AMERICAN JOURNAL OF BIOLOGY AND NATURAL SCIENCES
https://biojournals.us/index.php/AJBNS
ISSN: 2997-7185

Article

Digital 3D Scanning of Teeth in Orthodontics

Gurskaya Narmina Azad[1]

1. Doctor of Philosophy in Medicine Assistant, Department of Orthopedics and Dentistry, Azerbaijan Medical University, Baku, Azerbaijan.

* Correspondence: arshedalmansori@ec.edu.iq

Citation: Azad G. N. Digital 3D Scanning of Teeth in Orthodontics. American Journal of Biology and Natural Sciences 2026, 3(2), 112-115.

Received: 15th Nov 2025
Revised: 22nd Dec 2025
Accepted: 14th Jan 2026
Published: 10th Feb 2026

Abstract: The prevalence of early tooth extraction among children aged 4 to 7 is quite high and reaches up to 43%. This is a cause of the development of anomalies and deformities of the dentofacial system. Digital 3D scanning of teeth in orthodontics is a modern, accurate, and comfortable method for creating a three-dimensional model of the jaws and teeth using an intraoral scanner, replacing traditional impressions. When choosing a method for fabricating impressions for orthodontic appliances aimed at preserving space in the dental arch, the safety of the procedure and speed are of great importance. An alternative method for obtaining impressions is digital scanning of the dental arches.

Keywords: Early Tooth Extraction, Band and Loop Appliance, Digital Scanning, Alginate Impressions, Primary Teeth.

Introduction

The prevalence of early extraction of primary teeth among children aged 4 to 7 is quite high and reaches up to 43%, which represents a significant problem in pediatric dentistry and orthodontics [1], [2]. Early tooth loss without the timely fabrication of an orthodontic space-maintaining appliance leads to the formation of dentofacial anomalies. This results in decreased masticatory efficiency, displacement of teeth adjacent to the defect, changes in the position of permanent tooth germs, which leads to a deficiency of space in the dental arch and the development of dental crowding [3], [4]. Swallowing function is impaired, and the trajectory of mandibular movement during mouth opening and lateral movements changes. At rest, hypertonicity of the temporalis muscles and sternocleidomastoid muscles is observed, indicating a significant disturbance in the functional state of the dentofacial system and requiring the attention of orthodontists and pediatric dentists [5].

One method of preserving space in the dental arch is the timely fabrication, within 2–3 months after extraction, of a fixed appliance in the form of a band-and-loop, which is fixed to an adjacent tooth [6]. When working with children, it is important to obtain a high-quality dental arch model as quickly as possible, with minimal discomfort and minimal risk of complications. An alternative to obtaining conventional analog impressions is the method of digital scanning of the dental arches [7], [8], [9], [10].

The aim of this study was to conduct a comparative evaluation of the effectiveness of digital intraoral scanning and traditional methods of obtaining alginate and C-silicone impressions for the fabrication of a fixed orthodontic band-and-loop appliance in children aged 4 to 7 years.

Materials and Methods

The study involved 90 children aged 4 to 7 years who consulted an orthodontist with dental arch defects resulting from the early extraction of first primary molars. All procedures were performed according to generally accepted protocols used in medical practice.

Clinical methods included the collection of complaints, medical history, clinical examination, and dental examination. The radiological method—orthopantomography (OPG)—was used to assess the presence and position of permanent tooth germs and to plan the design of the appliance. The study included children with early extraction of the first and/or second primary molars in the maxilla and/or mandible. Inclusion criteria were the children's age (4–7 years) and the extent of the defect (no more than one tooth per segment).

Depending on the method of impression taking, all patients were divided into three groups. The first study group included 30 patients for whom alginate impressions were taken to fabricate the appliance. Subsequently, fixed band-and-loop appliances were manufactured in the dental laboratory using gypsum models.

The second group included 30 patients for whom impressions were taken using C-silicone material to fabricate the orthodontic appliance. The gypsum models were then sent to the dental laboratory for the fabrication of the fixed appliance.

The third study group included 30 patients who underwent digital tooth scanning using a digital intraoral 3D scanner. This group consisted of 26 children with one extracted first primary molar and 4 children with an extracted second primary molar. The three-dimensional digital models were sent to the dental laboratory. The laboratory fabrication time for the appliances was the same in all groups.

During the study, the following parameters were evaluated: the time required to obtain alginate and silicone impressions; the time required for intraoral scanning of the dental arch to obtain a digital model; the relative risk of complications (presence or absence of a gag reflex during the procedure); and the discomfort index (patients' subjective sensations).

For a comparative evaluation of the effectiveness of the methods, an analysis of the use of traditional and alternative techniques for obtaining jaw impressions in children was performed. Temporal efficiency, patient comfort, and the absence of complications (absence of gag reflex) were analyzed across the groups. Statistical analysis was carried out using Microsoft Excel, including the calculation of mean values and standard deviations, and testing for normality of data distribution using the Shapiro–Wilk test. The significance of differences between groups was assessed using Student's t-test and Pearson's chi-square test [11], [12], [13], [14], [15].

Results and Discussion

Group 1.

The average time required to obtain a single impression during the clinical appointment was 130.0 ± 0.86 seconds. A gag reflex was observed in 12 patients (40.0 ± 0.86%). Unpleasant sensations were reported by 26 patients (86.7 ± 6.2%).

Group 2.

The average time required to obtain a single impression during the clinical appointment was 285.0 ± 1.02 seconds. A gag reflex was observed in 17 patients (56.7 ± 9.0%). Unpleasant sensations were reported by 24 patients (80.0 ± 7.3%).

Group 3.

The average time required to scan one dental arch during the clinical appointment was 115.0 ± 0.87 seconds. A gag reflex was observed in 3 children (10.0 ± 5.5%). Unpleasant sensations were reported by 3 patients (10.0 ± 5.5%).

The difference between the mean values of the time required to obtain impressions in Groups 1 and 2 and the time required to scan the dental arch in Group 3 was 15.0 ± 1.22 seconds and 170.0 ± 1.34 seconds, respectively. These differences were statistically significant ($p < 0.001$).

Conclusion

Thus, the procedure of digital scanning of the dental arches during an orthodontic appointment is comfortable for children, as it requires less time, does not cause unpleasant sensations, and almost never provokes a gag reflex, in contrast to traditional impression-taking methods. The method of digital tooth scanning for the fabrication of orthodontic appliances can be recommended for wider implementation in the practice of orthodontists in public dental clinics. The results of the present study also suggest that digital scanning of dental arches may be used in children whose oral sanitation was performed under general anesthesia.

REFERENCES

[1] E. S. Timofeyeva, R. R. Shakirova, E. V Nikolayeva, and R. I. Farrakhova, "Prophylactic use of dental clip in children with adentia," *Vyatskij Med. Vestn.*, vol. 3, pp. 17–20, 2025, doi: 10.24412/2220-7880-2025-3-17-20.

[2] T. Terekhova, A. Butvilovsky, N. Petrovich, A. Valadkevich, and D. Valadkevich, "Analysis of the dental status of children who need premature extraction of primary teeth," *Sovrem. Stomatol.*, vol. 1, pp. 54–58, 2020, [Online]. Available: https://elibrary.ru/item.asp?id=42642368

[3] A. B. Slabkovskaya and N. V Morozova, "Complications of early loss of deciduous teeth," *Ortodontiya*, vol. 4, pp. 18–27, 2021, [Online]. Available: https://www.elibrary.ru/item.asp?id=48358472

[4] M. A. Danilova, P. V Ishmurzin, and T. I. Rudavina, "Predictors of dental arch abnormalities in children with primary dentition (part two)," *Pediatr. Dent. Dent. Prophyl.*, vol. 24, no. 3, pp. 238–247, 2024, doi: 10.33925/1683-3031-2024-767.

[5] M. A. Postnikov, Y. E. O. Guseva, and G. V Stapanova, "Functional diagnosis and treatment of children with early removal of baby teeth," *Ortodontiya*, vol. 3, p. 69, 2022, [Online]. Available: https://www.elibrary.ru/item.asp?id=50253527

[6] N. V Morozova and A. B. Slabkovskaya, "Effect of premature loss of primary teeth on permanent teeth development," *Ortodontiya*, vol. 4, pp. 2–7, 2016, [Online]. Available: https://www.elibrary.ru/item.asp?id=29443384

[7] N. S. Averkina, "Digital technologies in dentistry," *Simvol Nauk.*, vol. 3, no. 4–1, pp. 126–134, 2024, [Online]. Available: https://elibrary.ru/item.asp?id=65614024

[8] E. N. Ovcharenko, T. R. Zaredinova, L. N. K. Kurtmulaeva, A. E. Tasinov, E. E. Tasinov, and R. I. Raupova, "Intraoral scanning in modern dentistry: advantages, disadvantages and development prospects," *Sovrem. Nauk. Aktual. Probl. Teor. i Prakt. Estestv. i Teh. Nauk.*, vol. 3–2, pp. 121–126, 2024, doi: 10.37882/2223-2966.2024.3-2.19.

[9] A. A. Manyakhina and E. V Nevzorova, "Effectiveness of digital technologies in dentistry," *Vestn. Nauk.*, vol. 4, no. 10, pp. 1024–1029, 2024, [Online]. Available: https://elibrary.ru/item.asp?id=73889553

[10] I. A. Yakimov and I. I. Sharipov, "Application of 3D printing and 3D scanning in dentistry," *Trends Dev. Sci. Educ.*, vol. 110–16, pp. 195–199, 2024, doi: 10.18411/trnio-06-2024-901.

[11] A. Garrocho-Rangel and A. González-Macías, "Fundamentals of Nonparametric Statistical Tests for Dental Research," *Dent. J.*, vol. 12, no. 10, p. 314, 2024, doi: 10.3390/dj12100314.

[12] E. E. Pérez-Guerrero and others, "Methodological and Statistical Considerations for Cross-

Sectional and Observational Studies," *J. Clin. Med.*, vol. 13, no. 14, p. 4005, 2024, doi: 10.3390/jcm13144005.

[13] Y. G. Choi and others, "Survey of the use of statistical methods in journal articles: a descriptive analysis of tests including Student's t-test and chi-square test," *J. Korean Assoc. Oral Maxillofac. Surg.*, vol. 44, pp. xx--xx, 2018, doi: 10.5125/jkaoms.2018.44.xx.xx.

[14] J. Arnastauskait\.e and others, "An Exhaustive Power Comparison of Normality Tests," *Mathematics*, vol. 9, no. 7, p. 788, 2021, doi: 10.3390/math9070788.

[15] Z. Meng and others, "Cauchy combination omnibus test for normality," *PLoS One*, vol. 18, no. 10, p. e0289498, 2023, doi: 10.1371/journal.pone.0289498.