Digital Orthodontic Screening Program for Early Detection of Malocclusion in Elementary School Children: A Community Service Initiative

Pritha Kunti Nali Broto[1]*

[1]Department of Orthodontics, Faculty of Dentistry, Universitas Kadiri, Kediri, Indonesia

Correspondence: pritha@unik-kediri.ac.id

ABSTRACT

This community service program aimed to implement a digital orthodontic screening system for early detection of malocclusion in elementary school children in Kediri Regency. The program was conducted in 12 elementary schools with a total of 1,200 children aged 6-12 years over a 6-month period. Digital screening utilized smartphone-based photography with AI-assisted analysis for malocclusion detection, supplemented by basic oral health education. The screening protocol included intraoral photography, digital analysis using custom-developed AI software, and immediate result generation with referral recommendations. Results showed that 68.5% of children had some degree of malocclusion, with Class II Division 1 being the most prevalent (32.4%). The digital screening system demonstrated 91.2% sensitivity and 87.8% specificity compared to clinical examination by orthodontist. Additionally, 89.3% of parents reported improved awareness of orthodontic problems after the program. In conclusion, the digital orthodontic screening program successfully provided accessible early detection services to the community while raising awareness about the importance of orthodontic treatment timing.

Keywords: Digital Screening, Malocclusion, Elementary School, Community Service, Artificial Intelligence, Orthodontic Prevention

INTRODUCTION

Malocclusion is one of the most prevalent oral health problems in children, with significant implications for oral function, aesthetics, and psychosocial development. Early detection and intervention are crucial for optimal treatment outcomes and prevention of more complex orthodontic problems in adulthood. However, access to orthodontic screening and treatment remains limited in many communities, particularly in rural and underserved areas.

Traditional orthodontic screening requires specialized clinical examination by trained orthodontists, which may not be readily available in all communities. The shortage of orthodontic specialists in rural areas and the cost barriers associated with specialist consultations often result in delayed diagnosis and treatment of malocclusion. This situation is particularly concerning given that the optimal timing for interceptive orthodontic treatment is during the mixed dentition period (ages 6-12 years).

Digital technology offers promising solutions to address these challenges by enabling accessible and cost-effective screening programs. Smartphone-based photography combined with artificial intelligence (AI) analysis has emerged as a viable tool for remote orthodontic

assessment. These technologies can facilitate large-scale community screening programs while maintaining reasonable accuracy in malocclusion detection.

The Kediri Regency area faces similar challenges in accessing orthodontic care, with limited specialist availability and geographical barriers affecting rural communities. Many children in elementary schools lack access to regular orthodontic screening, potentially missing the optimal window for interceptive treatment. Community-based screening programs using digital technology could help bridge this gap by providing early detection services directly in school settings.

Therefore, this community service program was designed to implement a digital orthodontic screening system for early detection of malocclusion in elementary school children in Kediri Regency, with the goals of improving access to orthodontic assessment and raising community awareness about the importance of timely orthodontic intervention.

METHODS

This community service program was implemented through collaboration between the Department of Orthodontics, Faculty of Dentistry, Universitas Kadiri, and the Education Department of Kediri Regency. The program was conducted from March to August 2024.

Program Location and Participants: The program was implemented in 12 elementary schools across Kediri Regency, selected to represent both urban and rural areas. A total of 1,200 children aged 6-12 years participated in the screening program. Schools were selected based on accessibility, willingness to participate, and representation of diverse socioeconomic backgrounds.

Digital Screening System: The screening system consisted of:

1. Smartphone-based Photography: Standardized intraoral photographs taken using smartphone cameras (iPhone 13 Pro) with specially designed intraoral retractors and consistent lighting conditions
2. AI-assisted Analysis: Custom-developed artificial intelligence software trained on 10,000+ orthodontic photographs for automated malocclusion detection and classification
3. Immediate Result Generation: Real-time analysis providing screening results and referral recommendations within 2 minutes

Screening Protocol:

1. Pre-screening Preparation: Consent forms distributed to parents, basic demographic data collection
2. Digital Photography: Five standardized intraoral photographs (frontal, right lateral, left lateral, upper occlusal, lower occlusal) taken by trained dental students
3. AI Analysis: Automated analysis for malocclusion detection, classification, and severity assessment

4. Result Communication: Immediate feedback to parents with written report and referral recommendations when indicated
5. Follow-up: Contact information provided for further consultation and treatment options

Educational Component: Comprehensive oral health education sessions conducted for children, parents, and teachers, covering:

- Importance of early orthodontic screening
- Common malocclusion types and their implications
- Preventive measures for malocclusion
- Proper oral hygiene during orthodontic treatment
- Available treatment options and optimal timing

Quality Assurance: A subset of 120 children (10% of total participants) underwent traditional clinical examination by experienced orthodontist to validate the accuracy of digital screening results. Data collected included demographic information, screening results, parental awareness questionnaires, and follow-up referral compliance. Statistical analysis was performed using descriptive statistics and diagnostic test evaluation metrics.

RESULTS AND DISCUSSION

The digital orthodontic screening program successfully reached 1,200 elementary school children across 12 schools in Kediri Regency, demonstrating the feasibility and effectiveness of community-based digital screening initiatives. The program achieved 96.8% participation rate among eligible children. Participants included 612 boys (51%) and 588 girls (49%), with age distribution: 6-7 years (28.3%), 8-9 years (35.7%), and 10-12 years (36.0%). Geographic distribution included 7 urban schools (58.3%) and 5 rural schools (41.7%). Digital screening revealed that 822 children (68.5%) had some degree of malocclusion requiring attention. The distribution of malocclusion types was:

- Class II Division 1: 32.4% (389 children)
- Class I crowding: 28.1% (337 children)
- Class III: 4.7% (56 children)
- Class II Division 2: 2.1% (25 children)
- Open bite: 1.2% (15 children)

The prevalence was higher in rural schools (72.3%) compared to urban schools (65.8%), possibly reflecting differences in access to preventive care and dietary habits.Validation against clinical examination showed that the AI-based screening system achieved 91.2% sensitivity and 87.8% specificity for malocclusion detection. Positive predictive value was 89.5% and negative predictive value was 89.8%. These results demonstrate acceptable accuracy for community screening purposes.

Community Impact and Awareness: Post-program surveys revealed significant improvements in community awareness:

- 89.3% of parents reported increased awareness of orthodontic problems
- 76.5% of parents indicated willingness to seek orthodontic consultation
- 84.2% of teachers expressed interest in incorporating oral health education in curriculum
- 67.8% of children demonstrated improved knowledge about malocclusion prevention

Of the 822 children identified with malocclusion, 394 (47.9%) were referred for orthodontic consultation. Follow-up at 3 months showed that 156 children (39.6%) had accessed orthodontic services, representing a significant improvement in treatment uptake compared to baseline community access rates.The digital screening model proved cost-effective, with per-child screening cost of approximately $2.50 compared to $15-20 for traditional clinical screening. The program established partnerships with local healthcare providers to ensure continuity of care for referred children. The high prevalence of malocclusion (68.5%) found in this study aligns with global epidemiological data, highlighting the significant need for orthodontic services in the community. The digital screening approach successfully identified children requiring orthodontic attention while providing immediate feedback to families. The acceptable accuracy of AI-based screening (91.2% sensitivity, 87.8% specificity) supports its use as a community screening tool. While not replacing comprehensive clinical examination, digital screening provides valuable first-level assessment that can guide referral decisions and resource allocation.The improved community awareness and treatment uptake demonstrate the educational value of school-based screening programs. By reaching children in their school environment, the program overcame traditional barriers to orthodontic access and created opportunities for early intervention.

The cost-effectiveness of digital screening makes it particularly suitable for resource-limited settings. The ability to screen large numbers of children efficiently while maintaining reasonable accuracy provides a scalable model for community orthodontic care.

CONCLUSION

The digital orthodontic screening program successfully provided accessible early detection services to 1,200 elementary school children in Kediri Regency, identifying 68.5% prevalence of malocclusion with 91.2% sensitivity and 87.8% specificity. The program significantly improved community awareness of orthodontic problems (89.3% of parents) and increased treatment uptake (39.6% referral compliance). This initiative demonstrates the potential of digital technology to enhance community access to orthodontic screening while promoting preventive oral healthcare. The cost-effective and scalable nature of this digital screening model supports its implementation as a sustainable community service program. Future initiatives should focus on expanding coverage to additional schools and developing integrated referral systems to ensure continuity of care for identified cases.

REFERENCES

1. Aikins, E. A., Onyeaso, C. O., & Isiekwe, M. C. (2012). Prevalence and pattern of malocclusion among school children in Port Harcourt. *Nigerian Journal of Medicine*, 21(2), 146-150.
2. Jung, M. H. (2010). An evaluation of self-esteem and quality of life in orthodontic patients: effects of crowding and protrusion. *The Angle Orthodontist*, 80(6), 1068-1077.
3. Klages, U., Claus, N., Wehrbein, H., & Zentner, A. (2004). Development of a questionnaire for assessment of the psychosocial impact of dental aesthetics in young adults. *European Journal of Orthodontics*, 26(3), 319-327.
4. Proffit, W. R., Fields Jr, H. W., & Moray, L. J. (1998). Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. *International Journal of Adult Orthodontics and Orthognathic Surgery*, 13(2), 97-106.
5. Thilander, B., Pena, L., Infante, C., Parada, S. S., & De Mayorga, C. (2001). Prevalence of malocclusion and orthodontic treatment need in children and adolescents in Bogota, Colombia. An epidemiological study related to different stages of dental development. *European Journal of Orthodontics*, 23(2), 153-167.