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Case Report

Esthetic rehabilitation with modified PEEK using analogue-digital protocol

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ABSTRACT

With the advancing digital technology and introduction of newer biocompatible materials with properties similar to biological tissues, CAD CAM fabricated restorations are gaining wide popularity. Introduction of Zirconia and BioHPP (High Performance Polymer) Polyether-ether-ketone (PEEK) has widened the horizons of clinical prosthodontics. Its use has been successfully demonstrated in implantology for fabrication of frameworks and as substructures for replacement of missing teeth. Literature evidence and clinical reports highlighting their usage for long span FDPs is however scanty. This article aims to highlight a combination of digital-analogue procedure for successful rehabilitation of mutilated and missing anterior teeth in a young adult using virtual articulator, modified Bio-HPP PEEK restorations and manufacturer recommended Visio.lign system.

1. Introduction

Rehabilitation of mutilated teeth or broken down dentition using full coverage restorations has always been a gold standard treatment modality with proven clinical longevity. Over the years, the full coverage restorative materials have evolved from use of noble metals to base metal alloys and in the present day to newer materials like zirconia and polyether-ether ketone (PEEK). The analogue, manual or conventional method of fabrication of these type of restorations involves tedious laboratory steps and requires skills of the operator and technician for procedures like pre-treatment diagnostic wax-up, impression making, interocclusal records, mounting of casts on articulator to establish accurate maxillomandibular relations, programming of articulator to permit proper wax pattern fabrication, use of customized incisal guidance for esthetic restorations, casting, veneering with porcelain and finishing. To reduce the chances of errors and to simplify the procedure, the technology has progressed to Digital workflow, wherein the entire procedure can be performed digitally. This involves sophisticated equipment including intraoral or extraoral scanners for obtaining a scan of the prepared tooth, transferring it to software for Computer Aided Designing (CAD) and Computer Aided Manufacturing (CAM).[1] Virtual articulators have been introduced which utilize the scanned maxillomandibular relation and records for programming of the virtual articulator and thereby, virtually designing the restorations.[2] This is followed by milling of restorations and layering or finishing as per requirement. The restorations designed are adjusted by the software based on the available clearance and the areas of interference are marked and removed while designing of the restorations.

Introduction of digital protocols in dentistry minimizes the errors, simplify the procedure to provide more precise and esthetic results. An amalgamation of digital-analogue techniques at various levels may be beneficial to obtain the advantages of precision and accuracy of virtual computer assisted procedure and economic benefits of conventional manual techniques.

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This case report highlights the rehabilitation of PDI class II partially edentulous patient with layered BioHPP PEEK restorations fabricated using digital-analogue technique utilizing a few basic steps performed in a conventional manner. The use of digital technology such as virtual articulator and modified BioHPP PEEK restorations using Visio. lign system as a successful treatment option for long span esthetic rehabilitation.

2. Case Report

A 22 years old male patient reported to the department of Prosthodontics and Crown & Bridge, AFMC Pune with chief complaint of unaesthetic appearance and difficulty in chewing food due to broken down upper front teeth and missing lower front teeth since last 02 years (Figure 1). Past dental history revealed that the patient had developed carious lesions in maxillary and mandibular anterior teeth about 03 years back, attempts were made for endodontic therapy of the teeth but mandibular teeth had to be extracted due to recurrent infection and discharge 02 years back. Clinical and radiographic examination revealed endodontically treated 12,11,21,22 with insufficient coronal structure in 11 and missing 32,31,41,42 (Figure 2). Based on examination and investigations, a diagnosis of PDI Class II partially edentulous arch was made. The treatment plan was to use a combination of 'analogue-digital protocol'. Maxillary rehabilitation was planned using a cast metal post and core in 11 followed by modified PEEK (BioHPP) crowns on 12,11,21,22. Mandibular rehabilitation was planned with tooth-supported modified PEEK (BioHPP) fixed dental prosthesis irt 32,31,41,42 using 33 and 43 as abutments.

The 'Analogue Protocol' included the implementation of conventional methods in fabrication of restorations. Diagnostic impressions were made in irreversible hydrocolloid impression material (Zelgan, Dentsply, India) and diagnostic mounting was done at maximum intercuspation using a interocclusal record. Diagnostic wax up was done, the procedure was explained to the patient and written consent was obtained. For rehabilitation of 11, post space preparation was done to fabricate a cast post and core in a conventional manner. Once the post was luted, removal of caries, light cured composite restorations and tooth preparation of adjacent teeth was carried out taking care to provide adequate bulk to restoration within physiological limitations (Figure 3). Analogue protocol was used for fabrication of provisional restorations. The putty index was made over the diagnostic wax up and were used to fabricate chair side provisional restorations using Accutemp Bis-acrylic, self-curing provisional restorative material (Medicept Dental, UK). The provisional restorations were adjusted based on esthetics and phonetics and luted using a temporary luting cement. Impressions were made for fabrication of customized incisal guide table using putty consistency of PVS impression material (Zhermack, Italy) (Figure 4). Protrusive and eccentric movements were done while the putty was still soft to record the customized guide table. This was eventually used for adjusting the final restorations. This was used for adjustment of restorations during the stage of layering with esthetic composite.

At this stage, the digital protocol was introduced for fabrication of definitive restorations using digtal protocol and modified PEEK restorations (Bredent, Germany) with visio.lign system (Bredent, Germany). For transferring of the relation recorded by analogue technique to a virtual system, Artex CR, semiadjustable articulator (AmannGirrbach AG, Austria) was used. The facebow with nasion relator was positioned and orientation relation was recorded and mounted on the articulator using a mounting jig. Interocclusal records were made using Alu wax (MAARC, India) in maximum intercuspation to mount the mandibular cast, protrusive records for programming of articulator and setting of horizontal condylar guidance, right lateral and left lateral records for setting of lateral condylar guidance on the articulator (Figure 5). The maxillary and mandibular cast were scanned using extraoral optical scanner and ceramill map software. The mounted casts were transferred on virtual articulator using a scanning jig. On the virtual articulator, the programming was done based on values obtained on Artex CR articulator which were recorded as horizontal condylar guidance of 25 degrees and lateral condylar guidance of 15 degrees on both right and left side. The treatment option for maxillary arch was to fabricate PEEK copings layered with esthetic composite layering material. For rehabilitation of mandibular edentulous area, the options were either to fabricate a fixed prosthesis using PEEK substructure with canines and first premolars as abutments, fixed-removable option such as Andrews bridge or a removable prosthesis. To gain the advantages of fixed restorations without challenging the ante's law, a combination of treatment options were selected with a bar fabricated using BioHPP PEEK, layered with compatible 'Neo.lign' teeth and 'crea.lign' veneering composite using 'visio.lign' system. Designing of definitive restorations comprised of reduced copings over canines and a bar connecting the two abutments using ceramill mind software (Figure 6). The designed restorations was adjusted as per the virtual articulator to permit desirable contacts and disclusion. Once designing was complete, the copings were milled in modified PEEK material. For attachment of pontics, instead of milling them in PEEK, Visio.lign system was used. Neo.lign high-impact PMMA composite teeth of suitable shade and size were selected visio.link primer was applied over the surface of teeth and polymerized using light activation. 'Combo.lign', a dual cure luting composite was selected based on shade. Following application of combo.lign, the teeth are placed over the BioHPP PEEK

bar and polymerized (Figure 7). 'Crea.lign' is a microfilled composite, used for veneering of the copings and as gingival layering material in regions of pontics and cured. The restorations were adjusted on the articulator using customized incisal guide table, tried into the patient and checked for mutually protected articulation (Figure 8). Luting of restorations were done using resin luting agent (Figure 9). Post- op instructions were given to the patient and the patient was followed up at 01 week, 04 weeks and 03 months.

Fig. 1: Pre-treatment Extra-oral view

Fig. 2: Pre-treatment Intra-oral

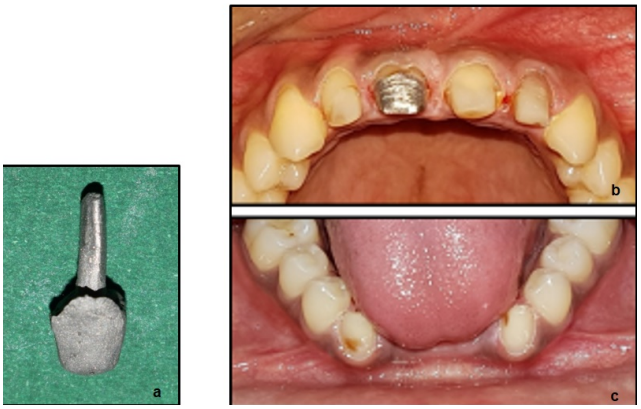

Fig. 3: Intra-operative

Fig. 4: Provisionalization & Fabrication of Customized Incisal guide table

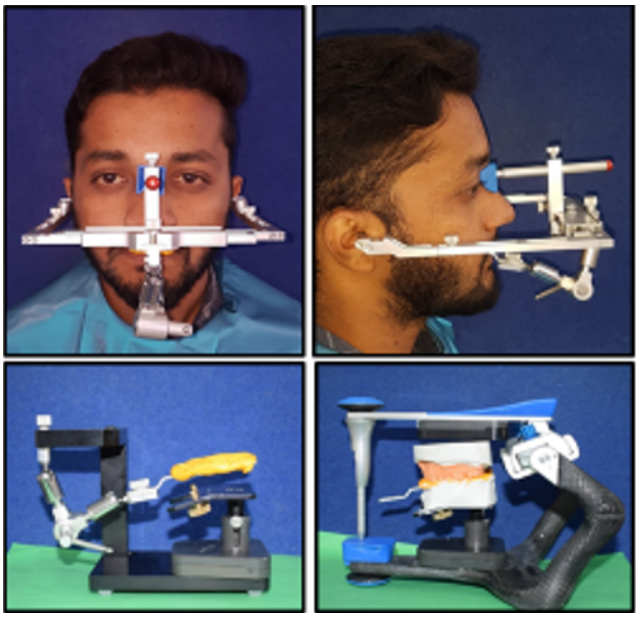

Fig. 5: Use ofArtex CR

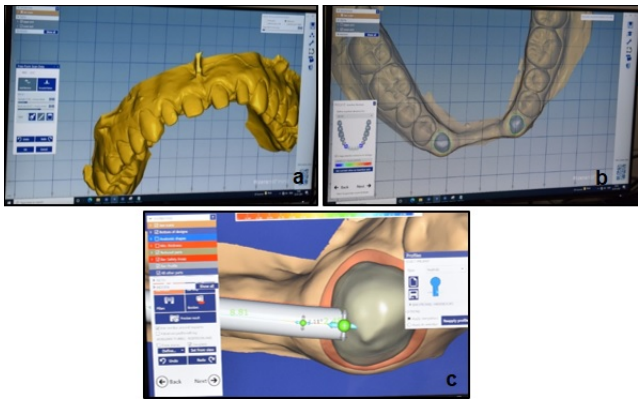

Fig. 6: Computer Aided Designing of restorations using Ceramill Mind

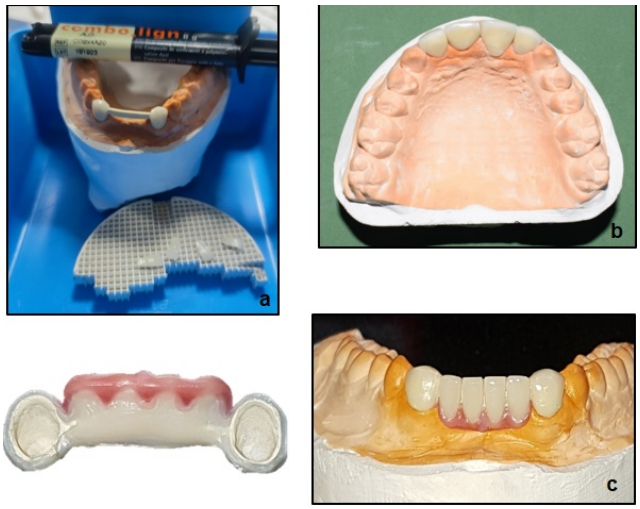

Fig. 7: Visio.lign system

Fig. 8: Mutually Protected Articulation in eccentric movements

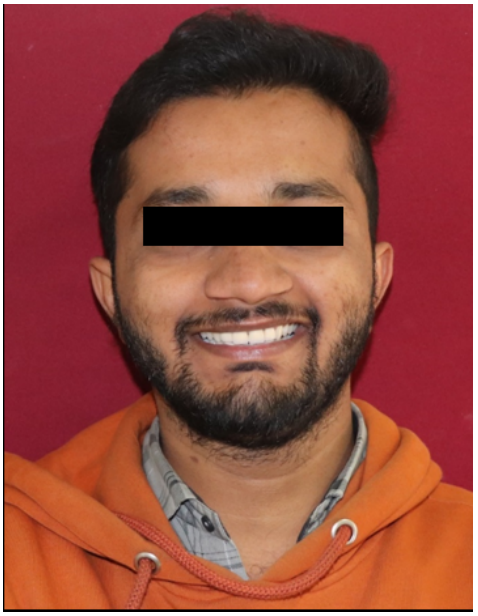

Fig. 9: Post-op Extra-oral view

3. Discussion

Long span anterior FDPs replacing incisors often pose a challenge in Prosthodontic practice. Various fixed-removable treatment options like Andrews Bridge, Resin retained restorations or implant restorations have been used.[3,4] The analogue or conventional method of fabrication of long span anterior esthetic restorations are based on various prosthodontic concepts and techniques like utilization of elastomeric impressions, programmed semi-adjustable articulator customized to patient's anatomy, use of customized incisal guide table, fabrication of a rigid framework and others. The digital protocol however is based on scanning, designing, milling using virtual facebow and articulation systems. In the present case, a combination of these protocols has been implemented with use of Bio-HPP PEEK and Visio.lign system.

PEEK is a polycyclic, aromatic, thermoplastic, semi-crystalline polymer. It is a light material due to its low density, superior mechanical strength and low cytotoxicity, it has been popularly used for fabrication of implant supported fixed restorations.[5,6] The manufacturers claim that because of modulus of elasticity similar to bone and excellent biocompatibility, they can be used in fabrication of long span fixed dental prosthesis as well.[7,8]

To utilize the benefits of the PEEK material without any deleterious impact on the abutment teeth, a manufacture recommended protocol using visio.lign esthetic and functional system was used. Suitable artificial teeth were selected based on size, shade and shape and was luted using crea.lign veneering material with combo.lign luting composite material. The advantage was that the abutment

teeth and the substructure bar was spared from excessive occlusal load, instead on excessive load the layering composite would fracture instead of substructure.

Virtual articulator is a software based tool which may be completely adjustable using jaw motion analyser or mathematically simulation of articulator movement. It serves as a connection link between virtual and manual prosthetic technology.[9] The advantages of Artex CR articulator includes that it offers the same functional scope as compared to its virtual component. The maxillomandibular relation as achieved on the Artex CR articulator can be precisely transferred to virtual system using Ceramill Fixator. This act as a functional interface between manual and digital techniques. This permits calculation of the fully anatomical construction is dynamic and static state using the values used for programming of articulator which allows adequate clearance for the veneering porcelain which is automatically planned during the designing procedure.[10]

Use of multiple contemporary material and technology helped in fabrication of an esthetic and functional restoration, with minimum loads over the abutment and enhanced esthetics with clinical longevity.

4. Conclusion

With the advancements in various aspects of prosthodontics like use of biocompatible materials like BioHPP PEEK, modified designs and using layering techniques such as Visio.lign system, CAD-CAM softwares and virtual articulators it has become possible to enhance accuracy and precision for fabrication of functionally integrated esthetic restorations. This case reports shows successful integration of these technologies in rehabilitation of the patient, enhancing his esthetics, form and function.

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6. Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Takeuchi Y, Koizumi H, Furuchi M, Sato Y, Ohkubo C, Matsumura H, et al. Use of digital impression systems with intraoral scanners for fabricating restorations and fixed dental prostheses. *J Oral Sci*. 2018;60(1):1–7. doi:10.2334/josnusd.17-0444.
2. Koralakunte PR. The Role of Virtual Articulator in Prosthetic and Restorative Dentistry. *J Clin Diagn Res*. 2014;8(7):25. doi:10.7860/jcdr/2014/8929.4648.
3. III JF, Salmon CA, II JP. Treatment Options for the Replacement of Missing Mandibular Incisors. *J Prosthod: Implant, Esthetic Reconstr Dent*. 2011;20(5):414–20. doi:10.1111/j.1532-849x.2011.00732.x.
4. Bhapkar P, Botre A, Menon P, Gubrellay P. Andrew′s Bridge System: An Esthetic Option. *J Dent Allied Sci*. 2015;4(1):36. doi:10.4103/2277-4696.167541.
5. Bathala L, Majeti V, Rachuri N, Singh N, Gedela S. Virtual articulators and virtual mounting procedures: where do we stand? *The role of polyether ether Ketone (Peek) in dentistry-A Review Journal of medicine and life*. 2019;12:5.
6. Mishra S, Chowdhary R. PEEK materials as an alternative to titanium in dental implants: A systematic review. *Clin Implant Dent Related Res*. 2019;21:208–22. doi:10.1111/cid.12706.
7. Sinha N, Reddy KM, Gupta N, Shastry YM. A cephalometric analysis of Class II dentate subjects to establish a formula to determine the occlusal plane in Class II edentate subjects: A neo adjunct. *J Indian Prosthod Soc*. 2017;17:226. doi:10.4103/jips.jips_21_17.
8. Garcia-Gonzalez D, Rusinek A, Jankowiak T, Arias A. Mechanical impact behavior of polyether–ether–ketone (PEEK). *Composite Structures*. 2015;124:88–99. doi:10.1016/j.compstruct.2014.12.061.
9. Lepidi L, Galli M, Mastrangelo F, Venezia P, Joda T, Wang HL, et al. Virtual Articulators and Virtual Mounting Procedures: Where Do We Stand? *J Prosthod*. 2021;30(1):24–35. doi:10.1111/jopr.13240.
10. Mancaş C, Freiman P, Lupulescu TE, Duminica T. The Advantages Of Mounting In Semi-Adaptable Articulators In Dental Prosthetics. *J Med Aradean (Arad Med J)*. 2011;14(3-4):90–4.

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