

# Esthetic Rehabilitation of a Post-trauma Patient Using Anterior Block Graft and Screw-retained Prosthesis over Ceramic-reinforced Polyetheretherketone Abutment: A Case Report

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Received on: 24 August 2023; Accepted on: 16 October 2023; Published on: xxxx

## ABSTRACT

**Aim and background:** This case report describes the comprehensive and conservative rehabilitation of a post-trauma patient with advanced techniques and materials along with laboratory steps of fabrication of a provisional crown.

**Case description:** A 19-year-old female reported a history of avulsion of her right central incisor during childhood and wanted a cosmetic replacement with a fixed tooth. A block graft was harvested to augment the deficient bone, followed by the placement of a narrow-diameter implant. Severe deep bite, implant with slight palatal with emergence, unfavorable gingival contour, and high esthetic demand were noticed on prosthodontic referral. Innovative modification in interim denture restored esthetics during the healing phase. Immediate provisional crown after modification of the gingival zenith with laser technology helped in the prosthetic and psychological rehabilitation of the patient. A customized hybrid abutment fabricated in ceramic reinforced polyetheretherketone (PEEK) [high-performance polymer (BioHPP)] and veneering with highly translucent composite provided life-like esthetics to the final restoration, which is maintained up to the 2-year follow-up.

**Conclusion:** A good prosthetic outcome satisfied the esthetic demand of the patient and helped in restoring her self-esteem.

**Clinical significance:** Customized titanium or zirconia abutments have been used to manage labially angulated implants, but rehabilitation of an implant with a palatal emergence implant has been less documented. Satisfactory results suggest that ceramic-reinforced PEEK can be considered to restore the esthetics of patients requiring implant-supported crowns in similar complex clinical situations.

**Keywords:** Anterior tooth trauma, Case Report, Dental implant, Esthetics, Polyetheretherketone, Implant abutment, Visual analog scale.

*Journal of Postgraduate Medicine, Education and Research* (2023): 10.5005/jp-journals-10028-1650

## INTRODUCTION

The beauty and symmetry of anterior teeth have a direct influence on the self-esteem of an individual. Loss of anterior teeth has a significant impact on the quality of life because of esthetic, functional, and psychological debilitations. Therefore, it is extremely important to replace missing anterior teeth, with special emphasis on fulfilling patients' expectations and esthetic requirements. Modern-day treatment concept advocates rehabilitation with dental implants; nevertheless, it is quite challenging in the anterior region because of high esthetic demands and compromised condition of the soft and hard tissues, especially if the tooth loss was due to trauma.<sup>1</sup>

For a predictable esthetic outcome and long-term success of implant-supported prosthesis, an implant should be placed precisely in all three dimensions.<sup>2</sup> This will ensure a good emergence profile, a harmonious soft tissue contour, and will preserve adjoining bone. However, in a few instances, patients are referred to the restorative dentist after implant placement. The most common malposition reported with an anterior implant is too far facial placement, leading to various consequences like facial bone loss, mid-facial gingival recession, and/or over-contoured lengthy prosthetic crowns.<sup>3</sup> Another iatrogenic malposition that is less frequently reported is the palatal placement of the implant, requiring a modified ridge lap variant of crown fabrication.<sup>4</sup>

Restoring the implants with palatal emergence conservatively is daunting and relies on the selection of a suitable prosthetic material. Angle correction screws or conventional materials like titanium or zirconia are being extensively used for the fabrication of customized

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**How to cite this article:** Pruthi G. Esthetic Rehabilitation of a Post-trauma Patient Using Anterior Block Graft and Screw-retained Prosthesis over Ceramic-reinforced Polyetheretherketone Abutment: A Case Report. *J Postgrad Med Edu Res* 2023;https://doi.org/10.5005/jp-journals-10028-1650.

**Source of support:** Nil

**Conflict of interest:** None

**Patient consent statement:** The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

abutments to handle excessive labial angulation errors of implants. However, the grayish hue of metal can lead to suboptimal results in patients having thin gingival biotypes or with compromised space for accommodating the sufficient thickness of the material.<sup>5</sup>

Polyetheretherketone (PEEK) or ceramic-reinforced high-performance polymer (BioHPP) is a relatively newer material, which has been recommended as an abutment material owing to its high biocompatibility, favorable hard and soft tissue response, and reduced stress shielding. It can be veneered with a composite or bonded with lithium disilicate, thus leading to a

better biological, mechanical, and esthetic outcome.<sup>6,7</sup> BioHPP has 20% ceramic fillers, which are responsible for their better physical and mechanical properties, optimal polishing properties, and good color stability.<sup>8</sup> The modulus of elasticity of PEEK is closer to the bone compared to zirconium oxide.<sup>9</sup> So, ceramic-reinforced BioHPP abutments with a titanium base can be a good alternative for the fabrication of interim or definitive single implant-supported crowns in the anterior region over titanium or zirconia abutments.<sup>6,10-13</sup>

This clinical report aims to describe the restorative challenges posed by the palatal emergence of an anterior implant, anterior deep bite, and unfavorable gingival zenith after the loss of the right maxillary central incisor in a young female patient. BioHPP abutment was digitally customized, followed by veneering with compatible composite material and delivery of screw-retained prostheses. Esthetic outcome and patient satisfaction were measured objectively with the help of the pink esthetic score and visual analog score, respectively.<sup>14</sup> To the best of my knowledge, the use of BioHPP as a long-term solution has not been reported in such a clinical scenario earlier in the literature.

## CASE DESCRIPTION

### Treatment Planning and Surgical Phase

A female patient in her late adolescence reported to the unit of prosthodontics with a chief complaint of a missing upper front tooth and wanted it to be replaced with a fixed tooth. The patient had suffered a roadside accident about 8 years back, which led to the avulsion of the maxillary right central incisor. She underwent an orthodontic treatment to gain mesiodistal space in the edentulous region prior to reporting to our center. Intraoral examination showed good oral hygiene, medium gingival biotype, and decreased mesiodistal dimensions of edentulous span.

Preoperative cone-beam computed tomography revealed inadequate available bone width, which was insufficient for even a narrow diameter implant (Fig. 1A). Possibility of horizontal bone augmentation was discussed with the patient, and she gave her consent for that. The patient was referred to an oral surgeon, where a block graft was harvested from the parasymphiseal region and placed in the region of the right central incisor under the effect of local anesthesia (Fig. 1B). After 6 months of healing (Fig. 2A) a narrow platform implant (3 × 11.5 mm, Nobel active; Nobel Biocare Pvt. Limited) was placed freehand by the oral surgeon and a healing

abutment was tightened over it (3.2 × 5 mm Nobel active; Nobel Biocare Pvt. Ltd.). Though the primary stability was good, a delayed loading protocol was planned as a narrow-diameter implant was placed in an augmented bone.

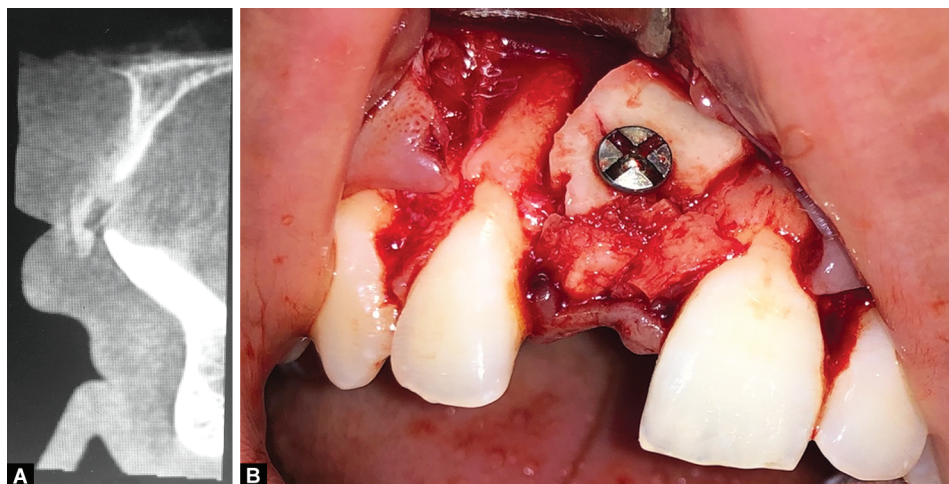
During the osseointegration phase, the patient was given an interim acrylic removable partial denture. A palatal emergence of the implant was noticed, along with an anterior deep bite. So, a relief hole was given in the region of the healing abutment to avoid any interference in posterior occlusion (Fig. 2B). Further scheduled follow-up appointments were delayed because of the coronavirus disease of 2019 (COVID-19) pandemic and its implications.

### Prosthetic Phase

Once she reported back, she was using the same partial denture and showed a well-healed site around the implant. However, it was noticed that the gingival zenith around the healing abutment was lower than that of the adjacent central incisor. An open tray impression was made, and the model was obtained in type IV Gypsum (Kalrock; Kalabhai Karson Pvt. Ltd.). A temporary abutment was modified according to available interocclusal space (Fig. 3A). An acrylic central incisor was trimmed to create a labial veneer (Fig. 3B). This was shown to the patient to give her an idea about the mismatch of gingival contour. The patient was esthetically very demanding and requested a better esthetic outcome. Thus, under topical anesthesia, bleeding spots were created with a UNC 15 periodontal (Hu-Friedy, Germany) to mark the desired contour of the gingival margin. The diode laser tip (200 µm fiber diameter, wavelength = 980 nm, power setting at 4 W; Biolitec, Biolitec Pvt. Ltd.) was moved in a continuous sweeping motion to join all the bleeding spots. (Fig. 4A).<sup>15</sup>

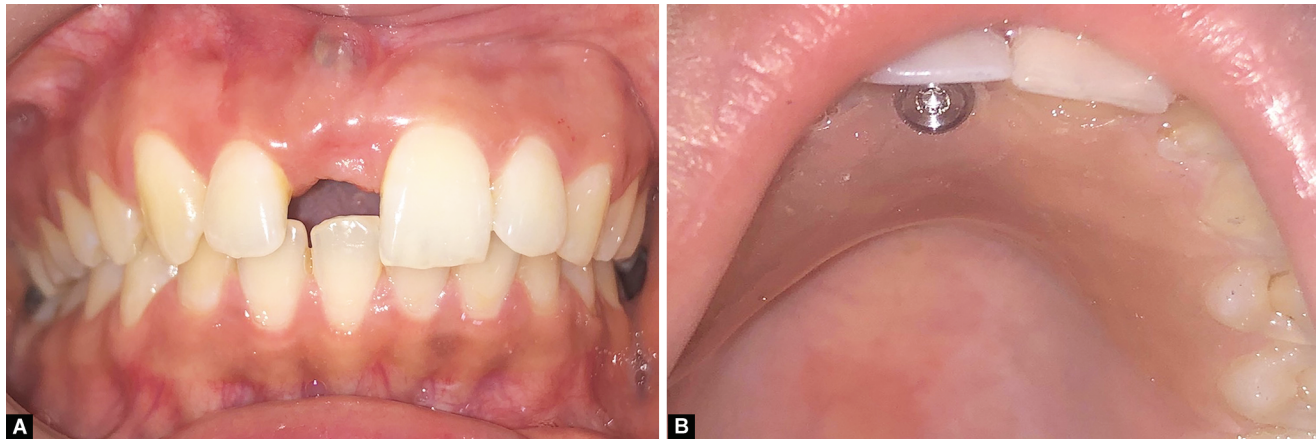
A screw-retained provisional crown was fabricated using the acrylic tooth veneer (Acryrock; Ruthenium Dental Products Pvt. Ltd.) and autopolymerizing resin (DPI), followed by contouring on the temporary abutment attached to implant analog on the model. It was relined with flowable composite intraorally and delivered to the patient immediately. The patient was comfortable with the esthetics and contour of the crown (Fig. 4B). After 2 weeks, a new implant-level impression was made with an open tray technique and poured in type IV Gypsum.

The definitive cast was scanned using an extraoral scanner (E3 series; 3shape) to generate a standard tessellation language file and transferred to software (Exoplan; GmbH) for computer-

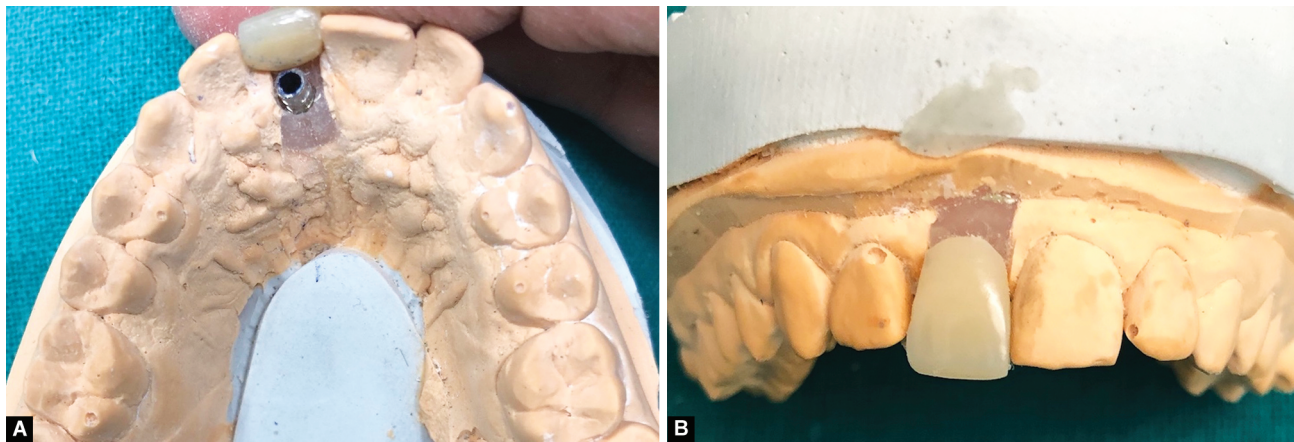


**Figs 1A and B:** (A) Preoperative radiograph; (B) Block graft for bone augmentation





**Figs 2A and B:** (A) Postgraft healed site; (B) Interim removable partial denture



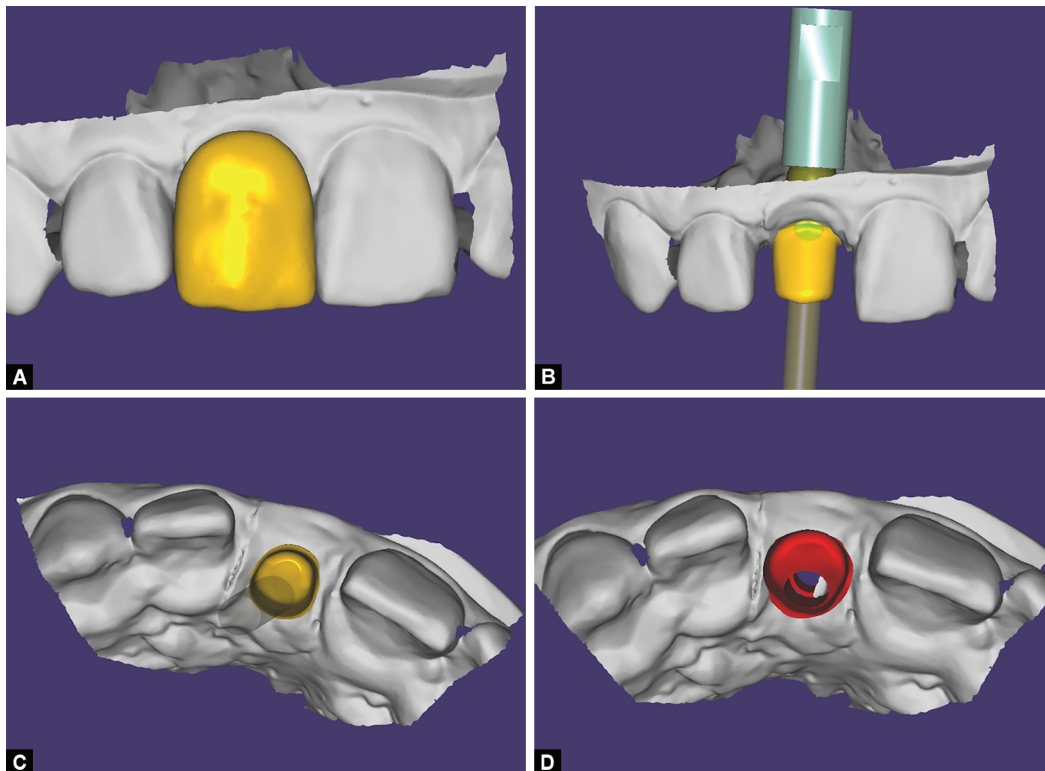
**Figs 3A and B:** Preparation of temporary crown using acrylic tooth facing/veneer



**Figs 4A and B:** (A) Marking of bleeding spots prior to gingivectomy; (B) Postgingivectomy screw-retained provisional crown

aided designing of final abutment and restoration. Owing to the palatal emergence of the implant and other contributory factors like a narrow implant, decreased interarch space, and high esthetic demand of the patient, a customized BioHPP abutment over a titanium base was planned (breCAM.BioHPP; Bredent, Germany) with computer-aided designing (Exocad) using cut-back technique (Fig. 5). It was attached to a titanium base using a primer (MKZ Primer; Bredent), sandblasted, layered with a primer (Visio.link; Bredent GmbH, Germany), and cured for 90 seconds in

a light polymerization device (wavelength range 370–400 nm).<sup>12</sup> A polychrome composite veneer was milled digitally in (breCAM. multiCOM; Bredent GmbH, Germany) and cemented over customized abutment using the recommended luting cement (Combo.Lign; Bredent GmbH, Germany). Extraoral luting avoided the risk of residual cement in the sulcus. Screw retained restoration was tightened at a torque of 15 Ncm after taking the patient's consent.<sup>11</sup> Access hole was sealed with Teflon tape and composite material (Filtek Z350; 3M ESPE Pvt. Ltd.). On the visual analog scale,



Figs 5A to D: Digital planning of prosthesis

she marked 9/10 for esthetics, as she found the crown to be slightly narrower than the adjacent central incisor, and 9/10 for function, as she was instructed not to bite anything hard from her front teeth. The pink esthetic score<sup>14</sup> and white esthetic score<sup>16</sup> were within clinically acceptable limits (13 and 9, respectively). Slight inflammation of marginal gingiva was observed at the 1-month follow-up. The patient was advised to use Waterpik with gentle pressure for the maintenance of soft tissue health. Well-healed peri-implant tissues were observed at all subsequent appointments. The screw access hole was packed with composite as it was dislodged slightly. Although BioHPP has been recommended as a preferred material for long-term provisionalization, the patient was happy and satisfied at the 2-year follow-up and did not want to change the prosthesis (Fig. 6). Should the need arise for any reason, retrieval is easy for repetition or maintenance, as the prosthesis is screw retained.<sup>17</sup>

## DISCUSSION

It is challenging to fulfill the esthetic requirements of a young patient who suffered the loss of an anterior tooth due to trauma. This patient did not want to compromise her two adjacent virgin teeth to replace a single tooth. Being a medical student, she was aware of dental implants and insisted on the same option. Owing to compromised bone width, she was referred to the oral surgeon for augmentation procedures and implant placement. Autologous bone grafts for horizontal bone augmentation have been reported frequently with predictable results in patients with a history of trauma and compromised bone before implant placement.<sup>18,19</sup>

The surgeon opted for freehand placement of the implant after the successful integration of the graft. It was well placed in a mesiodistal position, but the emergence of the implant shoulder

was palatal compared to adjacent teeth. Deviation in implant position has been reported frequently in the literature with freehand placement. Guided surgery or the use of a surgical stent could have yielded a better implant position, but the decision lay with the surgeon. As a restorative dentist, the fabrication of esthetic and functional implant-supported prosthesis with a conservative approach was a primary goal. The patient was kept informed about the anticipated complexities in treatment with the help of diagnostic wax-up at different steps.

During the healing phase, the patient was rehabilitated with a removable partial denture. As the interocclusal distance was less, it was difficult to achieve posterior occlusion. The patient could occlude well after exposing the secondary healing cap. This interim denture fulfilled the esthetic requirements of the patient while she could not visit us during COVID-19 restrictions.

Different treatment options were discussed with the patient after noticing the complex clinical presentation. The first option was to keep the implant sleeping, followed by the fabrication of a fixed dental prosthesis, and the second option was to remove the implant and replace it with a new one. Both options were denied by the patient. So, prosthetic rehabilitation was started with the fabrication of a provisional crown using a temporary abutment. Different techniques and materials have been mentioned in literature for the fabrication of a provisional crown, but we preferred using an acrylic tooth veneer as it was easily available in a compatible shade and had better color stability than an autopolymerizing tooth-colored resin.<sup>20,21</sup> The crown could be fabricated in our own prosthodontic laboratory with minimal added cost and time. Gingival recontouring with a diode laser helped in creating a good gingival zenith around the prosthesis. Performing the gingivectomy with laser was comfortable for the patient and led to a well-healed tissue within 2 weeks.





**Figs 6A to D:** (A) Frontal view of prosthesis at the 2-year follow-up; (B) Occlusal view of prosthesis at the 2-year follow-up; (C) Smiling view after delivery of prosthesis; (D) Intraoral periapical radiograph at the 2-year follow-up

High-performance polymer (BioHPP) was the material of choice for the fabrication of abutments over stock or customized abutments made up of titanium or zirconia. This was primarily because BioHPP has low plaque affinity and provides better esthetics owing to its nonmetallic color.<sup>6,7</sup> Another advantage offered is that it can be scanned with intraoral scanners, giving way to a complete digital workup. BioHPP also ensures the soft loading of bone by virtue of its biomechanical properties and may distribute the effect of functional forces across the implant onto the bone over a longer period.<sup>7,9,22</sup> This was favorable for the long-term survival of a narrow-diameter implant placed in the patient.

Polyetheretherketone (PEEK) abutments showed high torque loss; hence screw loosening and microleakage in an in vitro study to assess the mechanical and functional properties of PEEK abutments.<sup>10</sup> This might be because of higher vertical displacement and plastic deformation of PEEK abutments. To avoid this situation, hybrid abutments made up of modified PEEK (BioHPP) superstructure with titanium base were used. A titanium base makes the seating assessment feasible on a radiograph, which is difficult, with PEEK being a radiolucent material.<sup>6</sup>

A composite veneer made up of breCAM.multiCOM was cemented extraorally over the abutment for esthetic rehabilitation of the patient instead of a full coverage crown to avoid annoyance to the tongue due to the bulk of the material on the palatal side. The shear bond strength of the veneering composite was observed to be better on a computer-aided design (CAD)/computer-aided manufacturing (CAM) BioHPP framework compared to titanium.<sup>23</sup> Milled restorations have better physical properties, improved wear

resistance, and no risk of residual monomer over conventional polymethyl methacrylate-based or composite restorations, which can be attributed to the homogeneous structure, higher quality of material, and polymerization under high temperature and pressure.<sup>17,24</sup> With the help of customized BioHPP abutment and newer composite material, implant-supported prosthesis with reasonable esthetics could be delivered to the patient despite the complex clinical presentation. This was a conservation option, which proved to be in the best interest of the patient.

## CONCLUSION

Within the limitations of this report, rehabilitation of a young female patient with a history of dental trauma using a multidisciplinary approach has been presented. The patient was satisfied with the final outcome, and the prosthesis has been functional for 2 years. However, the author do understand and emphasize a longer follow-up or clinical research to assess the longevity of the material of abutment and prosthesis in such scenarios and to know its effect on the implant and peri-implant tissues.

## Clinical Significance

Rehabilitation of anterior tooth loss is difficult because it is mostly associated with significant loss of hard and soft tissues. Block graft harvesting can be considered for bone augmentation when there is a deficient width for implant placement. In this case, customizing the narrow abutment was difficult due to the deep bite and palatal emergence of the implant. Prosthetic rehabilitation with screw-



retained prosthesis using customized BioHPP hybrid abutment and esthetic composite veneer helped in achieving a satisfactory outcome. This option can be considered in similar complex presentations with predictable longevity.

## ACKNOWLEDGMENT

I sincerely acknowledge the contribution of Late Professor Sachin Rai for his contribution during surgical phase of this patient, Dr Uvashri Selvaraj and Dr Rhea Mahajan for literature search and clinical work up pertaining to this clinical report.

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## REFERENCES

- Norgaard Petersen F, Jensen SS, Dahl M. Implant treatment after traumatic tooth loss: a systematic review. *Dent Traumatol* 2022;38(2):105–116. DOI: 10.1111/edt.12730
- Higginbottom F, Belser U, Jones JD, et al. Prosthetic management of implants in the esthetic zone. *Int J Oral Maxillofac Implants* 2004;19:62–72. PMID: 15635946.
- Chen ST, Darby IB, Reynolds EC, et al. Immediate implant placement postextraction without flap elevation. *J Periodontol* 2009;80(1):163–172. DOI: 10.1902/jop.2009.080243
- Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: anatomic and surgical considerations. *Int J Oral Maxillofac Implants* 2004;19:43–61. PMID: 15635945.
- Yildirim M, Fischer H, Marx R, et al. In vivo fracture resistance of implant-supported all-ceramic restorations. *J Prosthet Dent* 2003;90(4):325–331. DOI: 10.1016/s0022-3913(03)00514-6
- Al-Rabab'ah M, Hamadneh W, Alsalem I, et al. Use of high performance polymers as dental implant abutments and frameworks: a case series report. *J Prosthodont* 2019;28(4):365–372. DOI: 10.1111/jopr.12639
- Koutouzis T, Richardson J, Lundgren T. Comparative soft and hard tissue responses to titanium and polymer healing abutments. *J Oral Implantol* 2011;37:174–182. DOI: 10.1563/AAID-JOI-D-09-00102.1
- Alexakou E, Damanaki M, Zoidis P, et al. PEEK high performance polymers: a review of properties and clinical applications in prosthodontics and restorative dentistry. *Eur J Prosthodont Restor Dent* 2019;27(3):113–121. DOI: 10.1922/EJPRD\_01892Zoidis09
- Lee WT, Koak JY, Lim YJ, et al. Stress shielding and fatigue limits of poly-ether-ether-ketone dental implants. *J Biomed Mater Res B Appl Biomater* 2012;100(4):1044–1052. DOI: 10.1002/jbm.b.32669
- Ortega-Martínez J, Delgado LM, Ortiz-Hernández M, et al. In vitro assessment of PEEK and titanium implant abutments: screw loosening and microleakage evaluations under dynamic mechanical testing. *J Prosthet Dent* 2022;127(3):470–476. DOI: 10.1016/j.prosdent.2020.09.033
- De Pascalis F. Soft tissue integration with a hybrid abutment using the "one abutment–one time" therapeutic protocol: case series. *Quintessence Int* 2022;53(7):590–596. DOI: 10.3290/j.qi.b3082565
- Atsu SS, Aksan E, Bulut AC. Fracture resistance of titanium, zirconia, and ceramic-reinforced polyetheretherketone implant abutments supporting CAD/CAM monolithic lithium disilicate ceramic crowns after aging. *Int J Oral Maxillofac Implants* 2019;34(3):622–630. DOI: 10.11607/jomi.7036
- Rosentritt M, Rembs A, Behr M, et al. In vitro performance of implant-supported monolithic zirconia crowns: influence of patient-specific tooth-coloured abutments with titanium adhesive bases. *J Dent* 2015;43(7):839–845. DOI: 10.1016/j.jdent.2015.04.011
- Furhauser R, Florescu D, Benesch T, et al. Evaluation of soft tissue around single-tooth implant crowns: the pink esthetic score. *Clin Oral Implants Res* 2005;16(6):639–644. DOI: 10.1111/j.1600-0501.2005.01193.x
- Dhiman M, Pruthi G, Shastry TD, et al. Use of diode lasers to enhance aesthetics of anterior implant supported prosthesis: a report of two cases. *J Clin Diagn Res* 2021;15(2):ZD05–ZD09. DOI: 10.7860/JCDR/2021/46407.14514
- Belser UC, Grutter L, Vailati F, et al. Outcome evaluation of early placed maxillary anterior single-tooth implants using objective esthetic criteria: a cross-sectional, retrospective study in 45 patients with a 2- to 4-year follow-up using pink and white esthetic scores. *J Periodontol* 2009;80(1):140–151. DOI: 10.1902/jop.2009.080435
- Preis V, Hahnel S, Behr M, et al. In-vitro fatigue and fracture testing of CAD/CAM-materials in implant-supported molar crowns. *Dent Mater* 2017;33(4):427–433. DOI: 10.1016/j.dental.2017.01.003
- Widmark G, Andersson B, Ivanoff CJ. Mandibular bone graft in the anterior maxilla for single-tooth implants. Presentation of surgical method. *Int J Oral Maxillofac Surg* 1997;26(2):106–109. DOI: 10.1016/s0901-5027(05)80827-6
- Jensen SS, Terheyden H. Bone augmentation procedures in localized defects in the alveolar ridge: clinical results with different bone grafts and bone-substitute materials. *Int J Oral Maxillofac Implants* 2009;24:218–236. PMID: 19885447.
- Bukhari SA, AlHelal A, Proussaefs P, et al. Use of patient's own natural teeth as part of the interim prosthesis on immediately placed single implants in a staged surgical approach: a clinical report. *J Oral Implantol* 2018;44(5):351–357. DOI: 10.1563/aaid-joi-D-17-00292
- Muta S, Ikeda M, Nikaido T, et al. Chairside fabrication of provisional crowns on FDM 3D-printed PVA model. *J Prosthodont Res* 2020;64(4):401–407. DOI: 10.1016/j.jpor.2019.11.004
- Najeeb S, Zafar MS, Khurshid Z, et al. Applications of polyetheretherketone (PEEK) in oral implantology and prosthodontics. *J Prosthodont Res* 2016;60(1):12–19. DOI: 10.1016/j.jpor.2015.10.001
- Jin HY, Teng MH, Wang ZJ, et al. Comparative evaluation of BioHPP and titanium as a framework veneered with composite resin for implant-supported fixed dental prostheses. *J Prosthet Dent* 2019;122(4):383–388. DOI: 10.1016/j.prosdent.2019.03.003
- Wimmer T, Ender A, Roos M, et al. Fracture load of milled polymeric fixed dental prostheses as a function of connector cross-sectional areas. *J Prosthet Dent* 2013;110(4):288–295. DOI: 10.1016/S0022-3913(13)60378-9