A SURFACE EMG STUDY OF HEALTHY JAW FUNCTION

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INTRODUCTION

A number of studies have linked temporomandibular disorders (TMD) to altered activation patterns of the masticatory muscles during occlusion (Ciancaglini et al., 2002). Treatment of TMD aimed at restoring neuromuscular function requires knowledge of how occlusal contact is achieved in the healthy population. The purpose of this study was to identify common masticatory muscle function patterns in the healthy population for maximum clenching on a range of symmetric and asymmetric occlusal interferences.

METHODS

Fifteen volunteers (12 males and 3 females, age 26.1 ± 4.5 years) with healthy jaw function gave informed consent to participate. Subjects were seated in the alert feeding position and, following a short familiarisation of sub-maximal clenches, completed maximal clenches for the following six conditions: natural dentition (ND); lucia jig (LJ); left molars on a tongue blade (TBL); right molars on a tongue blade (TBR); front teeth on a tongue blade angled at ~45° below the horizontal (TBF); both sets of molars on cotton rolls (CR). In each trial the subject was instructed to start relaxed, clench maximally for 4 seconds, and relax again. Surface EMG were collected bilaterally for the temporalis anterior (TA), masseter superficial (MS), digastric anterior (DA) and sternocleidomastoid (SCM) muscles using active bipolar surface electrodes. The signals were recorded at 2000 Hz and bandpass filtered at 10-600 Hz. EMG amplitude was evaluated as an RMS average over a 50 ms window and normalised based on the global maximum value recorded in all trials. Onset times were determined using the algorithm recommended by Hodges and Bui (1996). Selected EMG amplitude and onset timing parameters for the six maximal clench conditions were compared using one-way repeated measures ANOVAs and Tukey's HSD post-hoc test ($p \leq 0.05$).

RESULTS

Figure 1 presents the mean ± 1 standard deviation in each condition for: maximum normalised amplitude (AMPNmax) of the TA and MS; bilateral symmetry coefficient (POC) for the TA and MS; torque coefficient (TC); and anterior-posterior coefficient (APC). POC TC and APC from Ferrario et al. (2006).

DISCUSSION

Occlusal interferences that prevented molar contact (LJ, TBD) significantly reduced maximum AMPN of both the TA and MS by at least 50% as reported previously for the LJ (Becker et al., 1999). This has been suggested to result from the loss of periodontal ligament proprioceptive feedback. However, these interferences also produce geometrical changes in the position of the mandible relative to the maxilla, which could equally generate the feedback mechanisms that result in reduced muscle

activity. Indeed, the significantly different APC values for these interferences compared to ND condition, indicate differing amplitude reductions in the TA and MS which supports a geometry based feedback mechanism.

Asymmetric interferences (TBL and TBR) had minimal effect on MS but significantly affected the contralateral TA amplitude. For TBL, maximum AMPN of the RTA was significantly lower than that of the LTA, and vice versa for TBR. Similarly, the bilateral symmetry (POC) and torque coefficient (TC) values for the TA were significantly different between the TBL and TBR with both conditions generating significant asymmetry. There was also evidence for asymmetric onset timing in TA muscle activity with the contralateral TA activating first. However, a larger sample size is required to confirm the statistical power of this observation.

SUMMARY

This preliminary study has indicated some well defined activation patterns in the jaw musculature for maximum clenching under different symmetric and asymmetric conditions in the healthy population. Neuromuscular performance of the TA appears to be more affected by the presence of occlusal interferences compared to the MS.

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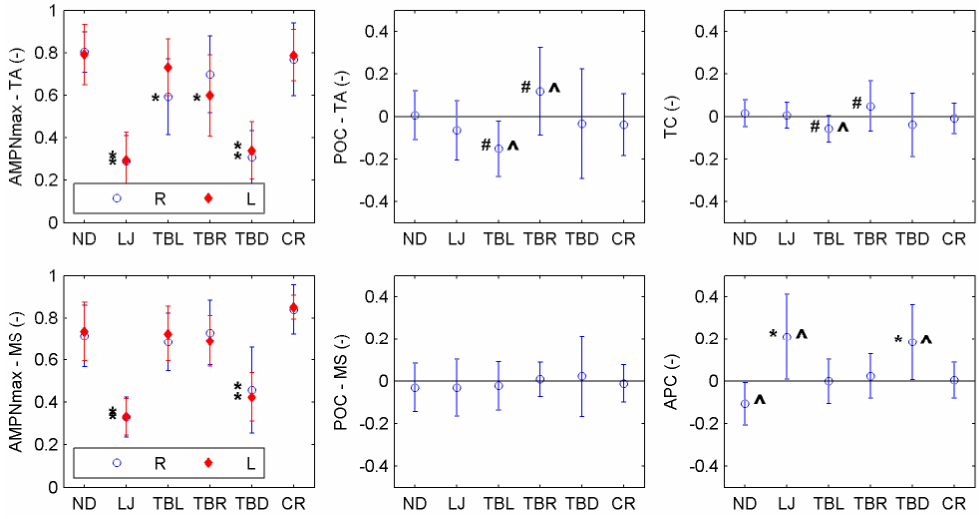

Figure 1. Amplitude parameters for the MS and TA in the six maximum clenches conditions (mean ± sd). Significant differences: compared to ND (*); between TBL & TBR (#); non-zero POC, TC & APC (^). POC = bilateral symmetry [0 = symmetric → ± 1 = left dominant (-1) or right dominant (+1)] TC = latero-deviating torque [0 = no torque → ± 1 = left dominant (-1) or right dominant (+1)] APC = anterior-posterior displacing force [0 = no force; posterior dominant -1; anterior dominant +1]