Journal of Biological Research

Bollettino della Società Italiana di Biologia Sperimentale

eISSN 2284-0230 - pISSN 1826-883
https://www.pagepressjournals.org/index.php/jbr/index

J Biol Res 2024 [Online ahead of print]

To cite this Article:
Azhari M, Anissa A, Melainin Y, et al. **Exploring dimensions and shapes of edentulous patients consulting the prosthodontics centre at Ibn Sina University Hospital in Rabat, Morocco: a cross-sectional study.** *J Biol Res* doi: 10.4081/jbr.2024.11507

Exploring dimensions and shapes of edentulous patients consulting the prosthodontics centre at Ibn Sina University Hospital in Rabat, Morocco: a cross-sectional study

Mohamed Azhari,[1] Abdelkoui Anissa,[1] Yehya Melainin,[2] Oussama Bentahar,[1] Faiza Benfdil[1]

[1]Department of Removable Prosthodontics, Faculty of Dental Medicine, University Mohammed V, Rabat; [2]Doctor of Dental Medicine (DMD), Dentist in the private sector, Morocco

Correspondence: Mohamed Azhari, Department of Removable Prosthodontics, Faculty of Dental Medicine, University Mohammed V, Avenue Allal Al Fassi, Rue Mohammed Jazoulit, Madinat Al Irfane, BP: 6212Rabat.

Tel.: +212661691307

E-mail: med.azhari.ma@gmail.com

Key words: edentulous arch dimension, edentulous arch shape, edentulous arch form, prosthodontics centre, Ibn Sina University Hospital, Rabat, Morocco.

Conflict of interest: the authors declare no potential conflict of interest, and all authors confirm accuracy.

Ethics approval: the Ethics Committee of the Faculty of Dental Medicine, University Mohammed V in Rabat, Morocco (FMDR-UM5), approved this study under approval code BFMDR 04/17. The study is conformed with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights.

Informed consent: all patients participating in this study signed a written informed consent form for participating in this study.

Patient consent for publication: written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article.

Acknowledgements: we extend our heartfelt gratitude to the patients who participated in this study, which was conducted at the Prosthodontics Centre, Ibn Sina University Hospital, Rabat, Morocco. Their willing participation and valuable insights have been essential to our exploration of the dimensions and shapes of maxillary and mandibular edentulous arches. We would also like to acknowledge the dedicated professionals at the Prosthodontics Centre for their exceptional patient

care, meticulous data collection, and insightful analysis. Their expertise has significantly enriched the quality of our research findings. We are indebted to Ibn Sina University Hospital for providing the necessary resources and support, enabling us to carry out this research successfully. Lastly, our appreciation goes out to the prosthodontics community for their ongoing dedication to advancing the field. The collaborative environment within this community has played a pivotal role in shaping the trajectory of our research.

Abstract

This cross-sectional study conducted at the Prosthodontics Centre, Ibn Sina University Hospital in Rabat, Morocco, investigates the dimensions and shapes characterizing maxillary and mandibular edentulous arches in a patient population seeking consultation. The objective is to provide insights crucial for optimizing outcomes in prosthetic therapy, informing decisions on impression trays, occlusion planes, prosthetic teeth, and implant attributes. Sixty-seven edentulous Moroccan patients (40 men, 27 women), aged 31 to 90, were recruited at the Prosthodontics Centre. Maxillary and mandibular casts were meticulously crafted, and precise measurements of anterior and posterior width and length were acquired for both arches. Arch shapes were categorized into O-shape, V-shape, and U-shape. Data were analyzed using Microsoft® Excel 2013 and SPSS software (IBM SPSS Statistics 23). Analysis revealed maxillary arch lengths ranging from 40 to 58 mm, maxillary arch widths from 38 to 58 mm, mandibular arch lengths from 33 to 56 mm, and mandibular arch widths from 30 to 60 mm. The predominant arch shape was the ovoid, constituting 34% (n=23) of maxillary cases and 54% (n=36) of mandibular cases. This study provides novel insights into the dimensions and shapes of maxillary and mandibular edentulous arches in patients seeking consultation at Ibn Sina University Hospital, Rabat, Morocco. The findings offer valuable guidance for prosthetic therapy decisions, emphasizing the importance of integrating established references and arch classifications for optimal outcomes in the treatment of edentulous patients in Morocco.

Introduction

The core objective of comprehensive prosthetic treatment is to prevent complications and restore the natural morphology of edentulous arches, ensuring both functional rehabilitation and aesthetic harmony. However, the gradual passage of time and the effects of prosthetic wear lead to significant

alterations in the dimensions and configuration of these arches, posing a considerable challenge to treatment strategies.[1] This dynamic alteration is primarily caused by the phenomenon of resorption, a process triggered after tooth extraction, leading to substantial structural reconfiguration of the underlying bone matrix.[2] Resorption plays a pivotal role in shaping the contours, structural form, and overall size of edentulous arches, exerting a profound influence on their intricate three-dimensional architecture.[3]

In our study, an encompassing age distribution was carefully designed to ensure the inclusion of individuals representing different life stages. This deliberate approach potentially highlights varying degrees of anatomical alterations in the edentulous arches of the participants. As individuals progress through different phases of life, these alterations, including bone resorption, temporomandibular joint (TMJ) arthritis, traumas, bone diseases, influences from dental prosthetics, and genetic factors, can be influenced by a variety of factors, making the age-diverse sample essential for a comprehensive understanding of the morphological changes in edentulous arches.[4]

While prior research has predominantly focused on the consequences of resorption on edentulous structures, particularly in the mandibular arch, limited attention has been given to the nuanced interplay between arch dimensions and proportions.[5] Paradoxically, as advancements in prosthetic technologies continue to unfold, notably exemplified by the emergence of implant-supported prostheses, the significance of arch configuration has gained renewed prominence.[6] Arch shape now transcends mere anatomical considerations, playing a pivotal role in implant selection, optimal spatial distribution, and the biomechanical dynamics underlying the restored arch structure.[7]

Recognizing the critical role played by arch morphology is paramount in achieving successful outcomes in modern implant treatments, ensuring enhanced stability, functional proficiency, and ultimately, patient satisfaction.[8]

Our study focuses on exploring the dimensions and morphological contours of maxillary and mandibular edentulous arches within a specific sample: patients seeking consultation at the Prosthodontics Centre, Ibn Sina University Hospital in Rabat, Morocco. Such an approach allows us to delve deeply into the complexities of arch morphology within a distinct population, enriching our comprehension of craniofacial structures in this specific context. By doing so, our study not only contributes significantly to local dental practices in Morocco but also broadens the international understanding of edentulous arch morphology, offering valuable insights for dental professionals worldwide.

Materials and Methods

Study design and sample

This cross-sectional study centred on a meticulously selected cohort of sixty-seven individuals diagnosed with edentulism, actively seeking treatment at the University Dental Hospital in Rabat, Morocco. The selection of inclusion criteria in this study is pivotal, ensuring the temporal relevance and contextual specificity of the obtained results. By specifically focusing on individuals with complete edentulism in both the maxillary and mandibular arches and considering the causes of edentulism, such as periodontal disease or dental trauma, the study aims to provide timely insights into this particular sample. This meticulous approach not only enhances the study's clinical applicability but also offers valuable guidance for dental practitioners and researchers working with edentulous patients in Morocco.

Conversely, in excluding individuals with arch malformations or significant tissue loss due to pathologies like tumours, the study maintains methodological integrity and ensures a focused exploration of edentulous arch dimensions and shapes. By eliminating cases influenced by such complications, the research can accurately reflect the dimensions specific to the chosen population and the factors contributing to their edentulism. This careful selection of participants enriches the study's validity, making the findings highly relevant to current dental practices and providing a comprehensive understanding of edentulous conditions within the defined context and timeframe.

Demographic characteristics

The age range of the participants spanned from 31 to 90 years, embracing a diverse spectrum of ages. This encompassing age distribution ensured the inclusion of individuals representing different life stages, potentially highlighting varying degrees of anatomical alterations in their edentulous arches. The sample also exhibited gender diversity, comprising 40 men and 27 women.

Data collection and measurements

The creation of study casts involved the utilization of irreversible hydrocolloid impression material (Alginate; Fine DFII, G-C. Co., Tokyo, Japan) and dental stone (New Plastone, G-C. Co, Japan). To ensure precision and consistency, a single investigator conducted all measurements employing an analogue caliper graduated in millimetres.

For each participant, meticulous three-dimensional measurements were undertaken to establish the dimensions of both maxillary and mandibular arches.[1] In the context of the maxillary arch, width measurement involved quantifying the distance between posterior points marking the termination of the right and left tuberosities. Conversely, length measurement encompassed the distance from the centre of the incisal papilla of the anterior alveolar ridge to the line intersecting the predetermined

endpoints of the tuberosities. For the mandibular arch, width measurement was derived from the posterior points of the two trigons. Simultaneously, length measurement was performed on the median sagittal line extending from the apex of the anterior alveolar ridge to the line used for width measurement.

Data analysis

Each participant's data profile included the categorization of edentulous arch shapes into O-shaped (ovoid arch), V-shaped (tapering arch), U-shaped (square arch), or irregular shapes, following the classification system introduced by House.[2] The categorization process involved visually assessing the curvature and configuration of the dental ridges, adhering to the criteria established by House's classification. An irregular shape was defined as any edentulous arch form that did not fit the criteria for O, V, or U shapes. These classifications were made through careful visual evaluation, following House's established dental criteria, allowing for the systematic categorization of participants' edentulous arch shapes, including irregular shapes. Robust data analysis was conducted using Microsoft® Excel 2013 and SPSS software (IBM SPSS Statistics 23) on the Windows platform. The analysis encompassed descriptive statistics and comparative methodologies, including chi-square tests and t-tests, with the threshold for statistical significance set at $p<0.05$.

Results

Sample characteristics

The study sample comprised 67 participants, including 40 men (60%) and 27 women (40%). The age distribution was as follows: Four patients (6%) were between 31 and 40 years old, six patients (9%) were between 41 and 50 years old, twenty-one patients (31.3%) were between 51 and 60 years old, twenty patients (29.9%) were between 61 and 70 years old, fifteen patients (22.4%) were between 71 and 80 years old, and one patient (1.5%) was between 81 and 90 years old. Among the participants, forty-one patients (61%) had never worn a prosthesis, while twenty-six patients (39%) were currently fitted with a prosthesis at the time of consultation.

Arch shape distribution

Among the 67 arches in the maxillary category, the distribution of arch shapes was as follows: 34% (n=23) exhibited an O-shape, 27% (n=18) demonstrated a U-shape, 27% (n=18) displayed a V-shape, and 12% (n=8) presented an irregular shape. Shifting our attention to the mandibular arches, among the same 67 arches, the distribution was: 54% (n=36) characterized by an O-shape, 25% (n=17) by a U-shape, 9% (n=6) by a V-shape, and 12% (n=8) by an irregular shape.

Arch dimension analysis

Concerning arch dimensions, the average width of the maxillary arches was approximately 46.67 mm, with a range from 38 mm (minimum) to 58 mm (maximum). The average width of the mandibular arches was approximately 48.25 mm, with a range from 40 mm (minimum) to 58 mm (maximum) (Figure 1). For the maxillary arches, the average length was approximately 54.69 mm, with a range from 30 mm (minimum) to 62 mm (maximum). The average length of the mandibular arches was approximately 45.07 mm, with a range from 33 mm (minimum) to 56 mm (maximum). (Figure 2)

Arch shape variation in relation to gender

Within the maxillary arches of women, distinct arch shapes were prevalent as follows: The O-shape constituted 40.7% (n=11), the V-shape encompassed 14.8% (n=4), the U-shape accounted for 22.2% (n=6), and the irregular shape also represented 22.2% (n=6) of cases. Conversely, in the male population, the O-shape was observed in 30% (n=12) of cases, the V-shape in 35% (n=14), the U-shape in 30% (n=12), and the irregular shape in 5% (n=2) of instances . Transitioning to the context of mandibular arches, women showcased a prevalence of 51.8% (n=14) for the O-shape, 7.4% (n=2) for the V-shape, 18.5% (n=5) for the U-shape, and 22.2% (n=6) for the irregular shape. In contrast, men demonstrated a prevalence of 55% (n=22) for the O-shape, 10% (n=4) for the V-shape, 30% (n=12) for the U-shape, and 5% (n=2) for the irregular shape. While the prevalence of the O-shape was seemingly higher in women, statistical analysis indicated that this difference lacked statistical significance. (Figure 3)

Dimensional variation with respect to gender

A comprehensive evaluation of the data demonstrated that gender did not yield a statistically significant influence on the length of the maxillary arch, the length of the mandibular arch, or the width of the maxillary arch. However, an intriguing discovery surfaced in the realm of mandibular arch width. Specifically, there existed a statistically significant variance between genders concerning the width of the mandibular arch. Remarkably, the width of the mandible in women stood notably narrower than that in men, with a calculated p-value of 0.041 .

Discussion

Our study aimed to explore the dimensions and configuration of edentulous arches in patients in Morocco, with a particular focus on variations based on age and gender. Significant variations were

identified in the dimensions and configurations of edentulous arches, underscoring the impact of age and gender on these specific anatomical features. These findings provide valuable insights crucial for planning and implementing tailored prosthodontic treatments. Notably, the dimensions of the maxillary and mandibular arches were assessed, revealing a range of lengths and widths. Moreover, we observed a slightly higher prevalence of O-shaped arches in women (40.7%) compared to men (30%) in the maxillary arch. Conversely, in the mandibular arch, men showed a slightly higher prevalence of O-shaped arches (55%) compared to women (51.8%). Importantly, when considering these results, it's essential to acknowledge that a substantial portion of our sample (39%) was currently fitted with a prosthesis, which introduces another dimension to our findings. The influence of prosthetic wear on these variations warrants further consideration, encompassing factors such as prosthesis type, fit, and duration of use. This additional parameter adds complexity to our understanding of edentulous arch morphology and underscores the multifaceted nature of factors influencing these anatomical characteristics in the Moroccan population.

Pietrokovski *et al*.[3] conducted a comprehensive study involving 24 maxillary and 99 mandibular completely edentulous dry specimens. These specimens were meticulously examined using macroscopic observations, as well as precise linear and caliper measurements. The width and length of the edentulous arches were meticulously recorded, extending from the molar regions to the crest of the incisor zone. This arch formation is influenced significantly by dental crowns and plays a pivotal role in defining the strength of the anterior component and facilitating the functions of the lips, cheeks, and tongue. The findings revealed that edentulous maxillae exhibited varying shapes, with 65% being O-shape, 25% V-shape, and 10% irregular. The arch width ranged from 39 to 60 mm (with an average of 48 mm), and the length ranged from 40 to 54 mm (with an average of 47 mm). In contrast, mandibular arches were predominantly O-shaped (77%), with 11% being U-shaped and 12% irregular. The width ranged from 73 to 84 mm, and the length ranged from 53 to 67 mm. Observing the occlusal aspect of the edentulous maxillae, distinct differences in sizes and shapes were noted between arches and among the adjacent residual ridges of the same jaws. Notably, the mandibular body arch exhibited an average width of 78 mm and an average length of 61 mm. These detailed measurements and observations provided valuable insights into the intricate anatomical variations present in edentulous patients.

Concurrently, Sekar and Govindaraj[5] in-depth study focused on the effects of edentulism and post-extraction alterations on the shape and dimensions of the dental arch. Their analysis demonstrated significant reductions in the depth and width of the arch, emphasizing the direct consequences of tooth loss and post-extraction changes on oral morphology. These findings, combined with our study, harmoniously underscore the complex interplay between age, edentulism, and post-extraction

alterations, all playing a crucial role in determining the shape and dimensions of dental arches. Together, these research efforts enhance our overall understanding of the multifactorial influences shaping dental arch morphology in edentulous individuals. Simultaneously, Al-Rahmani's[6] research on the edentulous Iraqi population delved into local factors influencing arch dimensions. Their thorough analysis explored elements such as facial shapes, without overlooking palate depth, to unravel intricacies within oral structures. Regarding the relationship between face shape and arch form, it is noteworthy that both oval and square face shapes each constituted 32%, while other categories showed lower percentages. This study also revealed a correlation between palatal vault depth and arch dimensions, indicating that a medium palatal vault corresponds to a medium-sized arch. These findings broaden our understanding of local factors influencing dental arch dimensions, providing meaningful insights for dental practice. Our study, along with the diverse research mentioned, collectively highlights the multifaceted nature of edentulous arch dimensions. These findings underscore the intricate interplay between age, edentulism, local factors, and arch morphology. By integrating these insights, we can better tailor prosthetic interventions to the unique characteristics of diverse populations, optimizing treatment outcomes for edentulous patients. Chrcanovic *et al.*'s study[6] significantly deepened our understanding of mandibular anatomy, particularly concerning the presence or absence of teeth. Their examination of 80 adult human dry mandibles, focusing on 32 different morphometric variations, provided crucial insights. Their research demonstrated that dentition status has a substantial impact on mandibular anatomy. Numerous measurements showed statistically significant differences between dentate and edentulous individuals, emphasizing how the presence or absence of teeth significantly influences the shape and dimensions of the mandible. Raberin *et al.*'s study[8] examined the primary mandibular dental arch forms of French adults. While gender differences were not significant in the distribution of these forms, women tended to have smaller dental arch dimensions. Mendes Costa *et al.*'s research[9] explored the impact of ageing on mandibular bone morphology and sexual dimorphism, contributing valuable insights into this aspect of craniofacial anatomy. Their study involved the examination of 160 Multi-Slice Computed Tomography scans from individuals aged 40 to 79 years. Using geometric morphometric analysis of fourteen osteometric landmarks, the study found that sexual dimorphism in mandibular shape remained significant as individuals aged. Conformational changes were observed between the ages of 50 and 70, with variations differing between men and women. Notably, women exhibited earlier and more pronounced age-related shape changes compared to men. While the onset of senescence-related changes varies among individuals, this research underscores the significance of considering age-related factors in the assessment of mandibular morphology. Yamaguchi *et al.*'s research[10] delved into the genetic regulation of human

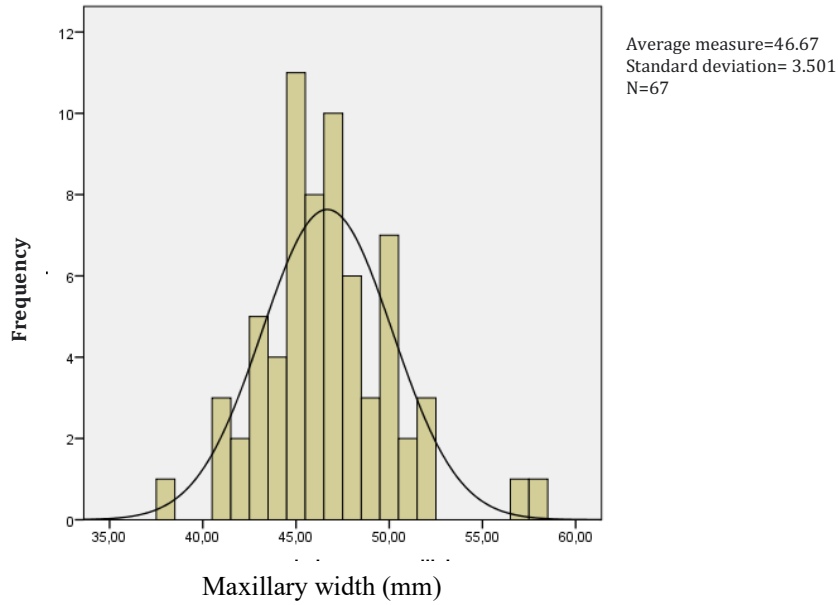
mandibular shape and size. This approach has provided explanations for the variations in dimensions and shapes of dental arches. The research has revealed that genomes have a significant impact on the forms and dimensions of the mandibular arch. It is noteworthy that genetic factors vary with geography and demographics. This has led us to conclude that the genetic component is paramount in shaping dental arch dimensions and form. Postic *et al.*[11] conducted a study examining the surface area of denture-bearing tissues in individuals without teeth. These participants were classified according to the system introduced by Ballard and Wayman,[12] where Class I signifies normal skeletal relationships between the maxilla and mandible, with no significant sagittal displacement. In men, the surface area of maxillary edentulous tissue was 4654±407 mm^2, while in women, it was 4212 ± 368 mm^2. For mandibular edentulous tissue, the surface area in men was 2843±339 mm^2, and in women, it was 2334±295 mm^2. The findings revealed that the denture-bearing surface area is greater in men than in women, and the maxilla is wider than the mandible in both genders. Additionally, another study examined alveolar arch shapes in adult patients using Magnetic Resonance Imaging (MRI). The results indicated variations in alveolar arch conditions depending on the examination method, whether through estimation methods in tooth models or using devices.[13] According to the study conducted by Yanikoğlu *et al.*,[14] U-shaped dental arches have the largest denture-bearing area in the maxilla (22.12 cm^2), surpassing V-shaped (20.91 cm^2) and O-shaped arches (21.62 cm^2). In the mandible, the denture-bearing area is also greater in U-shaped arches (12.46 cm^2) compared to O-shaped arches (12.13 cm^2) and V-shaped arches (11.98 cm^2). The U-shaped alveolar arches are advantageous in both the maxilla and mandible due to their larger surface area.

Conclusions

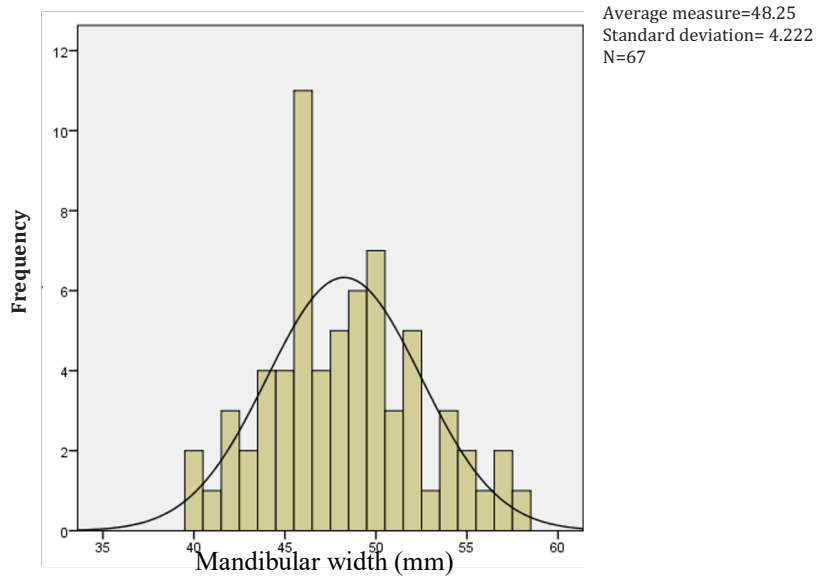
Our study provides results in line with existing literature while revealing specificities related to the Moroccan population, particularly those attending the university centre. Despite our modest sample size (67 individuals), it offers valuable insights into the edentulous population in Morocco, being one of the few studies examining the influence of age and gender on the dimensions of edentulous ridges in this country. Conducted over more than a year, involving obtaining patient consent, taking impressions, and measuring plaster models, this research aimed to establish a database on edentulous arch dimensions among the Moroccan population. These data could prove instrumental in the fabrication of tailored prosthetic devices, such as custom impression trays and implants designed specifically for this population. Consequently, future studies, with larger sample sizes, will focus on developing prosthetic tools tailored to dental practice in Morocco, further enhancing the quality of dental care in the country.

References

1. Pietrokovski J, Starinsky R, Arensburg B, Kaffe I. Morphologic characteristics of bony edentulous jaws. J Prosthodont 2007;6:141-7.
2. House MM. The relationship of oral examination to dental diagnosis. J Prosthet Dent 1958;8:208-19.
3. Pietrokovski J, Harfin J, Levy F. The influence of age and denture wear on the size of edentulous structures. Gerodontology 2003;20:100-5.
4. Carvalho RT, Braga FS, Brito F, et al. Temporomandibular joint alterations and their orofacial complications in patients with juvenile idiopathic arthritis. Rev Bras Reumatol 2012;52:907-11.
5. Sekar S, Govindaraj S. Morphological analysis of the maxillary arch and hard palate in edentulous maxilla of South Indian dry skulls. Surg Radiol Anat 2012;34:929-36.
6. Al-Rahmani F. Surveying of local factors in edentulous Iraqi population. Iraqi Dental J 2014;36:42-6.
7. Chrcanovic BR, Abreu MH, Custódio AL. Morphological variation in dentate and edentulous human mandibles. Surg Radiol Anat 2011;33:203-13.
8. Raberin M, Laumon B, Martin JL, Brunner F. Dimensions and form of dental arches in subjects with normal occlusions. Am J Orthod Dentofacial Orthop 1993;104:67-72.
9. Mendes Costa L, Delrieu J, Gillet C, et al. Sexual dimorphism of the mandibular conformational changes in aging human adults: A multislice computed tomographic study by geometric morphometrics. PLoS One 2021;16:e0253564.
10. Yamaguchi T, Kim YI, Mohamed A, et al. Methods in genetic analysis for evaluation mandibular shape and size variations in human mandible. J Craniofac Surg 2022;33:e97-e101.
11. Postic SD. Surface area analysis in edentulous jaws of patients with skeletal class I. Serbian Dental J 2011:58:209-13.
12. Ballard CF, Wayman JB. A report on a survey of the orthodontic requirements of 310 army apprentices. Dent Pract Dent Rec 1965;15:221-6.
13. Pigg M, List T, Abul-Kasim K, Maly P, Petersson A. A comparative analysis of magnetic resonance imaging and radiographic examinations of patients with atypical odontalgia. J Oral Facial Pain Headache 2014;28:233-42.
14. Yanikoğlu N, Ceylan G, Aladağ L.A Comparison of the basal seat areas of the maxillary and mandibular dentures according to arch shapes. Ataturk Univ Dis Hek Fak Derg 2005:15:29-33.

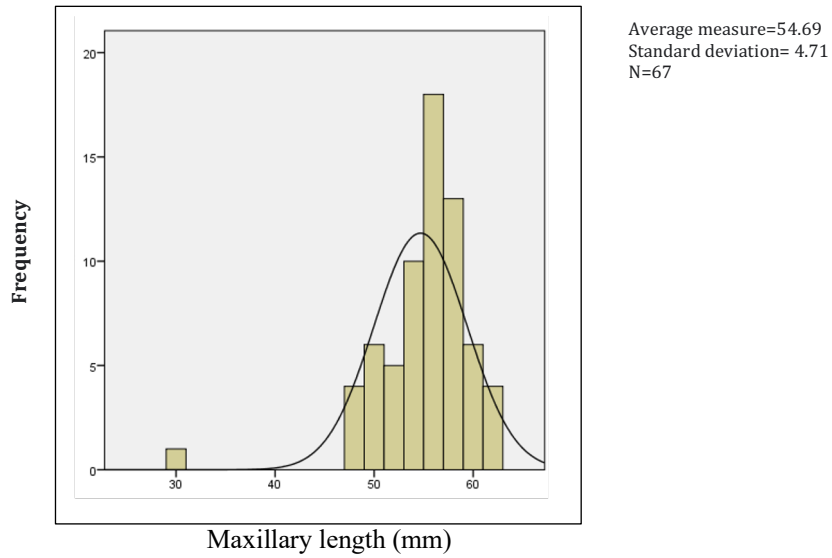


a

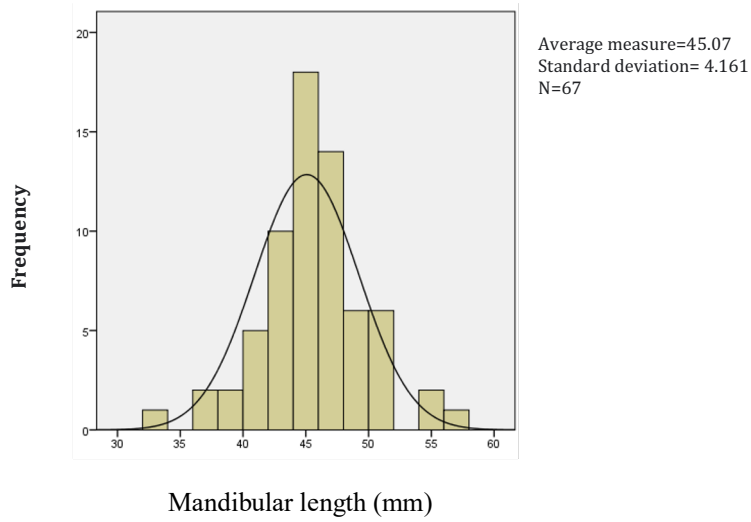


b

Figure 1. Maxillary (a) and mandibular (b) width measurements



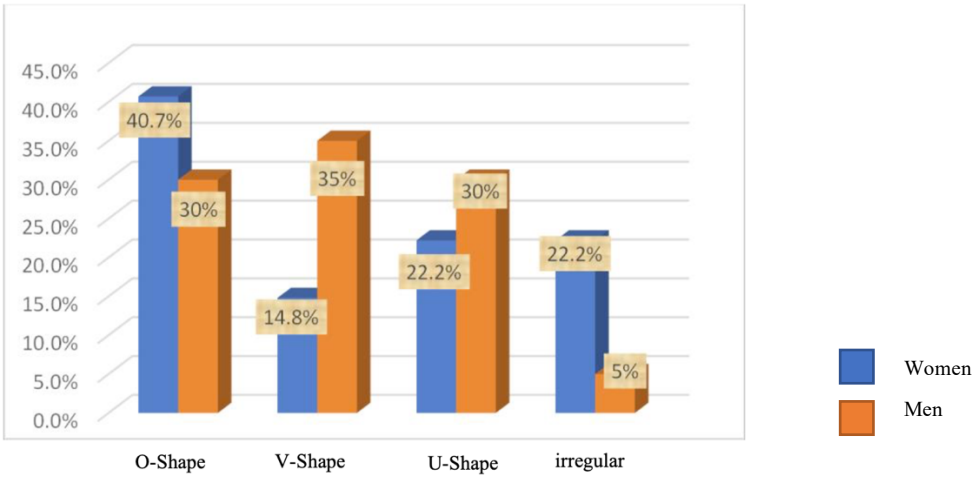
a



b

Figure 2. Maxillary (a) and Mandibular (b) length measurements.

a



b

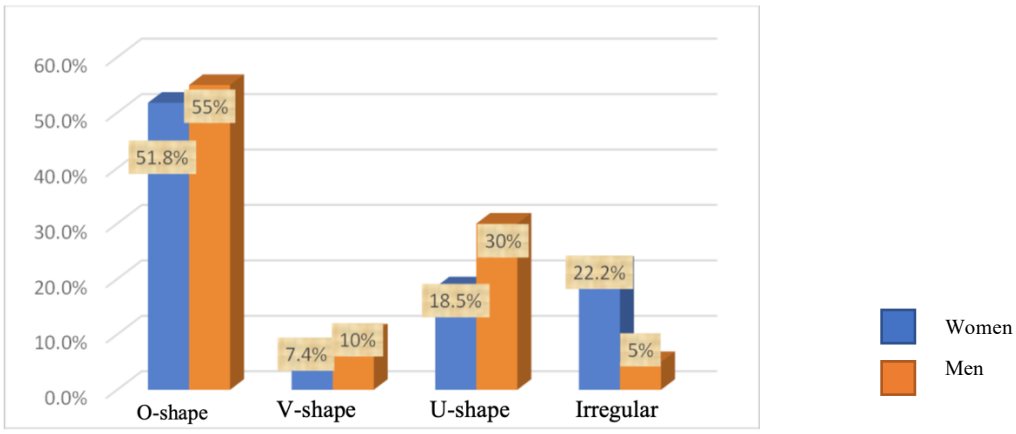


Figure 3. Distribution of maxillary (a) and mandibular (b) arch shape by gender.

Supplementary materials

Table 1. Face shape and maxillomandibular arch shape.

Face shape	**maxillary arch shape**			**p**
	O-shape	**V-shape**	**U-shape**	
Oval face	16	13	14	**0.229**
Triangular face	2	0	3	
Square face	5	5	1	
Face chape	**mandibular arch shape**			**p**
	O-shape	**V-shape**	**U-shape**	
Oval face	28	6	9	**0.167**
Triangular face	2	0	3	
Square face	6	0	5	

*chi-square test

Table 2. Gender and maxillomandibular arch shape.

Sex	**Maxillary arch shape**			**p**
	O-shape	**V-shape**	**U-shape**	
Women	11	4	6	**0.229**
Men	12	14	12	
Gender	**Mandibular arch shape**			**p**
	O-shape	**V-shape**	**U-shape**	
Women	14	2	5	**0.792**
Men	22	4	12	

*chi-square test

Table 3. Sex and maxillomandibular arch dimensions.

Patient gender		**Maxillary lenght (mm)**	**Maxillary widht (mm)**	**Mandibular lenght (mm)**	**Mandibular widht (mm)**
Women	**Average value**	47.15	45.81	44.15	53.26
	Minimum	41	38	38	47
	Maximum	54	58	50	60
Men	**Average value**	49	47.25	45.7	55.65
	Minimum	40	41	33	30
	Maximum	58	57	56	62
p		**0.078**	**0.100**	**0.135**	**0.041**

*t-test