Journal of Bodywork and Movement Therapies (2007) 11, 285–294

Journal of
Bodywork and
Movement Therapies

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APPLIED PHYSIOLOGY

Neurological influences of the temporomandibular joint

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Received 1 October 2006; received in revised form 21 November 2006; accepted 29 November 2006

KEYWORDS
Temporomandibular joint;
TMJ;
Temporomandibular disorder;
Proprioception;
Neural plasticity;
Dystonia

Summary This study reviews recent advances in temporomandibular joint (TMJ) or masticatory system related neurology, and suggests the TMJ as a neurological window and lever.

The TMJ is integrated with the brainstem centers via the sensorimotor system, including the body balance and coordination control systems. A dysfunctioning TMJ may reflect not only local problems, but also the underlying remote or systemic problems. Neurological examination, including balance testing, for example, may reveal the contributing imbalances and provide an additional evaluation of the appropriateness of TMJ therapeutics being attempted.

Repetitive or tonic sensory stimulations involving the TMJ may be related to therapeutic interventions, contributing to neural plasticity, which may be adopted as a therapeutic approach in treatment of neurological disorders, including dystonia and movement disorders.

TMJ related therapeutics, such as use of an occlusal splint, cranial manipulation, muscle/myofascial therapy, and acupuncture, ideally need to be practiced along with neurological monitoring, to ensure neurologically desirable effects.

Introduction

What is the ideal occlusion?

Occlusion, the alignment of the maxillary teeth and mandibular teeth when brought together, is one of the most controversial and continuously

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doi:10.1016/j.jbmt.2006.11.007

evolving areas of prosthodontics (Baker et al., 2005). Centric relation (CR) is the beginning of occlusion, and all treatment modalities are based on it (Keshvad and Winstanley, 2000). But there is still no consensus regarding the definition of CR.

One of the current definitions of CR is "the maxillomandibular relationship in which the condyles articulate with the thinnest avascular portion of their respective disks with the complex in the anterior-superior portion against the shapes of the articular eminences." (Jasinevicius et al., 2000).

Occlusal appliances are commonly used in the treatment of patients with temporomandibular disorders (TMD), and have been reported to improve TMD pain (Wahlund et al., 2003). Several factors influencing these effects have been discussed, such as reduced postural activity in the elevator muscles, elimination or alteration of the influence of noxious proprioceptive input from occlusal interferences, changes of the condyle-fossa relationship, the placebo effect, and the effect of stabilization of the occlusion, as well as an increase in the vertical dimension (Ekberg et al., 1998).

Occlusion related therapies, including use of occlusal appliances, treatment of masticatory muscles and cranial manipulation involve the posture of the temporomandibular joint (TMJ), which is under the control of, and relays proprioceptive signals to, the nervous system. This article reviews some of recent advances regarding the TMJ and tries to suggest a rationale for use of an occlusal splint, or TMJ related therapies, as being potentially useful modalities in the treatment of neurological disorders, including musculoskeletal dysfunctions.

Temporomandibular joint as a neurologic window and lever

The masticatory system is a functional unit composed of the teeth; their supporting structures, the jaws; the TMJs; the muscles involved directly or indirectly in mastication (including the muscles of the lips and tongue); and the vascular and nervous systems supplying these tissues. The importance of jaw movement has become apparent in fixed prosthodontics, periodontics, orthodontics, and in the diagnosis and treatment of pain disorders of the masticatory system (Soboleva et al., 2005). The TMJ serves, to some degree at least, as a window onto the nervous system, as well as a tool for influencing the nervous system. A window onto the nervous system refers to examination and appreciation, of the orchestrated motor control of the TMJ and related muscles.

The concept of this being a tool for influencing the nervous system refers to the sensory afferentation related to the TMJ, and the tissues in its vicinity.

Motor efferents of TMJ

Mastication is oral motor behavior reflecting central nervous system (CNS) commands, with many peripheral sensory inputs modulating the rhythmic jaw movements. Observation of masticatory movements may be of diagnostic value for assessing disorders of the stomatognathic system (Soboleva et al., 2005). Mastication becomes well coordinated around 4–5 years of age, by which time the primary teeth have erupted. It is believed that each individual has a characteristic basic pattern of masticatory movement (van Eijden and Turkawski, 2001).

Jaw movements are among the most complex and unique movements performed by the human body. The most important muscles for mastication are the temporal (anterior and posterior), the masseter (superficial and deep), the medial pterygoid, the lateral pterygoid (superior and inferior), and the digastric muscles. However, mastication involves far more muscles than these 'muscles of mastication', innervated by the trigeminal nerve. Synergistic movements of muscles innervated by facial and hypoglossal nerves are equally important (Soboleva et al., 2005). In masticatory muscles, the organization of motor control is more localized, and the classification of motor unit types is less distinct. These features imply that, in masticatory muscles, a finer gradation of force and movement is possible than in limb and trunk muscles (van Eijden and Turkawski, 2001). The control and rapid coordination of tongue movements is essential for a number of complex orofacial behaviors, such as swallowing, mastication, respiration, speech, licking, gaping, coughing, gagging and vomiting (Svensson et al., 2003). See Figs. 1 and 2.

Masticatory muscles are under the control of masticatory motoneurons.

Jaw muscle motoneurons are activated by three sources: the motor cortex, the central pattern generator (CPG), and the peripheral input (Türker, 2002; Lund, 1991). Unlike homologous left and right muscles in the upper or lower limbs, the masticatory muscles on the left and right side share a common mechanical action around the TMJs and are co-activated during biting tasks (Jaberzadeh