last communication with her was by telephone in November 1977, when she indicated continued oral comfort and function and no return of her original symptoms).

dentist is able to control the articulating conditions.

It should be restated that for the patient with **well matched jaws, a good symmetrical face, and no problems in the temporomandibular joints,** utilization of the existing **unstrained** centric relation continues to be useful for orienting the jaws for denture service or full mouth reconstruction. The dentist should never force the patient into the unphysiologic "terminal hinge position."

Figures 20 to 33 provide a representative sampling of some of the conditions described and the results of treatment based on the principles expounded.

Summary

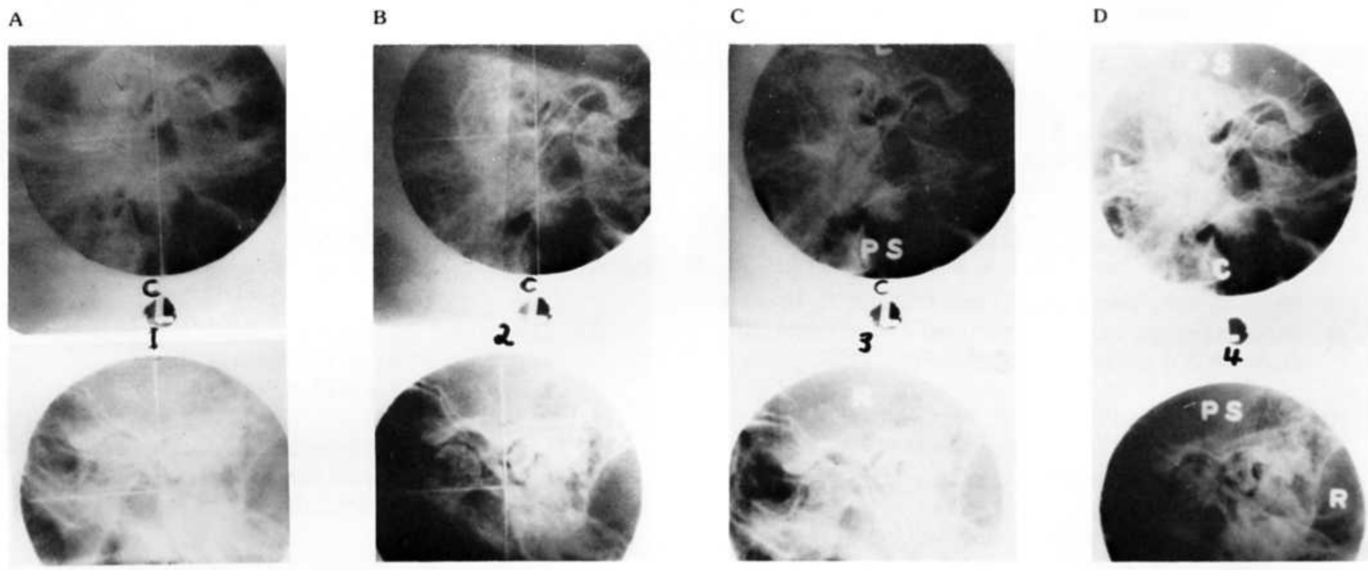
Dentistry's efforts and its potential to provide positive and comprehensive care has been compromised and circumscribed because of its allegiance to several erroneous fundamental, mechanically derived concepts that lack physiologic validity.

It has long been held that the temporomandibular joints **guide and control** mandibular movements; that the correct mandibular posture was generally as **retruded** as possible, and that its position relative to the maxilla was genetically **fixed** and **unalterable.**

A fixed retruded positional concept for the mandible is traceable historically to early prosthetic complete denture attempts for obtaining duplicable bites. The original method, derived for relating the maxillary and mandibular jaws for the edentulous patient, later gained acceptance as a **physiologic entity** for patients with teeth as well as for those who were edentulous. Ultimately, static centric relation led to entire systems of replication involving all mandibular movements; these attempted to match occlusal contacts with a "fixed condylar envelope of motion."

Here we have attempted to show that dentistry's adherence to a fixed and retruded mandibular posture concept disregarding spatial malrelationships of the jaws, has misdirected diagnosis and treatment for orthodontic care, orthognathic surgery, prosthetic dentistry, and for temporomandibular joint and associated neuromuscular disorders as well. Misdirected treatment too often has triggered or exacerbated the T.M.J./M.P.D. syndrome. That the problem is not more widespread is a tribute to the body's compensatory capacity and tolerance. That the dentist is generally not held accountable is a tribute to patient's ignorance of cause and effect. It has become painfully apparent that dentistry's continued tenacity and loyalty to out-

Temporomandibular Joint Radiographs of
60-Year Old Woman Shown in Figs. 30 to 32.



Figs. 33A to **D:** Radiographic representation of the right and left condyle-fossa relationship is informative in several aspects. **A:** Pre-treatment radiographs. The left fossa appears substantially deeper than the right, the condyle occupying a posterior superior position in the fossa, that reflects the mandible's transverse and distal shift to that side. **B:** Immediate post insertion radiograph indicating a decided anterior mandibular posture. The left condyle can be seen to be positioned almost atop the eminentia. (Note is made again of the abnormally steep left fossal slope and deepened fossa). **C:** Radiograph taken in December, 1970, six months following the reconstruction. A somewhat altered condyle-fossa relationship is seen bilaterally as some adaptation has taken place. **D:** After one year, the right condyle-fossa relationship appears to be in normal position. When the obvious pathologic fossa change is evaluated as a (cause and effect) result of abnormal condyle pressure from a forced retruded and transversed mandibular posture, the representation shown for the left joint may be extrapolated as being within physiologic normal range. The possibility of reversed bone remodeling to a more normal configuration with improved functional relationships, is an intriguing speculation.[22] It is interesting to compare upper to lower tooth with tooth positions of the intraoral photographs taken six months after the prosthesis insertion and those one year later. Tooth, jaw and facial relationships appear to be unchanged despite the observable modifications occurring in the temporomandibular articulation (Figs. 31 and 32).

moded and unsound practices and procedures is untenable. The Hippocratic dictum of **nil nocere** (do no harm) has become a compelling call for change in the light of present knowledge.

Beyond the function of tooth repair, salvation, or replacement, and co-existing with the requirement for maintenance of periodontal health, today's dentist has the opportunity and obligation to render comprehensive care that is physiologically sound and therapeutically rewarding. Diagnosis and treatment require understanding of the normal homeostatic interplay of the occluding dentition, mandibular posture, neuromusculature, temporomandibular joints, naso-respiratory function and soft tissue involvement.

The stomatognathic apparatus (operating in the dentist's sphere of influence and under his supervision) has dramatic implications in many other areas of the body; thus, the dentist's potential role and importance as a **primary** health team member is magnified far beyond historical or common perception.

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