ORIGINAL ARTICLE

Knowledge, attitude, and practice of digital dentures among dentists

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ABSTRACT

The objective of this survey was to evaluate the knowledge, awareness, and practice of digital dentures among dentists. This is a cross-sectional survey conducted from January to February, 2022. Fifteen close-ended questions were framed and circulated among 150 dental practitioners and interns using an online survey form. The responses were collected and statistically analyzed. The results summarize that 95.3% were aware of digital dentures and 4.7% were not. About 60.1% do not use digital workflow, 27% do not have essential equipment, 9.5% were not confident in practicing digital dentures, and 3.4% found that it was inaccurate, showed poor retention, and a well-skilled technician was required. Most dental practitioners are aware of digital dentures. Among all practitioners with postgraduation were more aware of digital dentures than the interns and undergraduate practitioners. Most dentists do not practice digital dentures due to the high initial setup cost and maintenance. The majority of practitioners agree that digital dentures will be the ultimate tool in future dentistry.

Key words: Awareness, computer-aided design/computer-aided manufacturing systems, digital dentures, innovation

INTRODUCTION

Despite the advances in dental technology, the number of patients becoming completely edentulous has not reduced considerably over the past decade.[1] Since the invention of polymethyl methacrylate in 1936, the compression molding process has been the gold standard for fabricating complete dentures.[2] This process entails a complex sequence of clinical and laboratory steps, a minimum of five clinical appointments, adjustments of the denture required on each subsequent visit, laboratory expenses, and time as determined by the complexity of the case. Another limitation is the lack of intimate fit between the denture and the underlying soft tissues which could be attributed to the polymerization shrinkage. As a result, there is a higher risk of human processing error, inaccuracy, and increased time and expense across the entire process.[3]

Computer-aided design/computer-aided manufacturing (CAD/CAM) technology has recently been used to fabricate complete dentures. Recent advancements in the field of technology have led to a steady rise in the number of companies, along with an increase in the number of systems.[4] Modified and shortened clinical procedures, computer-aided designing of the CDs, and 5-axis milling from pre polymerised polymethyl methacrylate (PMMA) blanks is believed to solve most of the limitations of conventional CDs. As a result, the overall treatment time

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is reduced without compromising the quality of care. Furthermore, patients and private clinicians also benefit from its cost-effectiveness.[5] Evidence suggests that complete digitalization can provide favorable clinical outcomes; improved retention;[6] reduced risk for Candida colonization, and therefore, healthier underlying tissues; enhanced material characteristics and biocompatibility;[7] improvements in the uniformity of clinical and scientific results, as well as the identification of anatomical landmarks on digital casts; reproducible and less time-consuming tooth arrangements;[8] easy data storage; and easy for duplication.

However, the digital denture protocol requires specialized stock impression trays, elastomeric impression materials or intraoral scanners, and special tools for documenting vertical dimensions and centric relations. This demands operators to have appropriate clinical training. The traditional technique, on the other hand, employs low-cost materials and widely available tools and requires no further training for experienced operators. According to Bidra *et al*., the ability to construct dentures using digital technology has vast educational, investigative, and therapeutic implications that can affect not only individual patient care but also global public health.[9] Despite the fact that various systems are now available and have been documented in the literature, their use by dentists and/or technicians on a regular basis are still minimal. The aim of the study was to evaluate the knowledge, awareness, and practice of digital dentures among dental practitioners.

MATERIALS AND METHODS

This cross-sectional survey was conducted from January to February, 2022, in Chennai city on a sample size of 150 dental practitioners among which 64 (43%) practitioners were MDS graduates, 73 practitioners were BDS graduates (49%), and 13 (8%) were interns. Fifteen close-ended, self-directed, comprehensive questions were framed and circulated among dental practitioners and interns using online survey forms (Google Forms) [Figure 1]. Responding to the questionnaire was regarded as an implicit consent, and no written consent was required. Clarity, competency, consistency, accuracy, and validity of the obtained data were reviewed on a regular basis. Data were analyzed using the IBM SPSS statistics software (IBM SPSS Inc., Chicago, IL, USA).

RESULTS AND DISCUSSION

The survey was conducted among dental practitioners and interns in an age group of 21–58 years with a mean age of 25.5 years and ± 4.14 years. Responses obtained from 64 (43%) MDS graduates, 73 (49%) BDS graduates, and 13 (8%) were interns. 95.3% of the practitioners were aware of digital dentistry, whereas 4.7% did not have a brief knowledge on it. Forty-six percent of postgraduate practitioners, 38% of undergraduates, and 7.33% of interns were aware of digital dentures. 52.82% of practitioners with 1–5 years of clinical experience never used digital modalities, whereas 4.3% often used it. 2.8% of practitioners with 5–10 years of practice always used digital methods. 0.7% of the practitioners with 10–15 years of experience always used digital modalities. 73.8% of the study population were taught about CAD-CAM in their educational institution. While 67.1% of the practitioners never used digital modalities for denture fabrication, 21.5% sometimes used digital modalities, 7.4% always used, and 4% often used them in practice. The study reported that 74.5% of dentists did not use intraoral scanners, whereas 25.5% used intraoral scanners. 14.8% of the dentists preferred Sirona Dentsply intraoral scanners, 21.8% preferred 3Shape TRIOS 4, 9.2% preferred Medit I500, 5.6% liked GC-Aadva IOS 200, 1.4% preferred Planmeca Emerald S, 2.1% preferred Dental Wings-Virtuo Vivo, 2.8% preferred Carestream health-CS 3700, 4.2% Align iTero element 5D, and 38% were not aware of these commercially available intraoral scanners. 27.7% of the practitioners were aware of Ivoclar Digital Dentures, 7.4% were aware of Sirona Digital denture systems, 12.8% knew about AvaDent system, 4.7% had knowledge on Baltic system, 6.8% were aware of Ceramill, 6.1% knew about DENTCA system, 4.1% knew about Wieland Digital dentures, and 26.4% were not aware of these commercially available digital denture systems in the market. 50.7% of the participants responded that digital dentures reduced the chairside time, 20.3% preferred digital dentures due to better esthetics, 18.2% found digital dentures to provide better retention, and 10.8% found digital dentures to be eco-friendly [Figure 1]. 60.1% of the study population did not use digital workflow in their practice as it was expensive, 27% did not have essential equipment needed to fabricate a digital denture, and 9.5% were not confident in practicing CAD/CAM due to a lack of knowledge, 3.4% of the practitioners assumed that digital dentures were inaccurate, showed poor retention and that a well-skilled technician was required to aid in the fabrication of the denture [Figure 2]. 38.5% of the dentists were not well aware of the presence of well-equipped dental laboratories around their surroundings. 36.5% of the dentists did not have dental laboratories that fabricate digital dentures in their locality, whereas 25% had access to laboratories [Figure 3]. 23.6% of the practitioners reported that traditional dentures had better precision and accuracy than the digital dentures, whereas 34.5% found digital dentures superior to the conventional ones, and 41.9% of the practitioners did not have a brief knowledge on accuracy and precision of digital dentures. 61.5% of the participants assume that virtual reality-based technology (VRBT) improves the patient's understanding of the treatment. 24.3% preferred it due to the possibility to repeat the procedure [Figure 4]. 43.9% of the practitioners found PMMA better due to decreased polymerization shrinkage, 27% found lesser residual monomer, and 10.1%

	Questions	Options	Responses
1	Are you aware of Computer Aided Designing / Computer Aided Manufacturing?	• Yes • No	• 95.3% • 4.7%
2	Were you taught about CAD-CAM in your educational institution?	• Yes • No	• 73.8% • 26.2%
3	Do you use any digital modalities during denture fabrication?	• Often • Sometime • Always • Never	• 4% • 21.5% • 7.4% • 67.1%
4	Do you use intraoral scanners in your clinical practice?	• Yes • No	• 74.5% • 25.5%
5	Which among the following do you prefer for intraoral scanning?	• Sirona-Dentsply • 3 Shape-TRIOS4 • Medit i500 • GC-Aadva IOS 200 • Planmeca Emerald S • Dental Wings Virtuo Vivo • Carestream Health-CS 3700 • Align iTero element 5 D • Not aware	• 14.8% • 21.8% • 9.2% • 5.6% • 1.4% • 2.1% • 2.8% • 4.2% • 38%
6	Which of the following denture systems are you aware of?	• AvaDent system • Baltic system • Ceramill • DENTCA • Wieland digital dentures • Pala digital system • Sirona digital dentures • Ivoclar digital dentures • Not aware	• 12.8% • 4.7% • 6.8% • 6.1% • 4.1% • 4.1% • 7.4% • 27.7% • 26.4%
7	What do you think are the advantages of CAD/CAM dentures?	• Reduced chair-side time • Better esthetics • Better retention • Eco friendly	• 50.7% • 20.3% • 18.2% • 10.8%
8	Reasons for not using digital dentures in clinical practice	• Expensive • I do not have the essential equipments • I am not confident in practising digital modalities • Others	• 60.1% • 27% • 9.5% • 3.4%
9	Do you think there are enough well equipped dental laboratories around your surroundings to fabricate digital dentures?	• Yes • No • Maybe	• 25% • 36.5% • 38.5%
10	Do you feel digital dentures do not have the same accuracy and precision as the traditional dentures?	• Yes • No • Maybe	• 23.6% • 34.5% • 41.9%
11	What is your attitude towards Virtual Reality Based Technology (VRBT) in denture fabrication?	• The possibility to repeat the procedure • Improves the patient's understanding about the treatment • No significant advantages	• 24.3% • 61.5% • 14.2%
12	What do you think are the advantages of Pre-polymerised Methyl Methacrylate (PMMA) over traditional acrylic resins?	• Lesser residual monomer • Decreased polymerisation shrinkage • Increased toughness • Not aware	• 27% • 43.9% • 10.1% • 18.9%
13	What is your opinion about the time taken to fabricate a digital denture?	• Lesser than the conventional dentures • More time required • Same as the conventional dentures	• 79.7% • 11.5% • 8.8%
14	What is your opinion about the number of appointments needed to fabricate a digital denture?	• 2 • 3 • 4 • More than 4	• 36.5% • 45.9% • 12.8% • 4.7%
15	Do you feel digital dentures will be the ultimate tool in future dentistry?	• Strongly agree • Agree • Strongly Disagree • Disagree	• 21.6% • 63.5% • 3.4% • 11.5%

Figure 1: Questionnaire form

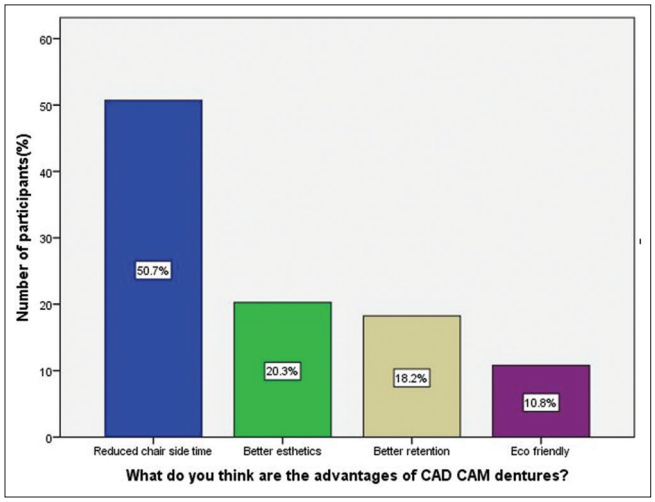

Figure 2: Frequency distribution based on the opinion on the advantages of CAD/CAM dentures. CAD/CAM: Computer-aided design/computer-aided manufacturing

found increased toughness [Figure 5]. 79.7% responded that the time taken for the fabrication of digital dentures was lesser than the conventional ones. 11.5% assume that it takes more time, whereas 8.8% assume that dentures of both systems are fabricated at the same time. 36.5% of the participants responded with two appointments to fabricate a digital denture. 45.9% assumed three appointments, 12.8% with four appointments, and 4.7% assumed to be more than four appointments. 63.5% of the dental practitioners agreed that digital dentures will be the ultimate tool in future dentistry, 21.6% strongly agreed, 11.5% disagreed, and 3.4% strongly disagreed [Figure 6].

Digital dentures have started a new age in dentistry. Many dentists who showed no interest in CAD/CAM technology are now converting their traditional impressions to digital ones while leaving the restorative work to the laboratory, whereas others are embracing it fully using a combination of chairside and laboratory digital workflows.[10] Therefore, this study was performed with the aim to determine the knowledge, attitude, and practice of digital dentures among dental practitioners. The majority of practitioners were familiar with digital workflow for denture fabrication and were taught about them in their dental school. When asked about the reason for not using digital workflow in clinical practice, most of the respondents found the cost of the equipment to be highly expensive. The duration of the learning curve, which can range from a few days to several months, is the key concern in a CAD/CAM purchase. This can lead to a decrease in office productivity, an increased patient treatment time, and a rise in clinicians' frustration. The high expense of the technology, the dental team's aversion to adopting it, and the clinician's lack of trust in employing a computerized system are all obstacles to putting it into practice.[11]

It was observed from the survey that most of the dentists do not have well-equipped dental laboratories around their surroundings to fabricate digital dentures. According to many surveys, dental technologists believe that using CAD/CAM will improve their job performance, efficiency, and knowledge. However, the most prevalent explanation given by them is the high initial investment cost, as well as the lack of such technology in their workplace.[12] These findings

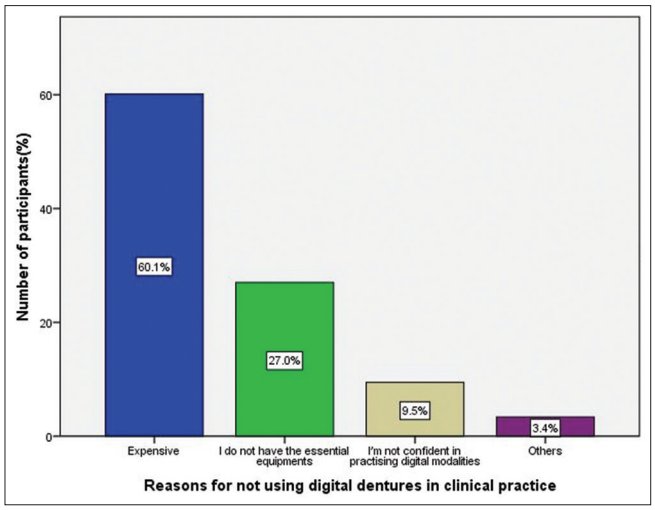

Figure 3: Frequency distribution based on the reasons for not using digital dentures in clinical practice

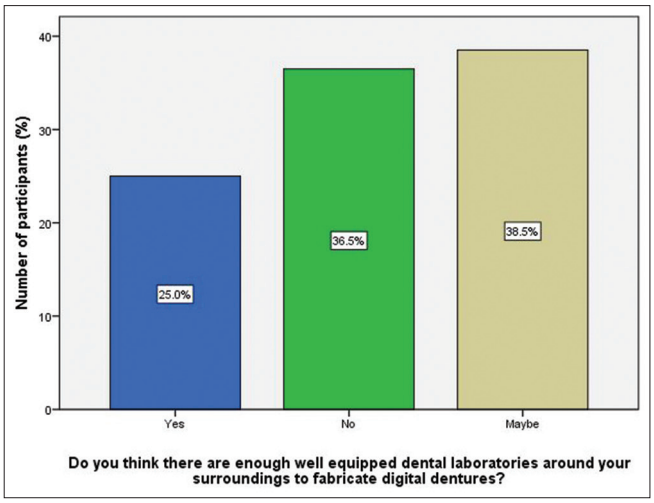

Figure 4: Frequency distribution based on the availability of well-equipped dental laboratories in their surrounding

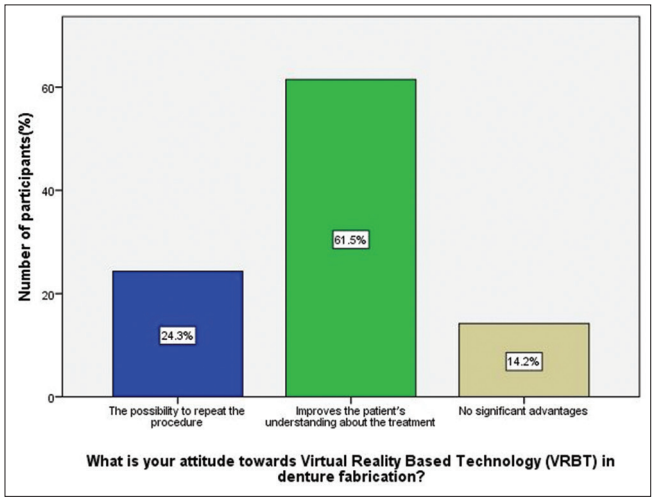

Figure 5: Frequency distribution based on their opinion on virtual reality-based technology in denture fabrication

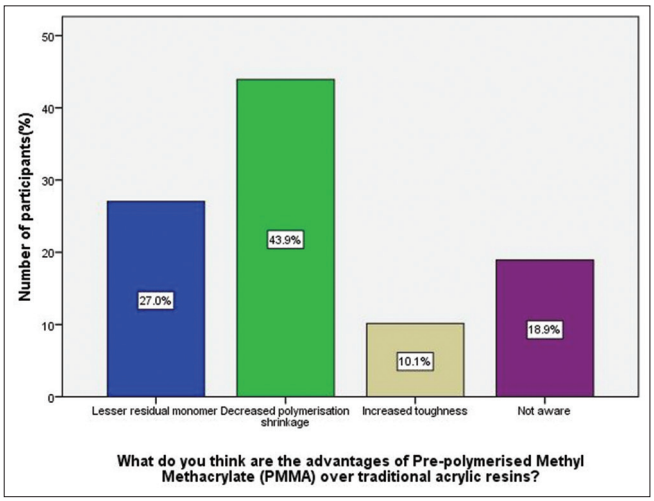

Figure 6: Frequency distribution of the advantages of PMMA over traditional acrylic resins. PMMA: Pre-polymerized methyl methacrylate

show that more specialized CAD/CAM education programs are required to produce more specialist CAD/CAM experts. In this survey, more than half of the practitioners did not use intraoral scanners and were not aware of the commercially available intraoral scanners. Despite the fact that IOS systems appear to be accurate and equivalent to traditional methods, they are nevertheless susceptible to errors.[13] Additional physiological factors, such as salivation, could make it difficult for the dentist to make an accurate impression. If tissue obstructs the view, optical scanners do not provide any reasonable impression.[14] When asked about the accuracy and precision of digital versus traditional dentures, most of the practitioners did not have knowledge about it. Maltar *et al*. reported that the majority of the participants in their study had heard of CAD/CAM technology and had favorable opinions about it, but they also claimed that they were underinformed and that extra education beyond the school's regular lectures was required.[15] Most of the practitioners were aware of the Ivoclar digital denture system. With the volume of literature available, it is reported that BPS systems by Ivoclar Vivadent outperformed conventional dentures in esthetics, patient comfort, and function.[16] It could be due to this fact that the dentists were aware of the company's digital denture also. Most of the dentists found VRBT in denture fabrication to improve patients' understanding about the treatment. Virtual treatment planning advancements in oral surgery,[17] prosthodontics, and orthodontics, such as smile design software, are important tools for clinicians and can help patients see the anticipated treatment outcome and facilitate better communication. In the present study, most of the practitioners responded that digital dentures required 1–3 appointments including the adjustments for digital denture, and the time needed to fabricate was lesser than the traditional ones. The practitioners reported that

PMMA has lesser residual monomer and has a decreased polymerization shrinkage. Blanchet *et al*. proposed that leaching out of the residual monomer from the denture base causes allergic reactions such as burning sensations, stomatitis, edema, and ulceration of the oral mucosa and also has a negative impact on both the mechanical qualities and biocompatibility of these resins.[18] In the manufacture of removable prostheses, the use of digital technology may minimize such drawbacks. Most dentists feel that digital dentures will be the ultimate tool in future dentistry. Previous literature published by the team helped to do the research.[19-26]

Limitations include a small sample size and the survey was conducted in a selected population further studies that would cover a larger population should be conducted. Data observed from this survey provide an insight into the attitude and practice of dentists toward digitalization which helps companies in the market to better understand the dentists' problems in using digital dentures. Furthermore, ways to subsidize the cost could be done to ensure greater availability of technology to the masses. This could ensure that digital denture companies could recover the cost through volume. Dental education must focus more on incorporating digital dentistry into the undergraduate and postgraduate curriculum so that more trained professionals enter into the field of digital dentistry that could revolutionize dentistry in terms of patient comfort, satisfaction, and decreased chairside time.

CONCLUSION

Within the limitations of this study, it was found that most of the dental practitioners are aware of digital dentures. The association between the qualification of the practitioners and awareness on digital dentures was found to be significant. Specialist dental practitioners were more aware of digital dentures than the residents and general dentists. The association between years of clinical practice and the use of digital modalities during denture fabrication was also significant. Most of the dentists do not use any kind of digital modality to fabricate a digital denture in their clinics due to the high initial setup cost and maintenance. A large number of practitioners agree that digital dentures will be the ultimate tool in future dentistry.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Felton D, Cooper L, Duqum I, Minsley G, Guckes A, Haug S, *et al.* Evidence-based guidelines for the care and maintenance of complete dentures: A publication of the American college of prosthodontists. J Prosthodont 2011;20 Suppl 1:S1-12.
2. Murray MD, Darvell BW. The evolution of the complete denture base. Theories of complete denture retention – A review. Part 4. Aust Dent J 1993;38:450-5.
3. Neumeier TT, Neumeier H. Digital immediate dentures treatment: A clinical report of two patients. J Prosthet Dent 2016;116:314-9.
4. Goodacre BJ, Goodacre CJ, Baba NZ, Kattadiyil MT. Comparison of denture base adaptation between CAD-CAM and conventional fabrication techniques. J Prosthet Dent 2016;116:249-56.
5. Srinivasan M, Schimmel M, Naharro M, O' Neill C, McKenna G, Müller F. CAD/CAM milled removable complete dentures: Time and cost estimation study. J Dent 2019;80:75-9.
6. AlHelal A, AlRumaih HS, Kattadiyil MT, Baba NZ, Goodacre CJ. Comparison of retention between maxillary milled and conventional denture bases: A clinical study. J Prosthet Dent 2017;117:233-8.
7. Infante L, Yilmaz B, McGlumphy E, Finger I. Fabricating complete dentures with CAD/CAM technology. J Prosthet Dent 2014;111:351-5.
8. Wimmer T, Gallus K, Eichberger M, Stawarczyk B. Complete denture fabrication supported by CAD/CAM. J Prosthet Dent 2016;115:541-6.
9. Bidra AS, Taylor TD, Agar JR. Computer-aided technology for fabricating complete dentures: Systematic review of historical background, current status, and future perspectives. J Prosthet Dent 2013;109:361-6.
10. Christensen GJ. Impressions are changing: Deciding on conventional, digital or digital plus in-office milling. J Am Dent Assoc 2009;140:1301-4.
11. Miyazaki T, Hotta Y, Kunii J, Kuriyama S, Tamaki Y. A review of dental CAD/CAM: Current status and future perspectives from 20 years of experience. Dent Mater J 2009;28:44-56.
12. Jung-Sook Nah. The need of education and practice to bring up CAD/CAM experts. Journal of Korean Acedemy of Dental Technology 2016;38:365.
13. Aswani K, Wankhade S, Khalikar A, Deogade S. Accuracy of an intraoral digital impression: A review. J Indian Prosthodont Soc 2020;20:27-37.
14. Róth I, Czigola A, Fehér D, Vitai V, Joós-Kovács GL, Hermann P, *et al.* Digital intraoral scanner devices: A validation study based on common evaluation criteria. BMC Oral Health 2022;22:140.
15. Maltar M, Miloš L, Milardović S, Kovačić I, Peršić S, Juroš I, *et al.* Attitudes of the students from the school of dental medicine in Zagreb towards CAD/CAM. Acta Stomatol Croat 2018;52:322-9.
16. Kasabwala H, Nallaswamy D, Maiti S. Awareness regarding digitalization of maxillofacial prosthesis among dental students and dental practitioners in India–A survey. J Res Med Dent Sci 2021;9:195-9.
17. Orentlicher G, Abboud M. Computed tomography-guided surgery and all on four. J Oral Maxillofac Surg 2011;69:2947.
18. Blanchet LJ, Bowman DC, McReynolds HD. Effects of methyl methacrylate monomer vapors on respiration and circulation in unanesthetized rats. J Prosthet Dent 1982;48:344-8.
19. Aparna J, Maiti S, Jessy P. Polyether ether ketone – As an alternative biomaterial for metal richmond crown-3-dimensional finite

element analysis. J Conserv Dent 2021;24:553-7.

20. Ponnanna AA, Maiti S, Rai N, Jessy P. Three-dimensional-printed malo bridge: Digital fixed prosthesis for the partially edentulous maxilla. Contemp Clin Dent 2021;12:451-3. doi: 10.4103/ccd.ccd_456_20.
21. Agarwal S, Maiti S, Ashok V. Correlation of soft tissue biotype with pink aesthetic score in single full veneer crown. Bioinformation. 2020;16:1139-44. doi: 10.6026/973206300161139.
22. Merchant A, Maiti S, Ashok V, Ganapathy DM. Comparative analysis of different impression techniques in relation to single tooth impression. Bioinformation 2020;16:1105-10.
23. Agarwal S, Ashok V, Maiti S. Open- or closed-tray impression technique in implant prosthesis: A dentist's perspective. J Long Term Eff Med Implants 2020;30:193-8.
24. Rupawat D, Maiti S, Nallaswamy D, Sivaswamy V. Aesthetic outcome of implants in the anterior zone after socket preservation and conventional implant placement: A retrospective study. J Long Term Eff Med Implants 2020;30:233-9.
25. Kushali R, Maiti S, Girija SA, Jessy P. Evaluation of microbial leakage at implant abutment interfact for different implant systems: An *in vitro* study. J Long Term Eff Med Implants 2022;32:87-93.
26. Merchant D, Ganapathy M, Maiti S. Effectiveness of local and topical anesthesia during gingival retraction. Braz Dent Sci 2022;25:e2591.