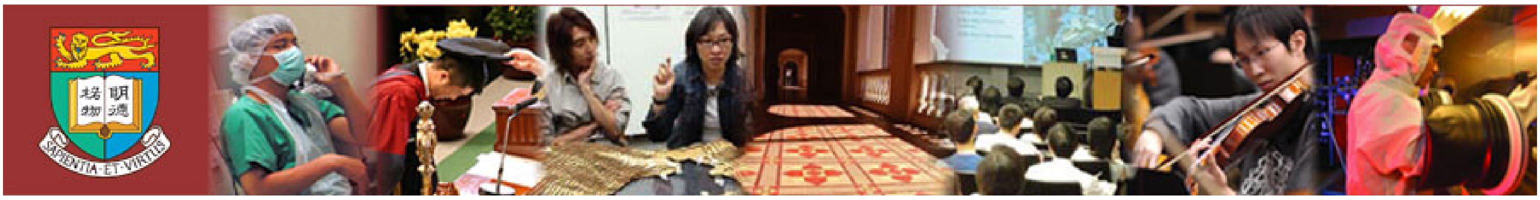

Masticatory muscle pain before, during, and after treatment with orthopedic protraction headgear: A pilot study

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The developing skeletal Class III malocclusion is one of the most challenging problems confronting the practicing orthodontist. Many clinicians have attempted to intervene early, using techniques such as the chincup appliance, reverse extraoral traction, or the functional regulator.[1-3] Protraction headgear has been used in conjunction with a palatal expansion appliance to correct maxillary deficiency and/or mandibular prognathism.[4-7] Dramatic skeletal changes have been obtained in animals with continuous protraction forces to the maxilla.[8-11] In general, 800 gm (400 gm per side) of orthopedic forces are used to protract the maxilla, with 75% of the force transmitted to the temporomandibular joint (TMJ).[12] The effect of this heavy intermittent orthopedic force on the TMJ has not been addressed in the literature.

The relationship between muscle activity and jaw dysfunction has been studied by several investigators.[13-16] In one study,[13] jaw muscle hyperactivity was induced in primates for an extended period. Changes in the muscles and joints of the jaw system as well as significant morphologic changes in the dentition were observed. In humans, electrical activity of masticatory muscles

Abstract

Protraction headgear has been used in conjunction with a palatal expansion appliance to correct Class III malocclusion with maxillary deficiency and/or mandibular prognathism. In general, 800 gm of orthopedic force is used to protract the maxilla, and 75% of this force is transmitted to the temporomandibular joint (TMJ) area via the mandible. The effect of this heavy intermittent force on the TMJ has not been reported in the literature. The objectives of this study were to determine the level of masticatory muscle pain and EMG activity in patients treated with maxillary protraction headgear. Ten patients with skeletal Class III malocclusion whose treatment plan called for maxillary protraction headgear treatment participated in this study. Nocturnal masticatory muscle activity was determined using a portable electromyographic (EMG) recording device. Subjects wore the EMG device 14 nights before treatment, 14 nights during treatment, and 14 nights 1 month after active treatment. Masticatory muscle pain level was determined by muscle palpation, scored on a scale of 0 to 3 each period, according to the method of Gross and Gale. The examiner followed a sequence outlined by Burch to examine the masticatory muscles. Results showed no significant differences for masticatory muscle activities before, during, and after treatment. Only a few patients experienced level 1 masticatory pain during treatment. None of the patients experienced masticatory muscle pain 1 month after treatment. These results demonstrate no significant increase in masticatory muscle activity or muscle pain associated with orthopedic treatment using maxillary protraction headgear.

Key Words

Class III malocclusion • Functional orthopedics • Muscle pain • Electromyography

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Table 1
Mean EMG readings for 3 experimental periods

Treatment period	Mean EMG level (uV per sec.)	Standard error
Pretreatment	14.4	5.7
During treatment	8.6	3.6
Posttreatment	8.9	3.5

Table 2
One-way analysis of variance evaluating the effect of treatment

Source	df	Sum of squares	Mean Square	F value	PR>F
Model	2	215.8	107.9	0.57	0.5739
Error	27	5140.2	190.4		
Corrected total	29	5356.0			

(EMG) has been studied by several investigators in the laboratory.[14-16] The results of these laboratory studies generally support the hypothesis that increased muscle activity is related to the painful musculoskeletal symptoms of jaw dysfunction. Clinically, Solberg, Woo, and Houston[17] examined 585 subjects and found that bruxers showed a statistically higher incidence of superficial masseter pain on palpation than nonbruxers. With the development of portable EMG recording equipment, attempts have been made to measure muscle activity in a natural environment.[18,19] Clark, Beemsterboer, and Rugh[20] examined 85 subjects with varied degrees of jaw dysfunction and found a significant correlation between the level of nocturnal masseter activity and signs and symptoms of jaw dysfunction.

The objectives of this study were to determine the level of masticatory muscle pain and EMG activity in patients treated with maxillary protraction headgear.

Materials and methods

Subjects participating in this study were patients at the Department of Children's Dentistry and Orthodontics, University of Hong Kong, whose treatment plan called for maxillary protraction headgear treatment. Ten patients were selected to participate in this study. The ages of the patients at the time of protraction headgear treatment ranged from 8 to 14 years. None had received previous orthodontic treatment. The criteria for patient selection included: concave profile, retrusive maxilla with or without mandibular protrusion, negative overjet, and other cephalometric data indicating a Class III skeletal pattern. None of the subjects had any painful dental or oral infections, nor were any taking prescription medications.

Electromyography

A portable electromyographic recording device (AL200 B muscle activity integrator, Aaron Laboratories, San Antonio, Texas) was issued to each patient to be used at home. The EMG integrator has been used in numerous clinical studies to investigate various aspects of nocturnal bruxing behavior, including the recent studies by Von Goten et al.[21] and Hudzinski and Walters.[22] Technical reviews of this type instrumentation were presented by Rugh[18] in 1979 and by Burgar and Rugh[19] in 1983. The electrode assembly uses bipolar surface electrodes and a ground electrode to collect masticatory muscle EMG activity. The bipolar electrodes were applied to the same side of the face throughout all three experimental periods. A calibration test was performed at the initial appointment. This test was used to check for unusual tissue impedance or other local factors that would affect the EMG recording, and to insure proper functioning of the EMG units.

Patients were instructed in the use of the EMG unit and application of the electrode assembly over their masseter muscle using surgical tape. They were instructed to clean the skin area over the masseter muscle with isopropyl alcohol. A preformed, double-sided adhesive electrode collar (Med Associates, Inc, E. Fairfield, Vt) was placed to hold the surface electrodes to the test site. The three silver/silver chloride electrodes (J & J Enterprises, Poulsbo, Wash) were then filled with electrode paste (Hewlett Packard, Waltham, Mass) and placed over the electrode collars to cover the exposed skin surface. A parent helped each subject position the electrodes on a fixed template so that the position of the electrodes on the skin would be similar from night to night. After electrode placement was completed, the portable EMG recording device was turned on and the sensitivity level adjusted so that no EMG activity would be recorded during swallowing, yawning, smiling, etc. This sensitivity level was adjusted only at the beginning of the first recording session of each experimental EMG data collection period. The instrument was calibrated to read in microvolts (uV) of muscle activity over time intervals from a few seconds to 12 hours and to display a cumulative total of masseter electrical activity above 20 uV. The recording units were calibrated so that a 100

V (peak to peak), 300 Hz signal maintained for 1 second would provide a readout of "1 EMG unit." The nightly total of measured EMG activity was recorded by a parent on the subject's data card. EMG recordings were performed during three experimental periods: 14 nights before active treatment for baseline data; 14 nights during active treatment; and 14 nights one month after active treatment with protraction headgear.

Masticatory muscle pain

The masticatory pain levels were determined by a standardized muscle palpation examination after each experimental period. The levels of muscle pain were scored on a scale of 0 to 3, according to a standardization method developed by Gross and Gale.[23] The examiner completed the examination of the masticatory muscles by following a sequence outlined by Burch.[24] The palpation pain scale was as follows:

0 = subject responded verbally that no pain was felt
1 = subject responded verbally that pain was felt but did not exhibit a facial or palpebral reaction
2 = subject responded with a palpebral reaction
3 = subject pulled head away from examiner as the palpation was about to take place.

Data analysis

The portable EMG data were analyzed using a one-way ANOVA. Significance between the various time periods was compared using Tukey's Studentized Range Test.

Results

The mean EMG level and standard error at the three experimental time periods are shown in Table 1. ANOVA revealed no significant differences among the three time periods (Table 2). Post hoc Tukey's Studentized Range Test revealed no statistically significant differences in the mean EMG levels between any of the three time periods.

Palpation data of 13 muscles for the three time periods are shown in Table 3. In all the responses, only level 1 palpation pain was reported. Before treatment, one patient experienced pain in the posterior temporalis and lateral pterygoid muscles. During treatment, one patient reported pain in the posterior temporalis muscle, one patient reported pain in the temporal tendon and lateral pterygoid muscles, one patient experienced pain in the lateral pterygoid muscle only, and one patient experienced pain in the superficial masseter muscle. No patient experienced masticatory muscle pain one month after treatment.

Table 3
Palpation examination before, during and after treatment
(Number of patients with level 1 response)

Palpating Muscle	Before Left	Before Right	During Left	During Right	After Left	After Right
Lateral aspect of TMJ						
Posterior aspect of TMJ	1	1				
Deep masseter						
Superficial masseter			2	2		
Anterior temporalis						
Posterior neck			1	1		
Sternocleidomastoid						
Medial pterygoid						
Digastric						
Temporal tendon	1	1	1	1		
Lateral pterygoid	1	1	2	1		
Vertex						

Discussion

The incidence of TMD in children is high. A survey of 7-to-14-year-old Swedish children revealed that 36% had symptoms of TMD, 15% had recurrent headaches, and 13% reported clicking sounds from the temporomandibular joints.[25] Orthodontic treatment, especially extraction, is often cited as a possible cause of TMD, based largely on anecdotal reports.[26-28] The use of chincups, delivering 800 gm of orthopedic force to the TMJ via the facemask, is particularly susceptible to such criticism.

The results of this study indicate that treatment with protraction headgear did not induce muscle pain or increase masseter muscle activity. An initial mean EMG level of 14.8 uV is similar to the levels reported by Clark et al.[20] for patients who were symptom-free with no clinical jaw dysfunction, such as limited mandibular range of motion or muscle pain on palpation. No increase in EMG activity was observed during treatment or after treatment. Level 1 palaption pain was noted only in a few patients on isolated facial muscles. No muscle pain was noted posttreatment. These results are in agreement with a previous study by Dibbets and van der Weele,[29] who reported no increase in TMD signs and symptoms in patients treated with fixed appliances and chincup therapy.

Why did 800 gm of orthopedic force fail to produce TMJ pain or an increase in muscle activity? A recent study showed that only 75% of the force was transmitted to the TMJ and 25% was distributed to the forehead. In addition, children usually wear these appliances for 12 hours a day, with a rest period of 12 hours.

The use of a portable EMG device allows measurement of muscle activities in a natural environment without disruption over a longer period. However, these results should be interpreted with caution. Reliable EMG measurements depend on standardized electrode application techniques. As with any self-monitoring technique, the technique itself can disrupt the behavior under study. Normal behavior can be disrupted by the act of recording or as a result of preconceived ideas of an acceptable reading. In the present study, although 13 muscles were palpated, recordings were made of only one muscle's activity. The masseter muscle is a heterogerous muscle and its activities may be different during static biting, opening and closing excursions, and chewing.[30]

Conclusions

The present study found no significant differences for masticatory muscle activities before, during, and after treatment with maxillary protraction headgear. A few patients experienced level 1 mastictory muscle pain during orthopedic treatment. No patient experienced masticatory muscle pain 1 month after treatment. These results demonstrate no significant increase in masticatory muscle activity or muscle pain associated with orthopedic treatment using maxillary protraction headgear.

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