research articles

(A) Masticatory Muscle Activity

Immediate electromyographic response in masseter and temporal muscles to bite plates and stabilization splints.
Dahlstrom L, Haraldson T.

The immediate influence on masticatory muscle activity of bite plates and stabilization splints was investigated in control subjects and patients with craniomandibular disorders. Electromyographic surface recordings were performed from the masseter and temporal muscles bilaterally with and without the appliances in situ.

Activity during maximal biting on stabilization splints was not different from that without the appliance while bite plates caused a decrease in activity in both muscles in both groups. The reduced maximal activity was probably due to the smaller number and exclusively anterior positioned occlusal contacts on the bite plate.

Effect of a prefabricated anterior bite stop on electromyographic activity of masticatory muscles.
Becker I, Tarantola G, Zambrano J, Spitzer S, Oquendo D.

This study measured the effect of a prefabricated anterior bite stop on the electromyographic activity of the anterior temporalis, posterior temporalis, masseter and anterior digastric during clenching and grinding tasks. A prefabricated anterior bite stop was fabricated for 30 randomly selected subjects. Electromyographic activity was measured during clenching and grinding both with and without the anterior bite stop.

The anterior bite stop had a significant effect in decreasing electromyographic activity for both clenching and grinding for all the tested muscles, except the anterior digastric.

Effect of occlusal splints on masticatory muscle EMG activity during clenching.
Loke WO, Yap A, Jee SZ, Lee WZ, Lai WP.

This study compared the effect of anterior (MCI), soft (PF) and full arch stabilization (SS) splints on the activity of masticatory muscles during clenching. It was hypothesized that anterior splints would reduce both temporalis and masseter muscle activity in contrast with other splints evaluated. Methods: Twelve patients with bruxism and no debilitating TMD/psychological distress and 3 aged-matched controls were recruited. Mean age of the subjects was 23.5 years. A cross-over design was used where the EMG activity of subjects were measured after insertion of each splint type. Subjects were randomly divided into 3 groups (with a control in each group) and tested in the following sequence: Group 1 – SS, MCI, PF; Group 2 – MCI, PF, SS; Group 3 – PF, SS, MCI. EMG measurements were repeated 3 times for each splint and with a 5 mins interval between each splint type. Results were analyzed using Kruskal Wallis and Mann-Whitney Test (p < 0.05).

Average percentage reduction in masseter EMG ranged from -44.8% (PF) to 49.8% (MCI) while reduction in temporalis EMG ranged from -38.8% (SS) to 59.4%(MCI). Significant differences in percentage EMG reduction were observed for both masseter and temporalis muscle and were as follows: Masseter – MCI > SS > PF; Temporalis – MCI > SS > PF.

The use of soft and full arch stabilization splints may increase masticatory muscle activity during clenching. The anterior splint was effective in reducing both masseter and temporalis muscle activity during clenching.
(B) Temporomandibular Joints


The two major muscle groups used during clenching activity are the masseter and temporalis muscles. EMG readings of the masseter and temporalis muscles rise significantly during times of macro-clenching. Clenching occurs when the masseter and temporalis muscles contract, pulling the mandible superiorly. The continued contraction of the masseter and temporalis muscles results in compression forces on the teeth and temporomandibular joints.

Theoretical joint loading models are utilized to demonstrate the load on the TMJ due to forces generated by the masseter and temporalis muscles. This study measures the EMG readings during bilateral macro-contraction of the masseter and anterior temporalis muscles. An appliance is fabricated to disengage the posterior teeth and a second series of EMG readings are taken to record lowered EMG readings.

The vector forces of the reduced EMG’s recordings demonstrate reduced condylar compression during macro-clenching.


The purpose of this study was to investigate the relationship between different incisal biting forces and condylar seating. Bite force was measured with strain gauges at the incisors in 22 adult subjects. The subjects were positioned with mandibles in retruded centric and with an opening not exceeding the range of hinge axis movement. Condylar movement was measured using standard true hinge axis location procedures. Condylar position was measured with no force, then with bite forces of 4.5 kg, 7.5 kg and a comfortable maximum.

Biting force significantly affected condylar movement (p < 0.001). As incisal bite forces increased, so did the amount of condylar seating to an average of 0.49 mm anteriorly and 0.27 mm superiorly using maximum biting force.

Therefore, when taking a centric relation record, a technique involving an anterior stop and sufficient biting force should seat the condyles more fully.


To determine whether shortened dental arches (SDAs) cause functional overloading of the teeth and the temporomandibular joints, which has been implicated in periodontal diseases and temporomandibular disorders, the influences of SDA on occlusal and joint loads were investigated.

Bite force and masticatory muscle electromyograms were recorded in five dentate subjects who clenched maximally on intra-oral appliances, creating symmetrical SDAs experimentally. Muscular forces estimated from the recorded electromyograms were fed into a finite element jaw model for calculating bite forces and joint loads. Comparison between the measured and the calculated bite forces ensured that the joint loads were representative. The bite force on each tooth increased with missing molar occlusions, while joint loads decreased.

The findings provide no evidence that SDA causes overloading of the joints and the teeth, which suggests that neuromuscular regulatory systems are controlling maximum clenching strength under various occlusal conditions.
(C) Occlusal Stability / Supra Eruption

Dynamic functional force measurements on an anterior bite plane during the night.
Wichelhaus A, Huffmeier S, Sander FG.

Anterior bite planes are used in removable and fixed appliance treatment. In removable appliance
 treatment the question arising is whether the delivered forces can achieve active intrusion in terms
 of their amplitude and duration. In fixed appliance treatment, the force effect on the incisors and
 associated pathologic side effects, in particular under the application of intrusion mechanics, have to be
 considered.

The aim of the present study was to investigate the effects of an anterior bite plane during the night. For
 this purpose ten subjects underwent nocturnal sleep investigations by means of a telemetric system.
 A silicon force sensor was integrated into an anterior bite plane for continuous measurement of bite
 forces and of the frequency of occlusal contact with the plate.

The occlusal forces exerted on the anterior bite planes ranged between 3 and 80 N.

The average forces were 5.5-24 N. In subjects with removable appliances, no active intrusion of teeth is
 possible during the night owing to the small number of occlusal contacts. Due to the partially very high
 forces in fixed appliance therapy, the integration of an anterior bite plane has to be assessed as critical
 in patients with unfavorable root geometry or bruxism.

Vertical position, rotation, and tipping of molars without antagonists.
Kiliaridis S, Lyka I, Friede H, Carlsson GE, Ahlqwist M.

There has been a general belief that permanent teeth without antagonists overerupt, creating, after
 some time, considerable clinical problems. However, very few studies in the literature support this
 statement. The purpose of this investigation was to examine the position of molars that had been
 unopposed for a long period and to test the hypothesis that overeruption does affect every tooth
 without an antagonist.

Fifty-three individuals were examined clinically, and dental casts were taken to evaluate the position of
 unopposed molars. There were 84 molars (61 in the maxilla and 23 in the mandible) with a documented
 period of at least 10 years without antagonists. Among these teeth, 25 molars had neither an
 antagonist nor a mesially adjacent tooth. A qualitative method was used to evaluate the position of the
 molars in the vertical direction: (1) teeth with no sign of overeruption, (2) teeth with slight overeruption (<
 2 mm), and (3) teeth with moderate to severe overeruption (> or = 2 mm).

Of the 84 molars examined, 15 teeth (18%) revealed no signs of overeruption, 49 teeth (58%) displayed
 overeruption of less than 2 mm, and 20 teeth (24%) showed moderate to severe overeruption.
Individuals with molars that had lost their antagonists in adult age had a lower risk for overeruption than
 the other subjects examined.

It is concluded that not all molars without antagonists overerupt, not even in a long term perspective.