



MEDIAL MANDIBULAR FLEXURE AND MAXIMUM BITE FORCE IN KENNEDY CLASS I PARTIALLY EDENTULOUS PATIENTS

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ABSTRACT

Objective: This study was conducted to assess the correlation between medial mandibular flexure and maximum bite force in Kennedy class I partially edentulous patients. **Subjects and Methods:** A sample of 40 Kennedy class I partially edentulous patients were selected from outpatient clinics, Faculty of Dental Medicine, Al-Azhar University. The median mandibular flexure was measured, the mean maximum bite force was recorded for each patient, and the correlation between median mandibular flexure and mean maximum bite force was statistically analyzed. **Results:** The median mandibular flexure range varied from -0.41 to -1.19 mm. The mean median mandibular flexure in the studied population was 0.69 ± 0.31 in men and 0.74 ± 0.15 mm in female patients. The maximum bite force in this study varied from 23.4 to 41.1 kg/N in women and from 31.8 to 51.2 kg/N in men. The Pearson correlation coefficient was calculated between median mandibular flexure and maximum bite force. The value of R is -0.315. There was no significant correlation between the mean median mandibular flexure and mean maximum bite force (P-Value is 0.312). **Conclusion:** The median mandibular flexure and mean maximum bite force should be considered in the treatment plan separately as there was no correlation found between them in Kennedy class I partially edentulous patients.

KEYWORDS: Median Mandibular Flexure; Maximum Bite Force; Partially Edentulous Patients

INTRODUCTION

Mandibular dimensions are affected by many forces acting on the mandible in different directions, which may change its dimensions and affect natural and artificial dentition ⁽¹⁾.

Median mandibular flexure (MMF) is a deformation characterized by the property of the mandible to flex inward during mouth opening and protrusion movements of the jaw with a reduction in the width of the mandibular arch. These movements

occur in the frontal plane of the mandible and are caused by the contraction of lateral pterygoid muscles. The mandible flexes around the mandibular symphysis with medial pull on the mandibular condyles and sagittal movement of the posterior segments ⁽²⁾.

MMF in prosthetic treatments can increase stress in abutments, fixed prostheses, and removable prostheses, thereby causing distortion and pain during function, breakage of implant screws, loosening of prosthesis cement, and porcelain fracture ⁽³⁾.

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The bending of the mandible can also affect the stability of the lower denture. Bending in the opening of the mouth begins after the mouth opens over 28% of the maximal mouth opening and then increases linearly with a rise in the mouth opening⁽⁴⁾.

As mandibular distortion affects the fit of the removable partial denture and puts undue stress on the abutment teeth of a bilateral partial denture, prostheses should be fabricated by sectioning, soldering, or using the passive fit technique. The frameworks constructed using the passive fit method induce a significantly smaller amount of strain on the prosthesis compared with the conventional technique⁽⁵⁻⁷⁾.

The mandibular deformation may range from a few micrometers to more than 1 mm^(3,8). Different methods used to evaluate and measure mandibular deformation include the following: intra-oral measuring techniques by calipers, gauges, strain gauges or transducers, extraoral measuring techniques by comparing diagnostic casts made from impressions taken at various openings of mandible and model simulations of three-dimensional finite element analysis^(2,3,8).

Maximum occlusal force (MOF) may be considered a measure of masticatory muscle function because it represents the effort exerted between the maxillary and mandibular teeth when the mandible is elevated. The large intersubjective variability of MOF results from a complex interaction of many factors such as sex, age, body mass index, presence of temporomandibular disorders, size and direction of the masseter muscle, craniofacial morphology, dental occlusal status, periodontal sensitivity, and psychological factors⁽⁹⁻¹¹⁾.

Raadsheer et al.⁽¹²⁾ stated that the magnitude of MOF depends on the size of the jaw muscles and the lever arm lengths of MOF and muscle forces, which would be related to craniofacial morphology. Technical factors depend on the measuring method and the mechanical characteristics of the bite force recording system^(13,14).

A wide range of devices have been used to measure bite force: bite fork, the strain gauge transducers^(15,16), the gnathodynamometer⁽¹⁷⁾, the foil transducers⁽¹⁸⁾, the pressurized rubber tube^(19,20), the pressure-sensitive sheet^(21,22) and the force-sensing resistors⁽²³⁾.

Even though median mandibular flexure and maximum biting force have an important role in the prosthetic outcome, the current study is one of few studies evaluating the correlation between the median mandibular flexure and maximum biting force in Kennedy Class I partially edentulous patients.

SUBJECTS AND METHODS

In this cross-sectional study, a sample of 40 Kennedy class I partially edentulous patients were randomly selected from Outpatient clinics (figure 1), the Faculty of Dental Medicine, Al-Azhar University; the sample size was calculated and determined based on previous study⁽²⁴⁾.

All patients signed an informed consent form after clarification of study procedures. This cross-sectional study was approved by Ethics Committee, Faculty of Dental Medicine, Al-Azhar University, with a reference number AUAREC20020050-09. The patients' age range was 35-45 years old, including 20 males and 20 females.

The inclusion criteria include the absence of second and third molar bilaterally, normal TMJ, and the absence of any systemic disease that may affect TMJ movements. The exclusion criteria consisted of a history of maxillofacial surgery, mandibular trauma, bone or musculoskeletal disorders, orofacial pain, and any systemic diseases which may affect the biting force.

MMF is due to the difference between the intermolar distance in the resting state and the maximal mouth opening. To make a closed-mouth impression technique, the triple-tray technique (First Bite, Dentsply Sirona, Pennsylvania, United States) was used in the closed-mouth mode.



FIG (1) Partially edentulous patient.

In the maximum mouth opening, a disposable tray was used with short flanges to prevent interference with the buccal mucosa during maximal mouth opening. After confirming the size and the absence of any interference, the impression was made with an appropriate amount of polyvinyl siloxane impression material (Panasil, Kettenbach GmbH, and Co. KG, Eschenburg, Germany). Each impression was poured with Gypsum type III (Snow rock, Mungyo Gypsum and Engineering CO, Gimhae, Korea).

On the occlusal surface of the first molar of a cast, an acrylic index was made to be placed on the surface of the first molar of the second cast without obvious error. Each index contained a hole through which the digital caliper's head could be inserted. The distance between the two indexes was measured by a standard digital caliper (Guangli, Guilin Guanglu Measuring Instrument Co, Ltd., Guilin, China).

It was measured in millimeters in each case, and the difference between the two recorded MMF was calculated. The calculation of MMF in each case was done blindly by the same researcher.

To measure the maximum bite force, an occlusal force meter (GM10, Nagano Keiki, Tokyo, Japan) was used with a measuring range from 0 to 1000 N, (Fig.1). The instrument was placed in the first

molar region with the patient in an upright position. Measurement was performed three times on each jaw side with a 1-min interval. The average bite force was calculated, and the maximum number was used for the statistical analysis.



FIG (2) Occlusal force meter.

Data were statistically analyzed by SPSS software Version 23.0. (IBM SPSS Statistics for Windows, Armonk, New York) using descriptive statistics, linear regression analysis, and Pearson correlation coefficient. $P < 0.05$ was considered statistically significant.

RESULTS

The purpose of this study was to investigate the correlation between MMF and MOF in a sample of 40 Kennedy class I partially edentulous patients (20 female and 20 male) at Outpatient clinics, Faculty of Dental Medicine, Al-Azhar University.

The MMF range varied from -0.41 to -1.19 mm. The mean median mandibular flexure in the studied population was 0.69 ± 0.31 in men and 0.74 ± 0.15 mm in female patients.

The Pearson correlation coefficient between MMF and age was calculated. The value of R is 0.152. Although technically a positive correlation, the relationship between the variables is weak (the nearer the value is to zero, the weaker the relationship). There was no significant correlation between mean MMF and mean age. The P-Value is .690.

Although the MMF was slightly higher in women than in men, The results of the t-test showed a

non-significant difference between male and female patients in MMF. The t-value is 0.291. The p-value is .389. The result is not significant at $p < .05$.

The occlusal bite force in this study varied from 23.4 to 41.1 kg/N in women and from 31.8 to 51.2 kg/N in men. The mean and standard deviation of MOF was calculated. The mean MOF in the studied population was 38.24 ± 8.5 kg/N in male patients and 32.9 ± 6.9 kg/N in female patients.

The Pearson correlation coefficient between MOF and age was calculated. The value of R is 0.312. Although technically a positive correlation, the relationship between your variables is weak (the nearer the value is to zero, the weaker the relationship). There was no significant correlation between mean MMF and mean age. The P-Value is 0.321

The results of the t-test showed a non-significant difference between male and female patients in MOF. The t-value is -1.071. The p-value is .152. The result is not significant at $p < .05$.

The Pearson correlation coefficient between MMF and MOF was calculated. The value of R is -0.315. Although technically a negative correlation, the relationship between the variables is weak (the nearer the value is to zero, the weaker the relationship). There was no significant correlation between mean MMF and mean MOF (P-Value is 0.389).

DISCUSSION

This is a cross-sectional, preliminary study to determine the correlation between medial mandibular flexure and maximum occlusal force in Kennedy class I partially edentulous patients.

Many studies have used a variety of methods to measure MMF and MOF. In this study, MMF was measured by calculating the variation of the intermolar distance from rest (R) to maximum opening (O) positions using an impression technique^(10,24).

In the present study, the MMF range varied from 0.41 to -1.19 mm., which is less than that measured in a similar study conducted by Ebadian et al.⁽⁸⁾. It may be due to the differences in the applied methods.

The mean mandibular flexion in men and women showed that the MMF was slightly higher in women than in men. However, the difference between the two groups was not statistically significant. Loth and Henneberg^(25,26) reported that there is a difference between men and women in the severity of posterior ramus flexion, which might be due to bone strength differences in the two genders.

In this study, the Pearson correlation coefficient test showed a positive correlation between MMF and age as the value of R is 0.144. There was no significant correlation between mean MMF and mean age (the P-Value is .690). these results not in accordance with that reported by Ebadian et al,⁽⁸⁾ who mentioned that there was a negative correlation between age and MMF; the amount of MMF being decreased with a rise in the age of the participants. Studies have shown a positive relationship between age and bone density, especially in dentate individuals, and a negative correlation between the number of teeth and bone density. As the age increases and the number of teeth decreases, bone density decreases⁽²⁷⁾. This difference might be due to the difference in the sample population's age and dental condition.

The maximum bite force has different values in various locations in the mouth, and it is highest recorded in the first molar region because most of the biting force is directed in that area^(28,29). The bite force is recorded three times for each patient as it is more reliable to measure multiple recordings of maximum bite force than a single record⁽³⁰⁾.

In this study, bite force was slightly higher in males when compared to females. The results of this study were found to agree with the previous studies reported that gender has no significant influence on bite force^(31,32).

However, some studies showed that the bite force was significantly higher in males when compared to females.^(14, 20, 33) The gender difference in bite force has been explained as greater muscle potential in men in many studies^(34, 35).

In the present study, there was no significant correlation between mean bite force and mean age. The P-Value is 0.321. this result is contrary to the results of Pereira et al.⁽³⁶⁾, who reported that MOF decrease with increasing age might occur mainly due to tooth decay.

In some studies, authors stated that there was no consensus among the national and international literature on the importance of age as a determinant of maximum bite force. There are reports that maximum bite force decreases in women after 25 years of age and in men over 45 years of age^(37, 38).

In the present study, there was no significant correlation between mean MMF and mean maximum bite force (P-Value is 0.389). Similar studies obtained similar results, these studies stated that as the amount of muscle mass and muscle strength increased, the maximum bite force was increased and, there is no relation between the amount of muscle mass and muscle strength and MMF^(24, 39).

CONCLUSION

Within the limitation of this study, there was no correlation between the maximum bite force recorded for Kennedy class I partially edentulous patient and the median mandibular flexure measured.

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