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REVIEW ARTICLE

Bite, occlusion and fixed appliance treatment

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ABSTRACT
Maximum bite force is a useful indicator of the functional state of the masticatory system and the loading of the teeth, and its recordings can be performed in a relatively simple way in the clinic. Previous studies have found a change in bite force due to orthodontic treatment, before and after treatment. This article reviews bite force, its measurement and changes by orthodontic treatment by fixed appliances.
Keywords: bite, occlusion, bite force, pain, fixed appliance

INTRODUCTION

Maximum bite force is one indicator of the functional state of the masticatory system.The force results from the action of the jaw elevator muscles (in turn, determined by the central nervous system and feedback from muscle spindles, mechanoreceptors, and nociceptors) modified by the craniomandibular biomechanics.[1]

Previous studies have found a change in bite force due to orthodontic treatment, before and after treatment.[2] Since bite force is associated with the number of teeth in occlusal contact, the lowest bite force is assumed to coincide with the treatment phase with the fewest number of teeth in occlusal contact.[3] Accordingly, bite force is assumed to increase after treatment due to the establishment of an increasing number of teeth in occlusal contact and close intercuspidation.

In skeletal class I patients with increased horizontal maxillary overjet and crowding, bite force was at its lowest point one week after bonding of fixed appliance. The bite force then increased and reached pre-treatment levels after 6 months of treatment.[4] In addition, it was found that for patients with class I and class II malocclusions, bite force increased immediately after debonding the fixed appliances and increased further after 3 months of retention. This was in disagreement with another study, in which it was found that bite force decreased immediately after debonding in skeletal class II patients. It has also been found that the bite force of patients with posterior cross bite decreased immediately after orthodontic treatment, but increased to the same level as subjects with neutral occlusion after the retention period.

BITE-FORCE MEASUREMENTS

Bite force is most often recorded with one or two transducers placed between pairs of opposing teeth during clenching. This is a simple, direct method for clinical use, but it

increases the bite height and leaves the rest of the dentition separated. Pressure-sensitive sheets, thin force-sensing resistors, and strain gauges in dental reconstructions do not disturb the dental occlusion as much, but their recordings need far more preparation or computer calculation.

TECHNIQUE

The recorded force during maximal clenching varies with the location of the measurement within the dental arch and the number of teeth included. Also, the use of coverage, splints, and other means of protecting teeth and transducers may influence the measurements. Maximum bite force is highest in the molar region. Unilateral measurement of maximum bite force in the molar region averages between 300 and 600 Newtons (N) in healthy adults with natural teeth. With the transducer placed on the anterior teeth the measured force is about 40% of the unilateral force recorded in the molar region, and with the transducer in the premolar region it is about 70%. If the force is measured bilaterally in the molar region, the recorded force is about 40% higher than the unilateral measurement.

Measurements of maximum bite force are dependent on the motivation and cooperation of the subject. Concern about damage to the teeth during the measurement, or ongoing pain and tenderness in the teeth, supportive structures, temporomandibular joint or masticatory muscles have a negative influence on the bite-force measurements. Pain limits the maximum bite force due to reflex mechanisms and impedes maximum bite-force measurements, but this factor may also indicate a patient's actual functional capacity and, therefore, provides useful information for the control of treatment. For example, pain in the temporomandibular joints from chronic arthritis and temporomandibular disorders (TMD) reduces the maximum bite forces by 40% compared with control values, probably because the pain is associated with a reflex "splinting" reaction that limits the ability to work against heavy loads. Maximum bite forces have also been shown to decrease with increased tenderness of the temporomandibular joint in patients with arthralgia. In addition, biting on a transducer may in itself provoke or aggravate pain.[5]

MALOCCLUSION

Most bite force studies have been comprised of subjects with a full complement of teeth, Angle Class I molar occlusions, and no dysfunction. However, there has long been an interest in how maximum bite force influences the development of facial morphology and malocclusions and in the planning of orthodontic treatment. It has also been shown that both bite force and occlusal tooth contact most often are reduced temporarily during orthodontic treatment. Malocclusions are often associated with reduced maximum bite force. Therefore orthodontic treatment may be needed to improve function. However, the bite force does not seem to vary between Angle malocclusion types. At the same time children with unilateral posterior cross bites have been reported to have both lower maximum bite forces and lower numbers of occlusal contacts than children without malocclusions. The same difference of bite force and occlusal contact is found between adults subjects with anterior open bite and subjects without malocclusion, but not in young children. Generally, there is not the same systematic relation between malocclusion and maximum bite force as with occlusal contact and maximum bite force. In subjects with malocclusion the reduced maximum bite force is probably related more to the effect of occlusal contact and the biomechanics of the jaws and masticatory muscles than to the classification of morphological occlusion per se. As a consequence it may be useful to routinely assess the occlusal contact together with the morphological occlusion of the teeth, and also take both into consideration when planning and evaluating orthodontic treatment.[6,9,10]

CHANGES OVER TIME

BITE FORCE AND OCCLUSAL CONTACT

In the previous studies, bite force changed during orthodontic treatment. In comparison with pre-treatment, bite force decreased at the first follow-up after the bonding of fixed appliances in both jaws, during treatment and at the end of orthodontic treatment. There was no significant difference in bite force between pre-treatment and the first retention follow-up. However, at the first retention follow-up there was a significantly increased bite force in comparison with the first follow-up after the bonding of fixed appliances in both jaws and during treatment. This means that the bite force decreased during fixed orthodontic treatment and recovered to pre-treatment levels at the first follow-up after treatment.

Another study on skeletal type I patients with a slightly increased horizontal maxillary overjet and minor crowding, which approximated the present study's treatment group, found that bite force was at its lowest point one week after the bonding of the fixed appliance, but then slowly increased and was at pre-treatment levels 6 months after treatment began.

The variation in bite force reflects the variation in occlusal contact due to the association between bite force and occlusal contact. The decrease in occlusal contact during orthodontic treatment and the increase in occlusal contact in the retention period may be explained by the change in intercuspidation during orthodontic treatment. During orthodontic treatment, the teeth are moved and, accordingly, intercuspidation is disrupted. After orthodontic treatment, the teeth settle vertically and the number of occlusal contacts increases during the retention period.[7,11,12]

PAIN

In the some studies, there was no significant difference in pain intensity during the orthodontic treatment of patients with neutral occlusion and minor crowding in the anterior region. There was a tendency towards increased pain between the first follow-up after the bonding of fixed appliances in both jaws and during treatment, but in general, the pain intensity was low during the entire treatment.

Previously, it was found for skeletal class I patients with increased horizontal overjet that the prevalence of pain and pain intensity were at their highest 1 to 2 weeks after bonding of a fixed appliance. There was then a general decrease in the prevalence of pain and pain intensity up to the 6 month follow-up during orthodontic treatment.[8,13,14,15,20]

Another study of skeletal class II patients found that the pain intensity increased up to one week after the start of fixed-appliance treatment, but at a one-month follow-up there was no significant difference in pain compared to pre-treatment. It was also found that pain intensity was at its highest 24 to 48 h after the bonding of a fixed appliance. Many factors influence pain intensity. In general, pain increases with age and women experience increased pain intensity compared to men. Pain intensity may also be associated with different cultures and with ethnicity. With regards to orthodontic patients, no significant association between pain intensity and severity of crowding has been found, but there was a significant association between a patient's motivation for orthodontic treatment and pain intensity.

CONCLUSIONS

Bite force and teeth in occlusal contact significantly decreased during treatment and reached baseline levels at retention. There was no significant difference in pain during or after orthodontic treatment. These normal conditions prior to orthodontic treatment did not change after orthodontic treatment for subjects with neutral occlusion and normal craniofacial morphology. These may prove valuable for informing orthodontic patients before treatment of minor crowding for aesthetic reasons, and for treatment considerations in healthy subjects with neutral occlusal and normal craniofacial morphology. The association between

maximum bite force and the amount of occlusal contact is closest in the posterior region, and as a consequence, loss of molar support results in reduction of force. In contrast, malocclusions defined solely on the basis of molar and canine relationships have less influence on the level of bite force.[16,17,18,19,21]

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