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Original Research Article

CLINICAL EVALUATION OF FIXED PARTIAL DENTURE IMPRESSION

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Abstract: *Accurate impressions of teeth and the area to be restored are required in fixed Prosthodontics treatment for the laboratory to fabricate the desired restoration without any faults. The study aimed to raise awareness about the importance of improving individual skills to minimise impression errors, provide patients with high-quality prosthetics, and enhance their comfort. The study's objectives were to evaluate the clinically detectable errors in the impressions and to determine co-relations between possible risk factors that cause impression errors. This study follows a descriptive cross-sectional study design, which involves the probability convenience sampling technique, consisting of 150 impressions studied for the type of tray, type of material, type of technique, type of prosthesis ordered, arch of impression involved, size of tray, number of units prepared and retraction cord used. Impression errors were also assessed, including finish line errors, tears in the finish line, air bubbles, voids, and blood formed in the impression. Data were analysed with SPSS version 25.0, and correlations were found through a chi-square test. One hundred fifty impressions were analysed, with 80 being maxillary arch impressions. Most impressions utilised full arch trays (91.33%), with Monophase being the predominant technique (77%). Alginate emerged as the most commonly employed impression material (76%), and the most commonly used tray was the full arch tray (137). Crown preparations accounted for 70% of cases. Notably, retraction cord usage was observed in 58.7% of impressions. The study analysed 150 Impressions, finding 56.7% finish line errors, 21.3% tears, 19.3% bubbles, 80.7% voids, and 6% traces of blood. Our study reveals that material type, impression technique, no crown, arch of impression, prosthesis ordered, and retraction cord have a significant association ($P < 0.05$) with the impression errors, except tray type having no significant association ($P > 0.05$) with the impression errors. Based on the study's outcomes, this research identifies alginate and the monophase technique as prevalent choices among clinicians. The most common were voids and finish line errors, with tray selection showing no significant impact. The use of retraction cords notably reduces impression errors, indicating a strong association. Overall, crown impressions exhibit greater accuracy compared to bridge impressions.*

Keywords: FPD, Impression, Impression Quality, Impression Errors, Dental Laboratories

Introduction

Accurate impression is the key to a successful prosthesis for a patient, and inaccurate impressions lead to improper fabrication of a prosthesis and, as a result, cause failure in the restoration of a patient. Accurate impressions are successful restoration as they are free from errors. Accurate impressions are achieved by identifying and analysing errors in accurate impressions and minimising these errors (Subiyantoro et al., 2020).Inadequate impressions of fixed partial dentures are one of the most common problems when making crowns or bridges. The most challenging and unpredictable procedure in dentistry is taking accurate and precise fixed partial denture impressions (Andreescu, 2015).

One of the essential and critical steps in making successful crowns and bridges is impression-taking and pouring (Rubel, 2007). The quality of fixed partial dentures is the primary concern of clinicians and the public because the demand for fixed partial dentures to replace missing teeth is increasing day by day, and fixed partial dentures have a high cost (Zu Saifudin et al., 2014). The critical part of prosthesis fabrication in fixed Prosthodontics' is transferring an accurate and precise record to a dental laboratory (Al-Odinee et al., 2020). An inaccurate impression causes a prosthesis misfit. As a result, many complications arise, such as mechanical and biological complications, which lead to the failure of fixed prosthodontic treatment (Idris et al., 1995). The long-term success of fixed prostheses depends on the quality of fixed prostheses (Papaspyridakos et al., 2020). The most critical and basic need in the manipulation of accurate fixed partial dentures is to make an accurate and precise final impression; this is all possible and depends on the skills of the clinician as well as on the selection of impression materials, type of tray selected and impression-taking techniques (Özcan et al., 2022).

There are various techniques used in taking fixed partial denture impressions: i) Single copper band technique, ii) Single-step technique in which impression material of only one viscosity is used(also called Monophase technique), iii) Single-step technique using two materials of two different viscosity that is the light and heavy body (also called sandwich technique), iv) The double step technique in which impression material used in two steps using two material of different viscosity in each step (also called putty wash two-stage technique, known as washing technique) (Kim et al., 2022). The monophase impression technique uses impression materials of medium viscosity to record finer details (Bishara et al., 2022).

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According to Craig, the advancement in impression materials has reached a point where the accuracy level can be more effectively regulated through proper technique rather than relying solely on the material itself (Varvara et al., 2015). However, other studies indicate that impression accuracy is not affected by impression techniques (Bishara et al., 2022).

A wide variety of trays are used for taking impressions of fixed partial dentures: Stock trays (metal and plastic), custom trays and dual arch trays with different impression materials: Alginate, Additional silicon, Condensational silicon, polyether, etc (Prosthodontics, 1999). Impression materials used in general dental practice can be classified into two classes, elastic and non-elastic (Rigid) impression materials. Elastic impression material is further subdivided into two classes: Hydrocolloids (Agar, Alginate) and Elastomeric (A-silicon-silicon, Polyether, etc (McCracken et al., 2020).

Some common errors are inadequate marginal detail (finish line), bubbles, voids, tears, blood shrinkage of materials, etc (Mahmood et al., 2013). The results from numerous studies exhibit improvement in impression materials' properties, qualities and accuracy. In 1997, a study was performed in the UK; impressions were sent to 4 commercial laboratories, and results of the evaluation of 290 impressions from 4 commercial dental laboratories presented that 36% of examined impressions had detectable errors. Two years later, the results of another survey presented that the quality of 50% of impressions and dies sent to dental laboratories was inadequate. Nusaiba M.Al-iodine in 2020, a total of 165 impressions were clinically evaluated impressions in private laboratories in Yemen, and it was found that 160(97%) of the total impressions had a single detectable error, of which 92% errors were at the finish line (Al-Odinee et al., 2020).

A recent survey in 2017 performed in North Carolina, USA, showed that 1157 impressions were clinically evaluated in 4 dental laboratories 86% of clinically evaluated impressions had at least a single detectable error, and 55% of clinically detectable errors were finish line errors. The author noted that the finish line error is mainly associated with the dual arch tray (Rau et al., 2017).

The study performed in Birmingham in 2019 showed that 92% of impression cases have good or excellent marginal detail, 90% have adequate tooth preparation, and other aspects of impression were marked suitable 88% of the time (Raghav et al., 2014).

A 2017 study at Liaquat University evaluated errors in dental impressions. Among 300 impressions by undergraduates and graduates, common errors included air bubbles (59%), inadequate sulcus record (53%), tearing of material from tray (40%), improper mixing (36%), voids (35%), and more. Skillful technique is crucial for successful impressions (Avhad and Avhad, 2019).

The main objectives of this study are to evaluate the clinically detectable errors in the impressions and to determine the co-relations between the possible risk factors that cause impression errors.

Methodology

This research employs a descriptive cross-sectional design using a non-probability convenience sampling technique. The sample size calculated through https://www.openepi.com for this study was 150 impressions. These impressions were examined at Sardar Begum Dental Hospital and the Craft Brother's dental Laboratory Peshawar from May 2023 to September 2023. This study included all fixed partial denture impressions except those with incomplete data (type of prosthesis ordered); damaged teeth and primary teeth impressions were excluded from the study.

First, the approval letter was taken from ETHIC BOARD COMMITTEE OF KMU for the study. Then permission for the study was taken from the head of department or dental laboratories. Impressions taken by the clinician are sent to a dental laboratory for pouring. After reaching impressions to a dental laboratory, impressions were examined under the supervision of prosthodontists and senior dental lab technicians before pouring.

The jaw, technique, tray type, material, retraction card, type of prosthesis ordered, and number of prepared units were recorded for each impression. Data referring to errors and visible defects were also documented, including finish line errors, tears at the finish line, voids, bubbles, and blood in the impression.

The analysis of the collected data was performed using SPSS 25.0. The collected data were examined to determine the frequency of each observation. The chi-square test was conducted to examine the frequency of occurrence of each observation and the correlations between different categorical variables and outcomes. The Pearson chi-square test was used to determine significance (a=0.05). Descriptive analysis and frequency tables were used to present data.

Results

A total of 150 impressions were examined, with 80(53.3%) being maxillary, 66(44%) mandibular, and 4(2.66%) dual arch impressions. When it comes to the types of trays used, 137(91.3%) were full arch trays, 7(4.66%) were anterior quadrant trays, and 6(4%) were posterior quadrant trays. The Monophase technique was the most popular technique, which accounted for 77% (116) of the impressions. Other techniques, like the Putty wash and sandwich techniques, were used in 20% (30) and 2% (3) of the impressions, respectively. In terms of the impression material, Alginate was the most commonly used, making up 76% (114) of the impressions, followed by addition silicon at 19.33% (29) and condensation silicon at 4.66% (7). Crown preparations accounted for 70% (105) of cases, while bridge preparations constituted 30% (45). Notably, retraction cord usage was observed in 58.7% (88) of impressions, while 41.33% (62) were taken without it. Finally, the most frequently ordered prosthesis types were PFM (Porcelain-Fused-to-Metal) at 79.3% (119), followed by Zirconia at 17.33% (26), and metal prosthesis at 3.33% (5), as shown in table 1.

This research study examined a total of 150 impressions, revealing significant findings. Among these impressions, 85 (56.7%) exhibited finish line errors, 32 (21.3%) had tears in the finish line, 29 (19.3%) contained bubbles, 121 (80.7%) displayed voids, and 9 (6%) had traces of blood as shown in the below table 2. These results shed light on common challenges encountered during the impression-taking process in dental practice.

Table 3 summarises that among various risk factors investigated in our study, the type of tray used shows no significant association with impression errors based on p-

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values obtained from chi-square test results (P> 0.05), While all other factors show significant association with most of the errors in impression as evident from p-values (P<0.05) given in below table. All impression errors having a p-value less than 0.05 reveal a correlation with risk factors involved; similarly, those having a P-value greater than 0.05 convey no correlation. It is also clear from this table that the type of material, technique and retraction cord used represent a strong relation as compared to other factors, and most factors have a significant association mainly with finish line error, tears in the finish line and voids formed in impression.

Table 1. Percentage of different variables in taking impressions

Type of tray	Metal tray (57.3%)	Plastic tray (42.7%)	Custom Tray (0%)	Dual Arch Tray (0%)
Type of materials	Alginate (76%)	A-Silicon (19.33%)	C-Silicon (4.66%)	Poly ether (0%)
Impression taking technique	Monophase (77%)	Sandwich (2%)	Putty wash (20%)	Copper band (0.66%)
The type of prosthesis ordered.	PEM (79.3%)	Metal (3.33%)	Zirconia (17.33%)	Resin veneer (0%)
Arch of Impression	Maxillary Arch (53.3%)	Mandibular Arch (44%)	Dual Arch (2.66%)	-
Size of tray	Anterior Quadrant 4.66%)	Posterior Quadrant 4%)	Full Arch (91.3%)	-
No units were prepared	Crown (70%)	Bridge (30%)	-	-
Retraction cord used	Yes (58.7%)	No (41.33%)	-	-

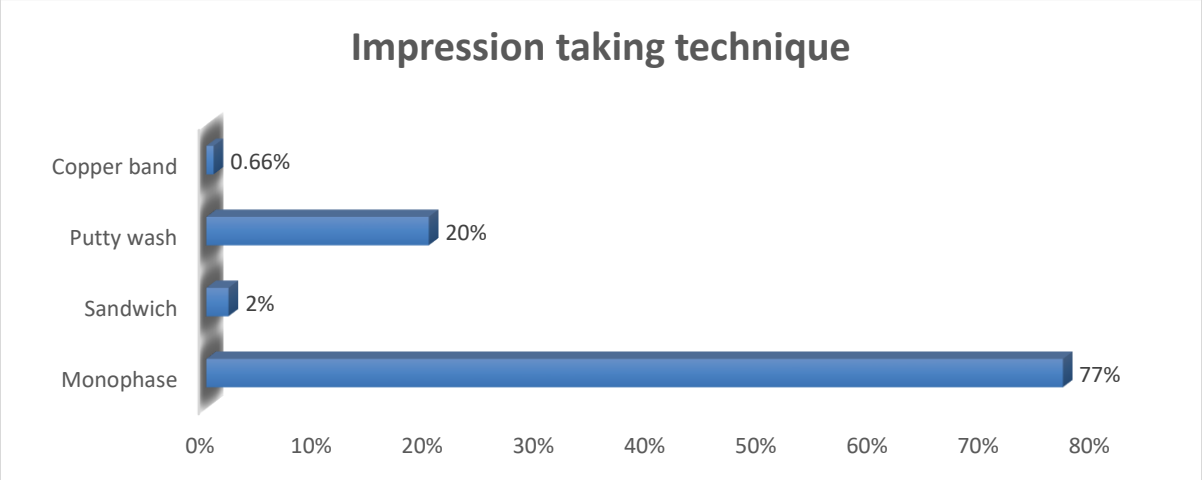

Figure 1: distribution of impression-taking technique.

Table 2. Frequency of detectable error

Errors	Present	Absent
Finish Line Error	85 (56.7%)	65 (43.3%)
Tear	32 (21.3%)	118 (78.7%)
Bubble	29 (19.3%)	121 (80.7%)
Voids	121 (80.7%)	29 (19.3%)
Blood	9 (6%)	142 (94%)

Table 3. Correlations of possible risk factors with detectable errors

Factors causing errors in impression	Finish line error. (p-value)	Tear in impression (p-value)	Bubbles in impression (p-value)	Voids in impression (p-value)	Blood in impression (p-value)
Types of tray	0.276	0.08	0.876	0.793	0.911
Types of material	0.000	0.028	0.928	0.000	0.609
Technique used in impression-taking	0.000	0.008	0.569	0.000	0.850
Type of prosthesis order	0.000	0.005	0.854	0.001	0.725
Arch of impression	0.846	0.904	0.000	O.589	0.307
Size of tray	0.091	0.373	0.004	0.538	0.435
No units were prepared	0.019	0.000	0.558	0.223	0.822
Retraction cord used	0.000	0.000	0.035	0.094	0.615

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Discussion

Fixed partial dentures are the most suggested treatment option when the nearby teeth are available in an ideal position with proper occlusion. Fixed partial dentures are usually used due to their economical, long durability, aesthetics, permanent retention and no desire for surgery. Successful fixed partial dentures depend on accurate impression making and pouring (Samejo et al., 2016).

Our study indicates a predominant use of alginate (76%) and minimal use of condensation silicon (4.7%) among clinicians for impressions, with a significant P value highlighting the impact of material choice on impression errors. This aligns with prior research by Memon, Sheikh, and others at Liaquat University, revealing issues like air bubbles (59.3%), tears (40%), and voids (35%) in 300 alginate impressions (Memon et al., 2019).

Our study results show that most clinicians prefer using the Monophase technique (77.3%) for impression-taking. This technique significantly correlates with voids, bubbles, and tears in the finish line. On the other hand, the least preferred technique is the copper band (0.7%). These findings align with a previous study conducted at 'G, D,' Annunzio' University of Chieti-Pescara, Italy, which also showed similar proportions of impression defects (Varvara et al., 2015).

The study reveals a predominant use of retraction cords (58.7%) among clinicians, highlighting its significant correlation with finish line and impression errors. Consistent with previous research, a study at the University of North Carolina found that 55% of impressions lacked retraction cords, leading to detectable errors (Rau et al., 2017). Another survey by Samejo in Sindh reported a contrasting trend, with 91% of specialists using retraction cord, while 84% of general dental clinicians did not (Samejo et al., 2016).

Results reported from our study indicate that 70% were crown impressions and 30% were bridge impressions. From the result, it was clear that crown and bridge impression significantly affect finish line errors and tears at finish line of the impression. Our study matches the previous study conducted by Nachum Samet at Hadassah-Hebrew University School of Dental Medicine, Jerusalem, Israel, which reported that 38.8% were crown impressions and 35.5% were bridge impressions (Samet et al., 2005).

Conclusion

Based on the outcomes obtained from the study, this research identifies alginate and the Monophase technique as prevalent choices among clinicians for fixed partial denture impressions. It is clear from the study that Finish line errors and voids are common errors in the impressions, with tray selection showing no significant impact. The retraction cords notably reduces impression errors, indicating a strong association. Overall, crown impressions exhibit greater accuracy compared to bridge impressions.

Recommendation

Clinicians are advised to systematically investigate and understand factors contributing to fixed partial denture impression errors during impressions. Identifying these factors will enhance accuracy, mitigate risks, and ultimately improve clinical outcomes in dental prosthetics.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department Concerned.

Consent for publication
Approved

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Conflict of interest

The authors declared absence of conflict of interest.

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