ORIGINAL ARTICLE

Awareness on three-dimensional printing of orthodontic appliances among dental students

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ABSTRACT

The aim of the study was to evaluate the knowledge and awareness regarding the use of three-dimensional (3D)-printed appliances used in orthodontics among students pursuing dentistry. The distribution of the questionnaire was done using an online Google Forms link to about 100 dental students. The questionnaire compromised questions that were designed for assessing the various findings and knowledge of update, and finally, questions related to facts on various 3D-printing appliances. Among the total population, 58% of the population are aware of 3D printing used for various dental applications, whereas 42% of the population are not aware of the same. Among the total population, 58% of the population are aware of 3D printing used in dentistry, whereas 42% of the population are not aware of 3D printing used in dentistry. Inside the limits of the review, it very well may be inferred that 3D-printed machines have a rising use in the majority of the dental fields and understudies chasing after dentistry know about it. The knowledge about the basic and fundamental working and the usage of such appliances is developing among undergraduate students. Further continuing education programs can be provided to improve the same.

Key words: Awareness, knowledge, orthodontic appliances, practice, three-dimensional printing

INTRODUCTION

Creative advances have been resonating with state-of-the-art dentistry for a long time. The dental practice is at this point not just about the customary capacities of the dental specialists but has gone past it with the wire of the latest inventive advances to make the treatment experience a stand-out one for patients anticipating quick and quality outcomes.[1,2] The utilization of three-dimensional (3D) printers is one such innovation which is set to totally change the assembling system. The device would not be anything without the personal computer (PC) supported plan computer-aided design (CAD) programming that permits objects, and for sure entire gatherings to be planned in a virtual climate.[3]

Progressions in PC development and programming applications are a great deal of a pieces of the groundswell of mechanical change that has taken 3D printing to where it is today. Late improvements in cone-beam computed tomography (CBCT) and optical output innovation, specifically, have reformed, and are significantly changing numerous parts of helpful and embedded dentistry.[4]

Various printing advances exist, each with their own benefits and inconveniences. Tragically, a typical component of the more useful and useful gear is the significant expense of

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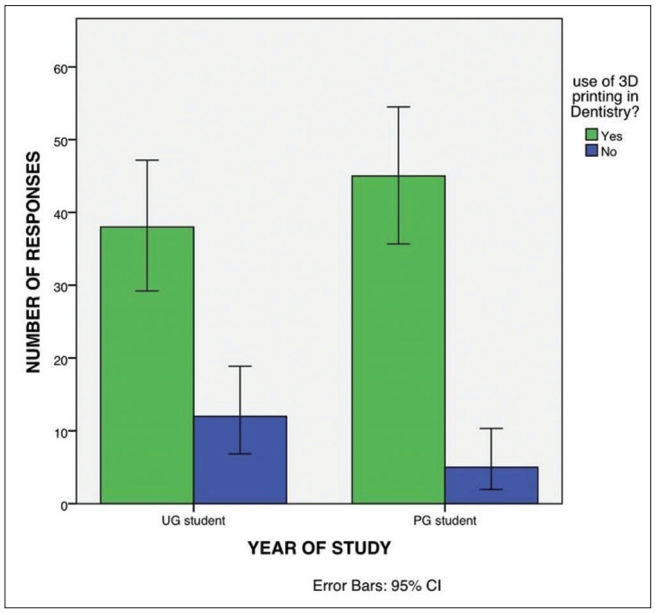

Figure 1: The bar graph represents the association of UG and PG on awareness of 3D printing. The X-axis represents the number of responses to the study and the Y-axis represents the frequency of responses in relation to the 38% responded yes and 12% – responded to no among UG, 45% responded yes, and 5% responded to no among PG. Association and awareness on 3D printing were done using the Chi-square test, $P = 0.062$, ($P = 0.05$) was found to be statistically significant. CI: Confidence interval, 3D: Three-dimensional

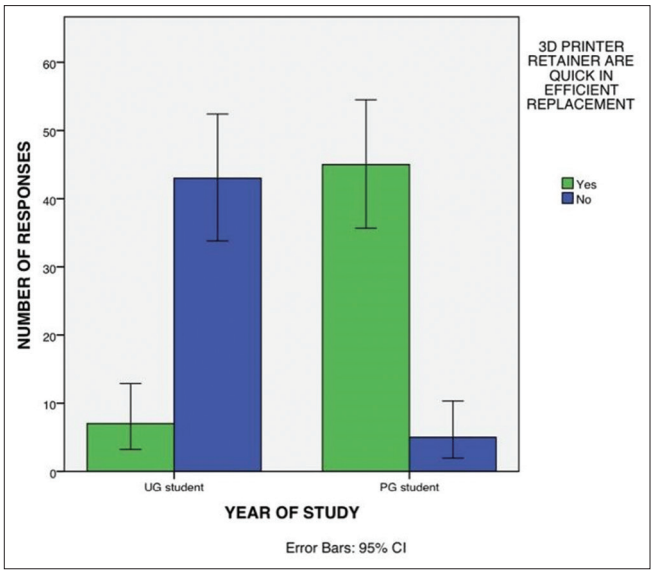

Figure 2: The bar graph represents the association of awareness on 3D-printed X-axis represents the number of responses of the study and the Y-axis represents the frequency of responses in relation to the 6% of UG students think that 3D-printed retainers are not in quick and efficient replacement for the current retainer therapy, 44% UG students think that 3D-printed retainers are a quick and efficient replacement for the current retainer therapy, and PG students think that 3D-printed retainers are not a quick and efficient replacement for the current retainer therapy, 43% PG students think that 3D-printed retainers are quick and efficient replacement for the current retainer therapy, Pearson Chi-square value is (0.064) $P = 0.867$, ($P < 0.05$) was found to be statistically not significant. CI: Confidence interval, 3D: Three-dimensional

the hardware, the materials, support, and fix, frequently joined by a requirement for chaotic cleaning, troublesome posthandling, and now and then difficult well-being and security concerns. We have considered numerous surveys tending to the utilization of 3D imprinting in dentistry. Nonetheless, the current lacunae of recently done examinations surveying the perception of 3D printing among dental specialists require this concentration on which targets evaluating the information on dental experts about the utilization of 3D printers and their involvement in it. The primary point of the review is to make mindfulness toward the dental understudies about the 3D printing utilized in orthodontic machines. This would energize further examination of this high-potential methodology that could totally change the essence of dentistry making it more persistent and clinician friendly.[5-9]

Our research and knowledge have resulted in high-quality publications from our team.[10-24]

The point of the study was to make mindfulness on 3D-printed appliances utilized in orthodontics among dental undergraduates.

MATERIALS AND METHODS

This survey was conducted among individuals pursuing UG/PG. The inclusion criteria were willingness of the individual to participate in the survey. The Institutional Clearance Certificate number is IHEC/SDC/ORTHO/21/052.

Data collection

A questionnaire was distributed through an online Google Forms link to about 100 UG/PG dental students. The results were collected from Google Forms and the compiled data were analysed for the statistical significance using a statistical software.

RESULTS

When asked about 3D printing, 38% of the population are aware of 3D printing used in dentistry, whereas 12% of the population are not aware of 3D printing used in dentistry from UG. Forty-five percent were aware of 3D printing used in dentistry and 5% were not aware of PG [Figure 1]. Twenty-eight percent of the population are aware of nondentistry-related uses of 3D printing, and 22% of the population are not aware of nondentistry-related uses of 3D printing used in dentistry from UG. Forty percent were aware of nondentistry-related uses of 3D printing used in dentistry from PG. Twenty-seven percent of the population are aware of the working principles of 3D printing, whereas 23% are not aware of the working

principles of 3D printing from UG. Thirty-eight percent were aware, whereas 12% are not aware of PG. Ten percent of the population thinks (CBCT) is required for the use of 3D printing, 5% of the population thinks 3D printing (intraoral scanners) is required for the use of 3D printing, and 10% of the population thinks casts and models are required for the use of 3D printing and 25% of the population answered to all the above from UG. Five percent of the population thinks (CBCT) is required for the use of 3D printing, 20% of the population thinks 3D printing (intraoral scanners) is required for the use of 3D printing, 6% of the population thinks casts and models are required for the use of 3D printing, and 19% of the population answered to all the above from PG. Twenty-two percent of the population thinks that 3D printing software is user-friendly, whereas 28% of the population are not aware that 3D printing software is user-friendly from UG. Moreover, 42% of the population thinks that 3D printing software is user-friendly, whereas 8% of the population are not aware that 3D printing software is user-friendly from PG. Twenty-five percent were aware that 3D-printed models enhance the ability to execute a surgical procedure, whereas 25% were not aware that 3D-printed models enhance the ability to execute a surgical procedure from UG. Forty-two percent were aware that 3D-printed models enhance the ability to execute a surgical procedure, whereas 8% were not aware that 3D-printed models enhance the ability to execute a surgical procedure from PG. Moreover, 10% of the population have access to 3D printing and 40% of the population does not have access to 3D printing from UG. Forty percent of the population have access to 3D printing, whereas 10% of the population does not have access to 3D printing from PG. Two percent of the population are aware that preoperative orthognathic surgical treatment/splint fabrication as their opinion toward future orthodontic practice, 8% of the population are aware that temporary anchorage devices as their opinion toward future orthodontic practice, 7% of the population are aware that implant dentistry as their opinion toward future orthodontic practice, and 30% skeletal and dental assessment their opinion toward future orthodontic practice from UG. Two percent of the population are aware that preoperative orthognathic surgical treatment/splint fabrication as their opinion toward future orthodontic practice, 2% of the population are aware that temporary anchorage devices as their opinion toward future orthodontic practice, 4% of the population are aware that implant dentistry as their opinion toward future orthodontic practice, and 40% skeletal and dental assessment their opinion toward future orthodontic practice from PG. Moreover, 40% of the population are aware that 3D-printed brackets are going to be more costlier when compared to current brackets used, whereas 10% are not aware that 3D-printed brackets are going to be more costlier when compared to current brackets used from UG. Moreover, 42% of the population are aware that 3D-printed brackets are going to be more costlier when compared to current brackets used, and 8% are not aware that 3D-printed brackets are going to be more costlier when compared to current brackets used from PG. Six percent of the population are aware that 3D-printed customized metal brackets reduce the risk of caries and white spot lesions and 44% of the population are not aware that 3D-printed customized metal brackets reduce the risk of caries and white spot lesions from UG. Thirty-six percent of the population are aware that 3D-printed customized metal brackets reduce the risk of caries and white spot lesions and 14% of the population are not aware that 3D-printed customized metal brackets reduce the risk of caries and white spot lesions from PG. Moreover 7% are aware that 3D-printed retainers are quick in efficient replacement for the current retainer therapy, and 43% of the population are not aware that 3D-printed retainers are quick in efficient replacement for the current retainer therapy from UG [Figure 2]. Moreover, 45% are aware that 3D-printed retainers are quick in efficient replacement for the current retainer therapy, and 5% of the population are not aware that 3D-printed retainers are quick in efficient replacement for the current retainer therapy from PG [Table 1].

DISCUSSION

In dentistry, 3D printing as of now has different materialism and holds a lot of vow to make conceivable numerous previously unheard-of medicines and ways to deal with assembling dental rebuilding efforts. Albeit 3D-printing mechanical assembly and innovations have been promptly accessible for over 10 years, it is advancements in, and admittance to scanner innovation, PC helped plan programming and crude computational power, that has begun to utilize the innovation useful, whereas business and public interest has brought issues to light and further developed admittance to assets.

Wide usage of 3D-printed appliances has been noted in medicine. There has been an extension in the usage of 3D printing for various dental applications. In dentistry, this plays a bigger role in the planning and making of various dental appliances than with the usage in diagnosis. In the event that we think about the benefits of 3D-printed reclamations with traditional or CAD/computer-aided manufacturing (CAM) rebuilding efforts, 3D-printing reclamations will doubtlessly be put on top. They give the chance of top-notch rebuilding efforts with fast and simple manufacturing. The nature of these rebuilding efforts has been shown by a few examinations, in spite of the fact that cost is as yet a significant issue.[25-30]

Huge advances in orthodontic innovation have happened in the past many years, to a great extent due to the joining of CAD/CAM innovation into the plan and manufacture of orthodontic appliances.[31-34]

Table 1: Representing responses of the study population to the questionnaire.

Questions	Choices	Responses Of Ug (Out Of 50)	Responses Of Pg (Out Of 50)	*P*
EDUCATION	UG PG	50%	50%	
Are you aware about the use of 3D printing in dentistry	YES NO	38% 12%	45% 5%	0.062
Are you aware of any non-dentistry related uses of 3D printers	YES NO	28% 22%	40% 10%	0.002*
Are you aware about the working principles of 3D printing	YES NO	27% 23%	38% 12%	0.021*
What do you think is required for the use of 3D printers	CBCT Intraoral Scanners Casts and models All the above	10% 5% 10% 25%	5% 20% 6% 19%	0.003*
Have you had any experience of either observing or working with 3D printed models?	YES NO	12% 38%	45% 5%	0.003*
What do you think is the best material for 3D printing	Light cure resin Powder blender Thermoplastic	10% 15% 25%	15% 10% 25%	0.441
Do you find the current 3D printing software user friendly?	YES NO	22% 28%	42% 8%	0.042*
In your opinion, does the use of 3D printed model enhance your ability to execute a surgical procedure?	YES NO	25% 25%	42% 8%	0.002*
Do you have access to 3D printing for your clinical practice?	YES NO	10% 40%	40% 10%	1.000
For what cases would you choose to use 3D printing in your future clinical practice?	Skeletal and Dental assessment Temporary anchorage devices Implant dentistry Extraction of impacted teeth Pre operative orthognathic surgical treatment/splint fabrication	30% 8% 7% 3% 2%	40% 2% 4% 2% 2%	0.423
Do you think 3D printed customised brackets are going to be costlier when compared to the current braces used?	YES NO	40% 10%	42% 8%	0.603
Do you think 3D printed customised brackets are going reduce the risk of caries and white spot lesion on the teeth?	YES NO	6% 44%	36% 14%	0.006*
Do you think 3D printed retainers are quick and efficient replacement for current retainer therapy?	YES NO	7% 43%	45% 5%	0.04*

*$P<0.05$ Statistically significant

CONCLUSION

Inside the limits of the review, it very well may be inferred that 3D-printed machines have a rising use in the majority of the dental fields, and understudies chasing after dentistry know about it. The knowledge about the basics and fundamentals of working and the usage of such appliances is developing among undergraduate students. Further continuing education programs can be provided to improve the same.

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Conflicts of interest

There are no conflicts of interest.

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