Digital Denture Care and Rehabilitation Program for Elderly Community: Implementation of Teledentistry and 3D Printing Technology

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ABSTRACT

This community service program aimed to implement a digital denture care and rehabilitation system for elderly residents in rural communities of Kediri Regency using teledentistry and 3D printing technology. The program was conducted in 8 elderly care centers and 15 village communities with a total of 450 elderly participants aged 60-85 years over a 12-month period. The digital system utilized smartphone-based oral health assessment, teledentistry consultations, and 3D printing for denture repairs and fabrication. Services included digital oral health screening, remote prosthetic consultation, denture maintenance education, and on-site 3D printed denture repairs. Results showed that 78.4% of participants had denture-related problems, with poor denture fit (45.2%) and broken dentures (33.2%) being the most common issues. The teledentistry system achieved 89.7% diagnostic accuracy compared to clinical examination. Digital denture repair services successfully restored function in 92.3% of cases within 24 hours. Additionally, 94.6% of participants reported improved denture care knowledge and 87.3% showed better oral hygiene practices after the program. In conclusion, the digital denture care program successfully provided accessible prosthetic services to underserved elderly communities while promoting preventive denture care practices.

Keywords: Digital Dentistry, Prostodontics, Elderly Care, Teledentistry, 3D Printing, Community Service, Denture Rehabilitation

INTRODUCTION

The aging population faces significant challenges in maintaining oral health, particularly regarding prosthetic care and denture maintenance. Edentulism remains prevalent among elderly individuals, with complete or partial dentures being essential for maintaining oral function, nutrition, and quality of life. However, access to prosthetic dental care is often limited in rural and underserved communities due to geographical barriers, transportation difficulties, and shortage of prosthodontic specialists.

Traditional prosthetic dental care requires multiple clinical visits for denture fabrication, adjustment, and maintenance, which can be particularly challenging for elderly patients with mobility limitations. The conventional approach to denture care often results in delayed treatment, prolonged discomfort, and compromised oral function when access to dental services is limited. This situation is especially problematic in rural areas where dental clinics may be located far from elderly care facilities and residential communities.

Digital dentistry technologies, including teledentistry and 3D printing, offer innovative solutions to address these accessibility challenges. Teledentistry enables remote consultation

and diagnosis, reducing the need for physical visits while maintaining quality care. 3D printing technology has revolutionized prosthetic dentistry by enabling rapid fabrication of denture components and repairs, potentially providing same-day solutions for common denture problems.

The elderly population in Kediri Regency faces similar challenges in accessing prosthetic dental care. Many elderly residents in rural communities and care facilities struggle with denture-related problems due to limited access to prosthodontic services. The combination of geographic isolation, transportation difficulties, and financial constraints creates significant barriers to receiving timely denture care and maintenance.

Community-based digital denture care programs can help bridge this gap by bringing prosthetic services directly to elderly communities. By utilizing portable digital technologies and establishing teledentistry networks, it becomes possible to provide comprehensive denture care services in familiar environments, reducing stress and improving accessibility for elderly patients.

Therefore, this community service program was designed to implement a digital denture care and rehabilitation system for elderly residents in rural communities of Kediri Regency, with the objectives of improving access to prosthetic care, providing immediate solutions for denture problems, and educating communities about proper denture maintenance practices.

METHODS

This community service program was implemented through collaboration between the Department of Prosthodontics, Faculty of Dentistry, Universitas Kadiri, local health authorities, and elderly care facilities in Kediri Regency. The program was conducted from January to December 2024. The program was implemented across 8 elderly care centers and 15 village communities in Kediri Regency, selected based on high elderly population density and limited access to dental services. A total of 450 elderly participants aged 60-85 years were enrolled in the program. Selection criteria included current or previous denture use, willingness to participate, and ability to communicate effectively.

Digital Denture Care System: The comprehensive digital system consisted of:

1. Mobile Teledentistry Unit: Equipped with intraoral cameras, digital measurement tools, and telecommunication equipment for remote consultations
2. 3D Printing Technology: Portable 3D printers (Formlabs Form 3B) with biocompatible resin materials for denture repairs and component fabrication
3. Digital Assessment Tools: Smartphone applications for oral health screening and denture evaluation
4. Remote Consultation Platform: Secure teledentistry software connecting field teams with prosthodontic specialists

Service Implementation Protocol:

1. Community Outreach: Information sessions at elderly care centers and village meetings to introduce the program
2. Digital Screening: Comprehensive oral health and denture assessment using standardized digital protocols
3. Teledentistry Consultation: Real-time consultation with prosthodontic specialists for diagnosis and treatment planning
4. Immediate Intervention: On-site denture repairs using 3D printing technology for urgent cases
5. Educational Sessions: Comprehensive denture care education for participants and caregivers
6. Follow-up Care: Scheduled revisits and remote monitoring through teledentistry platform

Educational Component: Comprehensive denture care education program including:

1. Proper denture cleaning and maintenance techniques
2. Recognition of denture problems requiring professional attention
3. Oral hygiene practices for denture wearers
4. Nutritional considerations for optimal oral health
5. When and how to seek professional denture care

3D Printing Services: On-site services included:

a. Denture base repairs and relining
b. Replacement of broken denture teeth
c. Fabrication of denture repair components
d. Custom denture cleaning devices
e. Emergency denture modifications

Quality Assurance: A subset of 90 participants (20%) underwent traditional clinical examination by experienced prosthodontist to validate digital assessment accuracy. All 3D printed repairs were clinically evaluated for fit, function, and patient satisfaction.

Data Collection and Analysis: Data collected included demographic information, denture assessment results, treatment outcomes, participant satisfaction scores, and knowledge assessment pre- and post-program. Statistical analysis employed descriptive statistics and paired t-tests for knowledge assessment comparisons.

RESULTS AND DISCUSSION

The digital denture care and rehabilitation program successfully reached 450 elderly participants across 23 locations in Kediri Regency, demonstrating the effectiveness of community-based digital prosthetic services.The program achieved 94.2% completion rate among enrolled participants. Demographics included 264 women (58.7%) and 186 men (41.3%), with age distribution: 60-69 years (42.4%), 70-79 years (38.9%), and 80-85 years (18.7%). Geographic distribution included 8 care centers (35.6% of participants) and 15 village communities (64.4% of participants). Digital screening revealed that 353 participants (78.4%) had significant denture-related problems requiring intervention. The distribution of problems was:

1. Poor denture fit and retention: 45.2% (203 participants)
2. Broken or cracked dentures: 33.2% (149 participants)
3. Missing denture teeth: 28.7% (129 participants)
4. Denture-related oral lesions: 19.1% (86 participants)
5. Inadequate denture hygiene: 67.3% (303 participants)

The prevalence was higher in village communities (82.1%) compared to care centers (72.3%), likely reflecting differences in access to routine dental maintenance.

Teledentistry System Performance: Validation against clinical examination showed that the teledentistry assessment achieved 89.7% diagnostic accuracy for denture problems. Sensitivity was 91.2% for detecting significant denture issues requiring intervention, with specificity of 87.4%. The remote consultation system successfully facilitated treatment planning for 96.8% of cases requiring professional intervention.

3D Printing Services Outcomes: On-site 3D printing services were provided to 267 participants requiring immediate denture repairs. Success rates included:

- Denture base repairs: 94.1% functional success rate
- Tooth replacements: 89.7% satisfactory aesthetic and functional outcomes
- Emergency modifications: 96.3% immediate problem resolution
- Overall participant satisfaction: 92.3% rated services as excellent or very good

Average service delivery time was 4.2 hours from assessment to completed repair, with 87% of repairs completed within same day.

Educational Impact Assessment: Pre- and post-program knowledge assessments showed significant improvements:

- Denture care knowledge scores increased from 3.2±1.4 to 7.8±1.1 ($p<0.001$)
- 94.6% of participants demonstrated improved understanding of proper denture maintenance

- 87.3% showed measurable improvement in denture hygiene practices
- 91.4% of caregivers reported increased confidence in assisting with denture care

Community Impact and Sustainability: Long-term impact assessment revealed:

- 78.5% reduction in denture-related emergency visits to distant dental clinics
- Establishment of 5 community denture care support groups
- Training of 23 local health workers in basic denture assessment
- Development of sustainable referral network for complex cases

Cost-Effectiveness Analysis: The digital denture care model demonstrated significant cost advantages:

- Average cost per participant served: $47 (compared to $180 for traditional clinic-based care)
- Transportation cost savings for participants: average $35 per service episode
- Time efficiency: 73% reduction in total time from problem identification to resolution

Discussion: The high prevalence of denture-related problems (78.4%) among participants highlights the significant unmet need for prosthetic care in elderly communities. The digital approach successfully identified and addressed many issues that would otherwise have remained untreated due to access barriers.

The acceptable diagnostic accuracy of teledentistry consultation (89.7%) supports its use as a primary assessment tool for denture problems. Combined with immediate 3D printing interventions, this approach provides a comprehensive solution for most common denture issues without requiring specialist clinic visits.

The educational component proved particularly valuable, with substantial improvements in denture care knowledge and practices. This suggests that many denture problems could be prevented through proper education and community support systems.

The sustainability of the program is enhanced by the establishment of local support networks and trained community health workers. This creates ongoing capacity for basic denture care assessment and maintenance within the communities.

CONCLUSION

The digital denture care and rehabilitation program successfully provided accessible prosthetic services to 450 elderly residents across 23 locations in Kediri Regency, identifying denture problems in 78.4% of participants with 89.7% diagnostic accuracy through teledentistry. The integrated 3D printing services achieved 92.3% success rate in immediate denture repairs, while educational interventions significantly improved denture care knowledge (from 3.2 to 7.8 points) and hygiene practices (87.3% improvement). This initiative demonstrates the potential of digital prosthodontic technologies to overcome geographic and accessibility

barriers in elderly care. The cost-effective and sustainable nature of this digital approach, combined with community capacity building, provides a replicable model for improving prosthetic dental care access in underserved populations. Future programs should focus on expanding geographic coverage and developing advanced 3D printing capabilities for complete denture fabrication.

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