

Assessment of Knowledge, Attitude, and Practice Regarding Impression Materials and Techniques Used in Fixed Prosthodontics Among Dental Students in Maharashtra: A Cross-Sectional Survey

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Abstract

Original Research Article

Background: Accurate impression making is fundamental to the success of fixed prosthodontic treatment. It requires appropriate knowledge of impression materials, tray selection, gingival displacement, and clinical handling techniques. Since dental students are introduced to these principles during undergraduate and postgraduate training, evaluating their knowledge, attitude, and practice can help identify gaps in teaching and clinical preparedness. **Methods:** A cross-sectional questionnaire-based survey was conducted among dental students from government and private dental colleges across Maharashtra, India. The study included III BDS students, IV BDS students, interns, and postgraduate students who had received training in fixed prosthodontics. Data were collected using a validated self-administered questionnaire. Responses related to knowledge, attitude, and practice of impression materials and techniques were analyzed using descriptive and inferential statistics. Associations between academic year and selected variables were assessed using chi-square and non-parametric tests, with $p < 0.05$ considered statistically significant. **Results:** A total of 500 responses were analyzed. IV BDS students constituted the largest proportion of respondents (34.4%), followed by postgraduate students (32.4%). More than half of the participants routinely made diagnostic impressions before tooth preparation (56.8%). Addition silicone was the most commonly used final impression material (54.8%), while custom trays were the most preferred tray type (39.2%). Knowledge of the difference between single- and double-cord gingival retraction techniques was reported by 63.0% of respondents, although only 39.6% routinely used retraction cord. Most participants agreed that newer digital impression techniques were more effective than traditional methods (85.2%), and 61.4% reported that they had not been taught digital impression techniques but wished to learn them. Significant differences were observed across academic years for several knowledge-, attitude-, and practice-related variables. **Conclusion:** Dental students in Maharashtra demonstrated generally favorable knowledge and attitudes regarding impression materials and techniques used in fixed prosthodontics. However, important gaps remained between theoretical understanding and routine clinical practice, particularly in gingival displacement and digital impression training. **Keywords:** Fixed prosthodontics; impression materials; dental students; knowledge attitude practice; digital impressions.

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INTRODUCTION

Fixed prosthodontic treatment depends on the accurate reproduction of prepared teeth, finish lines, and surrounding soft tissues, because deficiencies in impression making can adversely affect marginal fit, contour, and the overall quality of the definitive restoration. Proper gingival displacement, appropriate tray selection, and informed choice of impression material therefore remain core clinical steps in fixed prosthodontics [1,2].

At the undergraduate level, competence in these procedures requires more than theoretical familiarity with dental materials. Students must also develop confidence in handling impression materials, understand the rationale for selecting specific techniques, and translate preclinical instruction into clinical performance. Haralur and Al-Malki [3] reported that students viewed effective preclinical fixed prosthodontic training as important for a smoother transition to clinical work, while Moradpoor *et al.*, [4] showed that students valued practical work on real patients and modern

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educational approaches when learning fixed prosthodontics.

Existing literature also suggests substantial variation in how impression materials and techniques are taught across institutions. Randall *et al.*, [5] found marked differences between UK dental schools in the materials and protocols used for crown and bridge teaching, and Brand *et al.*, [6] later demonstrated similar heterogeneity across European dental schools in both teaching practices and students' perceptions of their training. In parallel, digital workflows are increasingly shaping prosthodontic education; Marti *et al.*, [7] found that students held favorable expectations toward digital scanning, although its introduction required additional instructional time. More recently, Al Khalaf *et al.*, [8] highlighted continuing international divergence in undergraduate prosthodontic teaching and assessment, reinforcing the need for curricular evaluation and standardization.

Regional evidence remains comparatively limited. A recent survey from Pakistan showed that although didactic teaching and demonstrations in fixed prosthodontics were common, undergraduate students often had limited direct clinical experience in fabricating fixed prostheses [9]. Taken together, the available literature is weighted toward teaching trends, curricular surveys, and technology-focused studies from regions outside Maharashtra, with relatively little published work specifically examining the knowledge, attitudes, and routine practices of dental students regarding impression materials and techniques in fixed prosthodontics.

The present study was therefore undertaken to assess the knowledge, attitude, and practice of dental students in Maharashtra regarding impression materials and techniques used in fixed prosthodontics. The specific objectives were to evaluate students' knowledge of commonly used impression materials and their applications, assess their attitudes toward conventional and newer techniques, examine their self-reported clinical practices related to impression making, and compare these domains across different academic levels.

MATERIALS AND METHODS

The present cross-sectional, questionnaire-based descriptive study was conducted over a period of two months from November 2025 to January 2026. The study protocol was approved by the institutional ethical review board (REF NO). The study population comprised students from government and private dental colleges across Maharashtra, India. Participants were drawn from academic groups with prior exposure to fixed prosthodontics teaching, namely third-year BDS students, final-year BDS students, interns, and postgraduate students. Participation in the survey was voluntary, and only students who agreed to participate and provided consent were included. The participants

were free to withdraw from the survey process at any time.

Sample Size and Sampling

The sample size was estimated using a single-proportion formula based on an expected prevalence of 60% and an absolute precision of 5%, which yielded a minimum required sample of 468.79. To improve representativeness and account for possible non-response, the planned sample was rounded to approximately 500 participants. A stratified random sampling approach was adopted to ensure adequate representation from all subgroups.

Participant Selection

Students currently enrolled in dental colleges in Maharashtra and having received basic training in fixed prosthodontics were considered eligible for inclusion. The study specifically targeted third-year students, final-year students, interns, and postgraduate students. Only those willing to participate and provide informed consent were included. Students unwilling to participate or declining consent were excluded. Participants were also excluded from final analysis if they submitted incomplete questionnaires, particularly when missing responses affected data reliability substantially, such as omission of more than 20% of questionnaire items.

Study Instrument and Data Collection

Data were collected using a validated, self-administered questionnaire prepared in Google Forms. The questionnaire was structured to obtain information across demographic, knowledge, attitude, and practice domains. Demographic items included age, gender, year of study, academic institution, and previous clinical exposure. The knowledge domain assessed awareness of different impression materials, their indications, contraindications, properties, manipulation, impression techniques, and common errors. The attitude domain explored perceptions regarding material selection, cost and accessibility, importance of accurate impressions, confidence in handling materials, and attitudes toward newer materials and techniques. The practice domain addressed frequency of use of specific materials, choice and application of impression techniques, manipulation methods, perceived clinical success, time management, and the role of supervision during clinical procedures.

Outcome Measures

The primary outcome of the study was the overall knowledge, attitude, and practice profile of dental students in Maharashtra regarding impression materials and techniques used in fixed prosthodontics. Secondary outcomes included assessment of students' knowledge of different impression materials and their applications, attitudes toward various materials and techniques, practical application of these techniques in clinical settings, and factors influencing knowledge, attitude, and practice, including academic year, clinical exposure, and teaching methods. Analysis of these parameters across

different academic levels was also performed to identify changes in understanding and competency as students progressed through training.

Data Management and Statistical Analysis

Responses from all participants were combined into an MS Excel Sheet (Microsoft Excel v2019, Redmond, USA) and analyzed using a statistical software package such as SPSS. Descriptive statistics were planned to summarize the dataset, with categorical variables expressed as frequency and percentage and numerical variables expressed as mean and standard deviation. Questionnaire responses based on Likert scales were coded numerically for analysis. Comparisons between categorical responses and independent variables were performed using the chi-square test. For ordinal or Likert-scale data, non-parametric methods were planned, with the Mann-Whitney U test used for two-group comparisons and the Kruskal-Wallis test used when more than two groups were compared. An alpha error of 5% and beta error of 20% were considered,

corresponding to a study power of 80%, and a p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 500 responses were included in the analysis. IV BDS students constituted the largest subgroup (34.4%), followed by postgraduate students (32.4%), interns (18.4%), and III BDS students (14.8%). More than half of the respondents reported routinely making diagnostic impressions before tooth preparation (56.8%), while 19.2% did so only for specific cases. For final impressions, addition silicone was the most commonly used material (54.8%), and custom trays were the most frequently preferred tray type (39.2%). Most respondents reported some degree of difficulty while taking impressions for fixed prosthodontics, with 63.6% reporting occasional difficulty and 26.2% frequent difficulty. Core participant distribution and practice-related findings are presented in **Table 1**.

Table 1: Participant distribution and core practice-related responses (n=500)

Variable	Response	n	%
Year of study	III BDS	74	14.8
	IV BDS	172	34.4
	Internship	92	18.4
	PG student	162	32.4
Routine diagnostic impressions before tooth preparation	Yes	284	56.8
	Only for specific cases	96	19.2
	No	120	24.0
Routine gingival retraction cord use	Yes	198	39.6
	No	302	60.4
Most commonly used final impression material	Addition silicone	274	54.8
	Condensation silicone	112	22.4
	Irreversible hydrocolloid	82	16.4
	Polysulfide	16	3.2
	Alginate	6	1.2
	Reversible hydrocolloid	5	1.0
	Polyether	5	1.0
Preferred tray for final impression	Custom tray	196	39.2
	Prefabricated plastic tray	169	33.8
	Metal tray	135	27.0
Difficulty encountered while taking impressions	Yes, frequently	131	26.2
	Yes, occasionally	318	63.6
	No, rarely	34	6.8
	No, never	17	3.4
Most important factor when choosing an impression material	Dimensional accuracy	317	63.4
	Ease of use	75	15.0
	Cost	42	8.4
	Patient comfort	38	7.6
	Setting time	28	5.6

Knowledge-, attitude-, and training-related responses are summarized in **Table 2**. Overall, 63.0% of respondents reported knowing the difference between single- and double-cord retraction techniques. Confidence in using impression materials was most

commonly reported as somewhat confident (35.0%) or neutral (30.6%). A large majority agreed or strongly agreed that newer digital impression techniques were more effective than traditional materials (85.2%), and 79.8% considered it extremely important to stay updated

on new techniques and materials. Regarding training, 39.6% felt that training was adequate but could be improved, whereas 26.2% reported that training was inadequate. Only 37.4% had been taught digital

impression techniques either occasionally or frequently, while 61.4% had not been taught these techniques but expressed interest in learning them.

Table 2: Knowledge, attitude, confidence, and training-related responses (n=500)

Variable	Response	n	%
Knowledge of difference between single- and double-cord techniques	Yes	315	63.0
	No	185	37.0
Confidence in using impression materials for fixed prosthodontics	Very confident	60	12.0
	Somewhat confident	175	35.0
	Neutral	153	30.6
	Not very confident	85	17.0
	Not confident at all	27	5.4
Perception that newer digital techniques are more effective than traditional materials	Strongly agree	149	29.8
	Agree	277	55.4
	Neutral	57	11.4
	Disagree	6	1.2
	Strongly disagree	11	2.2
Importance of staying updated on new techniques and materials	Extremely important	399	79.8
	Somewhat important	64	12.8
	Neutral	20	4.0
	Not very important	17	3.4
Perceived adequacy of training in impression materials and techniques	Yes, completely	109	21.8
	Yes, but it could be improved	198	39.6
	Neutral	62	12.4
	No, there is not enough training	108	21.6
	No, training is insufficient	23	4.6
Teaching exposure to digital impression techniques (CAD/CAM)	Yes, frequently	60	12.0
	Yes, occasionally	127	25.4
	No, but I would like to	307	61.4
	No, and I have no interest in using it	6	1.2

Detailed responses to conditional and multiple-response items are shown in **Table 3**. Among respondents who provided a valid answer for diagnostic impression material, irreversible hydrocolloid was the most frequently reported material (60.2%). Among valid responses for gingival retraction approach, retraction cord was preferred by 85.0% of respondents. Among those who reported a method of cord use, chemical-assisted use was more common than plain cord use (64.0% vs 36.0%). Among respondents specifying a

chemical agent, aluminium chloride (43.8%) and epinephrine (39.7%) were the most frequently reported agents. To avoid impression distortion, ensuring proper setting time (52.6%), maintaining proper tray fit (48.8%), and using the right viscosity of material (48.2%) were the most commonly selected strategies. The most frequently perceived reasons for final impression failure were clinical error (56.8%) and choice of impression material (50.0%).

Table 3: Conditional and multiple-response items

Variable	Response	n	%
Diagnostic impression material used among valid responses (n=442)	Irreversible hydrocolloid	266	60.2
	Addition silicone	113	25.6
	Condensation silicone	47	10.6
	Alginate	6	1.4
	Reversible hydrocolloid	5	1.1
	Polyether	5	1.1
Preferred gingival retraction approach among valid responses (n=319)	Retraction cord	271	85.0
	Combination	21	6.6
	Rotary curettage	21	6.6
	Retraction paste	6	1.9
Mode of gingival cord use among valid responses (n=339)	With chemical	217	64.0
	Plain	122	36.0

Variable	Response	n	%
Chemical agents used for gingival retraction* (n=297)	5% and 25% aluminium chloride solution	130	43.8
	0.1% and 8% epinephrine	118	39.7
	100% alum solution (potassium aluminium sulfate)	76	25.6
	13.3% ferric sulfate solution	38	12.8
	8% and 40% zinc chloride solution	10	3.4
Techniques used to avoid impression distortion* (n=500)	Ensuring proper setting time	263	52.6
	Maintaining proper impression tray fit	244	48.8
	Using the right viscosity of material	241	48.2
	Using a double-mix technique	210	42.0
	Using tray adhesives	186	37.2
Perceived reasons for final impression failure* (n=500)	Clinical error	284	56.8
	Choice of impression material	250	50.0
	Experience	169	33.8
	Lab error	105	21.0
	Patient's mental attitude	65	13.0
	Improper oral hygiene maintenance	48	9.6

*Multiple responses allowed.

Year-wise comparisons are shown in **Table 4**. Significant differences across academic years were observed for routine diagnostic impressions before tooth preparation, routine gingival retraction cord use, knowledge of single- versus double-cord techniques, most commonly used final impression material, tray preference, and the factor considered most important when selecting an impression material. Ordinal response

distributions also differed significantly across academic years for confidence, perceived effectiveness of digital techniques, perceived adequacy of training, teaching exposure to digital impression techniques, and reported difficulty while taking impressions. The largest gradient was seen for knowledge of single- versus double-cord technique, which increased from 28.4% in III BDS students to 96.9% in postgraduate students.

Table 4: Association of year of study with selected outcomes

Outcome	III BDS (n=74)	IV BDS (n=172)	Internship (n=92)	PG student (n=162)	Statistic	p value
Routine diagnostic impressions before tooth preparation, Yes (%)	58.1	52.9	65.2	55.6	$\chi^2=55.81$	<0.001
Routine gingival retraction cord use, Yes (%)	27.0	36.6	40.2	48.1	$\chi^2=10.49$	0.015
Knowledge of single vs double cord technique, Yes (%)	28.4	46.5	62.0	96.9	$\chi^2=138.09$	<0.001
Addition silicone as most commonly used final impression material (%)	51.4	61.6	43.5	55.6	$\chi^2=120.13$	<0.001
Custom tray preference for final impression (%)	50.0	51.2	28.3	27.8	$\chi^2=63.30$	<0.001
Dimensional accuracy considered the most important factor (%)	20.3	65.7	77.2	72.8	$\chi^2=110.35$	<0.001
Confidence score, median [IQR]	3 [3–4]	3 [2–4]	3 [3–4]	4 [4–5]	H=124.74	<0.001
Perceived effectiveness of digital techniques score, median [IQR]	4 [4–4]	4 [4–4]	4 [4–4]	5 [4–5]	H=85.52	<0.001
Perceived adequacy of training score, median [IQR]	4 [2–5]	4 [2–4]	3 [2–4]	4 [4–4]	H=39.34	<0.001
Teaching exposure to digital impression techniques score, median [IQR]	2 [2–3]	2 [2–3]	2 [2–2]	3 [2–4]	H=129.48	<0.001
Difficulty taking fixed prosthodontic impressions score, median [IQR]	3 [3–4]	3 [3–4]	3 [3–3]	3 [3–3]	H=42.61	<0.001

DISCUSSION

The present study showed that addition silicone was the most commonly used final impression material, diagnostic impressions were performed routinely by more than half of the respondents, and dimensional

accuracy was the dominant factor influencing material selection. These findings suggest that students are generally aware of the fundamental requirements of fixed prosthodontic impressions and tend to favor materials associated with accuracy and dimensional

stability. This pattern is consistent with the broader prosthodontic literature, in which polyvinyl siloxane or addition silicone has been described as the most widely used impression material in restorative dentistry because of its favorable handling properties and accuracy [10]. It also broadly parallels the Indian practitioner survey by Moldi *et al.*, which found continued reliance on elastomeric materials in fixed prosthodontic practice [11]. At the same time, the present preference for custom trays appears more academically driven, since Mitchell *et al.*, reported that impressions received by a commercial laboratory were more often made in plastic and dual-arch trays, highlighting a difference between teaching-oriented preferences and real-world practice patterns [12].

An important finding was the gap between knowledge and routine clinical use of gingival displacement. Although nearly two-thirds of respondents reported knowing the difference between single- and double-cord techniques, less than half routinely used gingival retraction cord. Among those who answered the relevant items, conventional cord-based retraction remained the preferred method. This is clinically meaningful because adequate gingival displacement is central to exposing the finish line, controlling sulcular fluids, and improving the accuracy of fixed prosthodontic impressions [13]. The lower routine use in this study may therefore reflect limited clinical exposure, selective use only in more demanding cases, or lack of confidence in soft-tissue management rather than lack of theoretical knowledge. That interpretation is supported by the fact that most respondents also reported occasional or frequent difficulty while making impressions, suggesting that impression making is still perceived as a technique-sensitive procedure during training.

The responses related to digital impressions were particularly noteworthy. A large majority believed that newer digital techniques are more effective than traditional methods, yet most had not been taught these techniques and expressed a desire to learn them. This combination of positive attitude and limited exposure closely resembles the findings of Marti *et al.*, who observed that dental students had high expectations for digital scanning and anticipated that it would become their primary future impression technique, even though it required greater instructional time initially [14]. Favorable perceptions toward digital workflows are also understandable in light of evidence showing better patient comfort with digital impressions than with conventional techniques [15]. However, the present study indicates that curricular exposure has not yet kept pace with student interest. This aligns with Al Khalaf *et al.*, who highlighted continuing international divergence in undergraduate prosthodontic teaching and assessment [16], and with Lone *et al.*, who found that although didactic teaching and demonstrations were common,

preclinical and direct clinical implementation remained variable across institutions [17].

Another consistent pattern in the present study was the progressive improvement across academic years, with postgraduate students showing better knowledge of retraction techniques, greater confidence, and greater exposure to digital impression teaching than junior students. This trend is expected, but it is still important because it indicates that competency in impression making develops cumulatively with clinical experience rather than being achieved fully in early undergraduate years. Haralur and Al-Malki previously reported that students experience difficulty during the transition from preclinical to clinical fixed prosthodontics [18], while Moradpoor *et al.*, emphasized the importance of practical work on real patients and modern teaching methods in improving learning [19]. The present findings support those observations and suggest that repeated clinical reinforcement is essential for translating theoretical understanding into routine practice.

This study has certain limitations. The findings were based on self-reported questionnaire responses and are therefore subject to recall bias, social desirability bias, and subjective interpretation of confidence or competence. The cross-sectional design also limits causal inference, and the study assessed perceived practice rather than objectively measured clinical performance. In addition, the sample was restricted to dental students in Maharashtra, so the results may not be fully generalizable to other regions or educational systems. Future research should include multicenter studies from different states, objective assessments of impression-making skills, and direct comparison of preclinical versus clinical competence. Longitudinal studies would also be useful to determine how knowledge and confidence evolve over the course of training and whether structured integration of digital impression teaching leads to measurable improvements in student competence and readiness for clinical practice.

CONCLUSION

Dental students in Maharashtra demonstrated generally positive awareness and attitudes toward impression materials and techniques used in fixed prosthodontics, particularly regarding dimensional accuracy and newer digital workflows. However, gaps were evident between theoretical knowledge and routine clinical practice, especially in gingival displacement and digital impression training. These findings highlight the need for stronger clinical reinforcement and more structured exposure to contemporary impression techniques during dental education.

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