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Bite Force Evaluation in Unilateral Posterior Crossbite Patients

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ABSTRACT

Background: The maximum bite force (MBF) refers to the highest force exerted by an individual during the fragmentation of food, which is closely associated with the process of mastication. Many studies showed that malocclusions frequently exhibit an association with diminished maximal bite force. Furthermore, Occlusion may contribute to mental disorder such as anxiety, tension, Alzheimer's, and senile dementia. **Aim:** The current study aimed to assess the difference in maximum bite force between the sides of the jaw in cases of unilateral posterior crossbite. **Methods**: Sixty patients were chosen, and they were split into two groups: a group of teeth unilateral posterior crossbite and one tooth posterior crossbite group. The maximal bite force for each patient is recorded for each side and compared with the other side in the same group and between two groups. **Results**: the result shows a significant difference between sides in a group of teeth unilateral posterior crossbite (P=0.007) and a non-significant difference between sides in single tooth posterior crossbite (P=0.365). Between the groups, the crossbite side shows a significant difference (P=0.010) while the non-crossbite side shows a non-significant difference(P=0.160). **Conclusion**: There exist variations in bite force between cases involving numerous teeth in posterior crossbite as opposed to those involving a single tooth. There is no discernible variation observed among the groups with regard to the normal side, in contrast to the crossbite side.

Keywords: Maximum Bite Force, unilateral posterior crossbite, mental disorder, occlusion, single tooth crossbite.

Introduction

The force that a person can exert when the mandible is closed on the bite-pads of an instrument is called bite force. Muscles of mastication especially temporalis, masseter, and internal pterygoid muscle are the main muscles responsible for this force or pressure (Edmonds and Glowacka, 2020).

Several fields of dentistry studied bite force and consider it as an output of the chewing system (Bakke, 2006; Castelo et al., 2010). The prediction of chewing system function can be based on many characteristics, including bite force along with occlusal contact area (Al-Dulayme, 2014). Greater biting force and a greater occlusal contact area are associated with improved efficiency in

mastication (Medhat and Al Haidar, 2019). Furthermore, According to certain theories, occlusion may be a major factor in the emergence of mental problems, including anxiety, tension, Alzheimer's disease, and senile dementia (Ulloa et al.,2022).

The maximum bite force (MBF) refers to the highest force exerted by an individual during the fragmentation of food, which is closely associated with the process of mastication. The determination of MBF is influenced by various factors such as occlusal factors (Manns et al.,2022), malocclusion (Kaur et al., 2022), psychology of the individual (Khan et al., 2020), jaw elevator muscle (Moura et al., 2019), skeletal craniofacial morphology (Sánchez et al., 2020), age, and gender (Aishwarya et al., 2021; Hossain et al., 2020).

Malocclusion includes a range of deviations from the typical alignment of teeth, which, in certain instances, can have an impact on an individual's overall quality of life (Kadhum et al., 2021). Many studies showed that malocclusions frequently exhibit an association with diminished maximal bite force.; For instance, Previous studies have indicated that children exhibiting unilateral posterior cross bites tend to have diminished maximal biting strength and a reduced number of occlusal contacts in comparison to children without malocclusions (Kaur et al., 2022). Furthermore, children having normal occlusion demonstrated a statistically significant increase in maximum bite force compared to children with malocclusions (Tsai, 2004). A systemic review stated that patients with class I have more maximum biting strength than class II and class III patients (Kaur et al., 2022)

The objective of the current study was to assess the difference in maximum bite force among jaw sides in cases of unilateral posterior crossbite and to compare differences between cases involving a single tooth in the crossbite position and those involving multiple teeth in crossbite.

Material and methods

Sample

The sample was collected from patients who attended the Orthodontic Department of Al-Sha'ab Specialized Dental Center in Baghdad, Iraq. The participants are teenagers and their age range is 13-18 years. The study was approved by the research ethics committee at the College of Dentistry, University of Baghdad (Ref.=587, Date:10-3-2022). After the clinical inspection of the participants, only patients with unilateral crossbite were eligible for enrolment in this research. The total sample size is 60 patients composed of two groups: single-tooth unilateral crossbite and group of teeth unilateral crossbite.

Bite force recording

Each participant is sitting in the dental chair for a clinical examination of the oral cavity. First molar tooth status, TMJ evaluation, and type of crossbite and affected side should be carefully inspected and recorded in a special case sheet formed for this study.

Then the participants' maximal molar biting force was measured under controlled conditions. Each participant was sitting on a chair in an upright position with their backs supported and hands resting on the armrests. Additionally, their feet were comfortably placed on the ground. The participants were instructed to maintain a relaxed posture and gaze straight ahead during the measurement process. (Khan et al., 2020, 13).

In the same session, the measurement of maximal bite force was conducted in the first molar region with a portable occlusal pressure sensor manufactured by **NaganoKeiKi Company** in Tokyo, Japan. The bite force has been measured in Newton (NT) units and visually presented in digital format (Figure 1).

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Figure 1: Digital Bite force measuring device **(NaganoKeiKi CO.)**.

After encasing the biting component of the apparatus with a fresh plastic tube, position the apparatus within the first molar region and instruct the participant to exert a firm bite for a brief duration, to the best of their ability. The bite measurement will be conducted twice for each side, with a reversed order after intervals of 5 minutes. The maximum value obtained for each side will be recorded.

The plastic tube is replaced after each patient to ensure infection control since a dental professional's greatest danger is the risk of contracting and/or spreading life-threatening infectious diseases. It has been demonstrated that equipment supplies and instruments could be a source of microbial infection as they could make it easier for diseases to spread through saliva and blood (Nasser and Abass, 2023).

Results

The descriptive statistics are shown in table (1):

Table 1: the descriptive statistics of bite force (descriptive table)

Groups	Group of teeth crossbite		Single tooth crossbite	
side	Normal side	Crossbite side	Normal side	Crossbite side
mean	351.63	379.13	310.20	301.37
Standard deviation	108.93	114.240	94.056	93.121
minimum	174	208	184	168
maximum	633	729	500	471
Range	459	521	316	303

*All units in NT

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To determine the normality of data, the Shapiro-Wilk test was used for both groups and the results showed that there normal distribution of data for a group of teeth crossbite group with p-values (0.595,0.055) for the normal bite side and crossfire side respectively.

However single tooth crossbite group showed a non-normal distribution when tested with the Shapiro-Wilk test with p value (P= 0.027, P= 0.026) for the normal bite side and crossfire side respectively.

Wilcoxon signed-rank test (non-parametric test) was used to compare the normal bite side with the crossbite side for both groups. The results show significant differences between sides in a group of teeth unilateral posterior crossbite and non-significant differences between sides in the single tooth unilateral posterior crossbite group. The test results and P-value are presented in Table (2).

Table (2): Wilcoxon signed-rank test results (comparative test)

Groups	***Group of teeth crossbite***	***Single tooth crossbite***
Negative Ranks	*8*	*19*
Mean negative rank	*12.81*	*14.55*
The sum of negative ranks	*102.50*	*276.50*
Positive Ranks	*22*	*11*
Mean negative rank	*16.48*	*17.14*
The sum of positive ranks	*362.50*	*188.50*
Test value (Z)	*-2.674-*	*-0.905-*
P value	*0.007*	*0.365*

Regarding the group differences in bite force for both sides, the results show a significant difference in maximum bite force between the single tooth posterior crossbite group and a group of teeth posterior crossbite group on the crossbite side and a non-significant difference in the normal side. The results are presented in (Table 3)

Table 3: Group differences in bite force for both sides (inferential comparative statistics)

Side	Normal side	Crossbite side
Mann-Whitney U	355.000	275.000
Standardized Test Statistic	-1.404-	-2.588-
P value	0.160	0.010

DISCUSSION

Maximum bite force measurement was performed by a pressure gauge. It consists of a pressure meter inside the biting part and is covered by a replaceable plastic cover. Using this device has several advantages: simple to use, its thickness of about 5.4 mm, does not any special preparation, noninvasive, and infection control can be performed by replacing the plastic cover for each patient. There is a possibility for tooth trauma from high occlusal force application and this is prevented by excluding cases with large restorations in first molar teeth.

However, for more reliable results, several recordings were utilized. It is commonly established that several biting force records are more trustworthy than a single bite force recording (Castelo et al., 2007). This phenomenon is particularly evident among female patients, as supported by existing literature. It is widely acknowledged that females are susceptible to pain to a greater extent than males. This difference can be attributed to the perception that girls possess a greater susceptibility to pain due to their perceived fragility and heightened sensitivity, while males are generally

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characterized as being more resilient and capable of enduring higher levels of discomfort (Rafeeq et al., 2020). The highest possible number of bite force was utilized to prevent random errors.

The results show non-significant differences between sides in single-tooth posterior crossbites and this is in agreement with previous studies (Sonnesen et al., 2001, Ingervall and Minder, 1997).

These results can be explained by the fact that crossbites resulted from teeth that deflected out of line as a result of the over-retention of deciduous teeth, a deficient arch length, or an aberrant eruption pattern and none of these have a documented relation with bite force. Furthermore, mandibular elevation is a bilateral action and muscle-producing bite force acting bilaterally at the same time. This is probably the main reason why it is not possible to detect any differences between crossbite and non-crossbite sides (Kennedy and Osepchook, 2005; Sonnesen et al., 2001).

However, the results show a highly significant difference in bite force between the normal side and crossbite side in a group of teeth posterior crossbite group and the positive ranks in the Wilcoxon test refer to the values where the crossbite side is more than the normal side while negative ranks are the opposite. Since positive ranks are three times more than negative ranks, we could conclude that bite force on the crossbite side is higher than the normal side in 73% of cases. Furthermore, the mean of the crossbite side is higher than the normal side.

These findings are explained by the fact that in a group of teeth with a unilateral crossbite, the anterior temporal and masseter muscles exhibited considerably higher activity on the crossbite side at rest when compared to the normal side. Due to the fact that muscle activity serves as the primary determinant of biting force, there exists a significant difference in bite force between the two sides (Kecik et al., 2007).

The results indicate a significant difference between the group of teeth posterior crossbite and the single-tooth crossbite group on the crossbite side. This can be explained by the number of contact differences between groups which is a determinant of maximum bite force. However, the results show a non-significant difference in Maximum bite force on the normal side between the group of teeth posterior crossbite and single tooth posterior crossbite. These findings can be attributed to similarity in occlusal contact support (Ingervall and Minder, 1997: Lepley et al., 2011).

Conclusion

There is a significant difference between the crossbite side and the non-crossbite side in a group of teeth unilateral posterior crossbite group and non-significant differences in the single tooth posterior crossbite. Furthermore, there is no significant difference of bite force of the normal side between a group of teeth posterior crossbite and the single tooth posterior crossbite. However, there is a significant difference between the group of teeth posterior crossbite and the single tooth posterior crossbite group on the crossbite side.

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