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Physical therapy in the management of the craniomandibular complex

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Introduction

TMJ dysfunction, a disorder of the TMJ, is an abnormal condition that is not a disorder involving a developmental abnormality, nor a disease, nor is there any macro trauma involved. TMJ dysfunction applies to capsular and or intracapsular tissue(s) involvement. TMJ dysfunction can be a manifestation of these other disorders previously mentioned but can also occur as a separate entity. A complex of interrelationships of the above disorders can occur with any given patient in a clinical situation.

Epidemiological studies suggest that a very high percentage of the asymptomatic and symptomatic population has some degree of TMJ dysfunction. Some clinicians support the idea that early preventive or corrective measures are needed to avoid future problems in het asymptomatic population. This type of prediction presumes that the original system of examination and classification has been validated for the symptomatic population. Therefore, the prognosis for certain untreated conditions is known. On the contrary, a recent paper, **Report of the President's Conference on the Examination, Diagnosis, and Management of Temporomandibular Disorders (1983)** states; "Although temporomandibular disorders may not be new, they do constitute a relatively new area of research and study. As a result, few, if any organized or standardized approaches to the examination, diagnosis, or treatment of TM disorders exist".

Despite the dilemma pertaining tot the etiology, evaluation and treatment of a TMJ dysfunction, patients do need help in managing their legitimate syptoms. A very high percentage of patients who seek professional help have myofascial involvement with or without objective signs of TMJ dysfunction. Clinicians today recognize muscle hyperactivity to be a key factor in the management of TMJ dysfunction. The center of attention has now focused on a tissue outside the joint capsule; the muscles of the craniomandibular region. The dilemma cycle has now started over once again but this time pertaining to the etiology, evaluation, and treatment of myofascial involvement. The current popular bicausal theory combines the occlusion and psychological stress as contributing to muscle hyperactivity. Myopion is: when the neuromuscular system is implicated, such a bicausal theory is too-narrow approach to the management of the craniomandibular region,

An understanding of the functional interrelationships of the occlusion, psychological stress and the cervical spine results in optimal management of the craniomandibular complex. Cervical spine dysfunction pertains to restricted mobility of the cervical spine and improper position of the head on the neck. Cervical spine dysfunction will create adverse affects on the craniomandibular complex. Cervical spine dysfunction not only will diminish the effectiveness of occlusal and psychological therapy but will also contribute to improper interpretation of the signs, symptoms and sequence in treatment of the craniomandibular region. The importance of physical therapy in the management of the craniomandibular complex is to provide improved mobility and positioning of the cervical spine.

The intent of this presentation is to revies pertinent literature, research, and clinical observation in order to support the need for cervical spine evaluation and treatment of patients who have craniomandibular signs and symptoms. Why dentists need to be alert to cervical spine dysfunction is summarized in the following five general categories.

Cervical spine dysfunction:

- 1) Is a primary source of referred symptoms to the craniomandibular region
- 2) Influences masticatory muscle activity
- 3) Is a primary factor influencing the upright postural position of the mandible
- 4) Influences the trajectory of mandibular opening and closing movements
- 5) Influences the design and the sequence of use of an interocclusal appliance

In addition to the five categories previously mentioned above, an association between mandibular dysfunction and faulty posture (cervical spine dysfunction) may be deduced from the literature.

Epidemiological studies suggest a high association between functional disturbances of the masticatory system and impaired general health (Agerberg & Carlsson, 1975). Other studies have shown an interdependency between impaired general health and mans inadequate adaptation to the erect posture (Lendrum, 1951; Kiernander, 1956). A patient presenting with symptoms related only to disturbances of themasticatory system is not very likely. Clinically, the history obtained from the patient often reveals a history of chronic symptoms related to cervical spine dysfunction. The same patient often reports symptoms

which are related to the masticatory system to be of a more recent onset. A cause and effect relationship existing between mandibular dysfunction and cervical spine dysfunction is not necessarily suggested. However, dentists need to be alert to such a relationship between mandibular dysfunction and poor posture (cervical spine dysfunction) so as to manage more completely the involved patients.

The following three indications may be used by the dentist to assist the dentist in determining if cervical spine dysfunction is present:

First, the dentist will observe for altered positioning of the cervical spine frequently presents with the forward head posture (FHP). The FHP, as described by Kendall (1952), is an increased thoracic kyphosis and cervical hyperextension (backward bending) with the eyes remaining level. The cervical spine hyperextension is occurring primarily in the upper cervical spine. A flattening or decrease in the cervical lordosis is occurring in the lower cervical spine (Fig 1). Certainly, cervical spine immobility should not be ignored. The orthopaedic physical therapy evaluation used to determine the presence of restrictions in cervical spine mobility, is beyond the scope of this presentation.

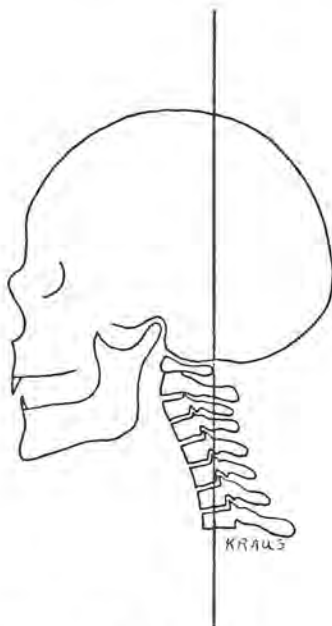


Fig. 1. Forward head posture.

Second, cervical spine dysfunction is recognized by presence of various symptoms. Weldon Bell suggests, "as a general rule, if pain involves cervical and facial structures simultaneously, the cervical pain is probably primary and the facial pain secondary unless separate causes or a common cause is identified. The practitioner should not be hasty in assuming that cervical symptoms are referred from dental, oral, or masticatory causes."

The anatomic and physiological relationship of the cranial nerves V, VII, IX, and X sensory neurons to the cervical nerves C1, C2, and C3 sensory neurons provides a scientific basis for the cervical spine referring symptoms. Cervical spine dysfunction refers such symptoms as headache, tingling, numbness into the region of the head, face, and jaw areas. Additional symptoms originating from cervical spine dysfunction but are not readily recognizable by the dentists are; ataxia, vertigo, and nystagmus (De Jong, 1977). Dentists need to recognize the previous symptoms as originating from the cervical spine and refer the patient for appropriate physical therapy treatments. The clinician should always be alert to pathological conditions which may mimic cervical spine dysfunction. A referral to the appropriate medical practitioner is indicated if a pathological condition is suspected.

Third, Cervical spine dysfunction should be considered when patients do not respond to or are aggravated by dental treatments. Whenever there is a change in the maxillo-mandibular relationship, brought about by the application of an interocclusal appliance, orthodontics, or orthognathic surgery, cervical spine dysfunction needs to be evaluated for. The influence of the cervical spine on mandibular positioning and movement will be the emphasis of the remaining section of this presentation.

The mandibular rest position

Attention will be directed towards the rest position of the mandible in order to relate how cervical spine dysfunction (FHP) influences the masticatory system. Identifiable yet imprecise, the rest position of the mandible is a position to which reference is made as a basic datum in many procedures in clinical dentistry. Dentistry continues to devise a means of scientifically evaluating the rest position of the mandible ranging from the use of cephalometric analysis to electromyography. Judgement and clinical trial are still the common choices of the clinician when determining the 'clinical' rest position of the mandible. Dentist who utilize such clinical methods in determining the rest position of the mandible must recognize cervical spine influences on the clinical rest position of the mandible.

Extension of the head on the neck influencing the upright postural position of the mandible

The rest position of the mandible is determined through two primary mechanisms; tissue elasticity tone and muscle tone.

Tissue elasticity tone: Yemm (1975) has demonstrated that when the head is extended on the neck, an increase in tension of the supra and infrahyoid muscle elasticity

and associated soft tissue tone occurs. This increase in tissue elasticity tone results in a force of depression and retrusion on the mandible. A subsequent increase in the freeway space occurs (fig. 2).

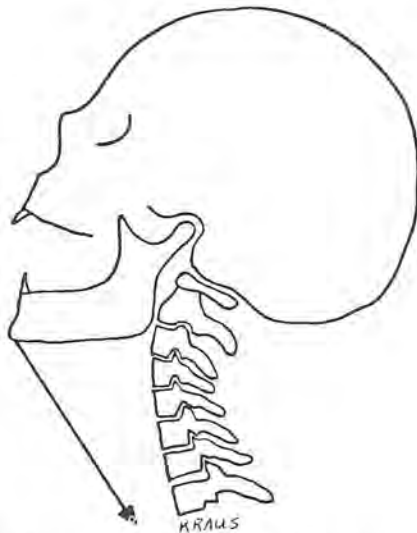


Fig. 2. The tissue elastic force results in depression and retrusion on the mandible during extension of the head on the neck.

the neck causes an increase in temporalis and masseter muscle activity (Funakoshi, 1976). An increase in muscle tone of these muscles elevate the mandible resulting in a force of elevation and retrusion on the mandible. A subsequent decrease in the freeway space occurs (fig. 3).

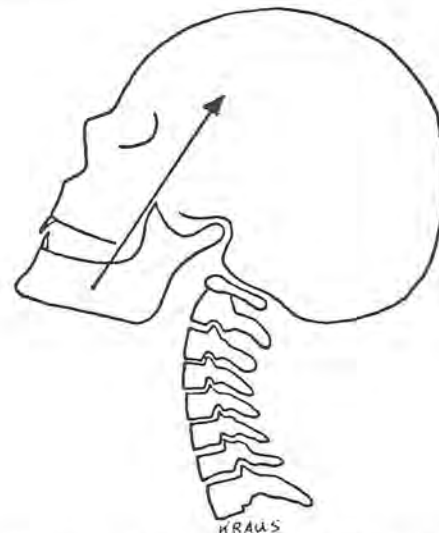


Fig. 3. Muscle activity results in elevation and retrusion on the mandible during extension of the head on the neck.

Muscle tone: Numerous studies reveal that the mandibular muscles are not at rest when the mandible is in the clinical rest position. In fact, the mandibular electromyographic position has an average 11 mm freeway space which far exceeds the 3 mm freeway space seen with the clinical rest position (Garnick & Ramfjord, 1962). The use of the word 'rest' is a misnomer, since muscle activity is still present at this clinical mandibular position. A more appropriate term is 'the upright postural position of the mandible' (UPPM), (Rugh & Drago), 1981).

Many factors increase motor unit activity thus resulting in an increase in muscle tone (muscle hyperactivity). Dentistry, from a clinical perspective, recognizes the patient's psychological state and the occlusion to be key factors which contribute to muscle hyperactivity. However, cervical spine influences on motor unit activity of the cranial nerve V motor neurons needs to be acknowledged. The capsules of the upper cervical spine facet joints, have receptors which are the origin of the tonic neck reflex (TNR). Trigemino-neck reflexes have been demonstrated to occur via motor neurons located in the subnucleus caudalis and in the dorsal horn of the upper cervical spine. The trigeminal and cervical motor neurons relationships gives an anatomic and physiologic basis of reflex activity to trigeminal areas stemming from the cervical spine (Bratzlavsky & Vander Eecken, 1977). Various studies have demonstrated that extension of the head on the neck influences the TNR (Funakoshi, 1973). A change in TNR as a result of extension of the head on

Soft tissue and muscle tone, as noted above, are influenced by extension of the head on the neck. By combining the soft tissue and muscle activity forces, a force of elevation and retrusion is suggested to be occurring on the mandible (Kraus, 1987), (fig. 4).

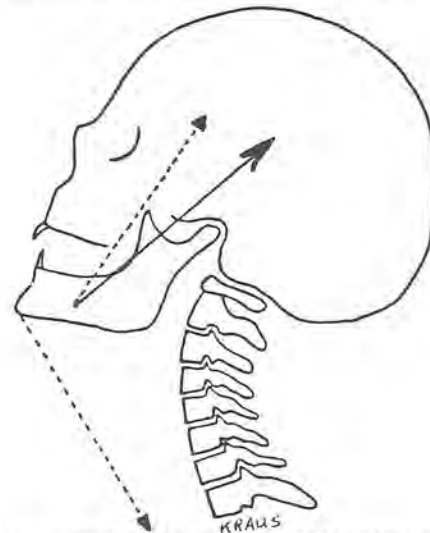


Fig. 4. When the head is extended on the neck, a force of elevation and retrusion is occurring on the mandible. The trajectory of mandibular closure and the initial occlusal contacts are posterior to the maximum intercuspated position.

Extension of the head on the neck influencing the trajectory of mandibular closure

"We must logically conclude that if rest position is altered by a change in head position, the habitual path of closure of the mandible must also be altered by such a change." (Mohl, 1976). Habitual closing pathways are posture-dependent; extension of the head on the neck produces more posteriorly placed habitual closing pathways with the initial occlusal contact behind the maximum intercuspated position (Mohl, 1984), (fig. 4). Conversely, flexion produces more anteriorly placed habitual closing pathways. Dentistry has acknowledge that cervical forward and backward bending can alter mandibular mobility and positioning. Historically, head-neck posture was thought to be controlled by maintaining a horizontal head position. Unfortunately, the eyes can be kept in the horizontal plane as the head assumes abnormal adaptive postural positions.

Forward head posture influencing mandibular position and mobility

To objectively study the influence of the forward head posture on the upright postural position of the mandible, a study utilizing a mandibular kinesiograph was

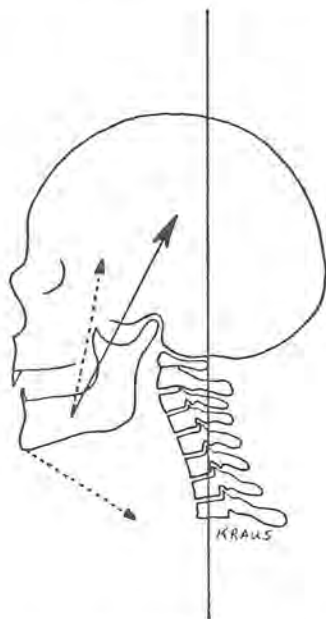


Fig. 5. In the forward head posture a force of elevation and retrusion is occurring on the mandible. The trajectory of mandibular closure and the initial occlusal contacts are more posterior to the maximum intercuspated position.

performed (Goldstein, Kraus, et al, 1984). The results of the study showed, as normal subjects assumed different degrees of anterior-posterior positions of the head in the sagittal plane, the vertical and anterior components of mandibular position and movement was altered. A significant decrease in the freeway space resulted as a forward head posture was assumed. A force of elevation and retrusion is proposed to be occurring on the mandible in the forward head posture (Kraus, 1987) (fig. 5). The trajectory of mandibular closure and the initial occlusal contacts are posterior to the maximum intercuspated position.

The conclusion that a force of elevation and retrusion is occurring on the upright postural position of the mandible during the forward head posture, can further be appreciated from growth and development studies. Statistical associations between head posture and craniofacial and dentoalveolar morphology has been demonstrated (Solow & Tallgren, 1976). On the average, extension of the head, relative to the cervical column, was seen in association with mandibular retrusion development.

Clinical observations

A change in the vertical dimension of occlusion (VDO) changes the relationship of the head on the neck.

Minimum EMG activity of the mandibular elevator muscles is recorded in a range of 11 mm of freeway space. As VDO is increased, EMG activity of mandibular muscles has been shown to decrease. A close correlation between trigeminal inputs and neck muscle activity has been demonstrated suggesting some degree of synergy exists (Manni et al, 1975). In a study involving 30 subjects, whose VDO was increased by 8 mm, 90 percent of the subjects postured their head in an extended position (Daly et al, 1982). Similar findings, though not significant to the .05 level, showed a trend towards increasing (by a mean of 1.45 degrees) the total head and neck angle (NSL/VER angle) as measured by cephalometric radiographs (Root, Kraus, Razook, et al, 1986). The previous information suggests that as VDO is increased, mandibular elevator and cervical muscle activity should decrease, and the head is postured in extension.

an anterior repositioning appliance is often used for disk-condyle derangement conditions. Such an appliance often over corrects the anterior/vertical position of the mandible. The response of the head-neck position to this change in VDO may be dependent upon the degree of cervical spine dysfunction. The initial response of the head-neck posture to the increase VDO is extension. however, because of the ocular/vestibular/tonic neck reflexes, the head-neck posture will adjust itself by bringing the eyes to the horizontal (Frankfort) plane. If minimal cervical spine dysfunction is present, the head-neck posture may compensate by attaining a more

upright position (fig. 6). This appropriate compensation of the head-neck posture promotes further relaxation of both the mandibular and cervical musculature and the associated symptoms. Such a favorable response to the increase in VDO may continue until the mandible is brought to its correct 'centric related' position (remember the initial mandibular position is often an over-corrected position anteriorly and vertically). When this change occurs in the VDO, the cervical spine and mandibular muscular symptoms may return. A false conclusion made by the dentist would be to assume the disk-condyle position is not stable. On the contrary, the disk-condyle position is stable but the cervical spine is not.

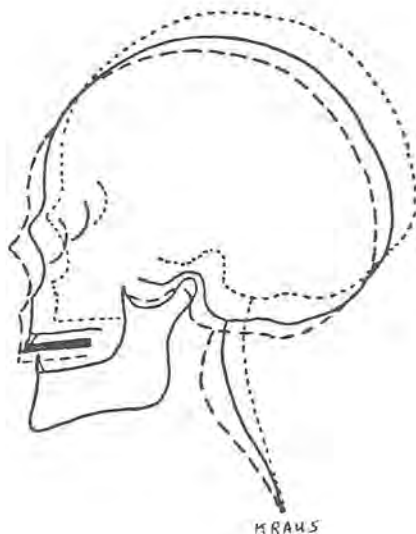


Fig. 6. The figure above represents the possible adaptive responses of the head-neck posture to a change in VDO. Note: regardless of the change in head posture, the peripheral mechanisms (ocular/vestibular/tonic neck reflexes) will maintain the eyes in the horizontal plane.

- Represents the pre-existing forward head posture prior to any change in VDO.
- Represents a change in the head-neck posture to a more upright posture in response to a change in VDO.
- Represents a change in the head-neck posture to a more forward head posture in response to a change in VDO.

An unfavorable response of the head-neck positioning may even occur with the initial application of the anterior repositioning appliance. The unfavorable response is suggested to be a more forward head positioning due to the significant degree of cervical spine dysfunction present. The inappropriate compensation of head posture permits the eyes to be horizontal but at the

expense of increase muscle activity and associated symptoms (fig. 6). The dentist may conclude that the disk-condyle derangement is beyond repair, due to the increase in muscle activity and associated symptoms and also to the patients' low tolerance to the appliance. If cervical spine treatments are initiated either before or at the beginning of the application of the appliance, patients' response is often very favorable.

A change in the trajectory of jaw closure as influenced by the interocclusal appliance and forward head posture may be beneficial or aggravating to the muscles of the craniomandibular and cervical spine regions.

Experiments with animals and humans have demonstrated that the mechanical stimulation of the teeth reduces or inhibits jaw closing muscle activity. There is no experimental evidence to support the contention that malocclusion or premature contacts between opposing teeth can directly initiate prolonged hyperactivity of the jaw closing muscles (Yemm, 1976). Instead, the existence of occlusal interferences result in altered patterns of neuromuscular activity which tend to circumvent the occlusal interferences (avoidance phenomenon). Such avoidance of the interferences are typified by increase EMG activity; muscle hyperactivity (Pruzansky 1963, Jarabak 1956, Perry 1955).

A clinical example would be related again to the anterior repositioning appliance. During the use of the anterior repositioning appliance, an anterior trajectory of jaw closure will be taken by the mandible. The presence of a forward head posture causes a posterior trajectory of jaw closure to be taken by the mandible. Two different trajectories of closure are being forced upon the mandible which conceivably would contribute to muscle hyperactivity (fig. 7). The end result is an increase in the muscular symptoms of the craniomandibular and cervical spine regions and a decrease in patients tolerance to the appliance. Correction of the forward head posture before or during the application of the appliance will promote a more down and forward positioning of the mandible. The down and forward position of the mandible allows for better adaptability by the patient to the appliance.

The previous clinical observations were examples of patients response to an anterior repositioning appliance when cervical spine dysfunction is present. These clinical observations may also be observed during the use of an appliance which positions the mandible in a 'centric related' position. When a patient is having negative responses to the centric related appliance secondary to the cervical spine dysfunction, the following should be considered:

1. the appliance is too thick (even the thinnest appliance may be too thick)
2. inclines of the appliance leading into the centric stops are too steep
3. the centric related technique used to establish the centric stops on the appliance was too aggressive
4. the centric related technique used was done without consideration of the head-neck posture
5. incorrect diagnosis and or too much emphasis was

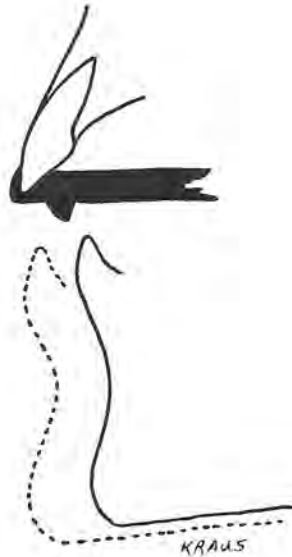


Fig. 7.

- A anterior repositioning appliance influences the mandible to posture itself down and forward and to close in a trajectory of closure more anteriorly.
- A forward head posture influences the mandible to posture itself up and back and to close in a trajectory of closure more posteriorly.

placed on joint noises and not enough emphasis on the cervical spine.

6. treatment of cervical spine dysfunction was not done before and or during the application of the appliance.

In summary, patients who have had the appropriate medical and psychological workup done and are still having symptoms, their symptoms may very well be related to the craniomandibular (TMJ, occlusion, and associated muscles) and or cervical spine regions. An evaluation of the cervical spine followed by appropriate treatments may decrease the patients' symptoms to such a degree that no treatments to the craniomandibular region are needed. Treatments offered to the craniomandibular region are needed. Treatments offered to the craniomandibular region may be enhanced by treatments to the cervical spine. A statement worthwhile remembering, made by Dr. Mohl (1984) is; "It therefore seems reasonable to consider that at least some of the dysfunctional problems involving the masticatory system could in some way be related to the adaptive requirements imposed by chronic or acute postural demands".

All figures 1-7 and portions of the written material were taken from:

Kraus S.: Cervical Spine Influences on the Craniomandibular Region. In: Kraus S, **Craniomandibular Complex: Physical Therapy and Dental Management.** Churchill Livingstone Inc., New York, To be published in September, 1987.

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