

## KNOWLEDGE AND AWARENESS ABOUT PEEK AS A DENTAL MATERIAL AMONG DENTAL STUDENTS.

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### ABSTRACT

**Background:** Many researches and studies are undergoing to discover new materials or to modify existing material for better aesthetic and biocompatibility. Polyether ether ketone is one of the newly innovated material in modern dentistry. This study is conducted to assess the knowledge and prevalence about the material among dental student in clinical practice. **Materials and Method:** Questionnaire based study was conducted among 100 under graduate and post graduate dental students of various ages and clinical experience in thai moogambigai dental college, chennai to assess the knowledge about the material. **Result:** More than 71% selected Zirconia to be most biocompatible and aesthetic material. Around 32% of students answered this material can be used as implants, prosthesis and orthodontic wires. Only 27% of students answered 1250-1383N as the masticatory force withstood by this material compared to 68% of students who opted for 800-1000N. Around 32% of students reported that they have never heard about PEEK material and about 35% of students are willing to learn about the material. **Conclusion:** From the study it can be concluded that the students have comparatively less knowledge about PEEK. More studies and research should be conducted to improvise the material and to widen its use among clinicians.

**KEYWORDS:** Poly ether ether ketone, knowledge, PEEK.

### INTRODUCTION

Restorative material in dentistry is constantly being innovated to satisfy the aesthetic and biocompatibility needs of the patient. Similarly, it is required by the dentist to be up to date with new dental material that is being introduced. Composite material, nano-particle combination material, zirconia etc are some of the advanced material. Among these materials, PEEK (Polyether ether ketone) is one of the newly innovated dental material that is being introduced into dentistry. PEEK has been previously used in orthopaedics for many years, because of its elastic modulus being closer to the bone and its elastic modulus can be made similar to the cortical bone by adding carbon fibres.<sup>[1,2]</sup> PEEK is a synthetic, polycyclic, aromatic, thermoplastic polymer and possesses excellent mechanical property, resistance to hydrolysis and chemical wear and it is a bioinert material.<sup>[3]</sup> Due to its good physical and mechanical

property this material have a good potential in modern dentistry as an implant material, prosthesis, orthodontic wires and restorative material. This study was conducted to assess the knowledge and prevalence of this material among dental students in clinical practice.

### MATERIALS AND METHOD

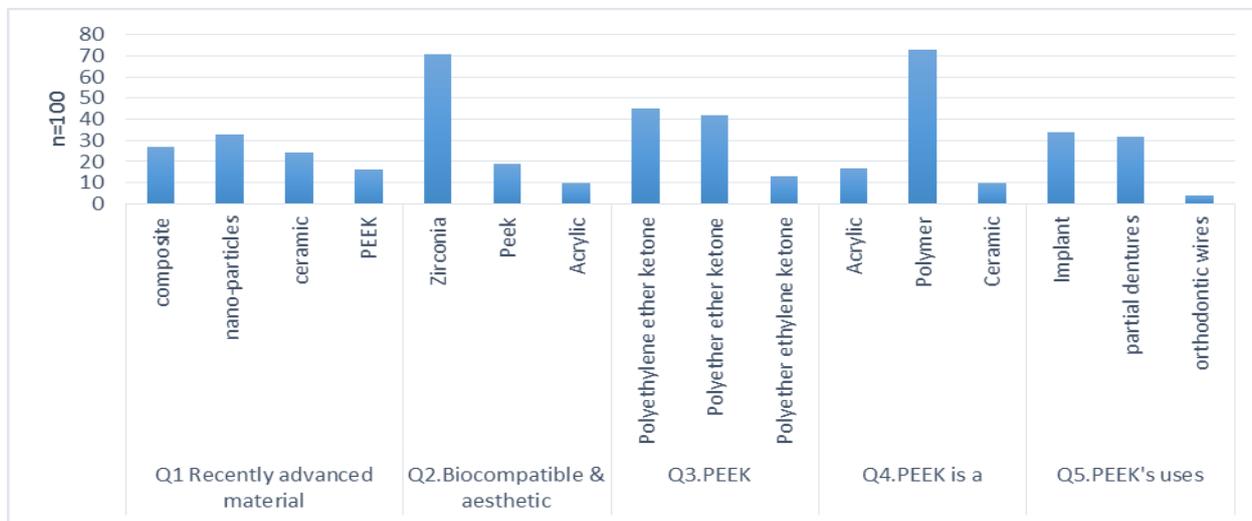
A questionnaire-based survey was conducted to assess the knowledge and prevalence about PEEK as emerging new dental material. The study was conducted among 100 clinical dental students from Thai moogambigai dental college and hospital of Dr MGR Educational and Research Institute deemed to be university in Chennai, India. Total of 100 undergraduate and postgraduate dental students of various age and clinical experience are selected randomly to participate in the study. All of them were informed about the study in detail and consent were obtained from the participating student with the

assurance of maintaining the personal detail of the participants confidential. Totally 16 questionnaires were asked about this restorative material. Obtained results are entered in excel spreadsheet and descriptive analysis is done in percentage and described in a bar chart.

**RESULT**

Recent advancements in dental material, 33% of the students opted for nano-particles compared to other

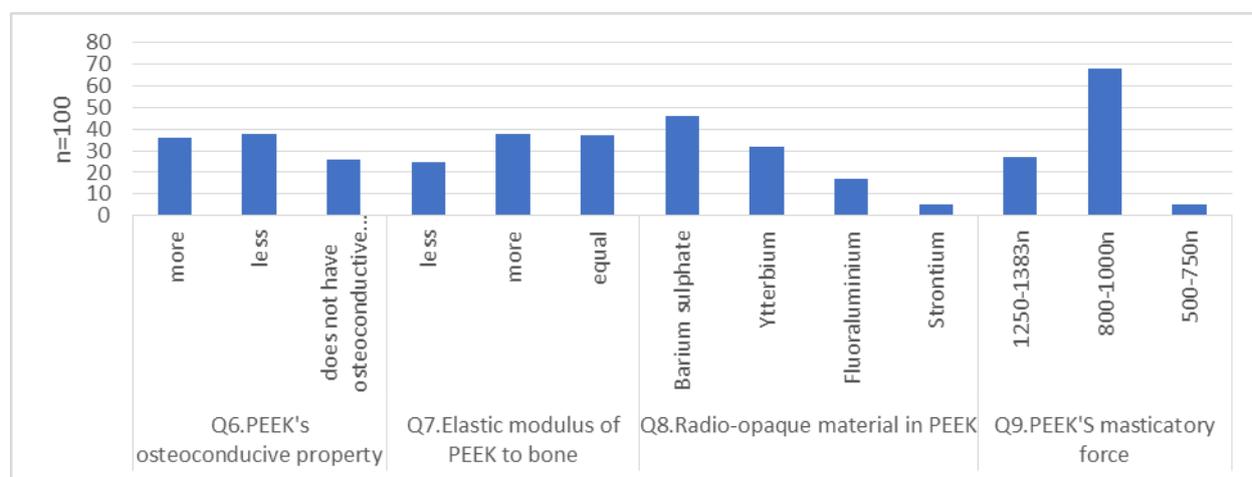
dental material. More than 71% selected Zirconia to be most biocompatible and aesthetic material. Around 42% of students answered Polyether ether ketone. More than 73% chose this material as a polymer. Around 32% of students answered this material can be used as implants, prosthesis and orthodontic wires. Presented in Figure - 1a.



**Figure 1a: Distribution of students response about the material.**

About 38% of students answered this material has less osteoconductive property. Around 38% answered PEEK's elastic modulus is higher and 37% answered equally to the bone. 46% of people chose barium sulphate is to be added to make this polymer material

radio-opaque. Only 27% of students answered 1250-1383N as the masticatory force withstood by this material compared to 68% of students who opted for 800-1000N. presented in figure -1b distribution of students response about the material.



**Figure 1b: Distribution of students response about the material.**

42% of students chose composite coated PEEK to have low fracture resistance. 36% of students chose this material to have High fracture resistance in CAD-CAM milling 33% of students answered that both hydroxy appetite and titanium coating can be given to improve the osteoconductive property of this material. Presented in

figure-1c distribution of student's response about the material.

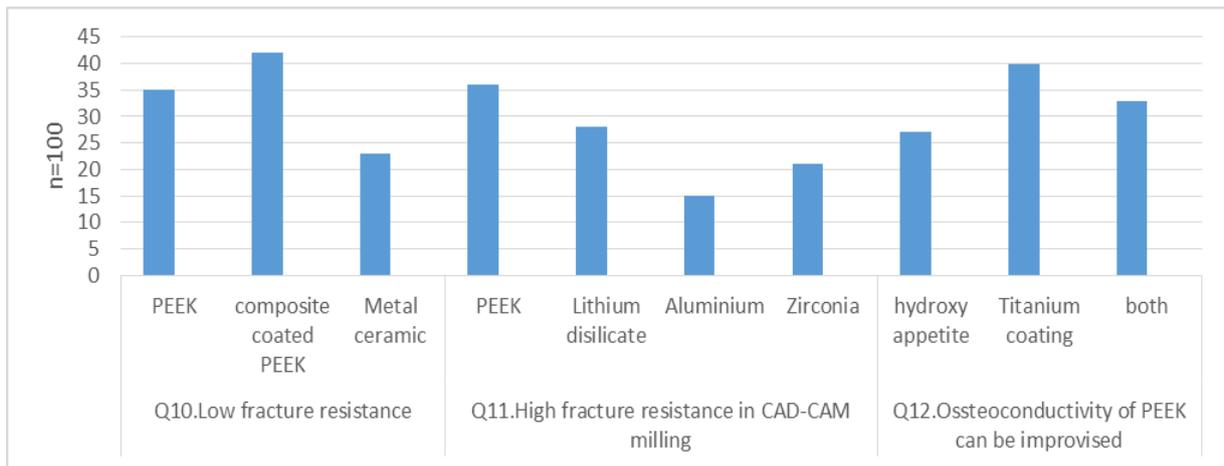


Figure 1.c: Distribution of student's response about the material.

Around 32% of students reported that they have never heard about PEEK material and about 35% of students are willing to learn about the material. Only 29% of the

students are willing to use this material in clinics and 26% are willing to recommend the material to the fellow dentist. Presented in figure-1d.

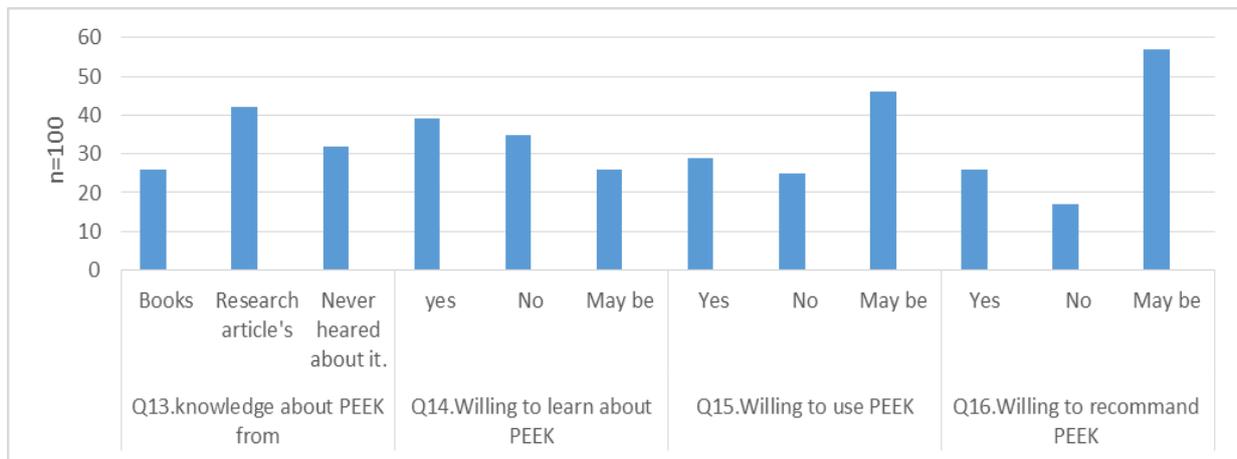


Figure 1d: distribution of student's reponce about the material.

**DISCUSSION**

There are numerous research being conducted to find new and modified material in modern dentistry to improve the quality of the procedure and give the patient a better choice of material which is both biocompatible and aesthetically pleasing. Among them composite, ceramics, nano-particles and polymers few of the materials being studied to increase its performance in oral cavity.<sup>[3,4,5]</sup> In our study, most of the students selected nano-particle(33%) as most recently advanced material followed by ceramic (27%). Though it is correct, PEEK a thermoplastic polymer, semi-crystalline with linear structure is also a recently advanced materials which is slowly being introduced in dentistry. From student's response to our study, most bio-compatible and aesthetic material is zirconia.<sup>[7]</sup> But according to studies PEEK material also have similar aesthetic and biocompatible properties.<sup>[8]</sup> Due to its superior mechanical property, biocompatibility, and aesthetic property this polymer material can be used as an implant, prosthesis, orthodontic wires and even as a restorative

material.<sup>[9-11]</sup> Only one-third of the students have responded with all the above-mentioned uses.

In our study, most of the students responded osteoconductive property of PEEK is less. According to studies, though osteoconductive property of this material is less a number researches are being conducted to improve the osteoconductive property of the material including coating PEEK implants with bioactive materials, increasing the surface roughness by chemical treatment and incorporating bioactive materials.<sup>[12,13]</sup> Relatively comparable number of students have responded that elastic modulus of PEEK material is equal or more to the bone. It does not confirm with studies which points that elastic modulus of this material (3-4GPa) is lesser than cortical bone(14GPa) and it can be improved by adding carbon fibre [CFR-PEEK(18GPa)]which increases the elastic modulus closer to cortical bone.<sup>[10,13]</sup> According to reports PEEK is radio-lucent material which makes it difficult to investigate it in radiographs hence to make it radio-opaque barium sulphate is added,<sup>[14]</sup> and in our study,

more number of students opted for barium sulphate to be added to make this material radio opaque. In our study, students responded the masticatory force of PEEK to be between 800-1000N. While the prolonged study conducted on 3-unit FPD, the masticatory force withstood by this material is 1250-1382N.<sup>[15]</sup> CAD/CAM-milled PEEK can withstand the masticatory force up to 2354N,<sup>[16]</sup> which has highest fracture resistance contrasted to lithium disilicate(950N), aluminium(851N) and Zirconia(981-1331N).<sup>[14]</sup> In our study, large number of students has responded that composite coated PEEK has low fracture resistance which complies with various published reports, because of inferior bonding strength between material surface and composite coating. As the polymer material is hydrophobic in nature and have high resistance to chemical wear.<sup>[17-19]</sup> In our study, selected students responded that the osteoconductive property of PEEK can be improvised by titanium coating. According to studies both hydroxy appetite and titanium coating, can positively enhance the osteoconductive property of the material.<sup>[20-22]</sup>

In our study, it is revealed that students know about PEEK material mostly through research articles and few students have no knowledge about the material. Most of students are willing to learn more about the material. Also, a number of students responded that they were undecided about using this material in their clinics and to suggest the material to their colleagues. Based on the questionnaire and response, students have less knowledge about the PEEK as dental material. More studies and research have to conducted to improve the quality of the material and increase the application of PEEK in day-to-day dental practice. Students must be encouraged to gain more knowledge about PEEK material. Limitation of the study is it has less number of study samples. There was no in-depth discussion with responders that might have had revealed more about why there was less knowledge about the material and their uncertainty regarding using the material in the clinics.

## CONCLUSION

From the study it can be concluded that the students have comparatively less knowledge about PEEK. It might be because of the less studies conducted on them, less awareness about the material and its property. More studies and research should be conducted to improvise the material and to widen it's use among clinicians.

## REFERENCES

1. Composite Technology for Total Hip Arthroplasty. : Clinical Orthopaedics and Related Research (1976-2007). LWW. [http://journals.lww.com/corr/Abstract/1988/10000/Composite\\_Technology\\_for\\_Total\\_Hip\\_Arthroplasty\\_.22.aspx](http://journals.lww.com/corr/Abstract/1988/10000/Composite_Technology_for_Total_Hip_Arthroplasty_.22.aspx). Published, 2019.
2. Kumar T A, Jei J B, Muthukumar B. Comparison of osteogenic potential of poly-ether-ether-ketone with titanium-coated poly-ether-ether-ketone and titanium-blended poly-ether-ether-ketone: An *in vitro* study. *J Indian Prosthodont Soc.*, 2017; 17: 167-74.
3. Tekin, S.; Cangül, S.; Adigüzel, Özkan; Değer, Y. Areas for Use of PEEK Material in Dentistry. *idr*2018, 8, 84-92.
4. MDS J. Nanotechnology in Dentistry: Clinical applications, Benefits, and Hazards | Compendium. <https://www.aegisdentalnetwork.com/cced/2017/05/nanotechnology-in-dentistry-clinical-applications-benefits-and-hazards>. Published 2017. Accessed July 22, 2019.
5. Yadav R, Kumar M. Dental restorative composite materials: A review. *J Oral Biosci*, 2019 Jun; 61(2): 78-83. doi:10.1016/j.job.2019.04.001. PMID: 31109861.
6. Zhang Y, Kelly JR. Dental Ceramics for Restoration and Metal Veneering. *Dent Clin North Am*, 2017; 61(4): 797–819. doi:10.1016/j.cden.2017.06.005.
7. Bathala L, Majeti V, Rachuri N, Singh N, Gedela S. The Role of Polyether Ether Ketone (Peek) in Dentistry - A Review. *J Med Life*, 2019; 12(1): 5–9. doi:10.25122/jml-2019-0003.
8. Nistor L, Grădinaru M, Rîcă R, et al. Zirconia Use in Dentistry - Manufacturing and Properties. *Curr Health Sci J.* 2019; 45(1): 28–35. doi:10.12865/CHSJ.45.01.03.
9. Skirbutis G, Dzingutė A, Masiliūnaitė V, Šulcaitė G, Žilinskas J. A review of PEEK polymer's properties and its use in prosthodontics. *Stomatologija*, 2017; 19(1): 19-23. Review. PubMed PMID: 29243680.
10. Rahmitasari F, Ishida Y, Kurahashi K, Matsuda T, Watanabe M, Ichikawa T. PEEK with Reinforced Materials and Modifications for Dental Implant Applications. *Dent J (Basel)*, 2017; 5(4): 35. Published 2017 Dec 15. doi:10.3390/dj5040035.
11. Zoidis P, Papathanasiou I. Modified PEEK resin-bonded fixed dental prosthesis as an interim restoration after implant placement. *J Prosthet Dent*, 2016 Nov; 116(5): 637-641. doi: 10.1016/j.prosdent.2016.04.024.
12. MAEKAWA M, KANNO Z, WADA T, et al. Mechanical properties of orthodontic wires made of super engineering plastic. *Dental Materials Journal*, 2015; 34(1): 114-119. doi:10.4012/dmj.2014-202.
13. Najeeb S, Zafar MS, Khurshid Z, Siddiqui F. Applications of polyetheretherketone (PEEK) in oral implantology and prosthodontics. *J Prosthodont Res.*, 2016 Jan; 60(1): 12-9. doi: 10.1016/j.jpor.2015.10.001. Review.
14. Chen Y, Pan Y. [Recent development of research on the biotribology of carbon fiber reinforced poly ether ether ketone composites]. *Sheng Wu Yi Xue Gong Cheng Xue Za Zhi.*, 2014 Dec; 31(6): 1405-8. 1418. PMID: 25868268.
15. Schwitalla A, Müller WD. PEEK dental implants: a review of the literature. *J Oral Implantol*, 2013 Dec; 39(6): 743-9. doi: 10.1563/AAID-JOI-D-11-00002.

16. Stawarczyk B, Eichberger M, Uhrenbacher J, Wimmer T, Edelhoff D, Schmidlin PR. Three-unit reinforced polyetheretherketone composite FDPs: influence of fabrication method on load-bearing capacity and failure types. *Dent Mater J.*, 2015; 34(1): 7-12. doi: 10.4012/dmj.2013-345.
17. Jung JH, Kim SY, Yi YJ, Lee BK, Kim YK. Hydroxyapatite-coated implant: Clinical prognosis assessment via a retrospective follow-up study for the average of 3 years. *J Adv Prosthodont*, 2018 Apr; 10(2): 85-92. doi:10.4047/jap.2018.10.2.85.
18. Zhou L, Qian Y, Zhu Y, Liu H, Gan K, Guo J. The effect of different surface treatments on the bond strength of PEEK composite materials. *Dent Mater*, 2014 Aug; 30(8): e209-15. doi: 10.1016/j.dental.2014.03.011.
19. Hallmann L, Mehl A, Sereno N, Hämmerle CHF. The improvement of adhesive properties of PEEK through different pre-treatments. *Appl Surf Sci.*, 2012; 258(18): 7213-7218. doi:10.1016/j.apsusc.2012.04.040.
20. Nazari V, Ghodsi S, Alikhasi M, Sahebi M, Shamshiri AR. Fracture Strength of Three-Unit Implant Supported Fixed Partial Dentures with Excessive Crown Height Fabricated from Different Materials. *J Dent (Tehran)*, 2016; 13(6): 400-406.
21. Cook SD, Rust-Dawicki AM. Preliminary evaluation of titanium-coated PEEK dental implants. *J Oral Implantol*, 1995; 21(3): 176-81.
22. Suska F, Omar O, Emanuelsson L, et al. Enhancement of CRF-PEEK osseointegration by plasma-sprayed hydroxyapatite: A rabbit model. *J Biomater Appl.*, 2014; 29(2): 234-242. doi:10.1177/0885328214521669.