

Effectiveness of Poly Ether Ketone (PEEK) material in over titanium: A cross sectional study

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Abstract

This study is aimed to review the applications of Polyether Ether Ketone (PEEK) in dentistry. The increased demand for aesthetics, legislation in some developed countries, few drawbacks with existing materials and clinicians shifting their paradigms towards metal free restorations led space for the metal-free restorations in today’s dental practice.

Poly(aryl-ether-ketone) materials (PAEKs), a class of high-performance polymers comprised of polyether ether ketone (PEEK) have attracted interest in standard dental procedures due to their inherent characteristics in terms of mechanical and biological properties.

An electronic literature search was conducted through Medline via PubMed, Wiley Online library, EBSCOhost, Science Direct, as well as the Google Scholar between January 2010 and March 2018 using the keywords: PEEK, modified PEEK, PEEK and Dental, advantages of PEEK, applications of PEEK in

dentistry and PEEK Implants. A total of 103 articles were found in the literature search and out of these, 18 were not related to our study and hence were excluded. Finally, 85 articles were found to be relevant. PEEK has been explained for several applications in dental practice. The literature showed that the PEEK material has superior mechanical properties with different uses in various specialties of dentistry.

Keywords: PEEK, Dental, Fixture.

Introduction

Prosthodontics, one of the important specialties of dentistry has paved way with various advancement over the years for treatment of missing teeth. Metal alloys has been go to material for ages in prosthodontics due to high mechanical properties but considering the esthetic and immune factor, non-metal alloys are welcomed. PEEK (Polyetheretherketone), a polymeric material developed in 1978 has gained popularity in last 2-3 years. PEEK, a semi-crystalline, polycyclic, aromatic,

linear thermoplastic polymer gives the material to withstand heat at high temperatures, greater bond strength and exceptionally high compatibility with agents such as glass and carbon fiber. As far the dentistry is concerned, PEEK is employed from Manu fracturing of clasps to implant superstructure, abutments, and fixture.

The difference in E-modulus between bone and biomaterials represents mechanical overloading of the bone, leading to damage to the surrounding tissue. Thus PEEK has lesser stress shielding effect, masking the main drawback of gold standard titanium which has low elastic modulus. Apart from these advantages, it is compatible with modern imaging technologies. PEEK is also lighter (9g) when made into prosthesis making it superior to traditional materials.¹⁰ Although, PEEK is gaining momentum in dental practice, awareness and knowledge about this material is unknown. This may be because of very few clinical practices on PEEK.

Awareness, knowledge, and attitude surveys are essential to judge both quantitative and qualitative information. Studies from reported that there is knowledge deficit, while others reported a higher level of awareness of 64.4%, 77%, and 79%, respectively. Studies also shows that dentists are considered the most common source of information about dental treatments which clearly shows the importance of the dentists. For this, up to date awareness and knowledge about both the conventional and newer materials used in dentistry is must for the dental professionals, so that patients will know about the advantages and limitations of treatment and set a realistic expectation pertaining to the treatment. Hence, the present study is conducted on undergraduate students pursuing dentistry to evaluate the awareness level and knowledge about Poly ether ketone material.

Methodology

The study design is a cross sectional study. An E-questionnaire with total of 25 item was distributed to dental undergraduates across various years in Chennai city. Responding to the questionnaire was termed as giving consent. The study period was carried out between January 2023 - March 2023. The study was approved by Institutional Human Ethical Committee (IHEC), CARE.

The questionnaire the questionnaire consists of 25 items divided into two different sections. The first section consists of five questions to assess the awareness level about PEEK and the next section consists of twenty questions to assess their knowledge about PEEK. The Responses of the latter were recorded in 5-point likert scale.

Inclusion criteria

Dental undergraduate students from first year to interns.

Exclusion criteria

Post graduate students of dentistry and the students pursuing non-dental professionals.

Sample size: The final sample size was 326 derived with significance level of 95%.

Statistical analysis: The data were analyzed for awareness across various years of undergraduate students and knowledge about PEEK using EPI-INFO (version 7.2.2.6, CDC license: Atlanta, Georgia US: public domain) software. Frequency distribution and cross tabulation was used to analyze the data. Significance level was fixed at 5% ($\alpha = 0.05$).

Results

A total of 300 dental undergraduates from various years of study participated in the study. 28% of the participants were from final years followed by third years 25%. In evaluating the awareness section, greater number of negative responses were recorded across each

year of undergraduates and only 30% of the participants were aware of the PEEK material of which 3/4th of them were interns. Compared to all the years, Interns recorded have maximum awareness about the material. Statistically significant association was found between awareness level and undergraduate from various years. It was noted that as the year of study progressed the awareness was higher.

In terms of the knowledge about the material, 60% of participants were unsure about the material and 8% of all the participants have strong knowledge about the material. Of the 8% of the participants, nearly 1/4th have strongly agreed to the question 'Full form of PEEK is Poly ether ketone' and lowest respond was given to the question pertaining to the mechanical property of the material.

Discussion

Biomaterials have been used for patient care for a long time. However, In spite of countless inventions in material science the search for improved material is still going. Since, awareness is the key for prevention of oral health problems, health professionals having lack of appropriate awareness cannot educate the patients. Hence, it is important for all health care professionals, including the dental students to have the necessary knowledge about the emerging materials to maintain and promote oral health. Questionnaire-based studies being effective for collecting and analyzing information. This cross-sectional questionnaire survey has been made about the emerging material PEEK.²⁰ Metal alloys which has been choice of interest for ages in dentistry is slowly being replaced by non-metallic options due to obvious reasons. ¹ PEEK, being superior among the non-metal options has gained momentum in dentistry. It's clinical use varies from an alternative to PMMA, CAD-

CAM restorations, copings etc to metal braces and hooks among others.

Dental undergraduates who participated in this study were not aware of the current usage and properties about the material. Of the 39.6% participants who had awareness about the material, 13.7%, 57.1%, 24.4%, 53.7% and 70.7% were from the first, second, third, fourth and intern year respectively. This study results shows that the overall awareness of the dental students is minimal regarding the PEEK material and there was significant association between awareness and year of study

In this study, first year had lower awareness and interns had most awareness which is in agreement with the study conducted by Guarnizo-Herreño et al ²¹. In which they stated, as the year of study increases; awareness of the individual increases. This is justified as the students exposed to clinical setting have certainly high exposure to traditionally used materials and have high awareness about the disadvantages of the conventional materials than the non-clinical students.

In analyzing the 20-item questionnaire pertaining to knowledge, the knowledge level about the material varied. We calculated mean of the total participants of which more than 60% of the respondents were unaware about PEEK material and its properties. Only 8% of all the participants strongly agreed to the knowledge pertaining to the material. A study done by Coyle et al. found that early exposure of health professionals to the dental education programs had positively affected their awareness and knowledge levels.²² Our results provide insight into students' knowledge that could influence treatment choice in future. This survey is clinically significant as students' awareness were determined regarding new material and its perceived knowledge were determined.

Conclusion

The dental students have low awareness and knowledge about the new material. However, the limitation of this study was small sample size and single institutional setting during a short span, thus generalized comments cannot be strongly made. Importance, properties and advantages of newer materials upon traditional materials are to be inculcated among the students through continuous education program in order to provide the best care and treatment for patients. Furthermore, there is a need to improvise the existing educational material by employing most current advances in technology.

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Legend Table and Figure

Table 1: Awareness about PEEK material.

	1st year	2nd year	3rd year	4th year	Interns	Total	P-value
Awareness about PEEK material							
Yes	10(13.7)	4(57.1)	20(24.4)	66(53.7)	29(70.7)	129(39.6)	0.001*
No	63(86.3)	3(42.9)	62(75.6)	57(46.3)	12(29.3)	197(60.4)	
Awareness about PEEK crowns							
Yes	6(8.2)	2(28.6)	19(23.2)	53(43.1)	28(68.3)	108(33.1)	0.001*
No	67(91.8)	5(71.4)	63(76.8)	70(56.9)	13(31.7)	218(66.9)	
PEEK belongs to polymers group							
Yes	14(19.2)	4(57.1)	18(22)	51(41.5)	28(68.3)	115(35.3)	0.001*
No	59(80.8)	3(42.9)	64(78)	72(58.5)	13(31.7)	211(64.7)	
PEEK used as an Implant material							
Yes	5(6.8)	3(42.9)	13(15.9)	43(35)	25(61)	89(27.3)	0.001*
No	68(93.2)	4(57.1)	69(84.1)	80(65)	16(39)	237(72.7)	
Aware about carbon fiber reinforced PEEK							
Yes	4(5.5)	1(14.3)	9(11)	33(26.8)	15(36.6)	62(19)	0.001*
No	69(94.5)	6(85.7)	73(89)	90(73.2)	26(63.4)	264(81)	

Chi-square tests for finding association between awareness and undergraduate students was performed.

Significant association was found between awareness and undergraduate students

Figure 1: Negative awareness vs Undergraduates from various years.



