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Bite force part I - An overview

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Abstract
Bite force indicates the health of the masticatory apparatus because it causes the muscles that lift the jaw to contract. It is used to study the activity related to the teeth, occlusal factor, dentures and implant therapy, temporomandibular disorders, and neuromuscular alterations. Calculations of the maximum biting force are intended to observe the force of muscles that elevate jaw. This force is created by the contraction of the mandibular and maxillary contract to produce the biting force, which is subsequently transmitted to the object being chewed by the teeth.

1. Introduction

The force that is produced when biting is a key sign of how well the muscles used for mastication are working. The temporomandibular joint, the masticatory muscles, and the dentition—whether natural or artificial—all play aimportant role in the ability to bite. The initial contact between the jaws and the food in mastication dictates the subsequent muscle force.

Low biting force during mastication is caused by slow jaw motion.[1] A quality-of-life concern, proper mastication is the main objective of implant aided dental rehabilitation.

Failures are to be anticipated during dental implant treatment. Failures might happen early or late in the course of treatment. The reasons for failures are a matter of debate. However, occlusal overload may be a factor in failure.[2] Mastication, diet, and parafunctional stresses in humans are cyclical,

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multidirectional, and have a range of magnitudes.[3] Human biting force is roughly three times greater in the back than in the front.[4]

VARIABLES IN PHYSIOLOGY AND MORPHOLOGY IMPACTING BITE FORCE VALUES

Face and cranium morphology

The face height, the mandibular inclination, and the gonial angle are skeletal measurements of the cranio-facial morphology that influence maximum biting power. It has been established that the biting force is a reflection of the geometry of the mandibular lever system. When the ramus is more vertical and the gonial angle is smaller, elevator muscles exhibit enhanced mechanical advantage.[5,6]A negative correlation between mandibular inclination and bite force has been discovered by Pereira et al[7]. This outcome is in line with past studies that have linked the long-faced type of cranio-facial morphology to lower biting force values.[8]Additionally, according to the same researchers, there is a strong link between bite force and muscle thickness and between the thickness of the masseter-temporal muscles and face shape. According to Farella et al., masseter muscles are thicker in short-faced subjects compared to normal- or long-faced subjects in this regard[9]. These research' findings suggest that those with shorter faces might bite with more force.

Age

Age-related changes in muscular power may be the cause. In actuality, the force of the jaw shutting increases with age and growth, remains generally constant between the ages of 20 and 40 or 50, and then begins to decline.[10] The amount of biting force in children between the ages of 6 and 18 with permanent teeth is closely proportional to age.[11] According to Bakke et al. male and female biting forces start to decline after age 25 and 45, respectively. Age greatly reduces bite force, especially in women.[12] Age-related changes in maximal biting force, average pressure magnitudes, and occlusal contact areas in senior and young Japanese participants have been studied by Shinogaya et al.[13]evaluated that the senior group's occlusal contact regions and maximal biting force were much bigger than those of the young group. The fact that the senior group's average occlusal pressure values were lower was another observation. It is clear that age has very little of an impact on biting force.

Gender

Males can bite with a maximum force greater than females can. The anatomical variations may be responsible for the male increased muscular potential.[7]In comparison to females, men's masseter muscles have type 2 fibres that are greater in diameter and sectional area. Furthermore, there is no obvious link between gender and maximal bite force up until a particular age.

Maximum biting force changes more rapidly in males than in females over the post-pubertal age, becoming gender-related. Ferrario et al. found that males had higher biting force values and attributed this to their larger dental structures. The larger periodontal ligament areas present by the larger dental size can result in a stronger bite. Wichelhaus et al., in contrast, showed no appreciable variations in biting force between men and females. They hypothesised that it might be because of the study's limited subject population and focus on functional forces that occur during nocturnal sleep. The majority of research has confirmed that males and females have different biting force values, despite some writers identifying a negligible gender effect..[14]

Tooth periodontal support

The periodontal ligament's mechanoreceptors regulate the loading forces that the masticatory muscles cause while chewing.[15] Because of this, a decline in periodontal support may result in a lower threshold for the mechanoreceptors' function.[16] According to Williams et al.[17] those who have experienced a loss of Attachment have sensory function issues that make it harder for them to control how hard they bite.Alkanet al.[18] participants with goodperiodontium had better biting strength than those with chronic periodontitis. These findings are in line with those of another study, which demonstrated a direct relationship between diminished periodontal support and diminished biting force.[16].Morita et al.[19] have shown that biting ability and periodontal status interact. Kleinfelden and Ludwig[18] in contrast, claim that the less support from periodontal tissues did not restrict the maximum bite force in the normal dentition. The discrepancies in recording methods and measurement contexts between

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these studies may be to blame for the mismatch. Laurell and Lundgren[20] evaluated the force in dentition reconstructed with cross-arch and found that the amplitude of the chewing force had a favourable relationship with these findings may be explained by the rather sturdy way in which the teeth were splinted together.

Pain and temporomandibular disorders

Temporomandibular disorders (TMDs) are signs and symptoms of discomfort and anatomical or functional problems with the mastication, particularly the temporomandibular and muscles used for mastication, or both. The multifactorial aetiology of TMDs is widely acknowledged. The most typical TMD indications and symptoms include pain in the temporomandibular joint and surrounding muscles, restriction of opening of mouth, clicking and crepitation. Measuring force of bite may be an extra helpful way to understand how individuals with orafacial illnesses develop their masticatory function and how muscle efficiency is affected by bite force.

Dental condition

Dentures, dental fillings, tooth location, and tooth count all have a major role in the biting force measurement. The quantity of teeth in contact and their number appears to be significant factors influencing the maximal bite force. The greater occlusal contact number of posterior teeth loaded during the biting motion may also have a role in the increased bite force in the posterior dental arch. For instance, when the maximum bite force level is increased from 30% to 100%, the occlusal contact surfaces are doubled.[14]

By Kampe et al., measurements of occlusal biting force at the molar and incisor teeth of participants with and without dental fillings were investigated. Patients who underwent dental fillings showed noticeably less bite power in the incisor region.[21]

Bite force measurements were examined by Fontijn-Tekamp et al,subjects wearing overdentures supported by dental implants exerted forces that were noticeably larger than those of the groups wearing complete dentures and overdentures with roots kept at the highest level of biting force. Even so, the implant group's maximal bite forces were still lower than those of the dentate patients.[22]

BITE FORCE RECORDING IN HUMAN SUBJECTS: GENERAL THOUGHTS

Some authors recommend that human subjects be seated upright without any support of head, with the Frankfort plane parallel to the floor, and with their feet flat on the ground while the bite force is being measured.

Hellsing E and Hagberg C assert the link between head position and biting force. There is a brief increase in biting force when the head is extended when compared to bite force in natural head posture. The bite force readings are also impacted by the transducer's position. Compared to anterior teeth, posterior teeth have a stronger bite force. Bilateral bite force measurements reveal greater bite force than unilateral bite force measurements.[23]

All subjects should be trained to use their strongest bite force prior to the recording. They should be told to firmly bite down on the object for three to four seconds without shifting their heads. They are instructed to bite for 15 seconds by certain researchers. The average of all measurements should be used to determine the maximum bite force for each side. It is advised to allow some downtime in between successive recordings to prevent masticatory muscle fatigue. After every bit, there should be a minimum of 30 seconds and, according to some scholars, a maximum of 2-3 minutes.

2. Recording Technique

Biting force varies depending on where in the oral cavity the transducer is positioned, with posterior placement recording the strongest biting forces. This can be due to the jaw's mechanical lever system. The posterior teeth can bear a stronger bite force due to their size. The numerous muscles involved in the force production may be impacted by a transducer that is positioned at various points along the dental arch. When the transducer is placed in the anterior region between the incisors, the masseter muscle and the medial pterygoid muscle will create the majority of the force, which will lead to a mandibular protrusion.[24]

3. Different Site Measurements

To calculate the force of bite is another aspect. Many studies found that bilateral clenching produces more

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bite force than unilateral clenching. Bilateral force of bite was evaluated in volunteers using conventional force transducers, with the force of the latter being 40% greater.

Using a strain-gage transducer to assess biting force and jaw muscle activity during bilateral and unilateral maximum clenching, it was shown that the bite force measured bilaterally was 30% greater. Bilateral measurements have been shown to be 30% larger than unilateral assessments in terms of the right and left masseter muscles and anterior temporal muscular movements.[25]

In the unilateral clenching studies, there were no discernible variations in the activity of the masseter, but there were differences in the activity of right and left temporal muscles, the loaded side was clearly more active. The unilateral bite should be equivalent to the force generated during a bilateral clench.

4. Acrylic Splints

Acrylic devices were used to protect tooth cusps and prevent dental fracture while clenching to the maximum extent. To reduce the risk of teeth breaking while biting strongly on the strain-gage transducers, acrylic materials were employed in contact with their metal faces. Because of the neuromuscular reflex that inhibited the maximal bite power when the subject bit the transducer's hard metal surface, the movements were uneven. Acrylic splints in this situation offer a complacent surface for the highest bite power. To compare the bite pressures of a single tooth and several teeth, acrylic splints were employed.

It is hypothesised that the increased bite force and larger periodontium surface area will be successful. Using a strain-guage transducer, the biting force were examined, and it was found that acrylic splints enhance bite force levels.[26]

5. Jaw Movements

The primary jaw elevator muscles' length and the location of head of mandible changed as the vertical dimensions of the orofacial structures increased. When the masseter muscle activity levels were kept constant, maximum biting forces were measured between 15 and 20 mm of anterior vertical jaw opening. The 17 mm incisal aperture was found to have the highest maximal incising force. The jaw spacing varied from this optimal opening, therefore the maximal incising force varied in strength.

6. Conclusion

A trustworthy way to evaluate the prosthetic treatment and the biomechanical characteristics of the muscles used for mastication is to measure the force of bite. However, other crucial factors should be taken into account when comparing the study's measurements of biting force.

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