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Authors
Salah Khalaf BDS, MSc, PhD
University Name: University of Anbar, Faculty of Dentistry, Prosthodontics Unit.
Email ID: den.salah.a@uoambar.edu.iq
ORCID ID: https://orcid.org/0000-0002-2487-0073

Abdul-Hadi NF BDS, MSc.
University Name: University of Anbar, Faculty of Dentistry, Prosthodontics Unit.
Email ID: noor.falah.@uoanbar.edu.iq
ORCID ID: https://orcid.org/0000-0002-6839-2907

Maha Mishaal Turki BDS, MSc.
University Name: University of Anbar, Faculty of
Dentistry, Prosthodontics Unit.
Email ID: maha-mishaal@uoanbar.edu.iq
ORCID ID: https://orcid.org/0000-0002-5291-2664

Address for correspondence: Dr. Salah Khalaf Abbas,
Prosthodontics Units, Faculty of Dentistry, University of Anbar, Iraq
E-mail: dr.salah_alrawi@yahoo.com;
Email ID: den.salah.a@uoambar.edu.iq

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Maximum Mouth Opening and Its Correlation with Endtulous Arch for Denture Size

Abstract

Aim: This study aimed to determine the number of edentulous residual ridges in stone casts of individuals with full dentures and to analyze the relationship between these ridges and mouth openness.

Methods: The sample consisted of eighty study casts, forty of which were upper and forty of which were lower. Measurements were taken with the assistance of a dry-point compass and a transparent ruler. The measurements for maximum mouth opening (MMO) were collected from volunteers who were instructed to open their mouths to their furthest extent until there was no more room to open. Utilizing a Boley gauge, the distance measured from the edge of the upper lip to the edge of the lower lip was determined.

Results: Correlations between mouth opening and arch size (length and width) were verified using Spearman correlation and simple linear regression. Individuals with larger maxillary and mandibular alveolar ridges had wider mouth openings.
Conclusion: A significant correlation was found between arch size (length and width) and mouth opening.

Keywords: Alveolar ridge dimensions; Complete dentures; Edentulous residual ridge; Maximum mouth opening; Oral morphometry; Prosthodontics.

INTRODUCTION

After tooth loss, the soft tissues that make up the alveolar ridge cover the remaining tissues in the mouth. The alveolar ridge is a component of the alveolar bone [1]. The denture-bearing mucosa, periosteum, submucosa, and residual alveolar bone make up this alveolar ridge. The remaining alveolar bone undergoes remodeling after tooth extraction, which results in morphological decrease and modification. This process occurs after tooth extraction [2, 3, 4]. The alveolar ridge is the part of the brain that shrinks the most in the first six months of life. In contrast, resorption activity in the alveolar ridge is a gradual process that continues throughout an individual's life [3, 5, 6, 7]. According to dental professionals, this alveolar ridge is the principal denture-bearing area. However, the form of the alveolar arch, which might be classified as tapering, square, or oval, usually conforms to the pattern in which the teeth are still intact. Changes in the shape and size of the alveolar ridge are brought about by the resorption process that occurs inside the alveolar ridge. [1,8]

The alveolar ridge is the location where permanent teeth are curved, and the jaw arch is the result of this combination [1]. The tuberosity zygomaticus, buccal vestibule, alveolar ridge, and palate are the components that come together to produce the maxillary arch. The retromolar pad, mylohyoid ridge, alveolar ridge, lingual vestibule, and buccal vestibule are the components that come together to create the mandibular arch. It has been discovered, on the basis of the preliminary study, that the three various forms of alveolar arches—ovoid, square, and tapering—each have varied denture-bearing areas, with the square arch shape having the biggest denture-bearing area. A higher overall denture-holding area corresponds to an increased surface area of the denture base. This process is conducted to optimize retention factors, including cohesion, capillary attraction, air pressure, interfacial force, and adhesion, to achieve better retention. [8,9,10,11]

The maximum mouth opening (MMO) serves as a crucial diagnostic criterion for dental practitioners during initial assessments. Limited mouth opening during mandibular movements may be attributable to oral submucous fibrosis, temporomandibular joint dysfunction (TMD), infection, rheumatic disease, facial trauma, or malignancies. [12, 13]. In order for dental clinicians to be able to objectively assess the outcomes of therapy and establish therapeutic objectives for patients who are undergoing mandibular functional exercises, it is possible that establishing a normal range for MMO is necessary. In previous research, an effort was made to assemble a range of physiological mouth-opening capacity data that are representative of the average. However, the variability in MMO is rather high because it changes significantly with sex, age, race, mandibular size, joint condition, body height, cranial base size, and weight. [14-21]

Given that it is highly reliant on other specific physiological factors, there is currently no reference that clinicians can use to evaluate whether a patient has restricted mouth opening capacity. Therefore, it is essential to investigate the link between mouth opening and any physiological signs associated with it. The present study assessed the association between mouth opening in individuals wearing complete dentures and the anatomical variables (length, size, and width) of the maxillary and mandibular arches. This study was conducted because of the limitations of other studies mentioned above and the need to examine the architecture of the residual ridge to optimize treatment results for edentulous patients.

MATERIALS AND METHODS

An investigation of this kind was carried out at the “Department of Prosthodontics, College of Dentistry, University of Anbar.” This was a cross-sectional research that also included a time series. The university’s research ethics committee provided consent for this research before it was conducted. This research used a convenience sample of individuals who requested the college 's assistance with the fabrication of new dentures. Between the months of October 2025 and April 2026, patients were sent an invitation to take part in the research project. If they accepted the invitation, they signed the free and informed consent agreement. This research comprised a total of 80 patients and their respective anatomical stone casts, which were divided into two categories: upper and lower.

A separate researcher, not the one responsible for the molding process used to generate the study casts, carried out the anatomical measurements of the stone casts. For the goal of fabricating new prostheses, casts were taken from anatomical moldings. For the edentulous ridges, the moldings were manufactured using stock trays, and wax was employed to modify them. The top and bottom ridges were constructed using condensation silicon Silon 2 APS, which was manufactured by Dentsply in Petrópolis, Brazil. First, the moldings were cast utilizing gypsum stone ("Herodent, Rio de Janeiro, Brazil"). Subsequently, a trimming machine ("DCL, São Paulo, Brazil") was used to trim the moldings.

The approach used by Pietrokovski et al. [22] to measure the size of maxillary and mandibular arches on stone casts was employed in this study. First, intra-examiner adjustment was carried out. The 10 casts were evaluated once a week, and the kappa value was > 0.8, suggesting a high level of consistency (kappa = 0.981). We employed a dry-point compass ("JON, São Paulo, Brazil") and a clear 30-mm ruler ("TRIDENTI, Tapuí, São Paulo, Brazil") to assess the maxillary and mandibular models after defining the bearing area. Figure 1 illustrates that the dimensions of the edentulous arches were ascertained by observing both the length of the midline and the width.

Estimating the spacing from point A to point B allowed for the determination of the length of the maxilla. The width was determined through the calculation of the distance between the two locations, C. To acquire the length of the mandibular arch, the D to E distance was measured, and the width of the arch was determined by the space between points F. [23]

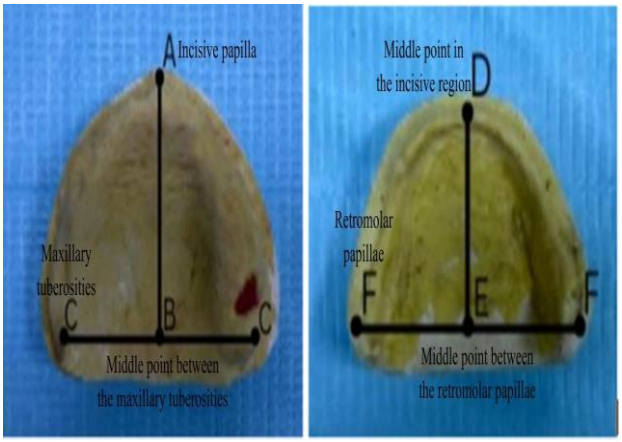

Figure 1. Measurements of the mandibular and maxillary arches

The below formula was used to convert the results into indices, which were then used to classify the arches into three different sizes:

$$ne = \frac{\text{Arch width}}{\text{Arch length}} 100 \quad (1)$$

Measurements of the maximum mouth opening (MMO) were obtained by specially trained examiners and subsequently standardized (kappa > 0.8). The participants were instructed to rest for a minimum of 10 min before the MMO (mm) measurement was performed. Subsequently, they were seated in the dental chair in a calm and upright posture, and they were instructed to stare in the direction of the road ahead. Each participant was given the instruction to ensure that their mouth was as open as it could possibly be. (Figure 2).

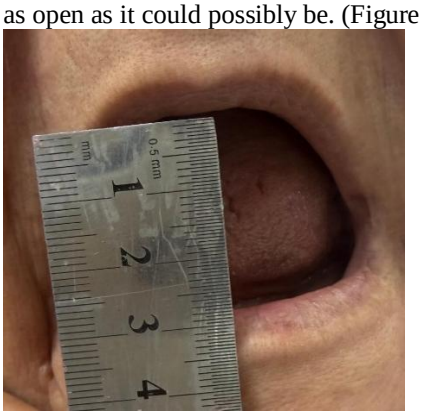

Figure 2. Measurement of mouth opening

A metal ruler was used to determine the linear lip distance between the lower and upper edges. For the purpose of ensuring the reproducibility and accuracy of the data, each subject was measured three times within a span of fifteen minutes after the first measurement. As the result of each and every analysis, the mean MMO measurements in millimeters was obtained and recorded.

Statistical analysis

Analysis using statistics. Using spreadsheets in "Microsoft Excel 2013 (Microsoft Corporation, Redmond, Washington, United States)," a database was constructed for the purpose of inputting the data that was obtained. These spreadsheets were then transferred to "SPSS version 20.0" for Windows in order to conduct quantitative statistical analysis. A comprehensive analysis of the data was conducted at the outset of the procedure. Spearman's correlation and simple linear regression were used to estimate the relationships between MMO and the arch sizes (width and length) of the mandibular and maxillary arches. Five percent was chosen as the threshold of significance for both of the tests.

Result

All of the individuals had a mean maximum mouth openness of 55.3 millimeters, with a standard deviation of 9.3 millimeters. The range was 35–75 mm (P < 0.001). All data are presented in Table 1.

Table 1. Normal mouth opening in all participants (P< 0.001).

Individual data	Value
Number of patients (N)	80
Mean (mm)	55.3
Standard deviation	9.3
Range (mm)	35-75

A moderately positive correlation was observed between the size (width and length) and the MMO of the mandible and maxillary prostheses. A significant association between MMO and the dimensions of the maxillary and mandibular prosthesis was observed (p = 0.004). This correlation tended to be significant (p = 0.087; "Pearson's correlation coefficient r Z 0.54; P < 0.001"), as well as between weight (P < 0.001; r Z 0.50) and MMO. Table 2 lists the correlations among arch length, width, and size.

Table 2. Correlations among the length, width, and size of arches with denture prostheses (n = 80)

Parameters	Denture Prostheses	P
Length of mandibular arch	-0.017	0.922
Length of maxillary arch	-0.059	0.743
Maxillary arch width	-0458	0.004
Mandibular arch width	-0.117	0.492
Maxillary arch size	-0.297	0.049
Mandibular arch size	-0.012	0.943

Note: Spearman 'scorrelation.

The tendency of MMO (mm) to increase with the length, width, and size of the arches with denture prostheses was evident, as shown in Figure 3, which displays scatter and linear regression diagrams. This relationship was observed to be significant. According to the regression model, it was calculated that the MMO (mm) rose by either 3.6 mm or 1.8 mm for every 10 cm that passed as input. Calculating the regression coefficient and intercept allowed us to derive the regression equations. Figure 3

shows that there is a statistically significant ($P < 0.05$) linear relationship within the width, length, and size of the arches with denture prostheses and the mouth opening, with correlation coefficients of -0.059, -0.017, -0.458, -0.117, -0.297, and -0.012, respectively.

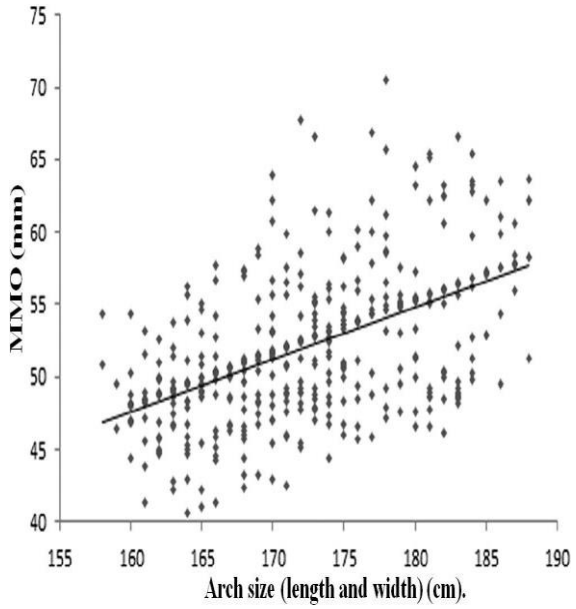

Figure 3: Linear and scatter regression of MMO with respect to arch size (length and width).

DISCUSSION

This search was carried out with the intention of determining whether or not there is a relation between the dimensions of the mandibular and maxillary arches and the dimensions of the mouth opening, including its width, length, and size. The significance of these results lies in the fact that a significant number of prosthodontic treatments are frequently performed in this region of the world without a suitable reference value. In light of the fact that the mouth opening is manifestly variable in various populations, it is evident that the inevitable reference to international statistics is not legitimate. The mouth opening of the patients who participated in this study was proportional to the size of their arches and was directly associated with their height. It seems that there are various elements that influence mouth opening. To unequivocally establish these factors and their significance for mouth opening, large multicenter studies should be conducted worldwide. In our opinion, the collection of such data will not only help us justify the treatment plan objectively but will also expand our knowledge of the numerous illnesses that impact mouth opening. The mouth opening varies from one group to another. [24]

The notion that stature is a significant factor influencing mouth opening has been documented by a few researchers, and these studies have suggested this as an explanation for the differences in mouth opening that exist across different groups. By the end of the study, Landtwing [25] came to the conclusion that the mouth opening considerably rises with age and that when measuring mouth opening, stature should be taken into consideration. Mouth opening may be measured using a wide variety of techniques, all of which have been detailed in the relevant literature. The interincisal distance that the participant achieves when actively opening their mouth is the measurement used most often when evaluating mouth opening.

On the other hand, since it does not take into account the overbite, this approach fails to accurately represent the movement of the mandible [24]. However, the clinically significant aspect is the presence of sufficient mouth opening, which enables patients to engage in typical social functions and provides acceptable access to the oral cavity for dentists. The measurement is essentially the interincisal distance, although it does not include overbite. [24]

There have been a wide variety of instruments used in the process of measuring linear mouth opening. After analyzing three different approaches to measuring the space between the teeth, Wood and Branco [26] concluded that the most accurate technique was direct measurement using a ruler. With the purpose of determining whether there is a connection between the length, width, and size of arches and MMO in individuals who wear full dentures, this research was conducted. We discovered that the maxillary and lower arches affected MMO in terms of length, width, and size. Furthermore, our results reveal that a straightforward correlation may not be sufficient to explain this situation. Only 62% of patients in the present study had a high maxillary arch, compared with 82.8% of patients with a large mandibular ridge arch. The remaining individuals, on the other hand, are more susceptible to the use of the prosthesis. [27]

The study also demonstrated a positive and significant correlation between the size of the maxillary and mandibular arches and the MMO dimension. This improvement was made possible by the increased size of the maxillary and mandibular arches, which allowed for a larger MMO. The decreased size of the mandibular and maxillary arches allowed for a more compact maxillofacial reconstruction (MMO). The discrepancies in correlations between the size of the jaw and MMO that were discovered were most likely due to this circumstance. The average MMO distance was found to be 52.85 mm.

Seven hundred normal scenarios were the subject of research by Cox and Walker. [28] They observed that the mean value for an MMO distance was 47.1 mm, with a range that went from 33.7 to 60.4 mm. The mean mouth opening in this research was 52.85 millimeters, with a standard deviation of 9.3 millimeters. The current research, on the other hand, demonstrates a clear decrease in mouth opening as the size of the arch increases. Considering the significance of this discovery, further research and analysis are urgently required. For the purpose of establishing facts beyond reasonable doubt, we suggest conducting comprehensive research that involves many centers. Therefore, it is necessary to perform a multivariate analysis that takes into account all of the elements that might potentially cause confusion. One of the terms that we use often in our day-to-day work is “mouth opening.” The denominator for many pathological entities is this particular one.

CONCLUSIONS

The mean maximal mouth opening was 52.85 mm (SD, 9.3). Mouth opening seems to increase with arch size. Even within the limits of the present investigation, it can be concluded that the greater the size of the prostheses, the more significant is the influence of MMO (mm).

Conflict of interest. None.

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