Available online at https://www.mmpubl.com/

International Journal of Prosthodontic Rehabilitation

Original Article

Wear resistance patterns of milled PEEK and PMMA provisional restorations for dental implant prosthesis

Aswana Jayaprakash[1], Ashwini Sukanya[2], Jayakrishna Kumar[3]

[1]Senior Lecturer, [3]Professor & HOD, Department of Prosthodontics and Implantology, Ragas Dental College and Hospitals, Chennai.

[2]Senior Lecturer, Department of Prosthodontics, Madha Dental College and Hospitals, Chennai.

How to cite: *Aswana J et al. Wear resistance patterns of milled PEEK and PMMA provisional restorations for dental implant prosthesis. Int J Prostho Rehabil 2022; 3: 2:44-57*

Received : 08.12.2022 *Accepted: 21.12.2022* *Web Published: 28.12.2022*

ABSTRACT

Aim & Objectives: Aim of this in vitro study was to comparatively evaluate the wear resistance of two different materials used as provisional implant supported restorative Prosthesis.

Materials & Methods: Twenty natural mandibular first premolar teeth were considered as antagonistic teeth specimens. Ten samples each of milled PMMA (GROUP I), milled PEEK (GROUP II) were designated as disc samples. The samples were subjected to wear tests in a pin-on-disc machine. Surface roughness, wear rate, was measured after wear testing. The results were statistically analyzed using paired t tests. SEM analysis was done for one representative tested sample from each test group.

Results: Mean surface roughness (Ra) values before and after wear test for GROUPS I, II were 0.8276, 6.0214, 0.473 and 1.1948, respectively. Mean wear rates (mg/min) of GROUPS I & II were 0.00087, 0.0108 respectively. SEM analysis revealed prominently roughened surface for GROUP I, and smoother surface for GROUP II.

Conclusion: Within the limitations of the study, milled PMMA exhibited significantly higher surface roughness both before and after wear test as compared to both milled PEEK which was corroborated by surface profilometry and SEM analysis. Milled PEEK exhibited a marginally smoother surface compared to Milled PMMA. Milled PMMA showed significantly higher wear as compared to milled PEEK indicative of least wear resistance.

Keywords: Wear rate, surface roughness, CAD PMMA, CAD PEEK, SEM

Address for Correspondence:
Dr. Aswana Jayaprakash,
Department of Prosthodontics and Implantology,
Ragas Dental College and Hospitals, Chennai.
Email id: aswanajj1981@yahoo.co.in

Introduction

The role of provisional implant supported prosthesis is crucial in implant therapy, since it allows proper contouring of the gingival soft tissues around the implant abutment junction[1]. The average time of an implant supported provisional restoration is usually three months, but this period can be prolonged if an extended evaluation period is required. The time period for which they need to remain in place are dependent on the implant site preparation prior to implant placement, the loading protocol and the soft tissue contouring required afterwards[2,3]. Long term provisional restorations are indicated in certain conditions such as medically compromised patients and also patients undergoing extensive rehabilitation procedures with multidisciplinary approach [4, 5]

Various methods have been recommended to fabricate implant supported provisional restoration (ISPR). They can be made either in the dental operatory or at the dental laboratory[6] The provisional materials used in the laboratory include, heat cured polymethylmethacrylate resin (PMMA), indirect laboratory composites and more recently, CAD CAM milled PMMA and Polyetheretherketone (PEEK) materials[7,8,9]. Traditionally, heat cured PMMA were widely used in the construction of interim restorations due to their ease of manipulation and low cost. However, they exhibit clinical disadvantages like polymerisation shrinkage, poor wear resistance and colour instability.[10] Millable PMMA materials are reported to overcome these drawbacks[11] CAD/CAM technology is being used for the fabrication of provisional restorations, which traditionally have been made of acrylic resins or composite resin materials. High density polymers based on highly cross linked PMMA or composite resins have gained interest recently[12].

The novel high performance composite polyetheretherketone (PEEK), with its favorable mechanical properties is a polymer form of polyaryletherketone (PEEK) is available in both granular form and milled blanks. It is biocompatible and is stable by both in organic and inorganic chemicals.[13] Stawarczyk etal reported a mean load bearing capacity of 1383N for a three unit PEEK fixed dental prosthesis (DP)[14] , suggesting the use of PEEK as a suitable material for this purpose.

An important prerequisite for the successful assessment of ISPR is the wear resistance of the provisional materials employed. Wear of the material is influenced by numerous factors including contact, geometry, surface roughness, micro structural features, fracture toughness, velocity, load, temperature, duration, environment and lubrication.[3,17]. Occlusal wear results in alterations in the surface texture of the substrate material. Changes in the surface roughness/topography, favors the formation of biofilm, leading to inadequate oral hygiene maintenance and eventually causes chipping or fracture of the restoration[3].

Surface texture analysis by 3-D surface profilometry aids in qualitative visualization as well as the quantitative measure of the surface roughness (represented as Ra values) and helps to extrapolate the results with those obtained from two-body wear tests and qualitative SEM analysis.[8,15,18] A sensitive method to study differences in the structural integrity of a dental restorative material is by determination of wear using a two-body wear test.[19] Two-body abrasion results in surfaces that are rubbed away from direct contact. In the mouth these conditions occur predominantly during non masticatory tooth movement.[20] There are several testing methods capable of analyzing two-body wear patterns between different bio materials such as pin-on-disc, reciprocating, ball and crater, twin disc, etc. Tribological wear process refers to the presence of a "third body" between the teeth and their opposing restorations during mastication.[20] Many authors have suggested the use of pin-on-disc as one of the most reliable methods to evaluate wear. These in vitro wear tests are conducted to simulate a particular duration of clinical use by setting a fixed number of wear cycles in the testing equipment. Pin-on-disc wear testing is a method of quantitatively evaluating the rate of wear, coefficient of friction, and volume loss of material between two materials. This tribological test can simulate multiple modes of wear including unidirectional, bidirectional and omnidirectional forces [21, 22].

Dental interest in CAD/CAM provisional materials, has increased due to its higher fracture resistance, better stress distribution and lower abrasion of the antagonist enamel.[23] Previous studies have evaluated the tribological behaviour for conventional composite resins and dental ceramics.[24] Studies evaluating the wear of CAD/CAM polymers used as a provisional ISPR material are very few.[25] The applications of PEEK as an interim material for implant supported crowns are still in its early stages and data pertaining to its wear behaviour is sparse.[26] Scanning electron microscopy (SEM) is used as an adjunct for qualitatively interpretation of in vitro test results. SEM images aid in improving our understanding of the effect(s) of various test parameters on the test materials. SEM has been used in previous wear tests studies to achieve this purpose. Since the wear behaviour of the long term provisional material is essential for the durability of the implant supported restorations, the tribological behaviour of these materials needs further evaluation. In view of the above, the present in vitro study was conducted to comparatively evaluate the wear resistance of two different materials used for provisional implant-supported restorations.

The null hypothesis of the present study was that the wear testing will not result in significantly different wear outcomes for the two test materials.

Materials and methods

The present in-vitro study was conducted to comparatively evaluate the wear resistance of two different materials used for provisional implant supported restorations.

Twenty extracted human mandibular first premolar (Figure 1) free of dental caries were used for this study and embedded into acrylic blocks to function as pins for the pin-on-disc testing procedures. They were randomly divided into two groups of 10 each. CAD/CAM PEEK, CAD/CAM PMMA blank materials were milled to the dimensions of 20mm X 5mm test discs These test discs were grouped as Group I(Milled PMMA) (Figure 2), Group II (Milled PEEK) (Figure 3)(n=10 per group)

Preparation of artificial saliva & storage of test samples for wear testing:

To one litre de-ionized water, 0.65g/litre of potassium chloride, 0.058 g/litre of magnesium chloride, 0.165 g/litre of calcium chloride, 0.804 g/litre of di-potassium hydrogen phosphate, 0.365 g/litre of potassium di - hydrogen phosphate, 2 g/litre of sodium carboxymethyl cellulose were added and dissolved to obtain artificial saliva. The test samples were soaked in saliva solution 24 hours before to simulate the oral conditions and to have thin film of saliva over the surface of the discs. (Figure 4)

Wear testing procedure:

The test sample was removed from artificial saliva after 24 hours of storage, and was positioned on to the customized metal mould disc. The mould disc along with the test sample was placed on the revolving disc of the wear testing machine (Pin-on-disc machine) (Figure 5 & 6). The pin/tooth was placed into the pin holder and the clamp screws were tightened to avoid slipping during the loading and rotation of the disc. The pin was then adjusted so that the tooth would have a point contact against the disc sample by adjusting the track diameter to 10mm (Figure: 6), the respective screws are tightened for the pin and the disc. Each test sample was subjected to 5000 wear cycles at 750 RPM. The time period required to fulfill these cycles and RPM was calculated using the following formula. Time in sec: (sliding distance in m *60000/3.14* sliding dia in mm* R.P.M) This calculated time was found to be 6 minutes and 32 seconds and was kept uniform for wear testing of all the test samples used in this study. The above mentioned parameters (wear cycles, RPM, time duration and the load=25N) were set in the control panel of the wear testing machine, and the wear testing was conducted individually for all the 20 test samples (test samples of Group I and Group II) . The entire procedure of wear testing was carried out under the constant flow of artificial saliva.

Tabulation of the results and statistical analysis: The results obtained were tabulated and the data was subjected to statistical analysis using the SPSS-16 software.

Results

The Groups I & II test discs were weighed using micro balance and surface roughness values measured using 3D profilometry before wear testing (Figure 11). The tooth pins and test material disc samples were individually subjected to wear testing in a pin-on-disc wear testing machine. All the test samples of GROUPS I, & II were weighed and surface roughness values were measured after wear testing (Figure 5-8 & 12-15) Basic and mean wear rates for each test group were obtained (Table 1). The results were statistically analyzed using paired‘t’ tests. (Table 2 & 3) SEM analysis was done for one representative tested sample from each test group. (Figure 9 & 10)

Sample No	Milled PMMA Disc		Milled PEEK Disc	
	Before (Ra)	After (Ra)	Before (Ra)	After (Ra)
1	0.871	0.593	0.705	1.39
2	1.49	3.11	0.226	4.79
3	0.768	14.9	0.741	0.627
4	0.58	0.331	0.352	0.537
5	0.631	10.1	0.691	0.71
6	0.54	1.33	0.286	0.341
7	0.911	6.96	0.508	0.526
8	0.667	15.3	0.285	1.26
9	1.14	6.51	0.311	0.805
10	0.678	1.08	0.688	0.962
Mean	0.8276	6.0214	0.473	1.1948

Table 1: Mean surface roughness (Ra) of Group I (milled PMMA disc), Group II (milled PEEK disc), test samples before and after wear test

Sample No	Milled PMMA (Milligrams /Min)	Milled PEEK (Milligrams /Min)
1	0.001533231	0.022270298
2	0.001145778	0.000104025
3	0.001747311	0.00000302
4	0.00000105532	0.000508062
5	0.0000030152	0.00000302
6	0.00000361825	0.012677426
7	0.00000452281	0.00000452
8	0.00000286444	0.049550358
9	0.002192053	0.010048168
10	0.002026217	0.013206594
Mean	0.000879535	0.010837548

Table 2: Mean wear rates (milligrams/min) for Group I (milled PMMA disc), Group II (milled PEEK disc) test samples after wear test

S.No	Group	Mean	SD	P value
1	PMMA (Ra BEFORE)	0.8276	0.294	0.020*
2	PMMA (Ra AFTER)	6.0214	5.768	
3	PEEK (Ra BEFORE)	0.4793	0.209	0.139
4	PEEK (Ra AFTER)	1.1948	1.306	

*$p < 0.05$, statistically significant.

Table 3: Comparison of the respective before wear test and the respective after wear test mean surface roughness values (Ra) within Group I (milled PMMA disc) and within Group II (milled PEEK disc)

Discussion

With regards to implant supported provisional restoration, PEEK biomaterial offers superior features such as excellent mechanical properties, natural radiolucency, lack of toxicity and MRI compatibility.[27] Another salient characteristic of PEEK is its lower elastic modulus which is important in the distribution of stresses to the cortical bone. Many studies have evaluated the biocompatibility of PEEK as a biomaterial. However, not many studies have been done evaluating the wear resistance of milled PEEK and its application as provisional material for implant supported restoration.

Studies evaluating the wear resistance of various biomaterials such as gold, amalgam, ceramics, acrylics, etc are all well recognized. Identical studies involving CAD/CAM polymers remain very few. Studies comparing[28]. The wear parameters of milled PEEK material along with quantitative and qualitative surface analysis are not much reported

A wear testing machine is intended to simulate the masticatory cycle both functional and parafunctional, which allows analysis of two-body and three-body wear process and has been used in various in vitro studies to evaluate the effect of wear resistance of different substrate materials against an antagonistic tooth.[29, 30, 31]

Pin-on-disc wear testing machine was used in this present in vitro study. The pin portion was represented by the mandibular first premolar tooth and the disc portion corresponded to the test materials. In some studies the test materials were positioned in the holder and the antagonist tooth on the disc assembly.[31]

The wear testing procedure was developed in an attempt to simulate the wear process that occurs in the mouth. The range of masticatory cycle for a given day range from 5000-300,000 cycles, to simulate this condition, wear cycle was followed in this study was is in accordance with the study done by Shetty MS et al. [32] The 12 wear test was done at 25N load at 750 rpm for 5000 cycles 51 and 750 rpm and the entire cycle lasted for 6 minutes and 32 seconds. Artificial saliva was made to flow on the substrate surface during the rotation of the disc.[33, 34, 35] All the test samples and the antagonists tooth specimens were weighed before and after the end of 5000 cycles of wear test and the final weight was noted and tabulated.

In the present study 3-D surface roughness texture analysis of all the test samples (GROUP I and II) were evaluated before and after the wear test using a 3-D surface profilometry. The mean surface roughness (Ra) for Groups I and II before wear test was found to be 0.8276 and 0.4373, respectively. The mean surface roughness of GROUPS I and II after wear test was found to be 6.0214 and 1.1948 respectively (Table 1)

On comparison of the mean wear rate of all the two groups GROUP I and II, it was found that the mean wear rate of PMMA samples were higher as compared to milled PEEK (Table 2). In a previous study by Santing HJ et al[36], the wear rate of indirect composite material and milled PMMA material were tested. And the results showed lesser wear for indirect composite and higher wear rate for milled PMMA. This is in contrast to the results obtained in the present study. This could probably be attributed to the differences in the design of the study, materials utilized and study parameters. Since there is a paucity of the studies pertaining to the present in vitro study the results cannot be comparable.

The influence of the surface roughness results indicate that, even though the presence of the roughness was observed on all the test samples after wear testing, GROUP I samples showed significantly higher value as compared to GROUP II. This is of clinical concern since roughened surface acts as a nidus for biofilm formation and predisposes the surface to an accelerated wear. So the selection of the biomaterial should be done cautiously based on the intended duration of the prosthesis function.[36]

The present study has some limitations. The study conducted was two-body wear and not a three-body wear. Hence situations replicating clinical scenarios and different masticatory cycles should be included in future study. The effect of thermocycling was not evaluated in the study, as the samples were only soaked in artificial saliva 24 hours prior to the wear test. Hence proper protocol for thermocycling should be done in subsequent studies for predictable results. Future studies incorporating these parameters including a larger sample size with comparing three different materials are recommended to add merit to the results obtained with the present study

Conclusion

Within the limitations of the present study, milled PMMA exhibited significantly higher surface roughness both before and after wear test as compared to milled PEEK which was corroborated by surface profilometry and SEM analysis. Milled PEEK exhibited a smoother surface compared to Milled PMMA. Milled PMMA showed significantly higher wear as compared to both milled PEEK, indicative of least wear resistance among the test materials. Future studies replicating clinical scenarios and incorporating one more material, longer wear cycles with a larger sample size are recommended to enhance the results obtained with the present study.

Authors' contribution

Aswana Jayaprakash: First Author and main methodology and manuscript editing

Ashwini Sukanya: Manuscript editing. Peer evaluation

Jayakrishna kumar: Guide and Manuscript editing

Acknowledgement

The authors would thank the dental institutions for the support

Conflict of interest

The authors have nothing to disclose or any conflicts of interest.

Source of funding- None

References

[1]. Duraisamy R, Krishnan CS, Ramasubramanian H, Sampathkumar J, Mariappan S, Sivaprakasam AN. Compatibility of nonoriginal abutments with implants: Evaluation of microgap at the implant–abutment interface, with original and nonoriginal abutments. Implant dentistry. 2019 Jun 1;28(3):289-95.

[2]. Nam J, Aranyarachkul P. Achieving the optimal peri-implant soft tissue profile by the selective pressure method via provisional restorations in the esthetic zone. Journal of Esthetic and Restorative Dentistry. 2015 May;27(3):136-44.

[3]. Wang WC, Hafez TH, Almufleh AS, Ochoa DD, Manasse M. A Guideline on provisional restorations for patients undergoing implant treatment. J Oral Bio. 2015;2(2):7.

[4]. Papathanasiou I, Kamposiora P, Papavasiliou G, Ferrari M. The use of PEEK in digital prosthodontics: A narrative review. BMC Oral Health. 2020 Dec;20(1):1-1.

[5]. Shetty M, Alva H, Prasad A. Provisional restorations in prosthodontic rehabilitations-concepts, materials and techniques. Journal of Health and Allied Sciences NU. 2012 Jun;2(02):72-7.

[6]. Santosa RE. Provisional restoration options in implant dentistr. Australian dental journal. 2007 Sep;52(3):234-42.

[7]. Jayachandran R, Rathi N. Provisional Restoration in Implant Dentistry. Int J Clin Implant Dent with DVD. 2010;3:31-8.

[8]. Preis V, Behr M, Kolbeck C, Hahnel S, Handel G, Rosentritt M. Wear performance of substructure ceramics and veneering porcelains. Dental Materials. 2011 Aug 1;27(8):796-804.

[9]. Reda R, Zanza A, Galli M, De Biase A, Testarelli L, Di Nardo D. Applications and Clinical Behavior of BioHPP in Prosthetic Dentistry: A Short Review. Journal of Composites Science. 2022 Mar 14;6(3):90.

[10]. Zafar MS. Prosthodontic applications of polymethyl methacrylate (PMMA): An update. Polymers. 2020 Oct 8;12(10):2299..

[11]. Burns DR, Beck DA, Nelson SK. A review of selected dental literature on contemporary provisional fixed prosthodontic treatment: report of the Committee on Research in Fixed Prosthodontics of the Academy of Fixed Prosthodontics. The Journal of prosthetic dentistry. 2003 Nov 1;90(5):474-97.

[12]. Sidhom M, Zaghloul H, Mosleh IE, Eldwakhly E. Effect of Different CAD/CAM Milling and 3D Printing Digital Fabrication Techniques on the Accuracy of PMMA Working Models and Vertical Marginal Fit of PMMA Provisional Dental Prosthesis: An In Vitro Study. Polymers. 2022 Mar 22;14(7):1285.

[13]. Ionescu RN, Totan AR, Imre MM, Țâncu AM, Pantea M, Butucescu M, Farcașiu AT. Prosthetic materials used for implant-supported restorations and their biochemical oral interactions: A narrative review. Materials. 2022 Jan 28;15(3):1016.

[14]. Soldatovic DM, Liebermann A, Huth KC, Stawarczyk B. Fracture load of different veneered and implant-supported 4-UNIT cantilever PEEK fixed dental prostheses. Journal of the Mechanical Behavior of Biomedical Materials. 2022 May 1;129:105173.

[15]. Culhaoglu AK, Park J. A comparison of the wear resistance and hardness of two different indirect composite resins with a ceramic material, opposed to human enamel. European Journal of General Dentistry. 2013 Sep;2(03):274-80.

[16]. Mandikos MN, McGivney GP, Davis E, Bush PJ, Carter JM. A comparison of the wear resistance and hardness of indirect composite resins. The Journal of prosthetic dentistry. 2001 Apr 1;85(4):386-95.

[17]. Sari T, Usumez A, Strasser T, Şahinbas A, Rosentritt M. Temporary materials: comparison of in vivo and in vitro performance. Clinical oral investigations. 2020 Nov;24(11):4061-8.

[18]. Stawarczyk B, Özcan M, Trottmann A, Schmutz F, Roos M, Hämmerle C. Two-body wear rate of CAD/CAM resin blocks and their enamel antagonists. The Journal of prosthetic dentistry. 2013 May 1;109(5):325-32.

[19]. Burgoyne AR, Nicholls JI, Brudvik JS. In vitro two-body wear of inlay-onlay composite resin restoratives. The Journal of prosthetic dentistry. 1991 Feb 1;65(2):206-14.

[20]. Lambrechts P, Debels E, Van Landuyt K, Peumans M, Van Meerbeek B. How to simulate wear?: overview of existing methods. Dental materials. 2006 Aug 1;22(8):693-701.

[21]. Blattner R, Gahr K-HZ. Wear Mechanisms and Influence of Humidity on the Tribological Behaviour of SSiC Ceramic under Unidirectional Sliding. Ceramics - Processing, Reliability, Tribology and Wear. 2006. p. 417–24.

[22]. Anand M, Burmistroviene G, Tudela I, Verbickas R, Lowman G, Zhang Y. Tribological evaluation of soft metallic multilayer coatings for wear applications based on a multiple pass scratch test method [Internet]. Vols. 388-389, Wear. 2017. p. 39–46. Available from: http://dx.doi.org/10.1016/j.wear.2017.01.119

[23]. Hensel F, Koenig A, Doerfler H-M, Fuchs F, Rosentritt M, Hahnel S. CAD/CAM Resin-Based Composites for Use in Long-Term Temporary Fixed Dental Prostheses. Polymers [Internet]. 2021 Oct 9;13(20). Available from: http://dx.doi.org/10.3390/polym13203469

[24]. Sultan MT, Jamir MR, Majid MS, Azmi AI, Saba N, editors. Tribological Applications of Composite Materials. Springer Singapore; 2021.

[25]. Scotti N, Ionescu A, Comba A, Baldi A, Brambilla E, Vichi A, Goracci C, Ciardiello R, Tridello A, Paolino D, Botto D. Influence of Low-pH Beverages on the Two-Body Wear of CAD/CAM Monolithic Materials. Polymers. 2021 Aug 30;13(17):2915.

[26]. Tekin S, Değer Y, Demirci FA. Evaluation of the use of PEEK material in implant-supported fixed restorations by finite element analysis. Niger J Clin Pract. 2019 Sep 1;22(9):1252-8.

[27]. Stawarczyk B, Jordan P, Schmidlin PR, Roos M, Eichberger M, Gernet W, Keul C. PEEK surface treatment effects on tensile bond strength to veneering resins. The Journal of prosthetic dentistry. 2014 Nov 1;112(5):1278-88.

[28]. Wassell RW, McCabe JF, Walls AW. Wear characteristics in a two-body wear test. Dental Materials. 1994 Jul 1;10(4):269-74.

[29]. Kaidonis JA, Richards LC, Townsend GC, Tansley GD. Wear of human enamel: a quantitative in vitro assessment. Journal of dental research. 1998 Dec;77(12):1983-90.

[30]. Monasky GE, Taylor DF. Studies on the wear of porcelain, enamel, and gold. The Journal of prosthetic dentistry. 1971 Mar 1;25(3):299-306.

[31]. Sripetchdanond J, Leevailoj C. Wear of human enamel opposing monolithic zirconia, glass ceramic, and composite resin: an in vitro study. The Journal of prosthetic dentistry. 2014 Nov 1;112(5):1141-50.

[32]. Shetty MS, Shenoy KK. An in vitro analysis of wear resistance of commercially available acrylic denture teeth. The Journal of Indian Prosthodontic Society. 2010 Sep;10(3):149-53.

[33]. Hacker CH, Wagner WC, Razzoog ME. An in vitro investigation of the wear of enamel on porcelain and gold in saliva. The Journal of prosthetic dentistry. 1996 Jan 1;75(1):14-7.

[34]. Hirano S, May KB, Wagner WC, Hacker CH. In vitro wear of resin denture teeth. The Journal of Prosthetic Dentistry. 1998 Feb 1;79(2):152-5.

[35]. Koczorowski R, Wloch S. Evaluation of wear of selected prosthetic materials in contact with enamel and dentin. The Journal of prosthetic dentistry. 1999 Apr 1;81(4):453-9.

[36]. Santing HJ, Kleverlaan CJ, Werner A, Feilzer AJ, Raghoebar GM, Meijer HJ. Occlusal Wear of Provisional Implant-Supported Restorations. Clinical implant dentistry and related research. 2015 Feb;17(1):179-85.

Figures

Figure 1: Mandibular First premolar teeth to be used as pin

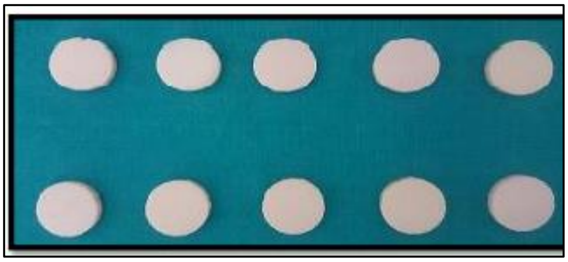

Figure 2: CAD CAM PMMA Discs

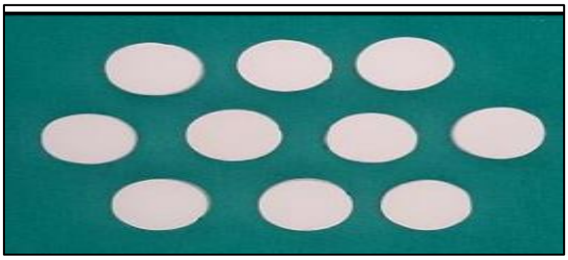

Figure 3: CAD/CAM PEEK Discs

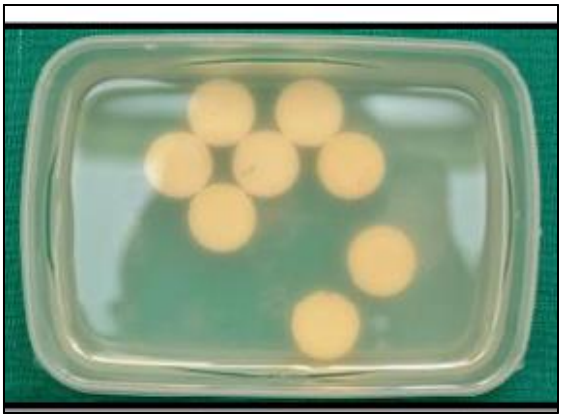

Figure 4: Discs soaked in artificial saliva

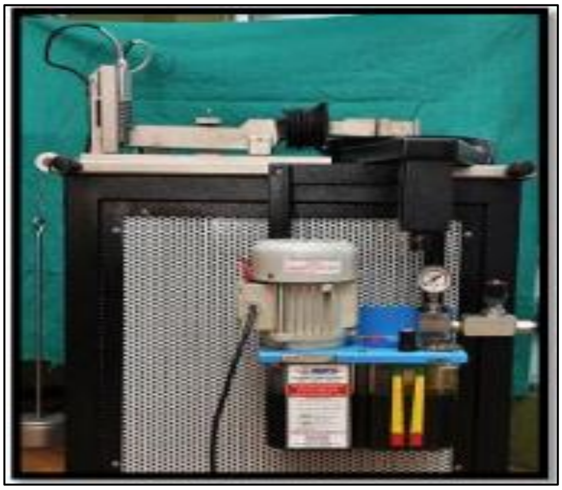

Figure 5: Pin -On- Disc Machine

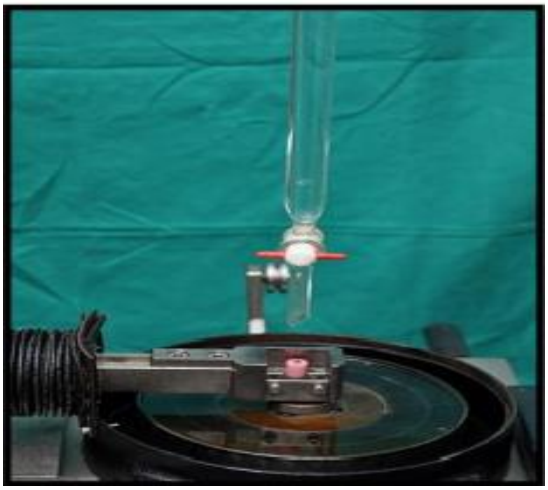

Figure 6: Wear test done under artificial saliva

Figure7: Wear tested PMMA Discs

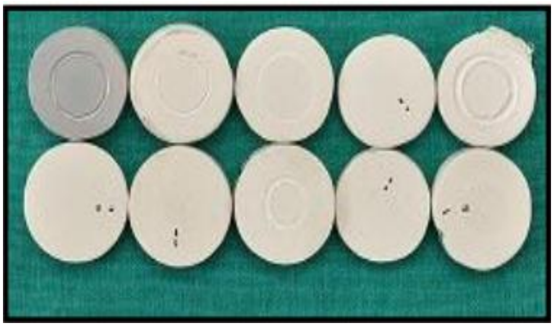

Figure8: Wear tested PEEK Discs

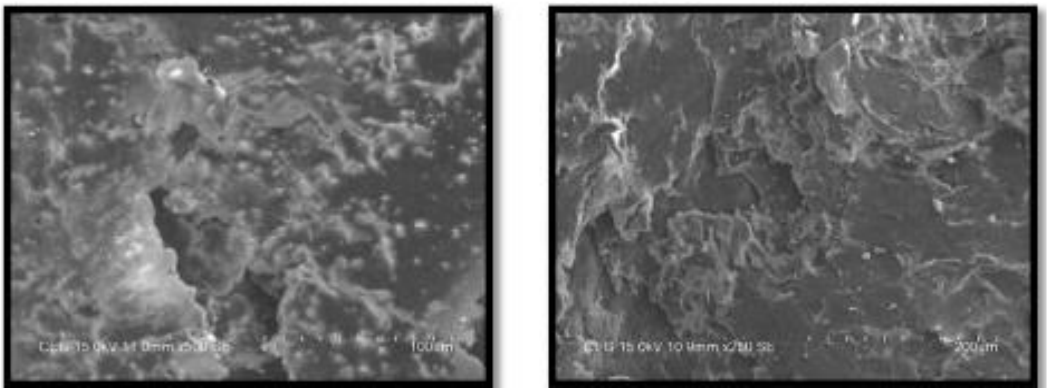

Figure 9: SEM photomicrograph of tested Group I sample under 200X and 500x magnification

Group I (milled PMMA) representative tested sample revealed a predominantly microroughened and frosty surface under 250x magnification. Under 500x magnification, the frosty areas were well defined and pronounced peaks and valleys distributed throughout the surface, indicative of greater surface roughening.

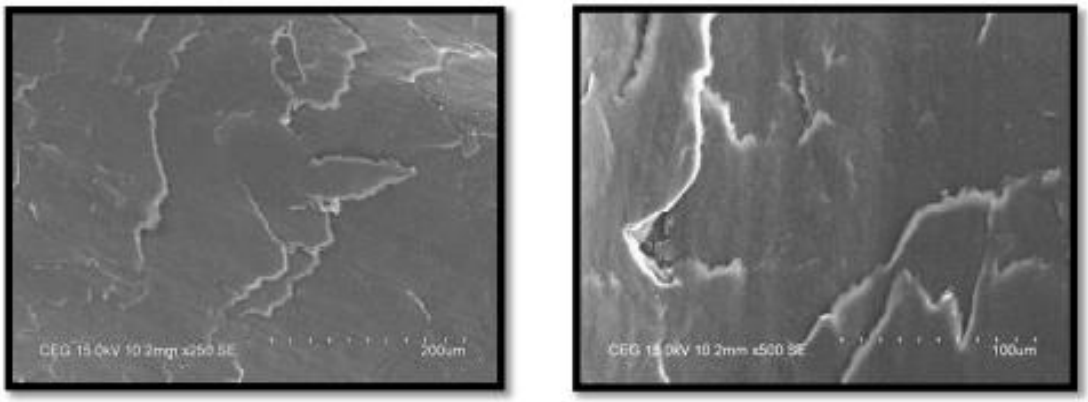

Figure 10: SEM photomicrograph of tested Group II sample under 200X and 500x magnification
Group II (milled PEEK) representative tested sample revealed a predominantly smoother surface with sparsely distributed elevations under 250x magnification. Under 500x magnification, these elevations appeared as sparsely distributed and poorly defined peaks indicative of a smoother surface

Figure 11: Non-contact 3D profilometer

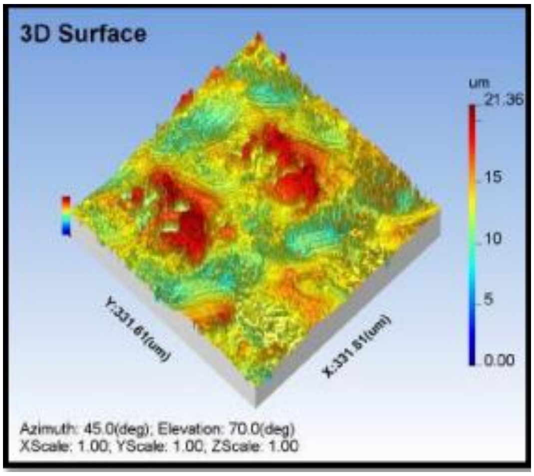

Figure 12: Advanced 3D view of surface topography of Group I (milled PMMA) test disc before wear test obtained by 3D surface profilometery.
Evenly distributed, distinct peaks and valleys visible throughout the surface of the sample. Peaks and valleys are of larger diameter, indicative of a moderately rough surface

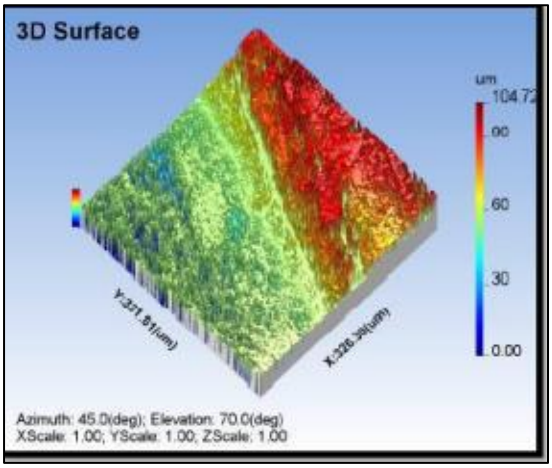

Figure 13: Advanced 3D view of surface topography of Group I (milled PMMA) test disc after wear test obtained by 3D surface profilometery.
Well defined, heavily pronounced and densely distributed peaks and valleys of greater depth indicative of a rough surface visible throughout the surface of the sample. The surface roughness was more pronounced in intensity over that of the before wear test

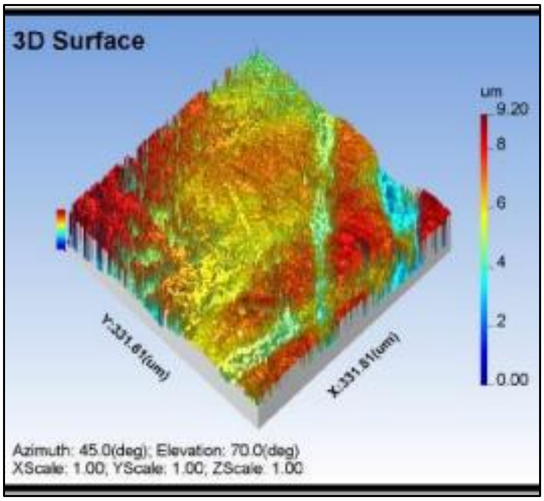

Figure 14: Advanced 3D view of surface topography of Group II (milled PEEK) test disc before wear test obtained by 3D surface profilometery
Peaks and valleys that were moderately pronounced were distributed sparsely throughout the surface of the sample. These were of smaller dimensions indicative of a moderately rough surface

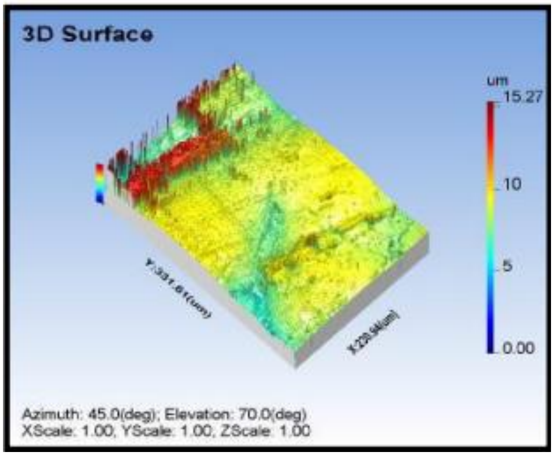

Figure 15: Advanced 3D view of surface topography of Group II (milled PEEK) test disc after wear test obtained by 3D surface profilometery.
Poorly defined peaks and valleys were found in patchy distribution throughout the surface of the sample. There were no obviously significant differences in surface roughness between the before and after wear test images.

Published by MM Publishers
https://www.mmpubl.com/ijprosthor