

Enhancing Denture Care Efficiency: Mobile Prosto Open-Source Software for Indonesian National Army Soldiers

Nining Handayani¹, Arief Budiarto², Arif Rachman³, Arlette Suzy Setiawan^{4*}

1. Postgraduate Doctoral Study Program Military Dentistry Faculty of Dentistry Universitas Padjadjaran Bandung West Java Indonesia.
2. Departement of Psychology Universitas Jenderal Ahmad Yani Bandung West Java Indonesia.
3. Departement of Cell Biology and Biomolecular, Faculty of Medicine, Indonesian Defense University, Bogor West Java Indonesia.
4. Department of Pediatric Dentistry, Faculty of Dentistry, Universitas Padjadjaran, Bandung, West Java, Indonesia.

Abstract

The evaluation of behavioural and non-behavioural aspects of acrylic removable denture users is currently primarily conducted using conventional methods. Applying artificial intelligence (AI) becomes crucial in prosthodontics to enhance evaluation efficiency. This research aims to assess the capability of the Mobile Prosto Open-Source Software application in evaluating the behaviour and non-behaviour of acrylic removable denture users among the Indonesian National Army soldiers.

This analytical study involved 46 soldiers using acrylic removable dentures for 4-6 years (2017-2019). They have undergone at least one post-placement evaluation of their dentures, received instructions on care, and are still using them effectively. The Mobile Prosto Open-Source Software application was designed with artificial neural networks to measure the behaviour and non-behaviour of acrylic removable denture users. This research compared the average time taken by the sample to answer questionnaires using Mobile Prosto Open-Source Software and conventional methods.

The average time the participant took to answer questionnaire questions with Mobile Prosto Open-Source Software was 1-2 minutes, while with traditional methods, it was 5-7 minutes. A total of 31 questions were answered by the participant simultaneously using Mobile Prosto Open-Source Software, whereas, with conventional methods, only six questions were responded to. Behavioural factors were positively related to the duration of denture use, while non-behavioural factors were negatively correlated. Behavioural and non-behavioural factors collectively influenced denture duration by 20.2%, with the remainder being influenced by other factors.

Mobile Prosto Open-Source Software is more efficient in measuring the behaviour and non-behaviour of acrylic removable denture users and has potential applications among the Indonesian National Army soldiers. Behavioural factors affect denture duration positively, whereas non-behavioural factors have the opposite effect. Although necessary, these factors have a relatively small contribution to denture duration compared to other factors.

Clinical article (J Int Dent Med Res 2024; 17(1): 209-214)

Keywords: Artificial Intelligence, Mobile Prosto Open-Source Software, Acrylic Removable Dentures, Indonesian National Army Soldiers.

Received date: 06 November 2023

Accept date: 01 December 2023

Introduction

Tooth loss significantly affects various aspects of an individual's life, including physical, functional, social, and psychological well-being.¹ Acrylic dentures offer a primary solution to this issue, but their success depends on patient

care.² A cross-sectional study in Indonesia emphasized the importance of patient behavior, such as daily cleaning and soaking dentures overnight, for long-term success.²⁻⁵ The Military Dental Institute of the Indonesian Navy (Ladokgi) RE. Martadinata has seen an increase in partial acrylic removable denture usage, reflecting improved patient oral health and denture care.

In the era of digital dentistry 4.0, artificial intelligence (AI) plays a vital role in dental practice, offering efficient data processing and analysis. AI can enhance care quality by

***Corresponding author:**

Arlette Suzy Setiawan,
Jalan Sekeloa Selatan No. 1 Bandung West Java Indonesia.
E-mail: arlette.puspa@unpad.ac.id

evaluating denture users' behaviour.⁶ This study introduces Mobile Prosto Open-Source Software, which uses AI to assess acrylic removable denture users' behavior, focusing on Indonesia's National Army soldiers. This application can contribute to better denture care and oral health among military personnel, aligning with previous research findings and positive changes in patient behavior.

With the rapid advancement of Android technology, this application has the potential to make a positive contribution to the care of removable dentures and oral health among the National Army of Indonesia's soldiers. Therefore, this research is relevant in maintaining the quality of life and oral health of military personnel who use partial acrylic removable dentures. The research's primary goal is to evaluate the Mobile Prosto Open-Source Software's effectiveness in assessing acrylic removable denture users' behavior, particularly among the National Army of Indonesia's soldiers, considering previous research and behavioral improvements.

Materials and methods

This analytical observational research assesses the behavior and non-behavior of acrylic removable denture users, comparing evaluations made with Mobile Prosto Open-Source Software and conventional methods. Ethical approval was obtained from the Universitas Padjadjaran Ethics Commission (No. 168/UN6.KEP/EC/2023, dated February 8, 2023).

The study involves a population of patients who received acrylic removable dentures between 2017 and 2019, totaling approximately 250 patients. Random sampling selected 46 participants, consisting of individuals seeking denture check-ups at Ladokgi TNI AL RE Martadinata and willing to use the researchers' prepared application.

The Mobile Prosto Open-Source Software, developed by the authors, is accessible via <https://i.diawi.com/vnSFcg>. It utilises artificial neural network principles and has undergone multiple modifications, reaching version 4.0. Testing the application involves 46 members of the Indonesian National Army who have used acrylic removable dentures for 4 to 6 years (2017-2019). Inclusion criteria encompass post-placement denture evaluation, denture care

explanation, practical denture usage, and willingness to participate. Individuals with dentures repaired within three years for non-chewing purposes and family members of Army personnel with dentures are excluded.

The study measures participants' response times to the Mobile Prosto Open-Source Software questionnaire and conventional methods. Additionally, it compares the consistency of participant responses between the two evaluation methods. The questionnaire consists of 18 questions measuring aspects of behaviour related to denture care and 10 inquiries related to the patient's oral condition (Supplement 1). Two specialist prosthodontic dentists conducted ICC (inter-class correlation) assessments as independent observers in this study. The data obtained were statistically analyzed using IBM SPSS version 22 software.

Results

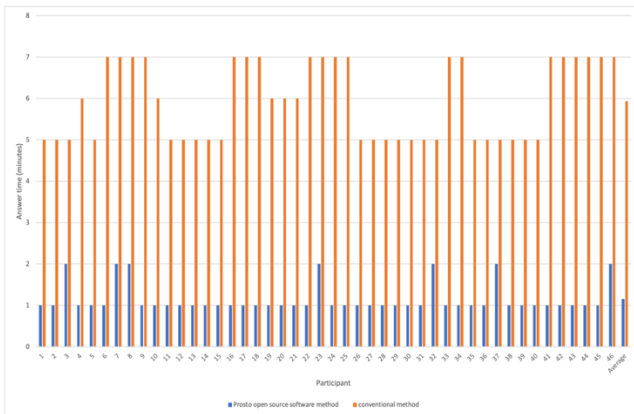
Table 1 summarizes the participant characteristics. The majority of participants were male, comprising 39 individuals (84.8%), and the age group between 50 and 59 years included 23 individuals (50%). Regarding the time needed for participants to complete the assessment, those using the Mobile Prosto Open-Source Software took an average of 1.2 minutes to answer questions related to behavior and non-behavior. In contrast, participants using the conventional method required substantially more time, averaging 5.9 minutes, as illustrated in Graph 1.

Characteristics	n	%
1. Gender:		
Male	39	84,8
Female	7	15,2
2. Age (years):		
<40	3	6,5
40-49	15	32,6
50-59	23	50
≥ 60	5	10,9

Table 1. Characteristics of Research Participants (n = 46).

The relationship between behavior and non-behavior scores and the duration of removable denture usage was assessed through multiple regression analysis, as summarized in Table 2. The final model's analysis reveals that behavior scores have a significant positive

impact on the dependent variable. Conversely, non-behavior scores in the final model significantly negatively affect the dependent variable.



Graph 1. Average time Taken by Participants to Answer Questionnaire Questions using Mobile Prosto Open-Source Software and Conventional Methods.

Additionally, the statistical analysis for the final model yielded an F value of 6.689, with a significance level of $p=0.003$ (Table 2). Moreover, the coefficient of determination (R^2) in the final model indicates that behaviour and non-behavior scores, when considered together, can explain approximately 20.2% of the variability in the dependent variable.

Variable	B coefficient	SE (B)	t-value	*p-value
Initial model:				
Behavioural score	0,253	0,098	2,598	0,013
Non-behavioral score	- 0,08	0,038	-2,102	0,042
Final model:				
Behavioural score	0,259	0,099	2,612	0,012
Non-behavioral score	- 0,073	0,038	-1,916	0,031
Constant	-33,45	-	-	

Table 2. Relationship between Behavior Scores, Non-Behavior Scores, and Duration of Removable Denture Usage Based on Multiple Regression Analysis.

These findings affirm the overall significance of the final model. Both independent variables, behaviour scores and non-behaviour scores, make substantial contributions to the dependent variable in the context of this research. Consequently, the final model effectively fits the available data, underscoring the pivotal role of behaviour and non-behavior factors in influencing the duration of removable denture usage.

Discussion

The study's primary objective was to assess the effectiveness of the Mobile Prosto Open-Source Software application in evaluating the behavior and non-behavior of acrylic removable denture users among the Indonesian National Army soldiers. The research findings reveal that this application offers a significantly more time-efficient evaluation compared to conventional methods. Specifically, the application requires only 1.2 minutes for participants to respond to questions related to behavior and non-behavior, whereas the conventional method takes approximately 5.9 minutes.

These results underscore the Mobile Prosto Open-Source Software's capacity to streamline the data collection process regarding patient behavior concerning the use of acrylic removable dentures. This efficiency holds particularly positive implications in dentistry, particularly in military settings, where time constraints often play a crucial role in conducting examinations and treatments. This can be explained by the fact that respondents can answer questions more quickly because they are no longer required to write on paper. The transition from conventional processes to digital ones offers the advantage of obtaining more accurate information or data.

This research aligns with the work of Alghazzawi et al. (2016)⁷ and Aldaadaa (2018)⁸, which explain that advances in digital technology-based design and its application in dentistry provide new methods or designs. However, these technological advances are not yet fully functional for maxillofacial prosthetic rehabilitation despite the urgent need to reduce production costs, shorten the time, improve comfort, and enhance patient accessibility. It also corresponds to a study by Jindal et al. (2018)⁹, which explains that conventional procedures, including the production of dentomaxillofacial prostheses, result in high costs, prolonged time, and uncomfortable experiences for patients. This study also aligns with the findings of Pareek et al. (2022)¹⁰, which explain that artificial intelligence in dentistry, particularly in prosthetics, has both advantages and limitations in its application. With the advent of digital dentistry 4.0, data can be obtained effectively for decision-making. Digital dentistry 4.0 is highly beneficial for dentists as

practitioners and patients, impacting the professionalism of dental care. Various advantages of digital dentistry 4.0 include time, financing, and human resources efficiency. Limited human resources drive communities and healthcare professionals to create solutions and innovations to ensure effective operations. Nevertheless, Mobile Prosto Open-Source Software, as a new application of artificial intelligence, offers the advantage of providing faster response times and patient information, making it an alternative to save time in Prosthodontics.

The results of this study, which show that respondents' ability to answer the same questions simultaneously using Mobile Prosto Open-Source Software and the conventional method, explains that more answers can be obtained from patients compared to the conventional method can be understood that the ease of selecting solutions digitally can provide a more significant number of responses, allowing for the maximization of the information obtained. Joiner (2018)¹¹ also explains that artificial intelligence encompasses the theory and development of computer systems capable of performing tasks typically associated with human intelligence, such as visual perception, speech recognition, decision-making, and language translation.

Mobile Prosto Open-Source Software has characteristics in its working system, particularly in the decision-making process based on artificial nerves. One part of AI, Machine Learning, focuses on developing algorithms and computer models that enable systems to learn and make predictions or decisions based on data without being explicitly programmed to perform specific tasks. Computer programs recognize patterns, understand data, and improve performance or behaviour through experience.¹²

Furthermore, the multiple regression analysis results indicate that the behavioural scores of acrylic removable denture users significantly impact the lifespan of removable dentures. This aligns with previous research findings that highlight the crucial role of patient behaviour in caring for their dentures. Therefore, a deeper understanding of denture user behaviour can assist in planning more effective and sustainable treatments.

This study is consistent with Matak (2000), who explains that behavioural changes

that affect the field of dentistry have not changed significantly or can be considered to have a minor role.¹³ The remaining natural teeth and supporting tissues must be maintained for their health after using dentures because neglecting them can lead to issues such as denture stomatitis and cavities.¹⁴ Dental and oral care, as well as the maintenance of dentures, also play a significant role in the longevity of denture use. Regular oral and denture hygiene habits are crucial for maintaining oral health and ensuring the long-term use of removable prostheses.¹⁵ Patient behaviour factors in caring for their dentures, such as daily cleaning of the dentures and soaking them in water at night or when not in use, play a crucial role in the durability of their dentures.³ The results of this study align with a study conducted by Moreno (2016), which explains that individuals with removable partial dentures who do not clean their dentures properly and do not maintain proper oral hygiene habits are influenced by various factors such as social status, age, education, systemic diseases, and smoking. Additionally, a lack of information about denture maintenance and regular check-ups plays a crucial role in such situations.¹⁴

On the other hand, non-behavioural scores, which encompass factors other than behaviour, significantly negatively impact the duration of removable denture use. Although their impact is lower than behaviour, these factors should not be disregarded. These results highlight the importance of comprehensive oral care, including non-behavioural factors such as the health of remaining natural teeth and oral hygiene.

The results of this study also indicate that the final model has overall vital significance, with a significant F-value and a coefficient of determination (R^2) of 20.2%. Combined, this signifies that those behavioural and non-behavioural scores can explain a significant portion of the variation in the duration of removable denture use. This means that Mobile Prosto Open-Source Software can be a valuable tool in identifying factors affecting denture lifespan and assisting in more effective treatment planning.

The utilization of Mobile Prosto Open-Source Software is an application of artificial intelligence in the field of dentistry, particularly in prosthodontics. A literature review conducted by Koc S. et al.¹⁶ also explains the utilization of

artificial intelligence in endodontics. Artificial intelligence has also been employed in oral diseases for diagnosis, prognosis prediction, and specific therapy strategies for each patient. The use of artificial intelligence in prosthodontics is continually growing, and its implementation results can be similar to or sometimes even better than those achieved by humans. Artificial intelligence can impact various aspects of prosthodontics, such as classifying prosthetic appliances, extracting marginal lines, and minimising human errors.¹⁰

To the author's knowledge, artificial intelligence in prosthodontics has predominantly focused on denture fabrication, needing a method for assessing behaviour during denture usage. Evaluating behaviour during denture wear is crucial for determining its ongoing suitability based on oral health requirements. Mobile Prosto Open-Source Software's analysis uncovered a significant correlation between behaviour and non-behavior factors and denture lifespan.

Mobile Prosto offers several advantages, such as enabling patients or users to independently assess their denture condition without immediate consultation with a prosthodontic specialist. It also provides guidance for denture maintenance to prolong their lifespan. Mobile Prosto can save users time, cost, and effort when evaluating denture lifespan, particularly for members of the Indonesian National Army seeking new dentures or approvals.

However, to the author's knowledge, an area for improvement in Mobile Prosto is that patient responses still require validation by a prosthodontic specialist to ensure accuracy. Moreover, prosthodontic specialists are expected to verify the consistency of these responses with daily behavior and provide final analysis and recommendations based on their clinical expertise.

Conclusions

In conclusion, the results of this study demonstrate that Mobile Prosto Open-Source Software has the potential to enhance the efficiency of evaluating the behaviour and non-behaviour of acrylic removable denture users among members of the Indonesian National Army. Behaviour and non-behaviour factors have been shown to influence the lifespan of

removable dentures, and this application can facilitate more efficient data collection. This research provides a significant contribution within the context of prosthodontics and denture care, especially in a military setting.

Acknowledgements

We thank DRPM Universitas Padjadjaran for their support in submitting this article. We also thank the Center for Military Dentistry Studies for their assistance in conducting this study. Your support has been invaluable in the completion of our research

Declaration of Interest

The authors declare that they have no conflicts of interest to disclose

References

1. Griffin SO, Jones JA, Brunson D, Griffin PM, Bailey WD. Burden of oral disease among older adults and implications for public health priorities. *Am J Public Health*. 2012 Mar;102(3):411–8.
2. Akinyamoju CA, Dosumu OO, Taiwo JO, Ogunrinde TJ, Akinyamoju AO. Oral health-related quality of life: acrylic versus flexible partial dentures. *Ghana Med J*. 2019 Jun;53(2):163–9.
3. Rahmayani L, Sofya P, Andriany P, Jingga C. Oral hygiene behavior of acrylic removable partial denture usage in Seuneubok District, West Aceh: A cross-sectional study. *J Int Oral Health*. 2020;12(2):163.
4. Lima de Paula LML, Sampaio AA, Costa JG, Gomes VE, Ferreira EFE, Ferreira RC. The course from tooth loss to successful rehabilitation with denture: Feelings influenced by socioeconomic status. *SAGE Open Med*. 2019;7:2050312119874232.
5. Harsono V, Prabowo H. Dental implant as an alternative treatment for single tooth loss rehabilitation. *Dentofacial*. 2012;11:170–3.
6. Javaid M, Haleem A, Singh RP, Suman R. Dentistry 4.0 technologies applications for dentistry during COVID-19 pandemic. *Sustainable Operations and Computers*. 2021;2:87–96.
7. Alghazzawi TF. Advancements in CAD/CAM technology: Options for practical implementation. *J Prosthodont Res*. 2016 Apr;60(2):72–84.
8. Aldaadaa A, Owji N, Knowles J. Three-dimensional Printing in Maxillofacial Surgery: Hype versus Reality. *J Tissue Eng*. 2018;9:2041731418770909.
9. Jindal SK, Sherriff M, Waters MG, Smay JE, Coward TJ. Development of a 3D printable maxillofacial silicone: Part II. Optimization of moderator and thixotropic agent. *J Prosthet Dent*. 2018 Feb;119(2):299–304.
10. Pareek M, Kaushik B. Artificial intelligence in prosthodontics: a scoping review on current applications and future possibilities. *Int J Adv Med*. 2022 Feb 23;9(3):367.
11. Joiner IA. Emerging Library Technologies: It Is Not Just for Geeks. In: *Emerging Library Technologies*. London: Elsevier; 2018. p. xiii–xvii.
12. Javaid M, Haleem A. Exploring Smart Material Applications for COVID-19 Pandemic Using 4D Printing Technology. *J Indust Integr Managt*. 2020 Dec 19;05(04):481–94.
13. Mattaki S. Review Patient -dentist relationship . *J Med Dent* . 2000;47:209–14.

14. Moreno A, Haddad MF, Goiato MC, Rocha EP, Assunção WG, Filho HG, et al. Epidemiological Data and Survival Rate of Removable Partial Dentures. *J Clin Diagn Res.* 2016 May;10(5):ZC84-7.
15. Harsono V dan PH. Implant dental sebagai perawatan alternatif untuk rehabilitasi kehilangan sebuah gigi. *Dentofasial [Internet].* 2012 Oct 3 [cited 2023 Sep 15];11(3):170–3. Available from: <https://jdmfs.org/index.php/jdmfs/article/viewFile/333/333>
16. Koc S, Felek T, Erkal D, Er K. The developing technology of artificial intelligence in endodontics: a literature review. *Akd Dent J.* 2023;2(2):99–104.