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RESEARCH ARTICLE

COMPARISON OF DIGITAL AND CONVENTIONAL IMPRESSION TECHNIQUES IN TERMS OF COMFORT, TIME AND ACCURACY IN CHILDREN AGED 7 TO 9 YEARS -A RANDOMIZED CLINICAL TRIAL

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Abstract

Background: Alginate impression material, a commonly used hydrocolloid in dentistry, offers accurate and cost-effective molds suitable for various applications, including study models and diagnostic casts. However, the advent of digital impression technology has transformed the field, moving from traditional alginate and silicone molds to precise digital scans.

Aim: To compare digital and conventional impression techniques in terms of comfort, time and accuracy in children aged 7 to 9 years.

Design: 50 children based on inclusion criteria were randomly divided into two groups: Group 1 (alginate impression) Group 2 (digital impression iScan Pro intraoral scanner). For each method, comfort levels, the time taken, and accuracy were assessed. The Mann-Whitney U Test was used for statistical analysis, and a p-value of less than 0.05 was considered significant.

Results: Digital impressions took less time ($p < 0.001$) compared to conventional impressions. However, there was no significant difference in comfort levels and accuracy between the two groups.

Conclusion: Digital impression required less time when compared to alginate impression method, but there was no difference in terms of comfort and accuracy in measurements.

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Introduction:-

Over the years, diagnosis and treatment procedures have relied on plaster models. However, these models present several disadvantages; they are bulky, fragile, require large storage space and multiple steps for fabrication leading to increased time.ⁱ Alginate, an irreversible hydrocolloid, is most commonly used for making impressions in dentistry. However, disadvantages such as difficulty in capturing fine details, distortion and discomfort especially for patients with strong gag reflex warrant an alternative.ⁱⁱ

Digital intraoral scanners have emerged as a dominant trend in dentistry, transforming the viability of intraoral scanning and digital models as an alternative to traditional impressions. An intraoral scanner is a handheld device that directly creates digital impression of oral cavity and provides accurate details of hard and soft tissues by creating high quality digital images. Light source from the scanner is projected onto the dental arches, and a 3D model processed by the scanning software is displayed in real-time on a touch screen.ⁱⁱⁱ This technology offers several advantages, including patient comfort, particularly for anxious children or those sensitive to gag or nausea.^{iv}

Additionally, it facilitates improved communication between colleagues and laboratories, reduces waste, lowers shipping costs to laboratories, eliminates the risk of disease transmission, the need for articulation of casts for occlusal corrections.^v

As intraoral scanning technology continues to advance with smaller scanners and faster acquisition times, patients and paediatric dentists may show an increased preference for digital impressions. Despite its promising aspects, research on the use of digital impression in paediatric dental practice is limited. Hence, this study aimed to compare digital and conventional impression methods in comfort, accuracy, and time in children aged 7 to 9 years.

Materials and Methods:-

Approval from the Institutional Research and Ethical Board was obtained (IREB/2024/PEDO/10) and the clinical trial was registered in CTRI (Trial REF/2024/04/082453). Written informed consent from the parent/guardian of the participants was taken in local and English language and randomization was done by using chit method. Keeping alpha error at 5% and beta error at 20% a sample size of 50 was determined using the formula, $N (\text{per group}) = 2 \times [Z (1 - \alpha / 2) + Z (1 - \beta)]^2$. A p value of < 0.05 was considered to be statistically significant.

Children belonging to class I ASA status with Frankl behaviour rating 3 or 4 requiring impressions for fabrication of appliances (fixed or removable) or study models with no history of previous impression were included. Children with presence of intraoral and/or extraoral swellings and parents/guardians who did not give consent to participate were excluded from present study. The participants were divided into two groups of 25 each, conventional impression (Group 1) using alginate and digital impression using an intraoral scanner, iScan Pro (Group 2) by using chit method. A single trained operator took the impressions in both groups. Following this, the comfort was assessed by using a self-report modified visual analog scale (mVAS) index (subjective parameter)^{viii} and sound, eye, motor (SEM) scale (objective parameter)^x, noted by an observer present in the operatory.

The time taken in group 1 was recorded from the selection of the tray until the impression was poured using dental stone. In group 2, the intraoral scanning time was standardized from powering up the digital scanner, registering patient details followed by scanning the occlusal, buccal, and lingual surfaces of teeth in the said order in both arches till saving of the file.

The accuracy was determined by measuring the intercanine width and intermolar width.^{vi} In Group 1, accuracy was measured on the dental stone cast by using a divider and scale. Whereas, for digital impressions (Group 2) measurements were done on the scanned image.

Statistical analysis was carried out in SPSS statistics software version 26. The normality of numerical data was checked using Shapiro – Wilk test. For numerical continuous data that was not normally distributed, inter-group comparison was performed using Mann Whitney U test. p values of less than 0.05 was considered to be statistically significant.

Fig 1:- VAS index modified for children^{viii} below to evaluate patient comfort in two impression methods.



Fig 2:- Eye and motor (SEM) Scale (Wright et al 1991)x below

Parameters	Comfort (Score 1)	Mild discomfort (Score 2)	Moderate discomfort (Score 3)	Painful (Score 4)
Sound	No sound	Non-specific sound	Verbal complaint, louder sound	Verbal complaint shouting, crying
Eye	No sign	Dilated eye without tears (anxiety sign)	Tears, sudden eye movements	Crying, tars all over the face
Motor	Relaxed body and hand status	Muscular contraction, contraction of hands	Sudden body and hand movements	Hand movements for defense, turning the head the opposite site

Results:-

No statistically significant difference was observed between between Group 1 and Group 2 in terms of comfort (p <0.176) and accuracy (p <0.30)(Figure 3,4,6,7) .The time required forimpression making in Group 2 was shorter than Group 1 and this difference was statistically significant (p <0.01) (Figure 5)

Fig 3:-Intergroup comparision of VAS.

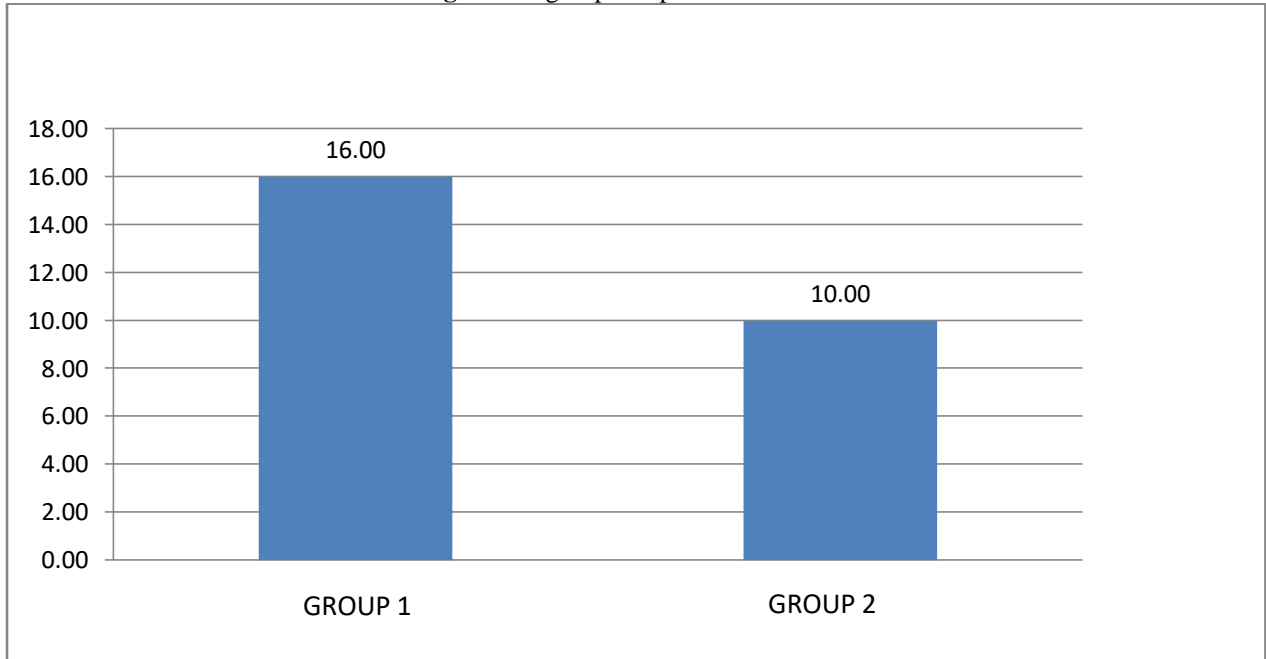


Fig 4:- Intergroup comparision of SEM.

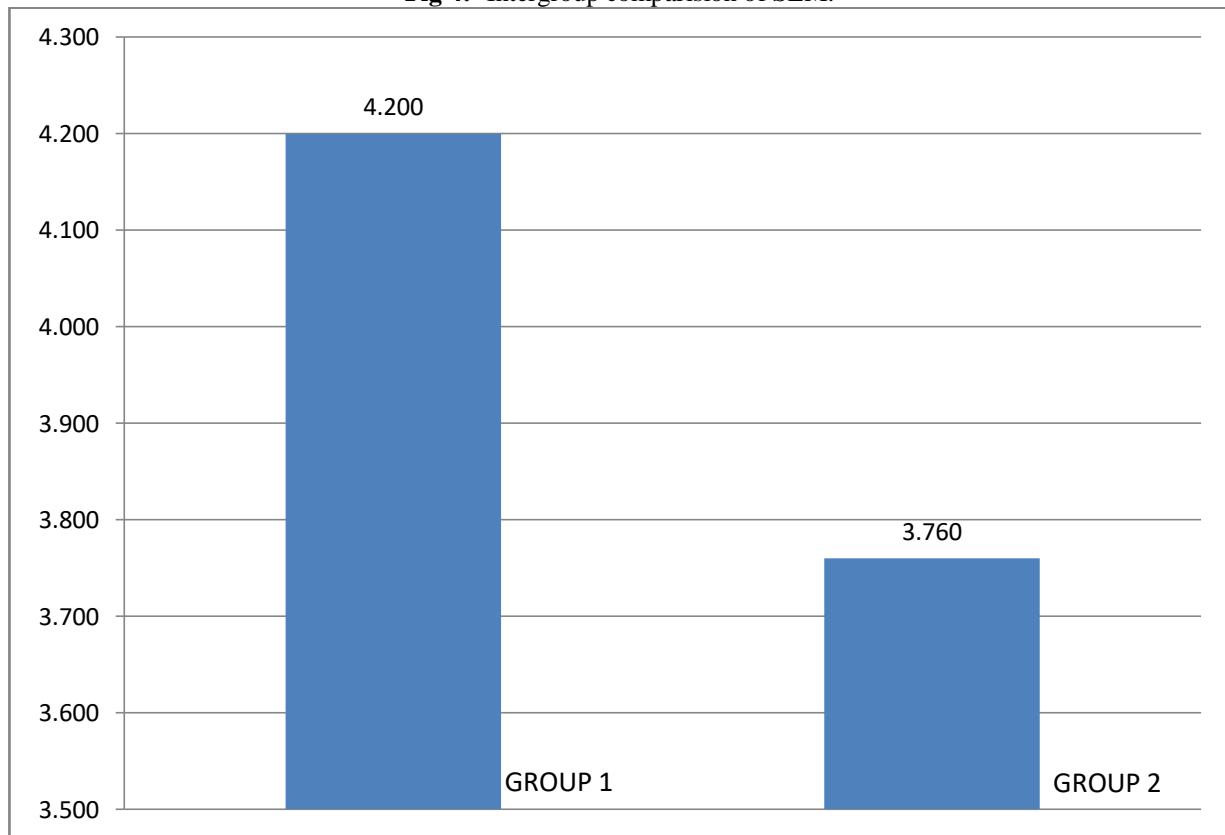


Fig 5:-Inter group comparison of time.

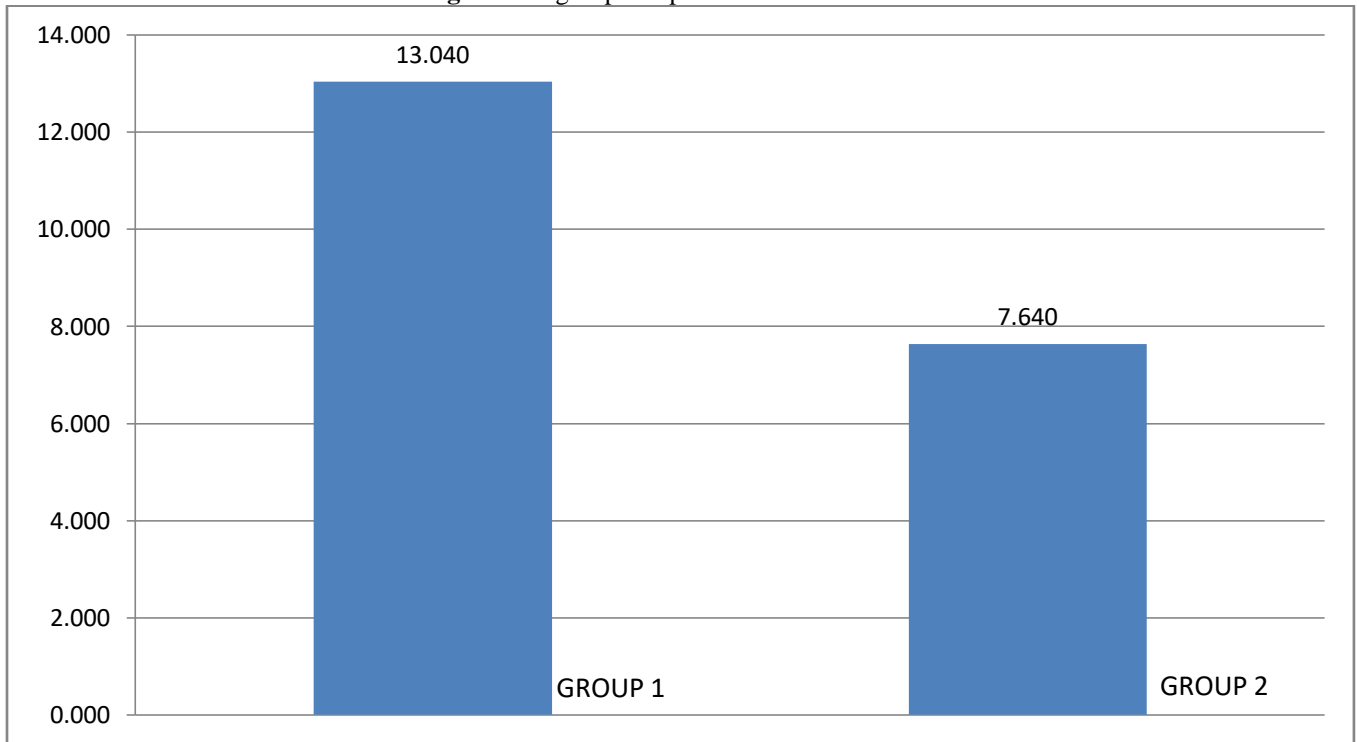


Fig 6:-Intergroup comparison of accuracy of canine.

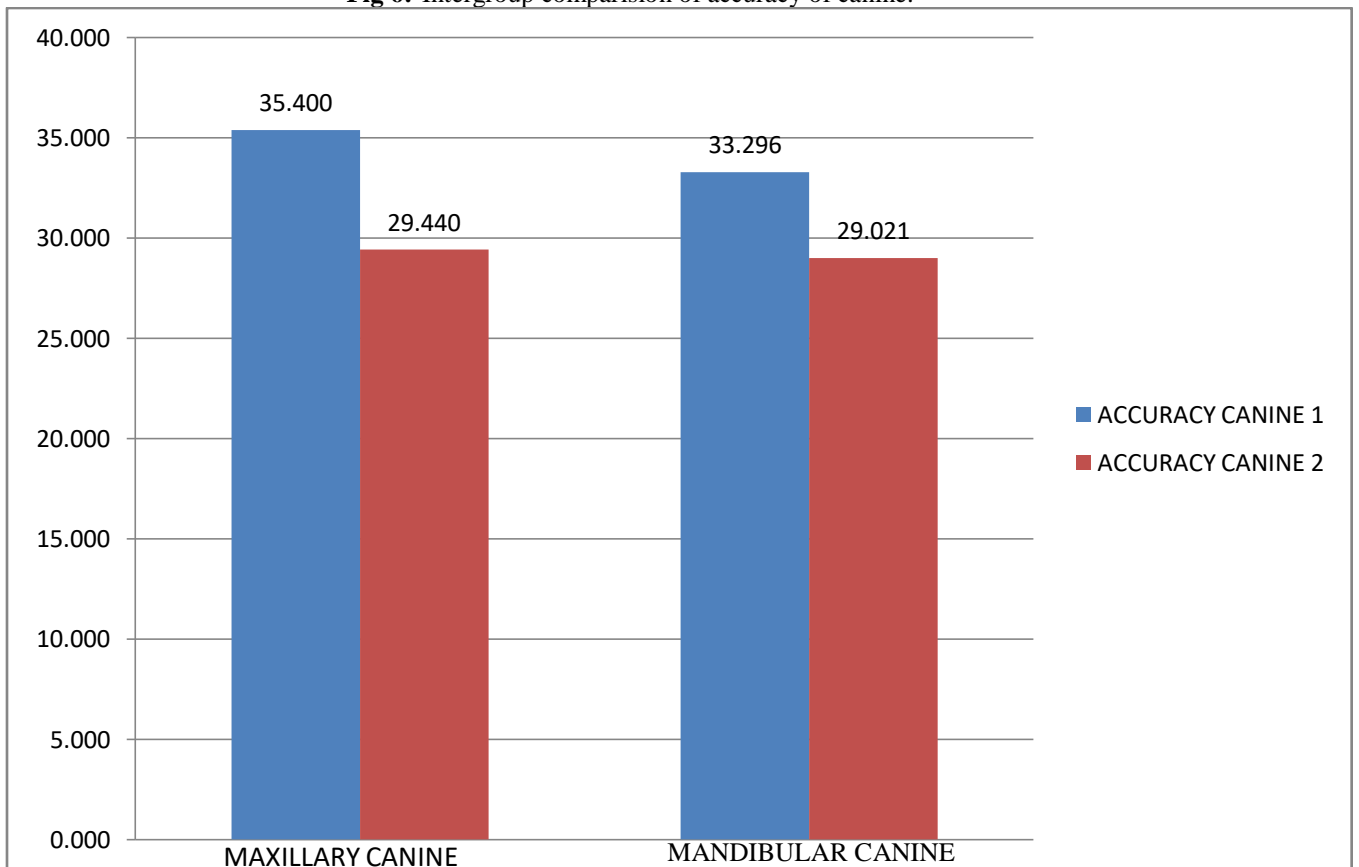
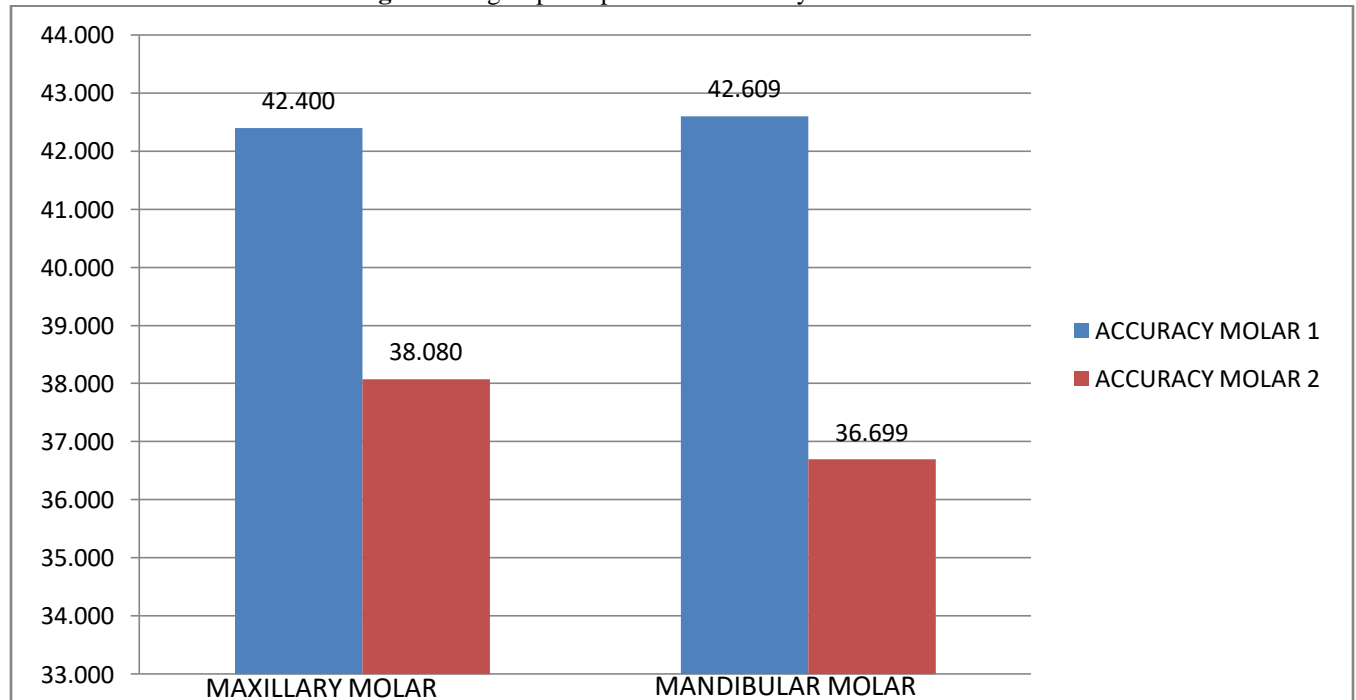


Fig 7:- Intergroup comparison of accuracy of molar.



Discussion:-

Alginate impression technique involves using a gelatinous material to create a mold of dental structures, which is then used to produce a physical model for diagnostic and treatment purposes. Digital impression technique utilizes intraoral scanners to capture detailed 3D images of hard and soft tissues, providing a more accurate, efficient, and comfortable alternative to traditional methods.^{vii}

The present study compared digital and conventional impression technique in terms of comfort, time and accuracy. In both groups impressions were made by a single trained operator for standardization and reliability. Impression of both arches may be required for fabrication of certain appliances, thus in the present study impression of both maxillary and mandibular arch was made for each patient and thus the cases were selected accordingly.

mVAS^{viii} scale is supported with facial emojis designed specifically to measure subjective characteristics in young children. This scale was employed in the current study as it is well accepted, simple, adaptable and faster.^{ix} The SEM scale was used to assess objective comfort as it offers a standardized evaluation framework that helps clinicians develop personalized treatment plans and monitor therapeutic outcomes effectively.^x

The findings of this study showed that there was no difference between the two techniques in terms of accuracy and comfort. However, time required for digital impressions was shorter when compared to that of alginate impressions. Contrary to our study, Yilmaz et alⁱⁱⁱ reported that the time required for digital as well as alginate impressions was the same whereas, Roflsen et al^{xii} reported a shorter time for alginate impressions. This variability in time taken could be due to lack of standardization across various studies. Additionally, another factor affecting the duration could be that in situations where the impressions have to be remade intraoral scanners are capable of scanning only the areas that need correction in the impression, whereas conventional impressions require the entire impression to be redone.^{xi} Therefore, the digital scanning is more advantageous than the conventional impression technique.

Yilmaz et alⁱⁱⁱ reported that digital impressions were more comfortable to pediatric patients when compared to conventional alginate impressions. However, in our study there was no difference in comfort levels between the two techniques. This could be due to the size of scanner which was not specific for the pediatric population.

Roflsen et al^{xii} reported that there was no difference in accuracy of intercanine and intermolar width measurements which was similar to that of the present study.

The limitation of this study was that only one intraoral scanner iScan Pro has been used which is designed to have larger overall dimensions which could be a cause of discomfort reported by few patients.

Conclusion:-

As intraoral scanner systems are continuously being updated, improved, and made faster. Knowledge regarding the availability of faster impression making technique can enable pediatric dentists to manage their practice more effectively. Therefore, it can be concluded that time required in digital impression is less and could be considered as an alternative to conventional impression method.

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