Original Research Paper

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Knowledge, Perception and Acceptance of 3-D Printed Dentures Among Dental Practioners in Asia.

Abstract:
3D printing has revolutionized every field in science and technology. In dentistry its usage ranges from diagnosis and treatment planning, fabrication of surgical guides to fabrication complete dentures. This study was done to assess the knowledge, perception and acceptance of 3D printed dentures among dental practioners in Asia. The survey's Google link was generated and sent to the willing participants via various offline and online modes. Knowledge of 3D printing in the dentistry is necessary due to its wide applications from diagnosis and treatment planning to fabrication of prostheses. Its perception and acceptance at an institutional level alongwith optional hands-on trainings shall ensure its use efficiently.

Key-words: 3D Printing, knowledge and perception, acceptance, dental practioner

Introduction:

Digital dentistry means treatment planning and procedures being performed by means of digital or computer-controlled components instead of mechanical or electrical equipment. The introduction of CAD-CAM and 3D printing has brought new era in diagnosis, treatment planning and fabrication of prostheses. 3Dprinted restorations have demonstrated a number of applications in all fields of dentistry. Studies have revealed that 3D printed restorations have much greater marginal fit and accuracy[1]. Temporary crowns can be made more precisely using 3D printing than using the traditional techniques[2]. Dentures fabricated using 3D printing technology have number of benefits like digital impression, fewer appointments, ease of fabrication of new prosthesis by retrieving previously acquired data. Surgical guides fabricated using 3D printing enhance surgeons' efficiency to perform a surgical procedure. For all these applications there is a need to enhance knowledge and acceptance of 3D printing among dental professionals. This knowledge, perception and acceptance survey will provide baseline data and identify gaps that may facilitate understanding and further action to plan, implement, and evaluate practice toward 3D printing technology among dental practitioners in Asia.

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Materials and Methods: The present study protocol was submitted for ethical committee clearancefrom Institutional Ethical Committee, Aligarh Muslim University and was approved with the approval number IECJNMC/1432. After obtaining approval from Institutional Ethical Committee, Aligarh Muslim University the study was started during the month of February 2024.

A cross-sectional, closed-endedquestionnaire was prepared for the present study and psychometric properties of the questionnaire were analyzed for reliability and for face and content validity after pilot work on 30 subjects. The self-administered questionnaire comprised of 18 questions out of which 5 questions were demographic, 4 questions were related to their knowledge and the remaining 9 were

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pertaining to their perception and acceptance of 3D printed dentures. (table 1)

Table 1. Knowledge Perception And Acceptance Of 3-d Printed Dentures

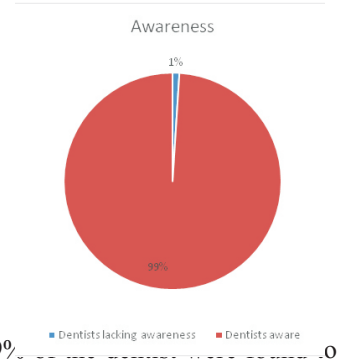
Gender	Male Female
Education	BDS MDS MDS, PhD
Numbers of years in practice	0-5 5-10 10-15 15-20 >20
State	
Have you heard of 3D printing for fabrication of denture	Yes No
Have you used 3D printing for fabrication of dentures	Yes No
Would you recommend fabrication of dentures using 3D printing	Yes No
Has its use in dentistry increased recently?	Yes No May be
Do you find the current 3D printing software user friendly?	Yes No May be
Do you find the current 3D printing software patient friendly?	Yes No May be
Do you believe that 3D printed models enhance your ability to execute a surgical procedure?	Yes No May be
Do you believe 3D printed dentures will minimize the efforts in fabrication of complete dentures?	Yes No May be
Do you believe that 3D printers allows for the storage of electronic data, enabling technicians to precisely duplicate a denture in a matter of hours?	Yes No May be
Do you believe it is easy to satisfy a patient as digital approach lacks wax try-in?	Yes No May be
Do you believe a digital impression will be more accurate than a conventional impression?	Yes No May be
Do you believe bonding of teeth to the denture base is compromised in 3D printed dentures as comparison to conventionally fabricated dentures?	Yes No May be
Would you like to discuss the uses of this technique in dentistry in more detail?	Yes No May be

The required sample size was calculated using G*Power Software, Version 3.0.10 (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany), based on a calculated effect size of 0.565 as per the results of a pilot study involving 30 subjects, with a 5% level of precision, 95% confidence interval and 80% statistical power. The minimum sample size was calculated to be 200 subjects.

The study was conducted in online/offline mode among registered dental practitioners in Asia. Non-probability, a convenient sampling method was employed. Anonymity and informed consent of all the study participants was maintained. The sampling frame consisted of dentists registered in Asia either working in dental colleges, dental clinics or both in government, as well as private settings who were willing to participate voluntarily ensuring confidentiality. Dental practitioners who couldn't be reached through any social media for the online survey, those not willing to participate in the study and those who responded beyond the completion of the set duration of the study were excluded.

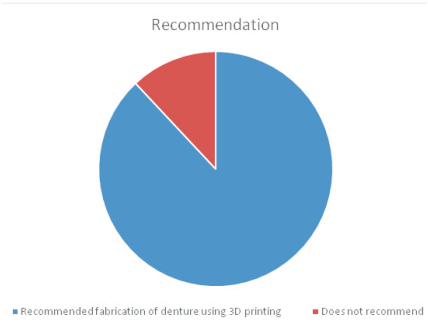
Results:

In the present study out of 206 subjects,38% respondents were male and remaining 62% were female, 70%of them were between 25-34 years of age having practice between 0-10years. 99% of the dentist were found to be aware of 3D printed dentures while 1% still lack awareness (Graph1).



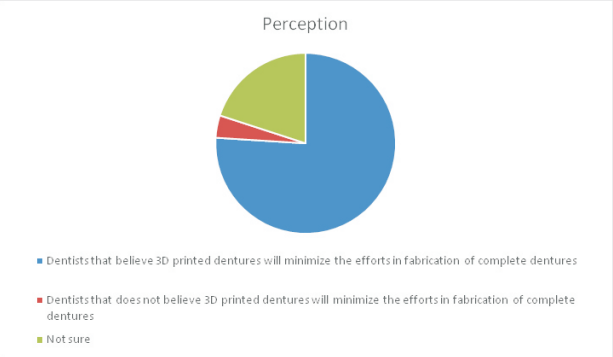
Graph 1: 99% [illegible] be aware of 3D printed dentures while 1% still lack awareness

According to survey only 12% of the dentists have used 3D printing for fabrication of dentures and88% recommend fabrication of dentures by 3D printing (Graph 2).



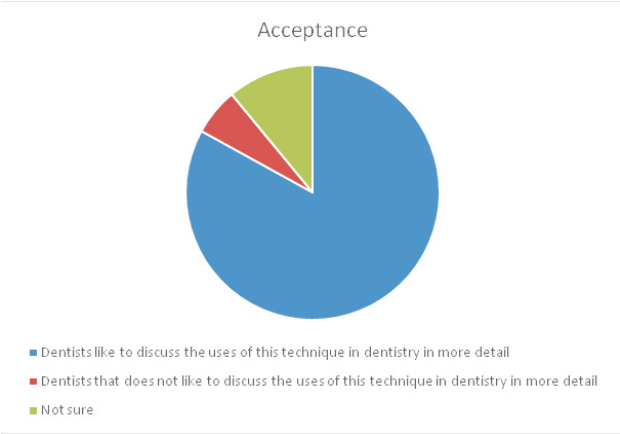
Graph 2: 88% recommend fabrication of dentures by 3D printing 71%think that its use has recently increased in

dentistry, 6% deny while remaining 23% are not sure about it. 45% found it user friendly and 48% said its patient friendly. 76% of the dentists believe that 3D printed models enhance the ability to execute a surgical procedure 1% deny 23% are unaware. 76% dentists are of opinion that 3D printed dentures will minimize the efforts in fabrication of complete dentures while 4% deny and 20% are not sure(Graph3).



Graph 3: 76% believe 3D printed dentures will minimize the efforts in fabrication of complete dentures while 4% deny and 20% are not sure.

83% believe that 3D printers allow for the storage of electronic data, enabling technicians to precisely duplicate a denture in a matter of hours. 53% believe it is easy to satisfy a patient as digital approach lacks wax try-in while 8% does not agree. 50% believe a digital impression will be more accurate than a conventional impression, 19 deny and 31% were not sure about it. 28% believe bonding of teeth to the denture base is compromised in 3D printed dentures as comparison to conventionally fabricated dentures 26% deny and 46% are not sure. 83% like to discuss the uses of this technique in dentistry in more detail 6% does not like to discuss and 11were not sure (Graph 4)



Graph 4: 83% like to discuss the uses of this technique in dentistry in more detail 6% does not like to discuss and 11% were not sure

Discussion:

3D printing is a computer-controlled process in whichsuccessive layers of materials are added to create 3D objects.The use of this technology spans over a plethora of fields ranging from aerospace, eco-friendly buildings to life-savingmedical implants, and even artificial organs using layers of human cells[3]. Fabrication of complete denture is considered one of the most challenging procedures in Prosthodontics because of multiple time-consuming steps being involved. The construction of dentures has become a more amiable process for patients since the advent of intraoral scanning and 3D printing[4]. Also, principles of each step may be condensed into fewer appointments. Shift from five appointments to three is one of the greatest benefits of 3D printing. Since steps are minimized chances of errors in final prosthesis are also less as comparison to conventional prosthesis in which minor errors at each step get compiled to a prosthesis not acceptable for the patient. Also new denture can be fabricated in matters of hours by retrieving previously acquired data. According to published case reports, detachable partial dentures can easily be fabricated for patients with restricted mouth opening or lip contractures using 3D printing [5]. With 3D printing it is now possible to fabricate fixed and removable dentures having physical characteristics similar to dentures fabricated using conventional method with less efforts and more acceptability [6]. Despite lack of wax up try in, most of the dentists are of opinion that patient can be satisfied with digital try in techniques.Numerous studies have demonstrated better retention in digital dentures compared to conventional dentures due to the absence of polymerization shrinkage in the denture base [7,8,9]. Majority of the dentists believe that digital impressions are more accurate than conventional impressions. Accuracy can further be enhanced by a technique proposed by Goodacre et al in which definitive impressions of edentulous maxillary and mandibular arches are made conventionally, that are later scanned. Assessment of of maxillary and mandibular anterior teeth positioning, palatal morphology, VDO, neutral zone and interocclusal relationship is also done digitally in this method to fabricate high quality denture base through milling [10]. As concluded from our data majority of dentist lack awareness about bonding of teeth with denture base in digitally fabricated dentures. Whereas as proven from studies the bonding between teeth and denture base is better in digital technique as the bonding takes place after the polymerization of the base. The release of the monomer that occurs during polymerization in conventional technique reduces the bonding capacity of the resin [11]

Conclusion:

The emerging using of digital technology in dentistry has made is possible to use a number of newer materials with improved properties and also made treatment procedure easier for dentists as well as patients. Additionally, we can rely on digital data instead of using excessive auxiliary material for fabrication and refabrication of prosthesis decreasing biohazards and enhancing comfort of patients. From our study it is concluded that majority of dentists have knowledge and acceptance for 3D printed dentures but their knowledge must be updated regularly for the benefit of profession and patients.

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