

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study

Lingeshwar Deenadayalan¹, Gopi Naveen Chander², Meenakshi Akshayalingam³

¹Senior Assistant Professor, Department of Prosthodontics, Tamil Nadu Government Dental College and Hospital, Chennai-600003, India; PhD Scholar, Department of Prosthodontics, SRM Dental College, Bharathi Salai, Ramapuram, Chennai-600089, India

Phone: 7418314035

Email: lingeshwar25@gmail.com

²Professor, Department of Prosthodontics, SRM Dental College, Bharathi Salai, Ramapuram, Chennai-600089, India

³Professor and Head, Department of Prosthodontics, Tamil Nadu Government Dental College and Hospital, Chennai-600003, India

Abstract

Purpose

Accurate impressions are essential for the successful fabrication of obturator prostheses in patients with maxillary defects. The emergence of digital intraoral scanning has introduced a potential alternative to conventional impression techniques. This study aimed to compare the accuracy, patient comfort, and clinical efficiency of digital impressions and conventional impressions in patients with Okay's Class 1b and Class 2 maxillary defects.

Materials and Methods

A prospective pilot clinical study was conducted on 12 patients presenting with surgically acquired maxillary defects classified as Okay Class 1b or Class 2. Each patient underwent both digital and conventional impression procedures. Digital impressions were recorded using an intraoral scanner, whereas conventional impressions were made using custom trays and polyvinyl siloxane materials. Conventional casts were digitized using a laboratory scanner. Three-dimensional deviation analysis was performed using surface matching software. Impression time and patient comfort were also evaluated.

Results

The mean deviation for digital impressions was 0.28 ± 0.09 mm, whereas conventional impressions showed a mean deviation of 0.34 ± 0.11 mm. The difference was not statistically significant ($p = 0.08$). Digital impressions required significantly less chairside time (7.2 ± 1.5 minutes) compared with conventional impressions (14.8 ± 2.3 minutes) ($p < 0.01$). Patient comfort scores were significantly higher for digital impressions (VAS score 8.6 ± 0.9) compared with conventional techniques (6.2 ± 1.4) ($p < 0.01$).

Conclusion

Digital impressions demonstrated comparable accuracy to conventional impressions for recording Okay Class 1b and Class 2 maxillary defects. Digital techniques significantly improved patient comfort and reduced impression time. Digital workflows may therefore represent a promising approach for maxillofacial prosthodontic rehabilitation.

Keywords:

Digital impression, maxillary defect, intraoral scanner, obturator prosthesis, maxillofacial prosthodontics, Okay's classification

How to cite this article: Deenadayalan L, Chander GN, Akshayalingam M. Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study. *Int J Drug Deliv Technol.* 2026;16(8s): 219-231; DOI: 10.25258/ijddt.16.8s.33

Introduction

Maxillary defects may result from surgical resection of tumors, trauma, congenital anomalies, or severe infections. These defects frequently lead to communication between the oral and nasal cavities, resulting in impairment of speech, mastication, swallowing, and facial esthetics [1,2]. Prosthetic rehabilitation using obturator prostheses remains one of the most widely accepted treatment modalities for restoring oral function and improving the quality of life in such patients [3].

An accurate impression of the defect area and remaining oral structures is essential for the successful fabrication of obturator prostheses. Conventional impression techniques using elastomeric materials have long been considered the gold standard in maxillofacial prosthodontics [4]. However, recording maxillary defects presents several challenges due to the presence of deep undercuts, irregular defect morphology, and large tissue voids. These factors may lead to distortion of impression materials and inaccuracies in the final prosthesis [5].

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study

The introduction of digital intraoral scanners has significantly transformed the field of prosthodontics. Digital impression techniques provide several advantages including elimination of impression materials, reduced clinical time, improved patient comfort, and streamlined digital workflows for prosthesis fabrication [6]. Numerous studies have demonstrated the accuracy and reliability of digital impressions in fixed prosthodontics and implant dentistry [7].

Despite these advantages, the application of digital impression techniques in maxillofacial prosthodontics remains relatively limited. The presence of large anatomical defects, reflective mucosal surfaces, and soft tissue mobility may influence the accuracy of intraoral scanning in such cases [8].

Classification systems play an important role in understanding the extent of maxillary defects and guiding prosthetic treatment planning. The classification system proposed by Okay and colleagues categorizes maxillary defects according to the relationship between the defect and the remaining dentition [1]. In this system, **Class 1b defects involve the maxillary alveolus posterior to the canines**, whereas **Class 2 defects involve part of the tooth-bearing maxilla including only one canine**. These defect types are frequently encountered in partially dentate maxillectomy patients and are often managed using obturator prostheses [3].

Although digital impressions are widely used in contemporary dentistry, limited evidence exists regarding their accuracy in patients with maxillary defects. Therefore, the present pilot clinical study was conducted to compare the accuracy of digital impressions with conventional impression techniques in patients with Okay Class 1b and Class 2 maxillary defects.

Materials and Methods

Study Design

This prospective pilot clinical study was conducted in the Department of Prosthodontics. Ethical approval was obtained from the institutional ethics committee prior to commencement of the study. Written informed consent was obtained from all participants.

Sample Selection

A total of twelve patients with surgically acquired maxillary defects were included in the study. Among them, six patients presented with Okay Class 1b defects and six patients had Okay Class 2 defects. The sample size was considered appropriate for this pilot clinical investigation to evaluate the feasibility and preliminary outcomes of digital impression techniques.

Patients aged between 18 and 70 years with surgically acquired maxillary defects classified as Okay Class 1b or Class 2, the presence of adequate residual dentition, and a healed surgical site of at least three months were included in the study. Patients with completely edentulous maxillary defects, extensive midfacial defects

involving orbital structures, severe trismus limiting intraoral scanner access, and those with uncontrolled systemic diseases were excluded from the study.

Digital Impression Procedure

Digital impressions were obtained using an intraoral scanner Medit i700 (Medit Corp., Seoul, South Korea) following a standardized scanning protocol. The scanning sequence included the residual dentition, palatal vault, defect margins, and internal defect surfaces to capture the complete morphology of the defect.

The acquired scans were exported in STL (Standard Tessellation Language) format for further analysis. Digital impressions eliminate potential inaccuracies associated with impression materials and gypsum casts [6].

Conventional Impression Procedure

Conventional impressions were obtained using a custom tray and elastomeric impression material.

The procedure included:

1. Preliminary impression using irreversible hydrocolloid
2. Fabrication of a custom tray with spacer
3. Final impression using polyvinyl siloxane material

The impressions were poured using Type III dental stone to obtain master casts [4].

Digitization of Conventional Casts

The stone casts obtained from conventional impressions were digitized using a laboratory scanner Shining 3D (Shining 3D Technology Co., Ltd. Hanzou, China) to generate STL files. This allowed direct comparison between digital and conventional datasets using three-dimensional analysis software Geomagic Control X (3D Systems, Rock Hill, SV, USA)

Accuracy Assessment

Accuracy was evaluated using three-dimensional surface deviation analysis. The digital models obtained from intraoral scanning and the scanned conventional stone casts were superimposed using best-fit alignment techniques to assess discrepancies between the two datasets. The parameters recorded included mean surface deviation, maximum deviation, and linear deviations at predetermined reference points. Three-dimensional deviation analysis has been widely used in prosthodontic research for evaluating the accuracy of digital impression techniques [7].

Patient Comfort Evaluation

Patient comfort during impression procedures was assessed using a Visual Analog Scale (VAS) ranging from 0 to 10, where higher scores indicated greater comfort.

Impression Time

Chairside time required for each impression technique was recorded in minutes from the start of the procedure until completion.

Statistical Analysis

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study

Statistical analysis was performed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). An independent *t*-test was used to compare the accuracy values between the digital and conventional impression techniques. Paired *t*-tests were used to analyze differences in impression time and patient comfort scores between the two methods. The level of statistical significance was set at $p < 0.05$.

Results

Digital impressions demonstrated slightly lower mean deviation values compared with conventional impressions. The mean deviation for digital impressions was 0.28 ± 0.09 mm, whereas conventional impressions showed a mean deviation of 0.34 ± 0.11 mm (Table 2). However, the difference between the two techniques was not statistically significant ($p = 0.08$).

Defect-wise analysis demonstrated similar trends, with digital impressions showing slightly improved accuracy in both Okay Class 1b and Class 2 maxillary defects.

Digital impressions required significantly less chairside time compared with conventional impressions. The mean impression time for the digital technique was 7.2 ± 1.5 minutes, whereas the conventional technique required 14.8 ± 2.3 minutes (Table 3).

Patient comfort scores were also significantly higher for digital impressions. The mean visual analog scale (VAS) score for digital impressions was 8.6 ± 0.9 , compared with 6.2 ± 1.4 for conventional impressions (Table 4).

Discussion

Rehabilitation of maxillary defects following surgical resection remains a complex challenge in maxillofacial prosthodontics. Loss of palatal and dentoalveolar structures frequently results in communication between the oral and nasal cavities, leading to compromised speech, mastication, swallowing, and facial esthetics. Prosthetic rehabilitation with obturator prostheses remains one of the most widely accepted treatment approaches because it restores oral function while allowing periodic evaluation of the surgical site and adjacent tissues [3,9].

Various classification systems have been proposed to categorize maxillary defects and assist in treatment planning. The classification proposed by Okay and colleagues is widely used because it considers the relationship between the defect and the remaining dentition, which is particularly relevant in prosthodontic rehabilitation [1]. Similarly, Brown and Shaw introduced another classification focusing on the extent of midfacial defects and reconstructive considerations [2]. In addition, systematic reviews have emphasized the importance of standardized classification systems for consistent communication among clinicians and researchers [20].

Accurate impression making is a critical step in the fabrication of obturator prostheses because it directly influences the retention, stability, and overall success of the prosthesis. Conventional impression techniques using

elastomeric materials have traditionally been used to record maxillary defects [4,5]. However, these procedures can be challenging due to the presence of deep undercuts, irregular tissue morphology, and large defect cavities. In addition, impression material distortion and patient discomfort may compromise the accuracy of the final prosthesis [16].

Digital dentistry has emerged as an important advancement in prosthodontics, offering new possibilities for recording oral structures with improved efficiency and reproducibility. Digital impression systems eliminate several steps associated with conventional workflows, including impression material handling, cast pouring, and physical storage of stone models [6,19]. Furthermore, digital workflows allow seamless integration with computer-aided design and computer-aided manufacturing (CAD-CAM) technologies, which have become increasingly important in modern prosthodontic practice [17,18].

Several studies have evaluated the accuracy of digital impression systems in dentistry. Patzelt and colleagues reported that intraoral scanners are capable of producing highly accurate full-arch digital impressions when appropriate scanning protocols are followed [7]. Similarly, Ender and Mehl demonstrated that digital impression techniques can provide accuracy comparable to conventional methods when evaluating trueness and precision of complete-arch scans [8]. Subsequent clinical investigations confirmed these findings, showing that digital impressions exhibit high precision both in vitro and in vivo [11,12].

In the present study, digital impressions demonstrated slightly lower mean deviation values compared with conventional impressions when recording Okay Class 1b and Class 2 maxillary defects. Although the difference was not statistically significant, the results suggest that digital impressions can achieve clinically acceptable accuracy for recording moderate maxillary defects. These findings are consistent with previous studies evaluating the accuracy of digital dental models and casts [21,22].

Another important observation in the present study was the significant reduction in chairside time associated with digital impressions. Digital scanning required considerably less time than conventional impression procedures. This finding is consistent with earlier research demonstrating improved clinical efficiency when digital workflow are implemented in prosthodontic practice [6,18]. Reduced clinical time may enhance patient satisfaction and improve workflow efficiency in busy clinical settings.

Patient comfort is another important consideration during impression procedures. Conventional impression techniques may cause discomfort due to the presence of impression trays and impression materials, particularly in patients with large palatal defects or heightened gag

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study

reflex. Digital impression techniques eliminate these issues and allow scanning to be paused and resumed when necessary. Previous studies have reported significantly higher patient acceptance of digital impressions compared with conventional techniques [13].

In addition to intraoral scanning, various digital imaging technologies have been investigated for capturing craniofacial structures. Three-dimensional stereophotogrammetry and facial scanning systems have demonstrated acceptable accuracy and reproducibility for capturing facial morphology [23,24]. These technologies may provide valuable adjunctive information in the digital rehabilitation of maxillofacial defects.

Rapid prototyping and additive manufacturing technologies have further expanded the possibilities of digital workflow in dentistry. These technologies allow the fabrication of accurate physical models and prosthetic components directly from digital data [14,15]. Several studies have demonstrated that three-dimensional printed dental models exhibit accuracy comparable to conventional stone casts [22,25]. Additionally, digital fabrication techniques may reduce production time and improve reproducibility of prosthetic devices.

The integration of digital impressions with additive manufacturing technologies has significant potential in maxillofacial prosthodontics. Digital workflow allow clinicians to design obturator prostheses using CAD software and fabricate them using advanced manufacturing techniques. Such approaches may improve treatment efficiency and facilitate more predictable prosthetic outcomes [10,14].

Despite the advantages of digital technologies, certain limitations should be considered. Large anatomical defects, mobile soft tissues, and reflective mucosal surfaces may interfere with accurate data acquisition during intraoral scanning. Moreover, the absence of stable anatomical landmarks within extensive defect cavities may challenge the stitching algorithms used by intraoral scanners.

Another limitation of the present study is the relatively small sample size, as it was designed as a pilot clinical investigation. Larger studies involving greater numbers of patients and different defect classifications are necessary to confirm the findings. Future research should also evaluate the long-term clinical performance of obturator prostheses fabricated using fully digital workflows.

Nevertheless, the results of this study suggest that digital impression techniques represent a promising alternative to conventional impression methods for recording moderate maxillary defects. Continued advancements in digital scanning, imaging, and additive manufacturing technologies are likely to further expand the role of digital workflow in maxillofacial prosthodontic rehabilitation.

Summary

Within the limitations of this pilot study:

- Digital impressions demonstrated comparable accuracy to conventional impression techniques.
- Digital impressions significantly reduced clinical procedure time.
- Patients reported greater comfort during digital scanning procedures.

Digital impression techniques may therefore represent a promising alternative for recording moderate maxillary defects in maxillofacial prosthodontics.

References

1. Okay DJ, Genden E, Buchbinder D, Urken ML. Prosthodontic guidelines for surgical reconstruction of the maxilla: a classification system for defects. *J Prosthet Dent.* 2001;86:352-363.
2. Brown JS, Shaw RJ. Reconstruction of the maxilla and midface: introducing a new classification. *Lancet Oncol.* 2010;11:1001-1008.
3. Aramany MA. Basic principles of obturator design for partially edentulous patients. *J Prosthet Dent.* 1978;40:554-557.
4. Zarb GA, Hobkirk J, Eckert S, Jacob R. *Prosthodontic Treatment for Edentulous Patients.* 13th ed. St Louis: Mosby; 2013.
5. Beumer J, Marunick MT, Esposito SJ. *Maxillofacial Rehabilitation.* 3rd ed. Quintessence; 2011.
6. Mangano FG, Hauschild U, Admakin O. Full digital workflow in dentistry: advantages and limitations. *BMC Oral Health.* 2018;18:56.
7. Patzelt SB, Emmanouilidi A, Stampf S. Accuracy of full-arch scans using intraoral scanners. *Clin Oral Investig.* 2014;18:1687-1694.
8. Ender A, Mehl A. Accuracy of complete-arch dental impressions: a new method of measuring trueness and precision. *J Prosthet Dent.* 2013;109:121-128.
9. Keyf F. Obturator prostheses for hemimaxillectomy patients. *J Oral Rehabil.* 2001;28:821-829.
10. Revilla-León M, Özcan M. Additive manufacturing technologies used for processing polymers. *J Prosthodont.* 2019;28:146-158.
11. Güth JF, Edelhoff D, Schweiger J, Keul C. A new method for the evaluation of accuracy of full-arch digital impressions in vitro. *Clin Oral Investig.* 2016;20:1487-1494.
12. Ender A, Attin T, Mehl A. In vivo precision of conventional and digital methods for obtaining complete-arch dental impressions. *J Prosthet Dent.* 2016;115:313-320.

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study

13. Yuzbasioglu E, Kurt H, Turunc R, Bilir H. Comparison of digital and conventional impression techniques: evaluation of patients' perception, treatment comfort, effectiveness, and clinical outcomes. *BMC Oral Health*. 2014;14:10.
14. Javaid M, Haleem A. Current status and applications of additive manufacturing in dentistry. *J Oral Biol Craniofac Res*. 2019;9:179-185.
15. Dawood A, Marti BM, Sauret-Jackson V, Darwood A. 3D printing in dentistry. *Br Dent J*. 2015;219:521-529.
16. Goodacre CJ, Garbacea A, Naylor WP. Clinical complications in fixed prosthodontics. *J Prosthet Dent*. 2003;90:31-41.
17. Mangano C, Veronesi G. Digital workflow in implant dentistry. *J Oral Implantol*. 2018;44:146-152.
18. Revilla-León M, Özcan M. Digital workflow in prosthodontics. *J Prosthodont*. 2020;29:230-237.
19. Mangano FG, Gandolfi A. Digital dentistry: new materials and technologies. *Materials*. 2021;14:1545.
20. Bidra AS, Jacob RF, Taylor TD. Classification of maxillectomy defects: a systematic review. *J Prosthet Dent*. 2012;107:261-270.
21. Ye H, Ma Q, Hou Y, Li M, Zhou Y. Generation and evaluation of 3D digital casts of maxillary defects based on multisource data registration: A pilot clinical study. *J Prosthet Dent*. 2017;118(6):790-795. doi:10.1016/j.prosdent.2017.01.014.
22. Ellakany P, Al-Harbi F, El Tantawi M, Mohsen C. Evaluation of the accuracy of digital and 3D-printed casts compared with conventional stone casts. *J Prosthet Dent*. 2022;127(3):438-444. doi:10.1016/j.prosdent.2020.08.039.
23. de Menezes M, Rosati R, Ferrario VF, Sforza C. Accuracy and reproducibility of a three-dimensional stereophotogrammetric imaging system. *J Oral Maxillofac Surg*. 2010;68(9):2129-2135.
24. Ye HQ, Lv LW, Liu YS, Zhou YS. Evaluation of the accuracy, reliability, and reproducibility of two different 3-dimensional face-scanning systems. *Int J Prosthodont*. 2016;29(3):213-218.
25. Hazeveld A, Huddleston Slater JJR, Ren Y. Accuracy and reproducibility of dental replica models reconstructed by different rapid prototyping techniques. *Am J Orthod Dentofacial Orthop*. 2014;145(1):108-115.

Table 1. Individual patient data comparing deviation values, impression time, and patient comfort between digital and conventional impression techniques.

Pa tie nt	De fe ct Ty pe	Digi tal Dev iati on (m m)	Conv entio nal Devia tion (mm)	Di git al Ti me (m in)	Conv entio nal Time (min)	Dig ital Co mf ort (V AS)	Conv entio nal Comf ort (VAS)
1	Cl as s 1b	0.21	0.29	6.5	14.2	9	6
2	Cl as s 1b	0.24	0.30	7.0	15.0	8	6
3	Cl as s 1b	0.27	0.34	6.8	14.5	9	7
4	Cl as s 1b	0.26	0.33	7.5	15.3	8	6
5	Cl as s 1b	0.22	0.28	6.9	14.1	9	6
6	Cl as s 1b	0.30	0.36	7.3	16.0	8	7
7	Cl as s 2	0.31	0.38	7.8	15.5	8	6
8	Cl as s 2	0.29	0.35	7.1	14.7	9	7
9	Cl as s 2	0.32	0.40	7.6	15.9	8	6

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study

10	Clas 2	0.28	0.33	7.0	14.4	9	6
11	Clas 2	0.34	0.39	8.1	16.3	8	5
12	Clas 2	0.30	0.36	7.2	15.2	9	6

Table 2. Mean deviation values for digital and conventional impression techniques

Impression Technique	Mean Deviation (mm)
Digital Impression	0.28
Conventional Impression	0.34

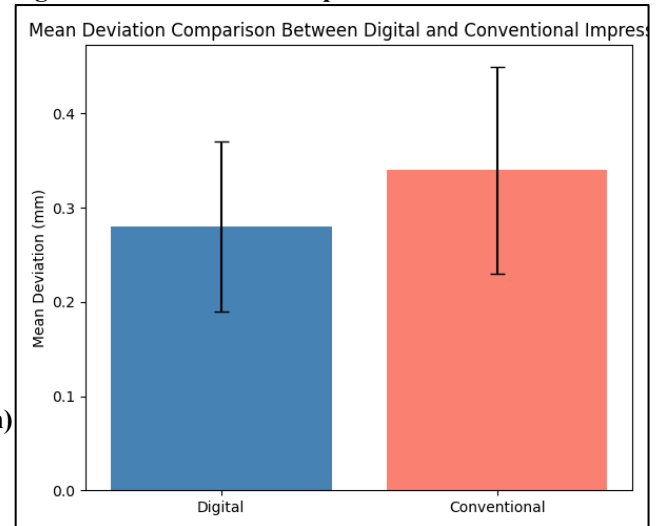
Table 3. Comparison of chairside impression time between digital and conventional techniques

Technique	Mean Time (minutes)
Digital	7.2 ± 1.5
Conventional	14.8 ± 2.3

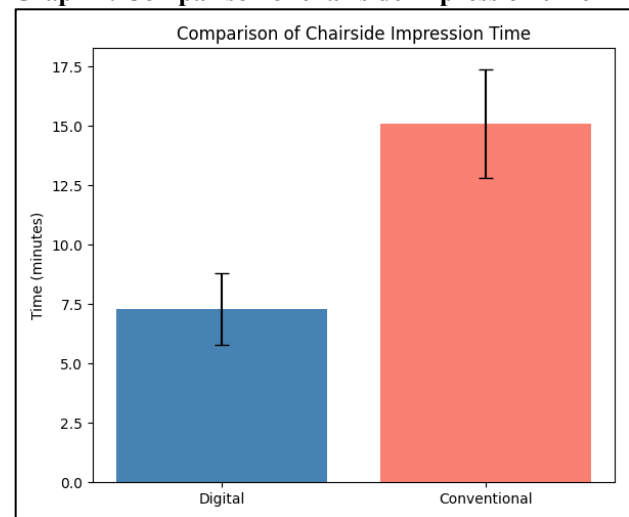
Table 4. Comparison of patient comfort scores between digital and conventional impression techniques

Technique	Mean VAS Score
Digital	8.6 ± 0.9
Conventional	6.2 ± 1.4

Graph 1: Mean deviation comparison between digital and conventional impressions

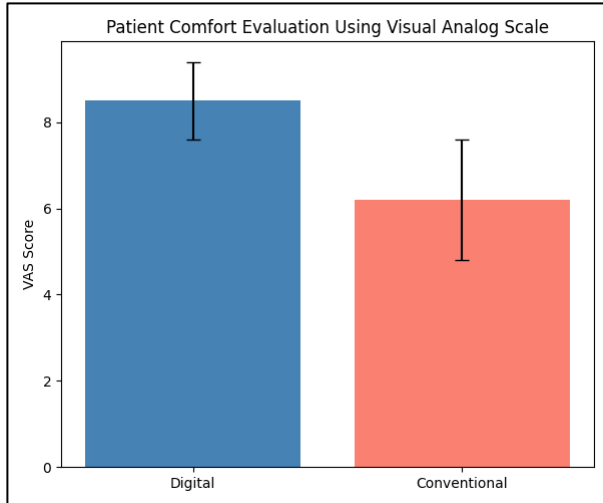


Graph 2: Comparison of chairside impression time



Graph 3 : Patient comfort evaluation using visual analog scale

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study



Graph 4 : Accuracy comparison according to defect classification

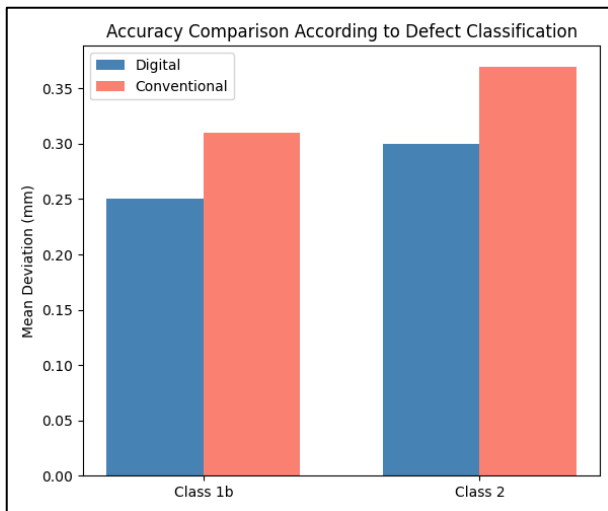


Figure 1: Preoperative intraoral view of Okay's Class 2 maxillary defect with left hemi-maxillectomy.



Figure 2: Digital intraoral scanning procedure of maxillary defect.

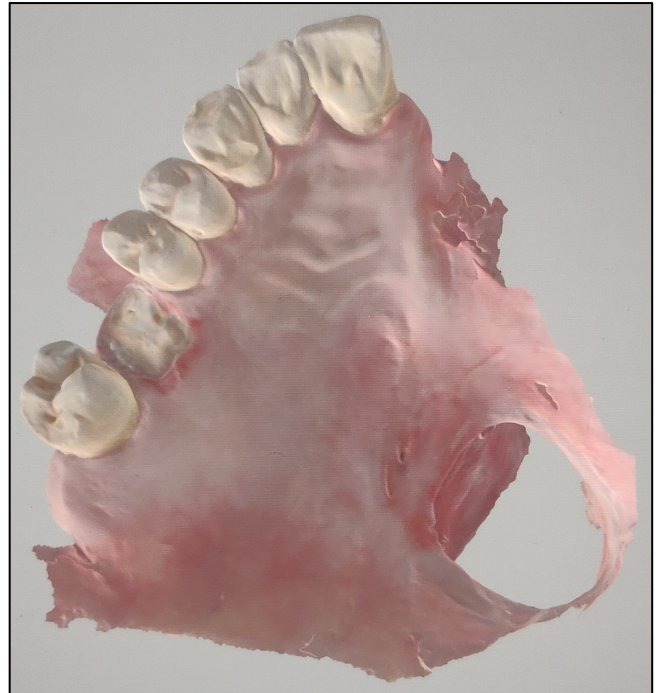


Figure 3: Digital 3D model obtained from intraoral scanner.



Figure 4a: Digital 3D design of Cast Partial Framework

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study



Figure 4b. 3D resin printed framework trial.



Figure 6b: Final obturator prosthesis in-situ.

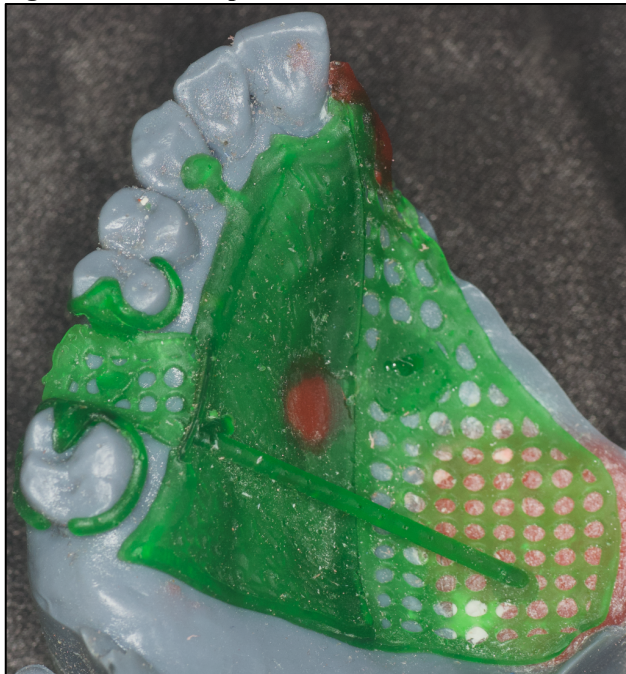
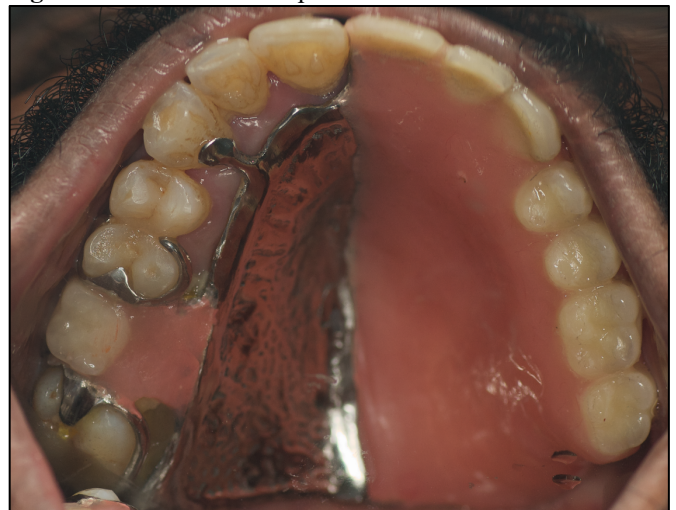


Figure 6a: Final obturator prosthesis.



Legends

Table 1. Individual patient data comparing deviation values, impression time, and patient comfort between digital and conventional impression techniques.

Table 2. Mean deviation values for digital and conventional impression techniques

Table 3. Comparison of chairside impression time between digital and conventional techniques

Table 4. Comparison of patient comfort scores between digital and conventional impression techniques

Graph 1: Mean deviation comparison between digital and conventional impressions

Graph 2: Comparison of chairside impression time

Graph 3 : Patient comfort evaluation using visual analog scale

Comparing the Accuracy of Digital Impression Versus Conventional Impression for Okay's Class 1b and Class 2 Maxillary Defects: A Pilot Clinical Study

Graph 4 : Accuracy comparison according to defect classification

Figure 1: Preoperative intraoral view of Okay's Class 2 maxillary defect with left hemi-maxillectomy.

Figure 2: Digital intraoral scanning procedure of maxillary defect.

Figure 3: Digital 3D model obtained from intraoral scanner.

Figure 4a: Digital 3D design of Cast Partial Framework

Figure 4b. 3D resin printed framework trial.

Figure 6a & 6b: Final obturator prosthesis.

Conflict of Interest

The authors declare no conflict of interest.

Funding

No external funding was received for this research.