Craniomandibular-Dental Imbalances Effect on Mandibular Closure Pattern, Condylar Position and Neuromuscular Stability: Case Evaluation

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PREFACE:
Craniomandibular disorders have long been the nemesis of obtaining a predictable neuromuscular bite. Instrumentation, while discerning a stable neuromuscular trajectory, does not lend itself to reveal the underlying skeletal imbalances that will produce neuromuscular relapse. This evaluation is the compilation of archial skeletal analysis, cause and effect on closure pattern and their relation to neuromuscular instrumentation. The use of neuromuscular instrumentation as a method of diagnosis and treatment without the aid of skeletal analysis, both pre and post treatment can be misleading when establishing phase III stability.

The objective in this article is to present a system and case analysis to predictably diagnose and detect cranial-skeletal imbalances as well as occlusal discrepancies. Further case analysis will address stability in finished cases either orthodontically, restoratively or a combination of both.

The ability to predict case stability relies on three evaluations.

1. Skeletal
2. Dental/occlusal
3. Closure pattern

Skeletal evaluation has always been the cornerstone in directing phase II stability. Without the ability to accurately identify skeletal imbalances and correct them, phase II treatment and phase III stability will always have relapse potential. Neuromuscular phase II trajectory does not account for craniomandibular imbalances. Identifying posterior, lateral and vertical defects with instrumentation and treating them via instrumentation will not account for discrepancies that are not corrected though osteo-mechanics. These underlying imbalances produce abnormal closure patterns resulting in the recurrence of tmd symptoms.

For purposes of discussion we can categorize skeletal analysis into three basic categories: [1]

Figure 1

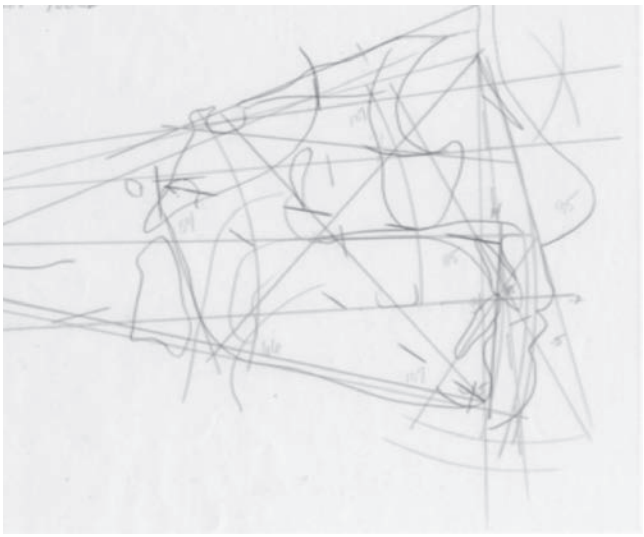

Figure 2

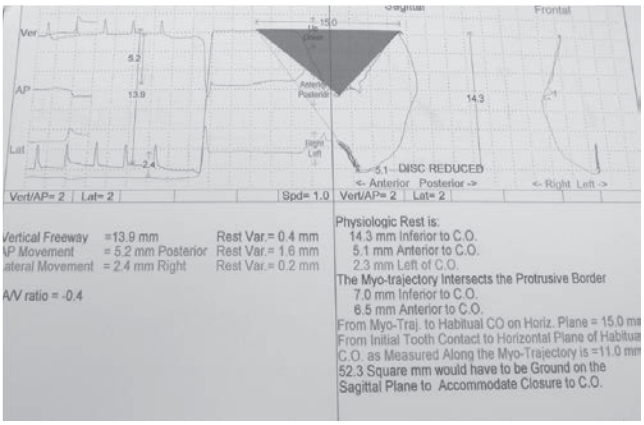

Figure 3

1. Angular
2. Ratio
3. Geometric archial proportions

Angular and ratio analysis usually compare the individual to a standard, which is *considered* normal. Archial analysis is based on an individual's geometric proportion. In other words we are comparing ones own stability based on their geometric proportion, be it skeletal or dental [1]. Phase I orthotic treatment allows for muscle balance but does not correct cranial and dental imbalances. Those imbalances, not corrected, allow for relapse via abnormal skeletal geometric proportion exacerbated through traumatic occlusal forces, i.e., abnormal closure patterns. Symmetry and stability in neuromuscular dentistry is based on geometric balance. Therefore it makes sense to use an analysis that can show ones own geometric symmetry verses comparing to a standard norm.

In an archial analysis we can compare the cranial skeletal system to itself or we can compare it to the teeth and the jaws. With the advent of the the Functional Classification of Craniomandibular disorders we now have the ability categorize and identify forces and patterns that can cause instability and relapse.

I have limited this article to imbalances that have an effect on producing abnormal closure patterns thru skeletal or dental abnormalities.

In order to identify an imbalance or interference we have to first be able to identify a geometric norm. I have always made the statement that " a little bit of orthodontics goes a long way". In the neuromuscular arena, " a little bit of geometric functional orthodontic analysis goes a long way".

There is little argument that orthodontics would be of little value in treating this case. At first glance we can only identify a loss of vertical *(Figure 1)*. Using the CMD classification (Wolford), we now have identified a single discrepancy in the vertical closure pattern. Applying a geometric archial analysis we can identify and abnormal posterior closure pattern due to the patients skeletal A/P [2] and retruded maxillary incisors.

Neuromuscular analysis reveals both A/P and vertical discrepancies in closure as well as a lateral closure discrepancy.

Correcting vertical alone will only correct the abnormal vertical closure pattern. If we do not identify and eliminate the cause of the posterior and lateral closure pattern the case will relapse.

Using an archial analysis and applying functional orthodontics we can eliminate the vertical and lateral abnormal closure patterns *(Figure 4, 5)*.

The remaining vertical discrepancy can be corrected and stabilized with full mouth restorative dentistry *(Figure 6, 7)*.

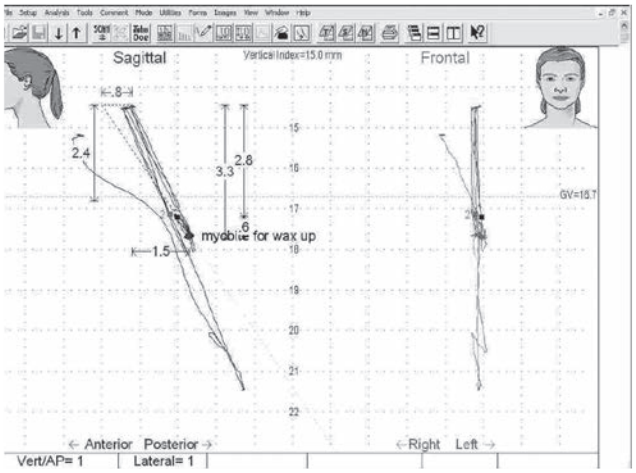

Figure 4

Contributory Factors to Abnormal Closure Patterns:

When we talk of closure patterns we are referencing mandibular closing pattern in relation to myotrajectory. Patients who have myofascial pain, internal derangements will close posterior to myotrajectory (Wolford,). Additionally, patients with uncorrected or induced skeletal imbalances will produce abnormal closure patterns.

Skeletal and dental imbalances are diagnosed and treated in three planes, vertical, sagittal, and A/P. Undiagnosed skeletal class II and III will produce abnormal closure patterns if not corrected *(Figure 8, 9)*, or degenerative condylar changes *(Figure 10)*.

75% of all malocclusions are skeletal Class II. Class II malocclusions produce posterior closure patterns with adaptive or maladaptive condylar changes [3] *(Figure 9)*

An often overlooked skeletal discrepancy is the under development of the transverse maxillary arch. These discrepancies are often masked by a normal buccal over jet of the posterior maxillary dentition. 90% of posterior crossbites in the developing dentition will exhibit lateral shifts of the mandible upon closure. [4] The rotational shift of the mandible results in the appearance of either a unilateral posterior crossbite or a less than normal buccal overjet [3,4] *(Figure 11)*

The loss of vertical dimension as well as transverse underdevelopment of the maxil-

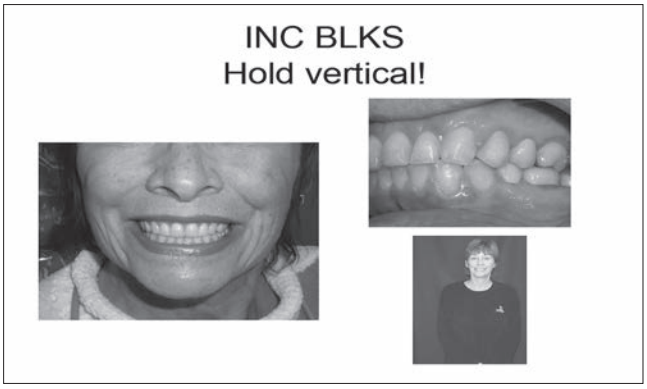

Figure 5

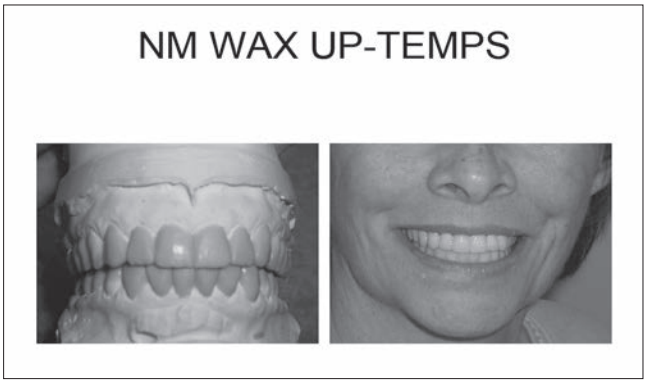

Figure 6

la results in a posterior displacement/altered

Figure 7

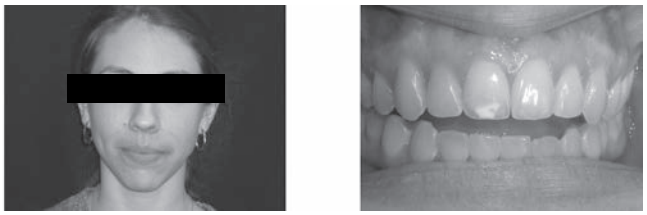

Figure 8. Post-orthodontic relapse.

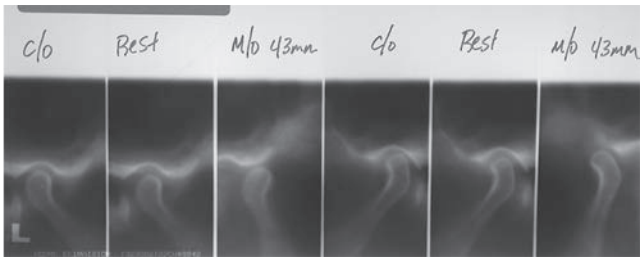

Figure 9. Adaptive condylar changes with a tear of the left capsular ligament.

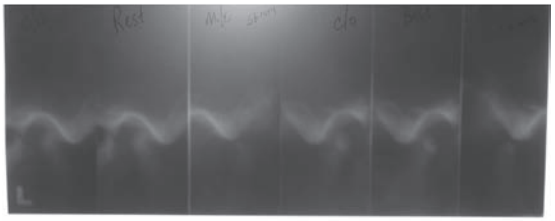

Figure 10. Degenerative condylar changes.

Figure 11. Maxillary skeletal crossbite.

Figure 12. Neuromuscular maxillary expansion appliances.

mandibular closure pattern. One-dimensional neuromuscular rehabilitation showing normal muscle physiology is bound for relapse if the overlooked skeletal imbalances are left undiagnosed and not corrected. The net result of skeletal imbalances and subsequent dental malocclusion is a mandible that is posteriorly displaced during function. [2,3,4,5]

Changes in structural anatomy across different age groups consistently demonstrate asymmetric patterns in condylar positioning and neuromuscular movements associated with posterior crossbites. This may result in long-term mandibular asymmetric growth and length as well as differential EMG loading patterns between sides with asymmetric maxillary/mandibular dentoskeletal adaptations. These results indicate that correction of posterior crossbilte will allow for a better condylar position and help eliminate traumatic closure patters when neuromuscular orthodontic and/or restorative procedures are necessary.

Skeletal A/P discrepancies can be more difficult to diagnose due to dental malocclusion patterns masking underlying skeletal deficiencies. Normal skeletal A/P can be altered, pathologically, by changes in mandibular closure patterns. The Structures of the TMJ must adapt to meet the functional demands placed upon them. Condylar remodeling is a physiologic process that allows this. [3,5] Traumatic closure patterns manifest themselves in two forms. If the neuromuscular system can withstand the additional dysfunctional load placed upon the abnormal closure pattern then the changes in the condyle will be adaptive. If the neuromuscular skeletal system cannot absorb the additional load the changes will be degenerative. *(Figure 9, 10).* In addition to skeletal deficiencies causing these changes we must understand that dental changes can induce adaptive and degenerative changes. Dental occlusion, missing teeth, malpositioned and/or anatomical changes in teeth, orthodontic and restorative dental treatment, as well as induced skeletal changes can produce adaptive or degenerative changes.

CLINICAL REPORT:

Mid twenties female presents for evaluation of changes in occlusion and anterior bite opening post orthodontics.

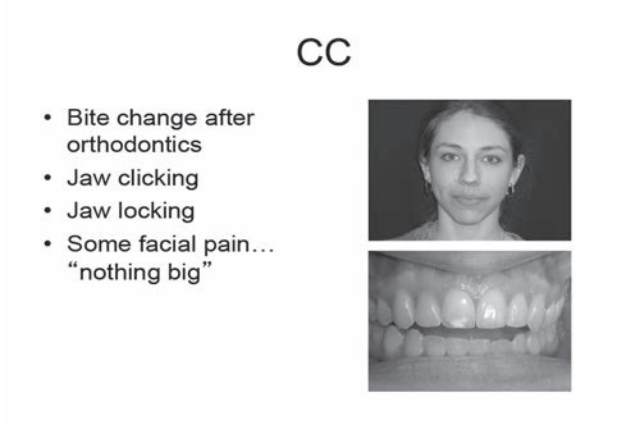

Figure A. Chief complaint of progressive anterior bite opening after finishing retraction orthodontics.

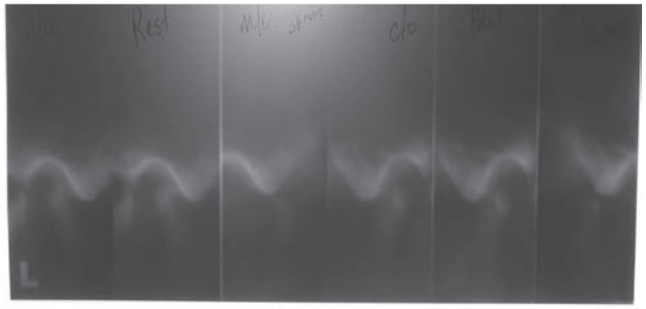

Figure B. Clinical and skeletal and neuromuscular evaluation revealed:

Class II skeletal
Posterior positioned Mx/Mn
Bilateral subluxation
Adaptive condylar changes
Abnormal vertical, posterior and lateral closure pattern
Idiopathic condylar hypoplasia
Anterior apertognathia
Posterior skeletal cross bite

A complete neuromuscular orthodontic diagnosis and treatment plan was completed. A neuromuscular orthodontic bite evaluation and diagnosis revealed deficiencies in vertical, A/P and lateral skeletal finished positions. *(Figures C, D)*

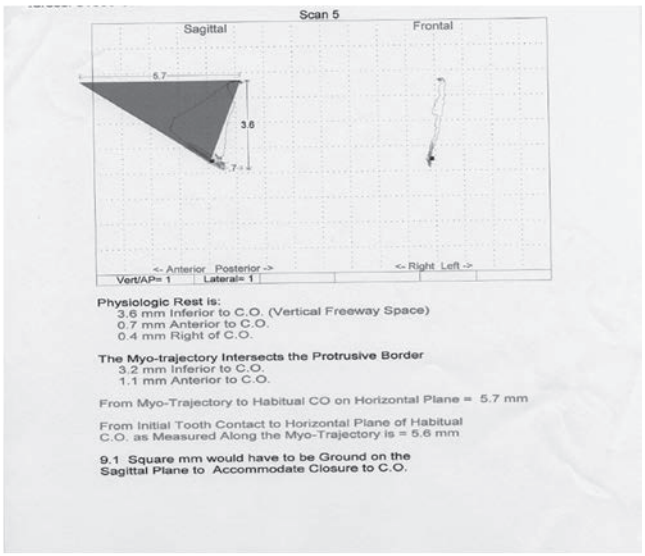

Figure C

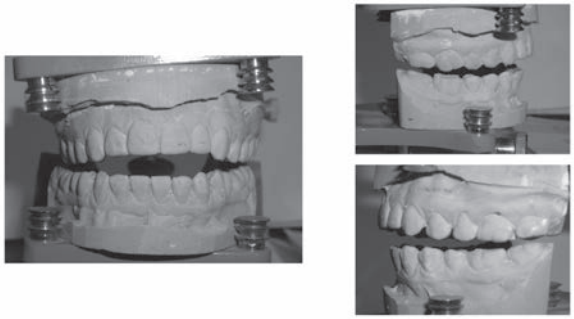

Figure D

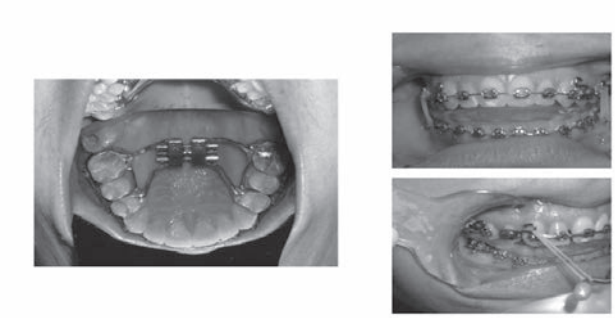

Figure E

Functional skeletal mechanics (transverse, A/P and vertical) were used to correct the deficiencies in conjunction with full orthodontic bracketing. *(Figure E).*

Post orthodontic archial analysis *(Figure F)* revealed positive changes in skeletal deficiencies. The relationship established between maxillary and mandibular skeletal position will provide for a

stable occlusal position and eliminate any potential abnormal closure patterns due to poor skeletal position and function. Post treatment Scan 5 demonstrates centric occlusion coincides with myo-trajectory *(Figure G)*.

CONCLUSION:

Abnormal closure pattern contributory factors are shown in both dental and skeletal imbalances. Eliminating only one of these discrepancies will only temporarily reflect CO = Myo-trajectory. The mandible is a human lever, which is neuromuscularly controlled. It stands to reason that if the muscles, being attached to the skeletal system, are not able to function coordinated with a well-balanced cranial anatomy, it will make coordinated muscle activity difficult causing muscle spacisity and an abnormal closure pattern[6]. It was also demonstrated that patients with occlusal interferences, initiated by skeletal interferences that were symptomatic, experienced relief and/or elimination of symptoms following treatment and occlusal stability, further suggesting the relationship between skeletal/occlusal balance and R\TMD [5]. It is understood that mandibular position and its effect on TMD is critical. Cranial imbalances that effect mandibular function and position will have an effect on occlusal stability. It is impossible to obtain correct position of the mandible to the cranial base until the maxilla is properly positioned in both sagittal and transverse planes [7]. Underdevelopment will result in latent development of abnormal closure patterns further exacerbated by the patient's skeletal tendency. There still exists the misconception that successful TMD treatment is unrelated to occlusion be it orthodontics or restorative [7,8]. Abnormal closure patterns (malocclusions) such as skeletal/dental cross bites, division II induced

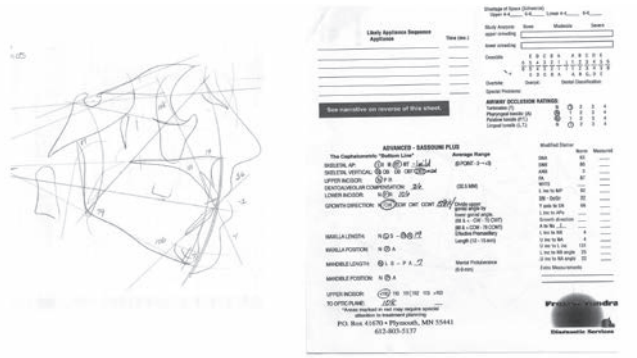

Figure F

POST-TREATMENT

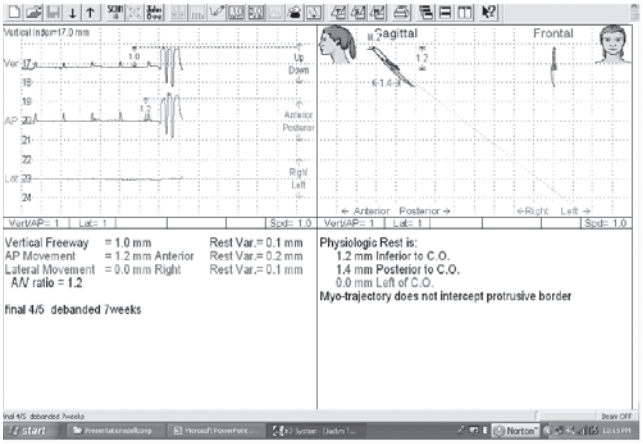

Figure G

posterior closure patterns, transverse skeletal arch discrepancies and inadequate A/P skeletal relationship place tremendous dysfunctional forces on the temporomandibular joints causing permanent distalizing effects on the mandible. Therefore, regardless of the final occlusion, skeletal and dental balance must be achieved so as to allow the temporomandibular joints to function correctly throughout the patient's life.

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