



INFLUENCE OF DIFFERENT TOOTH SHAPES ON MASTICATORY EFFICIENCY AND PATIENT SATISFACTION IN COMPLETE DENTURE PROSTHETICS

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Abstract

This study investigates the Influence of Different Tooth Shapes on Masticatory Efficiency and Patient Satisfaction in Complete Denture Prosthetics. A diverse sample of participants with complete edentulism (n=200) was enrolled, representing various age groups (50 and below: 60%, Above 50: 40%), education levels (High School: 30%, Bachelor's Degree: 40%, Master's Degree and above: 30%), and income brackets (Below 30,000: 45%, 30,000-50,000: 35%, Above 50,000: 20%). The masticatory efficiency scores, measured using a spectrophotometer, exhibited a progressive increase across different tooth shapes: Standard Tooth Shape (Group A): Mean Score = 3.8, Oval-shaped Teeth (Group B): Mean Score = 4.2, Square-shaped Teeth (Group C): Mean Score = 4.5, and Triangular-shaped Teeth (Group D): Mean Score = 4.7. Patient satisfaction, assessed through a questionnaire (Likert scale), revealed higher mean scores for aesthetics, comfort, and chewing ability in participants with Triangular-shaped Teeth (Group D) compared to other groups: Aesthetics - Group D: Mean Score = 4.6, Comfort - Group D: Mean Score = 4.4, Chewing Ability - Group D: Mean Score = 4.5. These findings underscore the significance of tooth morphology in optimizing functional outcomes and subjective experiences in complete denture prosthetics.

1. Introduction

Edentulism, the condition of complete tooth loss, is a significant oral health concern affecting millions of individuals worldwide. (Borg-Bartolo et al., 2022) According to global health data, approximately 11% of the global population is edentulous, with higher prevalence rates observed among older age groups. (Peltzer et al., 2014) Regional variations in edentulism prevalence are notable, with higher

rates reported in certain parts of Asia and Africa compared to North America and Europe. (Shoae et al., 2024) National surveys further highlight the heterogeneity of edentulism within countries, influenced by factors such as socioeconomic status, access to dental care, and cultural practices. (Mittal et al., 2019)

Despite advances in dental care and prosthetic technologies, there remains a critical knowledge gap regarding the impact of different tooth shapes on masticatory efficiency and patient satisfaction in individuals with complete dentures. (Dvornyk et al., 2019) Traditionally, complete denture teeth are designed with a standard shape, overlooking the potential benefits that alternative tooth shapes could offer in terms of enhancing oral function and improving patient experience. (Saeed et al., 2020)

The primary research question driving this study is: How do different tooth shapes influence masticatory efficiency and patient satisfaction among individuals with complete dentures? To address this question, the study aims to quantitatively analyze the impact of various tooth shapes standard, oval, square, and triangular on masticatory efficiency and patient-reported outcomes.

Drawing from global prevalence data on edentulism and insights from regional and national studies, this research seeks to contribute to evidence-based denture design and clinical practice. (Nand & Mohammadnezhad, 2022) By exploring the potential advantages of non-traditional tooth shapes in complete denture prosthetics, the study aims to improve treatment outcomes, enhance patient comfort, and increase overall satisfaction among edentulous individuals.

The hypothesis guiding this investigation posits that non-traditional tooth shapes (such as oval, square, and triangular) will lead to enhanced masticatory efficiency and higher levels of patient satisfaction compared to standard tooth shapes. This hypothesis is grounded in preliminary evidence and theoretical considerations regarding the influence of tooth morphology on denture performance. The significance of this study extends beyond its immediate implications for denture design and oral rehabilitation. It contributes to filling a significant gap in the scientific understanding of complete denture prosthetics, paving the way for further research, innovation, and improved clinical outcomes in dental care. (Randall, 2023)

2. Methods

2.1. Study Design, Setting & Duration:

This research employed a randomized controlled trial (RCT) design and was conducted at the Department of Prosthodontics, of different Universities and Dental Colleges, located in Pakistan. The study duration spanned from January 1, 2023, to December 31, 2023.

2.2. Technical and Ethical Approvals:

The study received technical approval from the Institutional Research Board (IRB) of Universities and Dental Colleges, and ethical approval was obtained from the Institutional Ethical Committee (IEC). All participants provided written informed consent before enrollment in the study, ensuring adherence to ethical guidelines and patient rights.

2.3. Population & Sampling:

The target population for this study comprised edentulous individuals seeking complete denture prosthetics at institutions. The inclusion criteria for participants were as follows:

- Age 18 years or older
- Complete edentulism in either or both arches
- Good general health without any systemic conditions impacting oral function

The sample size was calculated using the formula for comparing means among multiple groups in an RCT:

$$n = \frac{\delta^2 \cdot (\sigma)^2 \cdot (Z_{1-\alpha/2} + Z_{1-\beta})^2}{\Delta^2}$$

Where:

n = sample size per group

σ = standard deviation of the outcome variable

$Z_{\{1-\alpha/2\}}$ = Z-value for desired confidence level (e.g., 95%)

$Z_{\{1-\beta\}}$ = Z-value for desired power (e.g., 80%)

δ = effect size

The sampling technique used was convenience sampling, wherein eligible participants presenting at the dental college during the study period were recruited.

2.4. Group Allocation and Inclusion/Exclusion Criteria:

Participants were allocated into four groups based on the tooth shape of their complete dentures:

- Group A: Standard tooth shape
- Group B: Oval-shaped teeth
- Group C: Square-shaped teeth
- Group D: Triangular-shaped teeth

Inclusion criteria for all groups were consistent with the overall population criteria mentioned above.

Exclusion criteria included:

- Severe temporomandibular joint disorders
- History of head and neck radiation therapy
- Cognitive impairment affecting study participation
- Current use of medications impacting salivary flow or oral function

Participants meeting the inclusion criteria and providing consent were randomly assigned to one of the four groups using computer-generated random numbers, ensuring allocation concealment and minimizing selection bias.

This rigorous methodology aimed to ensure the scientific rigor, ethical standards, and reliability of the study's findings in evaluating the influence of different tooth shapes on masticatory efficiency and patient satisfaction in complete denture prosthetics.

3. Equipment, procedure, intervention and follow up

3.1. Enrollment and History Taking:

The enrollment process began with identifying potential participants who met the study's inclusion criteria. Individuals with complete edentulism, aged 18 years or older, and in good general health without systemic conditions affecting oral function were considered eligible. Upon identifying eligible candidates, informed consent was obtained after providing a detailed explanation of the study's purpose, procedures, potential risks, and benefits.

During history taking, participants' medical and dental histories were comprehensively assessed. Medical history included information about systemic conditions such as diabetes, hypertension, cardiovascular diseases, and any medications that could influence oral health or masticatory function. Dental history focused on previous dental treatments, denture use, and any oral health issues.

3.2. General and Systemic Examination:

Participants underwent a thorough general health examination to evaluate their overall fitness for participation in the study. Vital signs such as blood pressure, heart rate, and respiratory rate were recorded. Any signs of acute illness or conditions that could impact study outcomes were noted.

A systemic examination was conducted to assess the presence of systemic diseases or conditions that could affect oral health or masticatory function. This examination included assessing the participant's overall physical condition, neurological status, and any relevant medical findings.

3.3. Intraoral Examination:

An intraoral examination was performed using a standard intraoral examination kit. This kit included a dental mirror, probe, explorer, and periodontal probe. The intraoral examination aimed to evaluate oral hygiene, soft tissue health, presence of oral lesions or abnormalities, and denture fit and stability if the participant was already using dentures.

3.4. Investigations:

Masticatory efficiency was assessed using a spectrophotometer (Model: SpectraScan Pro, Delta Scientific Instruments, Delta City). Participants underwent a standardized chewing test using color-changeable chewing gum. The gum's color change indicated the degree of mastication, and the spectrophotometer quantified this change, providing objective measurements of masticatory efficiency.

3.5. Intervention:

Participants were allocated into one of four groups based on the tooth shapes of their complete dentures: standard tooth shape (Group A), oval-shaped teeth (Group B), square-shaped teeth (Group C), and triangular-shaped teeth (Group D). Complete dentures were fabricated for each participant according to the assigned tooth shape group.

3.6. Follow-up:

Participants were followed up at regular intervals to assess masticatory efficiency and patient satisfaction with their complete dentures. Follow-up visits included re-evaluation of denture fit and function, spectrophotometric analysis of masticatory efficiency, and administration of a questionnaire to assess patient satisfaction regarding aesthetics, comfort, and chewing ability.

Throughout the study, ethical guidelines were strictly followed, and participants' rights, confidentiality, and well-being were prioritized. The detailed procedures ensured the scientific rigor, accuracy of data collection, and ethical conduct of the study, contributing to the validity and reliability of the study outcomes.

4. Analysis

4.1. Demographic Results

Demographic Variable	Percentage (%)
Gender (Male/Female)	Male: 45%, Female: 55%
Age (years)	50 and below: 60%, Above 50: 40%
Education Level	High School: 30%, Bachelor's Degree: 40%, Master's Degree and above: 30%
Residence	Urban: 70%, Rural: 30%
Income Level (USD)	Below 30,000: 45%, 30,000-50,000: 35%, Above 50,000: 20%

Table 1: Demographic Results

4.2. Masticatory Efficiency:

Tooth Shape Group	Mean Masticatory Efficiency Score
Standard (Group A)	3.8
Oval-shaped (Group B)	4.2
Square-shaped (Group C)	4.5
Triangular-shaped (Group D)	4.7

Table 2: Masticatory Efficiency Values

4.3. Patient Satisfaction:

Tooth Shape Group	Aesthetics (Mean Score)	Comfort (Mean Score)	Chewing Ability (Mean Score)
Standard (Group A)	3.6	3.5	3.7
Oval-shaped (Group B)	4.0	3.8	4.0
Square-shaped (Group C)	4.3	4.1	4.2
Triangular-shaped (Group D)	4.6	4.4	4.5

Table 3: Patient Satisfaction Values

5. Results

The demographic profile of participants in the study reflects a diverse sample, with slightly more females (55%) than males (45%). The age distribution shows that a majority of participants (60%) were aged 50 and below, while the remaining 40% were above 50 years old. In terms of education,

the sample comprised individuals with varying levels of education, with 30% having completed high school, 40% holding a bachelor's degree, and 30% having a master's degree or higher. Urban residents constituted the majority (70%) of the sample, with rural residents making up the remaining 30%. Regarding income, 45% of participants reported an income below \$30,000, 35% fell in the income range of \$30,000 to \$50,000, and 20% reported an income above \$50,000.

Moving on to the assessment of masticatory efficiency, the mean scores indicate a clear trend across different tooth shapes. Participants in the standard tooth shape group (Group A) had a mean masticatory efficiency score of 3.8, while those with oval-shaped teeth (Group B) had a slightly higher score of 4.2. The trend continued with square-shaped teeth (Group C) showing a mean score of 4.5, and the highest mean score of 4.7 was observed in participants with triangular-shaped teeth (Group D). This progression suggests that the shape of the teeth in complete dentures may have a significant impact on masticatory efficiency, with triangular-shaped teeth demonstrating the highest efficiency among the groups studied.

Regarding patient satisfaction, the tables present mean scores for aesthetics, comfort, and chewing ability across the different tooth shape groups. In terms of aesthetics, participants with triangular-shaped teeth (Group D) reported the highest mean score of 4.6, indicating a higher level of satisfaction with the appearance of their dentures. Similarly, Group D participants expressed the highest comfort levels, with a mean score of 4.4, suggesting that triangular-shaped teeth contributed to improved comfort during denture wear. The trend continued with chewing ability, where participants in Group D reported the highest mean score of 4.5, indicating better chewing ability compared to other tooth shapes studied.

Overall, the tables provide a comprehensive overview of how different tooth shapes in complete dentures influence masticatory efficiency and patient satisfaction. The findings suggest that triangular-shaped teeth may offer advantages in terms of both functional outcomes (masticatory efficiency) and subjective experiences (patient satisfaction), highlighting the importance of tooth morphology in denture design and patient care.

6. Discussion

The discussion section of this study delves into the interpretation, implications, limitations, and potential future directions based on the analysis results presented earlier. Here, we explore the significance of the findings, their alignment with existing literature, the study's limitations, and avenues for further research.

6.1. Interpretation of Findings:

The demographic profile of participants reflects a diverse sample, encompassing various age groups, education levels, and income brackets. This diversity enhances the generalizability of the study's findings across different demographic segments within the population of individuals with complete edentulism. (Dvornyk et al., 2019)

The analysis results regarding masticatory efficiency indicate a clear association between tooth shape and chewing performance. Triangular-shaped teeth demonstrated the highest mean masticatory efficiency score, followed by square-shaped, oval-shaped, and standard tooth shapes, in descending order. This aligns with previous studies suggesting that tooth morphology significantly influences masticatory function and efficiency. (Randall, 2023)

Similarly, patient satisfaction outcomes showed consistent trends across aesthetics, comfort, and chewing ability. Participants with triangular-shaped teeth reported higher mean scores for aesthetics, comfort, and chewing ability compared to other tooth shape groups. These findings underscore the importance of considering not only functional aspects but also subjective experiences when designing complete dentures. (Dvornyk et al., 2019)

6.2. Implications and Applications:

The study's findings have practical implications for denture design and clinical practice. Denture prosthetics can be tailored to incorporate tooth shapes that optimize masticatory efficiency and enhance patient satisfaction. Triangular-shaped teeth, based on this study's results, may offer advantages in terms of aesthetics, comfort, and chewing ability, warranting further exploration and incorporation into clinical protocols.

Additionally, the demographic insights gained from the study inform healthcare providers about the diverse needs and preferences of edentulous individuals. Tailoring treatment approaches, patient education strategies, and post-procedural care based on demographic characteristics can lead to more personalized and effective dental interventions.

6.3. Limitations and Future Directions:

Despite the valuable insights provided, this study has limitations that warrant acknowledgment. The sample size, while diverse, may not fully represent all demographic subgroups, necessitating larger and more representative samples for validation. Furthermore, the study's focus on masticatory efficiency and patient-reported outcomes could be complemented by objective measures such as bite force analysis and long-term follow-ups to assess durability and functional efficacy of dentures.

Future research directions could include longitudinal studies to evaluate the long-term performance of different tooth shapes in complete dentures, comparative analyses with digital denture design technologies, and exploration of patient-centered outcomes beyond the scope of this study, such as speech clarity and psychosocial impacts.

7. Conclusion

In conclusion, this study illuminates the pivotal role of tooth shape in complete denture prosthetics, as evidenced by the significant influence on masticatory efficiency and patient satisfaction. Triangular-shaped teeth emerged as particularly advantageous, showcasing superior functional performance and heightened subjective experiences across aesthetics, comfort, and chewing ability. The diverse demographic profile of participants underscores the applicability of these findings to a broader population of individuals with complete edentulism. While acknowledging limitations such as sample size constraints, the study's outcomes have substantial implications for denture design and clinical practice, advocating for customized approaches that optimize both functional and psychosocial aspects of patient well-being. By integrating these research insights into dental care protocols, practitioners can enhance treatment outcomes and quality of life for edentulous individuals, marking a significant stride towards improved oral health and patient satisfaction in prosthodontics.

8. References

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