



"Beyond the Mold: Comparing Accuracy and Comfort in Digital and Conventional Dental Impressions"

Dr.Geethu Maria Jose,¹ Dr.Mridula Trehan,² Dr.Divyaroop Rai,³ Dr. Siby Benny,⁴ Dr.Praveenkumar.P,⁵ Dr.Annie Maxwell,⁶

^{1,6} Pg Resident, Department of Orthodontics and Dentofacial Orthopaedics, NIMS Dental College and Hospital, Jaipur, Rajasthan, India

²Professor, Department of Orthodontics and Dentofacial Orthopaedics, Mahatma Gandhi Dental College and Hospital, Jaipur, Rajasthan, India

³Professor and Head, Department of Orthodontics and Dentofacial Orthopaedics, NIMS Dental College and Hospital, Jaipur, Rajasthan, India

⁴Assistant professor, Department of Orthodontics and Dentofacial Orthopaedics, Royal Dental College, Chalissery Palakkad, Kerala, India

⁵Pg Resident, Department of Oral and Maxillofacial Surgery, NIMS Dental College and Hospital, Jaipur, Rajasthan, India

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ABSTRACT:

Background: The Aim is to compare conventional and digital impression techniques based on accuracy and patient experience and perception.

Materials and Method: A total of 30 patients were included in the study and divided into 2 groups. All the 30 patients have undergone both the impression techniques. Patients under group 1 underwent alginate impression technique and patient under group 2 underwent introral scanning technique. All the values were noted and interpretations were done.

Results: This study showed that both the methods does not have much difference in value. However, the statistical analysis shows that the Intraoral Scanning technique is more preferred technique than Alginate impression technique.

Conclusion: Thus, this study concludes that compared to the traditional impression technique, the digital impression technique proved to be more efficient. The total amount of time needed for the traditional impression method was more extensive than the digital impression method.

1. Introduction

Orthodontists use dental models for various diagnostic and treatment planning purposes. These include assessing space, modeling jaw and teeth movements, evaluating tooth positions and occlusal relationships, designing and fabricating appliances, and analyzing treatment outcomes. In recent decades, dental impression techniques have evolved significantly. Traditionally, dental casts were made using plaster casts and alginate impressions.[1]

Previous studies evaluating the accuracy of 3-D models have shown that they are comparable to plaster casts regarding arch registration, and linear and angular measurements.[2] As evidence supporting their accuracy increases, the use of digital impression methods in orthodontics is on the rise.

Dental impression materials are employed to form a negative mold of both the hard and soft tissues in the mouth. These materials are crucial in procedures like the creation of crowns and bridges. The precision and



dimensional stability of these materials are vital to ensuring that the final prosthesis fits accurately.[3]

The latest advancement is the direct creation of three-dimensional models with an intraoral scanner. By using a handheld imaging device, the orthodontist can scan the patient's teeth directly from the chairside. This technology offers several advantages, the most significant of which is eliminating the need for traditional impressions.[4]

Despite the advancements in intraoral scanning, the ongoing reliance on traditional impression methods has limited its full adoption in orthodontic private practices. Conventional materials are valued for their accuracy, broad acceptance, and generally low cost.[5] However, patients often find these impressions uncomfortable and unpleasant.

Additionally, traditional impression methods require inventory and storage for raw materials, as well as space for storing plaster models.[6] Because plaster models expand during the setting process and the impression material undergoes dimensional changes, they cannot be considered a precise replica of the oral cavity.[7]

Moreover, many laboratories can utilize digital models, which enhances efficient digital communication while ensuring high-quality fabrication of appliances, prosthetics, and restorations. The technical aspects of these devices have been assessed and cover performance, cost, vendor, compatibility, portability, features, and ease of use. Clinicians are advised to consider these factors, but they should also take into account patient-centered aspects of using the scanner.

Measurements carried out in relation to the Bolton analysis were not significantly different from those carried out on the 'gold standard' whether this was the original plaster model from which the virtual model was developed or a dentoform model.[8,9]

The digital intraoral impression has become integral to the CAD/CAM process. This study aimed to compare the accuracy, specifically trueness and precision, of digital impressions of the full arch with conventional impressions using an in-vitro model.[10]

For convenience and cost-effectiveness, orthodontists who typically work with pre- and posttreatment plaster casts are increasingly adopting computer-based digital models.[11]

The study aimed to compare the time, accuracy, and patient acceptance of acquiring dental casts using traditional alginate impressions with those obtained using a chairside intraoral scanner. Specifically, it sought to evaluate the comparative precision of digital orthodontic casts produced with the scanner.

Thus, the goal of the study is to assess and compare conventional and digital impression techniques in terms of accuracy and patient experience.

2. Material and Methods

The in-vivo study involved 30 new patients reporting to the NIMS Dental College and Hospital in Jaipur, Rajasthan, who had no prior experience with either traditional or digital impressions. Conducted in the Department of Orthodontics and Dentofacial Orthopaedics at NIMS Dental College and Hospital, the study ensured that all participants were informed about the research and provided their signed consent. The study received approval from the Institutional Ethics Committee at NIMS University Rajasthan, Jaipur, with Ethical Clearance ID: IEC/P-13/2022.

The inclusion criteria were : A full complement of permanent teeth excluding 3rd molars, Lack of familiarity with alginate impression techniques or digital intraoral scanning, No missing or heavily restored teeth, Maintaining good oral health, Patient without periodontal disease.

Study casts will be collected using two methods: conventional alginate impressions and digital intraoral scanning techniques. Each participant will undergo both conventional and digital impression techniques on the same day, with both methods performed by the same operator.

Conventional impressions will be taken using fast-set irreversible hydrocolloid material and standard perforated metal trays, with the patient seated upright. To minimize dimensional changes in the impression



material, dental stone will be poured into the irreversible hydrocolloid impressions immediately.

The iTero Element 2 mobile version scanner will be used for the intraoral scans. All digital scanning procedures will be carried out by the same operator, following the manufacturer's instructions.

The study divided patients into two groups: Group 1, where patients underwent the irreversible hydrocolloid impression technique, and Group 2, where patients underwent the intraoral scanning technique.

For the conventional technique, treatment time will be measured in seconds by a second operator, from the selection of the impression tray to the complete setting of the alginate impression and its retrieval from the oral cavity. For the digital technique, the time will be recorded from the start of the scan until the entire oral cavity has been scanned.

The accuracy of the measurements was assessed by measuring distances inside the mouth and on the dental stone cast using an intraoral digital Vernier caliper (Fig. no:1 and 2). Distances on the digital casts were measured using OrthoCAD software version 5.9 (Fig. no: 3).

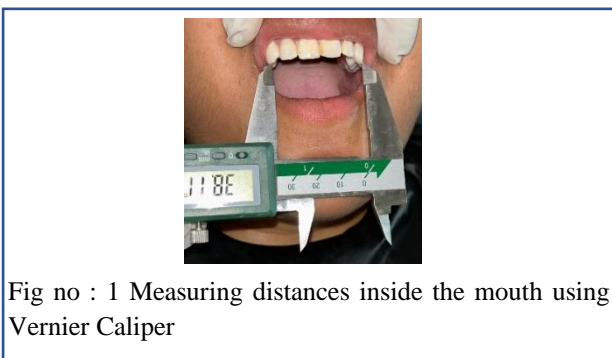


Fig no : 1 Measuring distances inside the mouth using Vernier Caliper

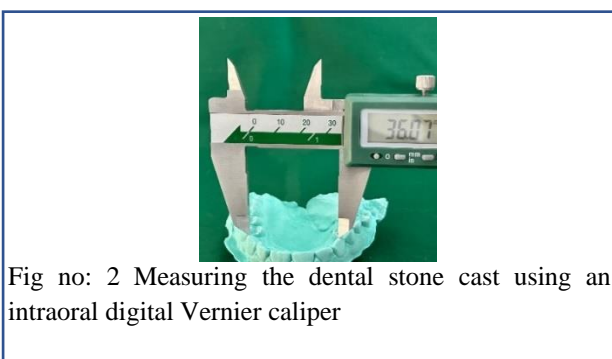


Fig no: 2 Measuring the dental stone cast using an intraoral digital Vernier caliper

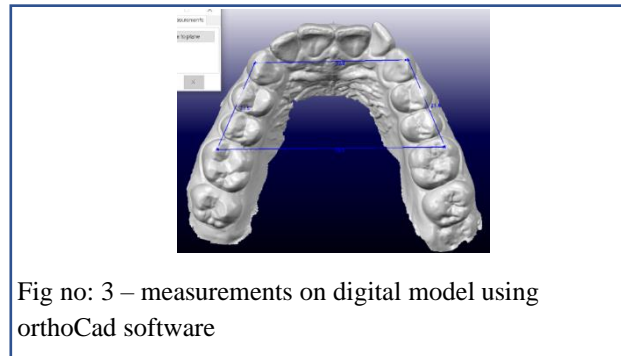


Fig no: 3 – measurements on digital model using orthoCad software

Results

A total of 30 patients participated in this study, comprising 13 males and 17 females. Their ages ranged from 21 to 29 years, with an average age of 25 years. None of the 30 patients had prior experience with either conventional or digital impressions.

Postoperatively, the patients were evaluated based on several parameters, including patient perception, accuracy, duration of the procedure, and patient preference.

All the data collected will be entered in Microsoft Excel and subjected to Statistical Analysis using SPSS Version 24.0. Categorical variables presented in number and percentage (%) and continuous variables presented as mean ± SD. Pearson chi-square/fisher exact test was applied for nominal data.

40% of patients felt comfortable, while 60% felt uncomfortable in group 1, 66.67% of patients felt comfortable, and 33.33% felt uncomfortable in group 2. The difference in comfort levels between this group and the digital scanning group was statistically significant, with a **p-value of 0.038.**(Table no: 1)

Table no: 1 Patient experience in Group 1 and 2 Patients

Groups	Comfortable N(%)	Uncomfortable N(%)	X ² Value	P value
Group 1 (alginate impression)	12 (40%)	18 (60%)	4.286	0.038
Group 2	20(66.67%)	10(33.33%)		



(intraoral scan)				
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There is a significant difference in preferences between the two groups. The majority of the study population preferred the intraoral scan technique (Group 2) at 66.66%, while 33.33% preferred the alginate impression technique (Group 1) with a **p-value of 0.01.**(Table no: 2)

Table no: 2 Patient preference in Group 1 and 2 Patients

Groups	Preferred N (%)	X ² Value	P value
Group 1 (alginate impression)	10 (33.33%)	6.667	0.01
Group 2 (intraoral scan)	20 (66.66%)		

In Group 1, significant differences were found in the measurements for canine to canine and molar to molar distances. In Group 2, none of the measurements showed significant differences.

The mean difference in canine to canine measurements between Group 1 (alginate impression) and Group 2 (intraoral scan) is statistically significant, with a **p-value < 0.001.**

The mean difference in molar to molar measurements between Group 1 (alginate impression) and Group 2 (intraoral scan) is statistically significant, with a **p-value < 0.001.**

The mean difference in canine to molar (right) measurements between Group 1 (alginate impression) and Group 2 (intraoral scan) is statistically significant, with a **p-value = 0.013.** The mean difference in canine to molar (left) measurements between the two groups is not statistically significant, with a **p-value = 0.275.**

The comparison of procedure duration between Group 1 (alginate impression) and Group 2 (intraoral scan) shows a statistically significant difference, with a **p-value =**

0.001. This indicates that the duration of the procedure for Group 1 is significantly longer than for Group 2.

Discussion

Purpose of the current study was to ascertain how patients felt about the Intra oral scanner and irreversible hydrocolloid impression techniques, to evaluate the accuracy of impressions and how much chair-side time was needed for each impression technique. There have been few, inconsistently rated studies on the application views of patients regarding intraoral scanners in the orthodontics field. 73.3% of patients chose alginate impression over intraoral scans, according to research by Grunheid et al (2014).[4]

Numerous research works have compared the accuracy of digital casts created by direct and indirect scanning to traditional plaster casts. Tomita et al. (2018) discovered that measurements obtained through direct and indirect scanning methods exhibit high levels of accuracy, making them potentially useful in clinical settings.[12] It's possible that direct intraoral scanning is more accurate than conventional study casts.

According to a study by Emir Yuzbasioglu et al. (2014), which found that the Compared to the conventional impression technique, the digital impression approach needed less treatment time overall.[13]

In the study by Olja Glisic et al (2019) There was no difference in chairside time between the two methods, which is in contradiction to this study.[14]

In this study, in order to standardize and homogenize the study population, participants who had never taken a traditional or digital impression were included. It is appropriate to homogenize the study population in order to maximize objectivity and reduce bias when examining the clinical results from the two methods of impression. It's crucial to take this stance in order to prevent patients with prior dental impression procedure bias from being reported.

In this study, the effectiveness of the two impression techniques, patient preference and experience, under carefully monitored clinical settings were the main research objectives. The patients were subjected to two impression techniques- irreversible hydrocolloid impression (Fast Set alginate) and intraoral scan (iTero Element 2 Scanner), values were noted and



interpretations were done. There was a significant difference in preferences between the two impression techniques. 20 subjects (66.66%) preferred digital impression technique whereas 10 subjects (33.33%) preferred conventional impression technique, which is significant statistically.

In this study; for group 1(alginate impression), 40% of the group, reported a comfortable experience, while 60% of the group, reported uncomfortable experience, which is significant statistically (table 2) . Patients with sensitive gag reflex found conventional alginate impression technique uncomfortable as they reported uneasiness and difficulty in breathing compared to intraoral scanner.

For Group 2 (intraoral scan), approximately 66.67% of the group, reported comfortable experience, while approximately 33.33% of the group, reported uncomfortable experience, which is significant statistically. Patients reported a discomfort while scanning the buccal aspects and distal of mandibular and maxillary surfaces 2nd and 3rd molars.

In this study, the average duration for irreversible hydrocolloid impression was between 8 minutes to 11 minutes while the average duration for intraoral scanner was between 4 to 6 minutes, mean duration for the two techniques was 4.46500 which is significant statistically.

In the present study, the mean post-operative difference from canine to canine for the patient who underwent alginate impression was .698 and patient who underwent intraoral scanner was -.033 which is statistically significant for the irreversible hydrocolloid group (p value - <0.001). The mean post-operative difference from canine to molar in right side for the patient who underwent irreversible hydrocolloid impression was .25233 and patient who underwent intraoral scanner was -.14233 which is statistically significant for alginate group (p value -0.009). The mean post-operative difference from canine to molar in left side for the patient who underwent irreversible hydrocolloid impression was .07300 and patient who underwent intraoral scanner was -.20033 which is statistically insignificant for both the groups , (p value - .059 for digital casts) (p value - .668 for alginate group).

A study conducted by **Matthew G. Wiranto et al (2012)** discovered that, in line with the current investigation, there were notable disparities in the anterior Bolton ratio and linear measures, such as tooth widths, between computerised models and plaster castings.[15] Marcel reported a similar finding stating that experience is a factor when using digital models.[16]

This study presented limitations as the measurements were solely recorded on the maxillary arch. Any error in recording of intraoral measurements due to interferences or lack of accessibility could have led to inaccuracy in evaluating the efficiency of the impression techniques. The research was profoundly reliant on technique sensitivity, as the comparative variables hinged upon the proficiency and expertise of the operator.

Conclusion:

Compared to the traditional impression technique, the intraoral scanning method demonstrated greater accuracy. The traditional impression method required more time than the digital impression method. Overall, the intraoral scanning technique was found to be more efficient and preferred by participants when compared to the traditional impression technique.

Data Availability The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy regulations.

Conflict of interest The authors declare no conflict of interest. The authors have no relevant financial or non-financial interests to disclose.

Institutional Review Board Statement Ethical approval was waived by the local Ethics Committee of NIMS University, Rajasthan in view of the nature of the study and all the procedures being performed were part of the routine care.

Informed Consent Statement Patient consent was taken.

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