



ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF DIGITAL ORTHODONTICS AMONG ORTHODONTIST IN MAHARASHTRA: A QUESTIONNAIRE STUDY

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ABSTRACT

Introduction: The digital technology has contributed to improve and simplify diagnosis, treatment planning and execution in Orthodontics. Among CAD/CAM system (Computer-Aided Design / Computer-Aided Manufacturing) applications in Orthodontics, we highlight the installation and removal of fixed appliance, clear aligners, customized appliances, and retainers fabricated in digital environment.

Objectives: To develop a questionnaire tool which evaluated knowledge , attitude and practice of digital orthodontics among orthodontist in Maharashtra.

Methodology: The current study was web based questionnaire study conducted on practicing orthodontist. On using OpenEpi software, sample size of 200 orthodontist was selected. The responses obtained were automatically listed in Microsoft Excel and data was analysed using SPSS software.

Results: Majority of participant are of age between 30 to 35 years. Majority of participant had a clinical experience between 5 to 10 year (mean 7.12 year). Majority of the participant in our study were utilizing DP and radiography i.e. about 40.5%. All the participant were aware of digital orthodontics and were willing to invest in digital and customised orthodontic systems in future . About 89.5% participant think that digital orthodontics will have significant role in field of orthodontics in future.

Conclusion: Orthodontist of Maharashtra displayed adequate knowledge about digital orthodontics. The male orthodontic population is more aware of digital technologies. Their attitude towards digital orthodontics is positive and they would like to invest in various technologies in future. The practice of digital orthodontics is lacking , mostly because of the high investment cost that it required.

Keywords: Dental bonding. Orthodontic brackets. Digital Orthodontics

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INTRODUCTION

From the description of the first orthodontic appliance in 1728 by Pierre Fauchard¹ to the current wide use of aesthetic aligners, Orthodontics has undergone a great evolution of technique and materials. Some events may be highlighted such as the Edgewise appliance patented by Edward Angle,² the direct bonding of orthodontic accessories to enamel³ and more recently the use of CAD/CAM (Computer-Aided Design/Computer-Aided Manufacturing) for diagnosis, treatment planning and customized orthodontic appliances fabrication.⁴ The CAD/CAM technology allows three-dimensional (3D) images manipulation through computer software and 3D printing of customized devices in different materials.⁵ Among the orthodontic applications, there are the precise and efficient aligners production, customized devices, indirect bonding trays, as well as the virtual brackets debonding for retainer manufacture.⁶ CAD/CAM technology is supported by three pillars: the digital image acquisition of patients' dental arches; the visualization and manipulation of these images in specific software; and the files 3D-printing, whether the devices designed or the models in which the devices will be made. This process is called Digital Workflow.

The objective of applying this technology in Orthodontics is to reduce the professional's chair and laboratory time, as well as turn the treatments faster, predictable, aesthetic and more comfortable to patients.⁵ Even with all the benefits arising from the digital workflow, orthodontists still underuse technology in their practice, perhaps due to lack of technical knowledge to introduce it and its high cost. Various technologies like digital photography (DP) (Conon, Nikon, Sony, etc.), Digital Radiography (DR) like CBCT and OPG (PreXion3D, Planmeca, Vatech, Dentsply, Carestream CS 9300, Kodak, etc.), facial 3D scans (Artec 3D, Shining, Creafom, etc.), 3D Photography (Ortery, PhotoRobot, Snap 36, etc.), Intra-oral scanning (IOS) or Digital Impressions (DI) (3Disc Imaging, 3shape, Align Technology, Carestream Dental, Condor, Dental Wings, iTero, Denterprise, Dentsply

Sirona, Imetric 4D Imaging GmbH, Intelliscan, Medit, NewTom, Planmeca, Runyes Medical Instrument Co., Ltd., Shining 3D, Video Dental Concepts, Zimmer Dental, etc.), digital study models (DSM), Clear Aligners (CA) (Invisalign, Flash, Illusion, etc.), rapid prototyping (RP) (Stereolithography (SLA) or Vat Photopolymerization, Selective Laser Sintering (SLS), Fused Deposition Modelling (FDM) or Material Jetting, Selective Laser Melting (SLM) or Powder Bed Fusion, Laminated Object Manufacturing (LOM) or Sheet Lamination, etc.), 3D Printing (3D Systems, AddUp, Arcam, Concept Laser, DMG Mori, EOS, etc.), digital cephalometric analysis (DCA) (Dolphin, NemoCeph, Proceph, Ceph Ninja, Facad, etc.), robotic wire bending (MOTOMAN UP6, LAMDA system, Cartesian type archwire bending robot, Suresmile, etc.), finite element modelling (FEM) (MFEM, COMSOL Multiphysics, SDC Verifier, deal.II, Abaqus CalculiX, etc.), digital surgical planning (DSP), virtual bracket placement/removal (VBPR), etc. have helped orthodontists diagnose facial deformities, skeletal discrepancies, impacted teeth, etc. provided a virtual space for planning to aid in comprehensive clinical execution for getting a precise treatment outcome.⁷⁻¹⁰

After a thorough review of current available literature, there was no study found that assessed the knowledge, attitude and practice of digital orthodontics among orthodontists in Maharashtra. Hence, this study was planned with the objectives of this study to develop a questionnaire tool which evaluated knowledge, attitude and practice of digital orthodontics among orthodontist and in Maharashtra.

Material and methods:

The current study was web based questionnaire study conducted on practicing orthodontist. On using OpenEpi software, sample size of 200 orthodontist was selected. The responses obtained were automatically listed in Microsoft Excel and data was analysed using SPSS software. A cross-sectional survey was conducted with a



pretested questionnaire comprising of 14 questions to assess sociodemographic characteristics, knowledge (06), attitudes (05), practice (03 questions) among the orthodontists. A structured online questionnaire along with informed consent was prepared, which was sent through social media platforms with the help of google form. The Sample size was estimated using G* power software (Version 3.1) by keeping the alpha error probability as 0.05, with an effect size of 0.4 and power 0.95 which accounted for 200. All the practicing orthodontists from Orthodontic Study Group willing to participate in the study were included. Orthodontists who had no registered mail, id and not willing to provide informed consent were excluded. The study was started after obtaining the Institutional ethical approval.

A questionnaire was designed in accordance with the identified domains using relevant literature as well as upon the opinions based on the professional expertise of the authors. The questionnaire validity was carried out by evaluating the content and face validity by the subject experts (07 experts). The subject experts were asked to rate the questions on a 4-point ordinal scale (1: not relevant), (2: somewhat relevant), (3: quite relevant) and (4: highly relevant) [6]. The quantitative assessment of validation was done using the content validity ratio (S-CVI) obtained by dividing number of experts who scored the item 3 and 4 by the total number of experts. (Table 1). An average score of 92% was obtained suggesting minor changes to be done in the questionnaire. The minor corrections in the questionnaire were done according to the suggestions of the subject experts and then subjected to the online survey.

The responses of the questionnaire was accepted till 20 days of period. The reminder mail was sent to a maximum of 3 times with an interval of 5 days to all the participants. According to the answers given by Orthodontist responses were recorded. Respondents could submit their answers only after answering all the questions. The

questionnaire could be accessed through email account only once. The respondents could not change their answers after submission.

Statistical analysis:

The data was assembled, organized and entered in Microsoft Excel and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS, IBM version 20.0). The level of significance was fixed at 5% and $p \leq 0.05$ was considered statistically significant. Kolmogorov- Smirnov test was employed to test the normality of data. Chi Square test was performed for the quantitative variables.

Results:

The present study was carried out to assess the knowledge, attitude and practice of digital orthodontics among orthodontists. The results are based on questionnaire based analysis of 200 samples assessing the knowledge, attitude and practice of digital orthodontics.

The following results shows the evaluation of knowledge, attitude and practice of digital orthodontics among study participants. Majority of participant are of age between 30 to 35 years. Majority of participant had a clinical experience between 5 to 10 year (mean 7.12 year). 87% subjects are completely aware about the field of orthodontics. Only 60% subjects have used 3D soft tissue prediction softwares for orthognathic surgeries. Around 83% subjects were aware usage of digitally customized bracket systems and wires along with virtual diagnosis and treatment planning, total orthodontic treatment time will decrease compared to the conventional methods. Majority of participants i.e. 85 % subjects will be investing in digital and customized orthodontic systems in the future. Majority i.e. around 81% participants believe the use of the increased cost of these digital technologies deterring them from using them in your routine practice. While, 82.5% believe that availability of 3D printers and digital tools in today's world starting a trend for companies to directly deliver aligners and



orthodontic appliances to patient at doorstep. Around 89.5% subjects believe that digital orthodontics will have a significant role in the field of orthodontics in future [Table 1]

All the participants were aware of digital orthodontics and were willing to invest in digital and customized orthodontic systems in the future. Majority of the participants in our study were utilizing DP and radiography. For making impressions of patients a major proportion of the participants were practicing conventional technique (48.5%). Around 42% participants believed that digital impression making method gives more convenience as per operator and patient perspective. Participants felt that in Covid 19 pandemic, DI (52%) making will be a better opinion when compared with the conventional one. Majority of the participants were not using 3D soft tissue prediction software and felt that increased cost of digital technologies is deterring them from using. All the participants felt that digital orthodontics will have a significant role in the field of orthodontics in future. Still, 42% participants use conventional radiography method [Table 2]

Discussion

Awareness among the patient's encountering pathogens transmitted through blood or other body fluids has led to stringent protocol for sterilization and disinfection in clinical practice with limited chair side time especially during the COVID-19 pandemic.¹¹⁻¹² Digitalization in the field of dentistry is helpful in reducing the spread of these infections by providing a virtual room to reduce the time required for diagnosis and treatment. Living in a generation where digital technology is increasing exponentially, making processes easier, less time consuming and laborious, dentists are not far from catching up. Dental practitioners have started using most of the digital technology available, but a majority of the population is still unaware of the various tools available that can make their professional life easier. Orthodontists are amongst dental professionals who require most of the technological tools available in the field of dentistry. This study assessed the

knowledge, attitude and practice of digital orthodontics among orthodontists in Maharashtra through a questionnaire.

The objective of the study required accessibility to a large population, even the ones we don't know personally; in a short amount of time and at the same time, it should be economical and should not require any special equipment or skills. Hence a questionnaire study was planned.¹³ The Questionnaire survey also helped us in gaining knowledge about perspectives of orthodontist from every corner of Maharashtra. The questionnaire was first subjected to content and construct validity using the CVI. If the S-CVI for individual question was higher than 79 percent, the question was considered appropriate. If it was between 70 to 79 percent, a need of revision was considered. If it was less than 70 percent, the question was eliminated.¹⁴ 17 out of 20 items showed 100% validity, 2 items showed 71% validity and changes were made in those questions accordingly and only 1 item showed 57% validity which was then removed from the questionnaire. Suggestions made by the experts were to combine question numbers 4 and 5 and make a provision for question number 6 to choose multiple option answers. The questionnaire was sent after making the necessary changes.

Majority of respondents in this study were males (55.5%) with mean clinical experience of 7.12 years and most of the people who responded to this questionnaire were private practitioners who were aware of digital orthodontics. All of the respondents knew about DP, DI, DSM, DR (CBCT, OPG, etc.), DCA, DSP, digital fabrication of appliances and retainers, CA, 3D printing in orthodontics. A few participants were not aware of certain technologies including FEM, RP, and VBPR. Most of the respondents preferred only DP and DR in their routine dental practice, additionally a very few have preferred to use DI, DCA and CA, and DSP in routine practice. These results were similar to observations made by Pradeep Philip George et al. who also

concluded that orthodontists in Kerala were aware of tele-dentistry and its use, but were not willing to practice, it routinely.¹⁵

Maximum respondents preferred both, conventional and DI making techniques (44.6%) and 71.7% of respondents felt that DI making technique was more convenient for both the clinician and patient. However, the impact of COVID-19 pandemic was pragmatic, 88.6% subjects of the participants responded that DI making was a better option. A study by Schott et al. concluded that dental students were able to practice both, conventional and DI with ease without any prior training for the same.¹⁶ A maximum number of participants preferred both manual and digital methods of cephalometric analysis (68.4%). Around, 56% of participants preferred 3D soft tissue prediction software for planning orthognathic surgeries.

A majority of the sample believed that treatment duration of orthodontic treatment decreases with the usage of digitally customized bracket systems and wires along with virtual diagnosis and treatment planning. This was contradictory to the results of a study by Margarita Papakostopoulou and Dominic Hurst who concluded that the customized orthodontic system was not associated with significantly reduced treatment duration, and treatment quality was comparable between the 2 systems, however, it has a significant effect in decreasing the clinical time and improving patients' experiences.¹⁷

All of the orthodontists responded positively regarding investment in digital technologies used in orthodontics and almost all of them had a wish to invest in CA. Additionally, very few had inclination towards investing in other technologies like intra oral scanners, DI, 3D printing and Digitally Fabricated Appliances. The probable reason for orthodontists wanting to invest in these digital technologies can be attributed to the marketing through social media, conferences, etc. and the urge

of clinician to upgrade his clinical setup to be at par with his contemporaries.

Both orthodontists agreed that digital technology plays a significant role in the present and future of orthodontics, but most of the participants (91.9%) are not able to use the newer technologies in routine practice due to their high cost. A study by Ahmed *et al.* pointed out this limitation of high investment cost at an early stage.¹⁸ Even though the returns for the same will be high if properly and adequately implemented in clinical practice, clinicians are hesitant about investing a huge amount of money into digital technologies. Hence development of specific marketing centres can facilitate and endorse adequate implementation of these technologies in routine clinical practice. Dental 3d printing, RP, finite element and intra oral scanning equipment's needs to be upgraded in commercial dental laboratories or establishment of specific commercial centres is the new arena in the dentistry.

Majority of the participants were concerned about companies delivering aligners directly to patient, hence eliminating their role in the orthodontic treatment process. Do-It-Yourself Aligners or Direct-to-Consumer Orthodontics provide an easy, convenient and economical means to align teeth without visiting an orthodontist.¹⁹⁻²¹ However, all of these also suggest the patients to consult an orthodontist as these at-home aligners can cause deleterious effects like root resorption, poor occlusal contacts, etc. as well. The National Dental Council in consultation with the orthodontic council needs to tackle this problem for the benefit of the patients. The lack in practice and adoption of digital orthodontics is predominantly because of lack in knowledge regarding the use of these technologies and inadequacy in training of dental team for the same. This can be overcome by attendance of various hands-on courses in the areas of technology and prospective revisions in the under graduate and postgraduate dental curriculum.

A questionnaire-based survey proved to be a useful tool to efficiently acquire information regarding knowledge, attitude and practice of digital orthodontics amongst Orthodontist of Maharashtra. Further studies are required to assess knowledge, attitude and practice of clear aligner therapy among general dentists. Based on these studies, various courses can be designed and conducted for the betterment of patients.

Conclusion

Following Conclusions can be drawn from this study

i. Orthodontists of Maharashtra displayed adequate knowledge about digital orthodontics.

iii. Their attitude towards digital orthodontics is positive and they would like to invest in various technologies in future.

The practice of digital orthodontics is lacking, mostly because of the high investment cost that it required.

Table 1: Knowledge , attitude of study population

	Yes N (%)	No N (%)
1.Aware of Orthodontics	174 (87%)	26 (13%)
8.Do you use 3D soft tissue prediction softwares for orthognathic surgeries	120 (60%)	80 (40%)
Q9) Do you think that with usage of digitally customized bracket systems and wires along with virtual diagnosis and treatment planning, total orthodontic treatment time will decrease compared to the conventional methods	166 (83%)	34(17%)
10.Will you be investing in digital and customized orthodontic systems in the future	170 (85%)	30 (15%)
12. Is the increased cost of these digital technologies deterring you from using them in your routine practice	162 (81%)	38 (19%)
13. Are you concerned about the availability of 3D printers and digital tools in today's world starting a trend for companies to directly deliver aligners and orthodontic appliances to patient at doorstep	165 (82.5%)	35(17.5%)
14. Do you think digital orthodontics will have a significant role in the field of orthodontics in future	179 (89.5%)	21 (10.5%)

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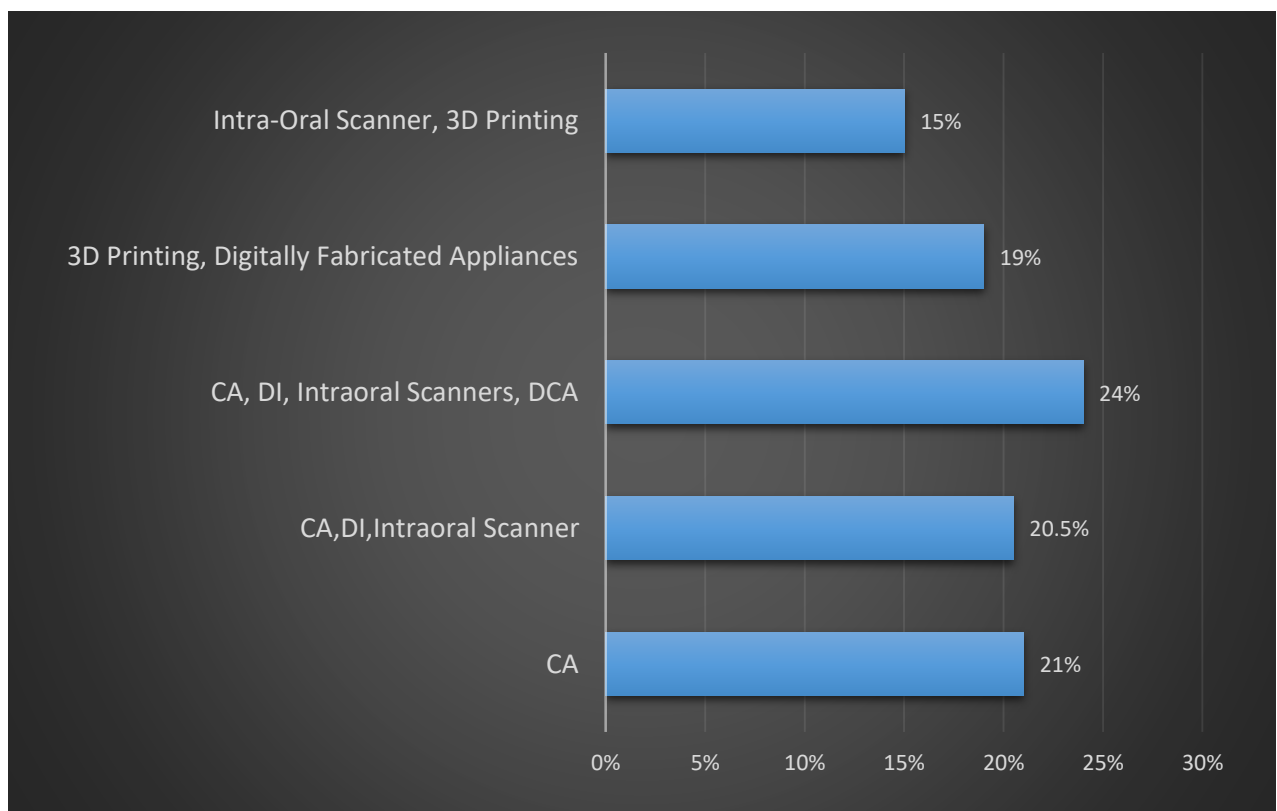
Table 2: Knowledge, practice of study participants regarding impression technique and radiographic method.

Conventional	Digital	Both
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What method do you practice for making impressions of patients	97 (48.5%)	47 (23.5%)	56 (28%)
Which method of making impression gives more convenience as per operator and patient perspective according to you	70 (35%)	84 (42%)	46 (23%)
In the COVID-19 pandemic, which method of impression making will be a better option according to you	51 (25.5%)	104 (52%)	45 (22.5%)
What method of radiographic analysis do you practice	84 (42%)	74 (37%)	42 (21%)

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Graph 1: Which digital technologies used in orthodontics would you like to invest in



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