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An Implant And Tooth-Supported Fixed Dental Prosthesis For Esthetic And Functional Rehabilitation: A Case Study

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Abstract
Implant-supported prosthesis has emerged as preferred treatment of choice due to their reliable functional and aesthetic outcomes. However, the clinician can encounter several challenges in accomplishing the task. Failure to understand stress factors and stress distribution often lead to bone loss and restoration failure. This case study aims to provide a comprehensive explanation of the entire prosthetic rehabilitation process using a fixed dental prosthesis supported by a tooth and an implant, all in accordance with standard guidelines.

Keywords- *dental implant, fixed dental rehabilitation, FP-3 prosthesis, DMLS*

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I. Introduction

In recent years, the replacement of missing teeth by dental implants has gained popularity as a mode of treatment among edentulous patients. Fixed implant restorations eliminate the risk of further resorption associated with tissue-borne prostheses since they are entirely implant supported and do not transfer load to denture-bearing regions.

The implant-supported fixed restoration (FP-3) restoration replaces the natural teeth crowns and a portion of the soft tissue. There are essentially two approaches for an FP-3 prosthesis: a hybrid restoration of denture teeth, acrylic and metal substructure, or a porcelain-metal restoration In addition to implant treatment, achieving a patient's high aesthetic standards requires fulfilling number of biological and mechanical goals.[1] Porcelain veneered fixed dental prostheses (FDPs) are well known for pleasing esthetics, biocompatibility, colour stability, and resistance to wear.[2] In recent years, direct metal laser sintered (DMLS), a digitalized metal casting technology, has been used as a substitute for traditional metal-ceramic fixed partial denture prosthesis. Additive manufacturing is comparatively new, yields precise restorations, simplified post-processing techniques, is porosity-free unlike traditional castings, and has enhanced electromechanical properties.[3]

This paper provides a detailed explanation of the protocol-based esthetic and functional rehabilitation using tooth and implant supported restorations for a patient with partially edentulous maxillary and mandibular jaw.

II. Case Report

- A 27-year male patient, named Arjun reported to the Department of Prosthodontics and Crown & Bridge, Career Institute of Dental Sciences and Hospital, Lucknow with the chief complaint of difficulty in eating and unpleasant facial appearance. History of present illness revealed that the patient met with a severe road traffic accident four years back due to which he lost most of his maxillary and mandibular teeth. Past Dental history

revealed that he had undergone a surgery for fixation of mandibular fracture. Patient also gives a history of few implants being placed in maxillary and mandibular arch somewhere else.

- Medical history was non-contributory and deleterious habits were absent.
- In the subsequent appointments close-up photographs of intraoral view and facial profile were taken. Preoperative evaluation involved a comprehensive clinical examination and panoramic radiograph.

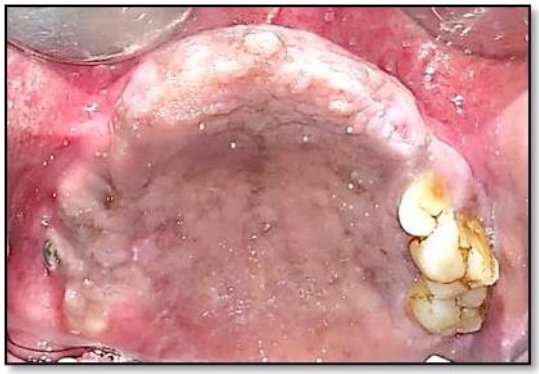

Fig. 1(a) Occlusal view of maxillary arch

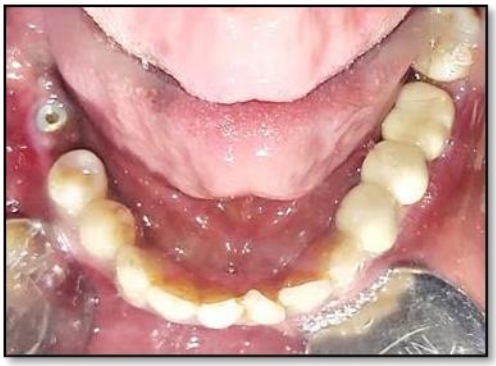

Fig. 1(b) Occlusal view of mandibular arch

Intraoral examination revealed missing teeth irt 16,15,14,13,12,11,21,22,23,24 in maxillary arch and 47 in mandibular arch. Presence of Cover screw was noticed clinically irt 17and 46. Faulty bridge was present irt 35,36 and 37. (**Fig. 1(a)(b)**)

- Radiographic interpretation revealed implants being placed in 17, 16, 15, 11, 22, 24 region of the upper jaw and 46 region of the lower jaw.
- Supra-eruption of maxillary posterior teeth was suggestive of an improper occlusal plane.
- Bone loss was evident in the region of 36 and 37.**(Fig. 2)**

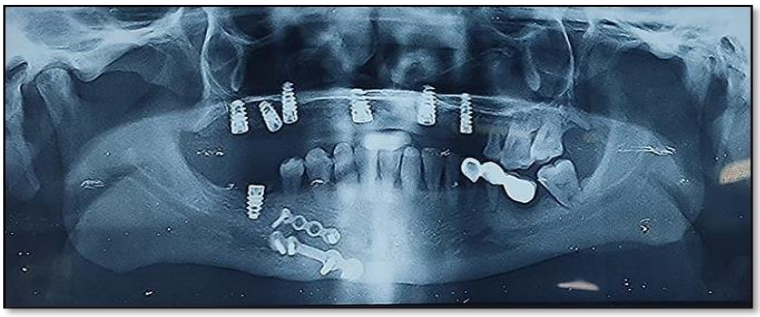

Fig. 2 Pre-op panoramic radiograph

Primary impression were made with irreversible hydrocolloid and resultant diagnostic casts were poured in dental stone.(Fig. 3)

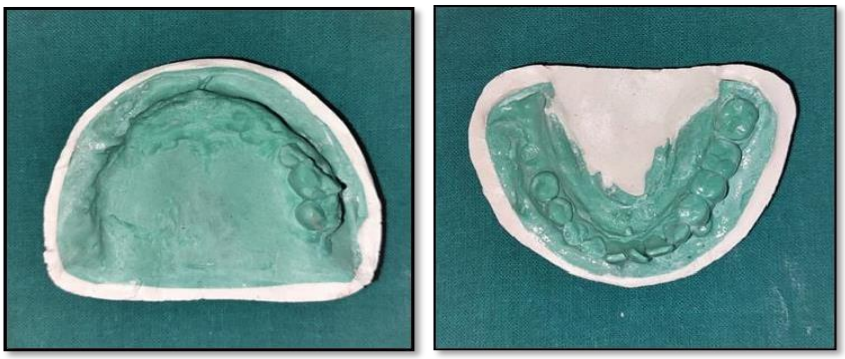

Fig. 3 Diagnostic casts of maxillary and mandibular arch

After the evaluation of study models, radiographs and photographic analysis, tentative jaw record was done and diagnostic casts were mounted on a semi adjustable articulator. Wax mock was done in the same relationship and treatment plan suggested to the patient was-

- Removal of faulty prosthesis irt 34,35 and 36
- Endodontic treatment irt 25,26,27 and 34,35,37 followed by tooth supported fixed dental prosthesis
- Esthetic and functional rehabilitation of missing edentulous span with implant supported fixed dental prosthesis irt 16-11, 21-24
- Correction of Occlusal Plane

After careful removal of the faulty prosthesis patient was referred to the dept. of Conservative and Endodontics for endodontic assessment of 25,26,27 and 34,35,37. Grade II mobility was noticed irt 35 while grade I mobility was present in 37. Patient was informed about the questionable prognosis of these two teeth but he choose to continue with root canal treatment as he wished to retain his remaining natural dentition as far as possible. Root canal treatment was performed and teeth were restored with provisionals successfully.

Prosthetic Phase

i) Placement of Gingival formers-

Meanwhile the PROSTHETIC PHASE began with **Second stage surgery.** Free incisions were given under local anaesthesia and mucoperiosteal flaps were raised. Cover screws were replaced with transmucosal healing abutments/ gingival formers (Genesis Implant system) and sutures were placed. **(Fig. 4)** Implant irt 16 was left as buried/sleeping because it was mis-angulated and in close approximation with implant irt 15.

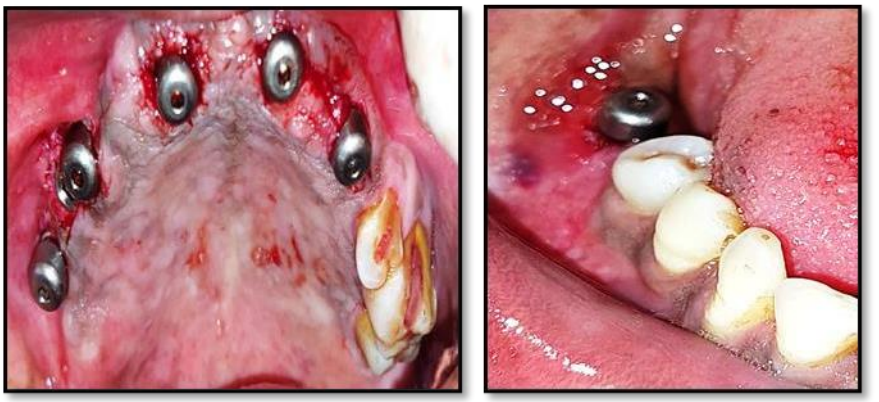

Fig. 4Placement of Gingival formers(a)maxillary arch(b)mandibular arch

***ii)* Open tray impression-**

A rigid custom tray was fabricated over a stone cast, with windows cut through, corresponding to the implant position. **(Fig. 5)**

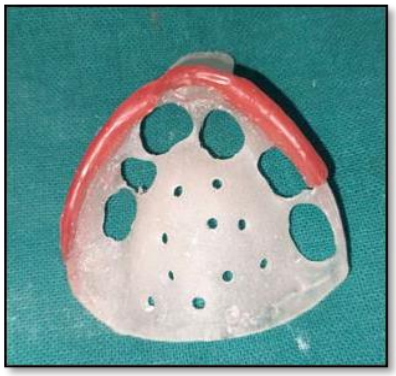

Fig. 5 Custom tray with windows

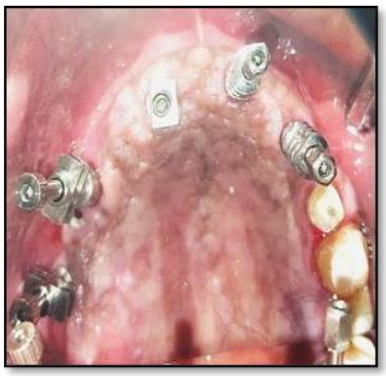

Fig. 6 Open tray impression copings

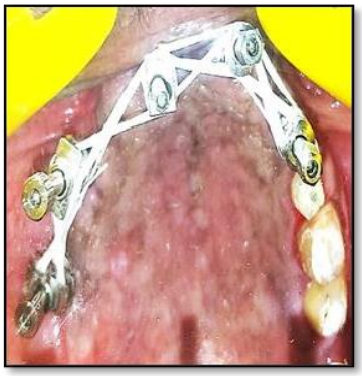

Fig. 7 Open tray impression copings secured with dental floss

The healing abutments were removed once the gingival collars had formed, and device called OSSTELL was used to measure each implant's stability quotient (ISQ).

Appropriate open tray impression copings were selected and tightened on the implant fixture with the help of a hex.**(Fig. 6)** The complete passive seating of each impression coping was confirmed with radiographs.

The open tray was tried in the mouth to ensure that the impression copings emerged at the level or above the level with the windows cut in the custom tray. The open tray copings were fastened together with a dental floss and splinted using pattern resin.**(Fig. 7)** A single step, silicone impression material of two different viscosities were used to record the implant impression .**(Fig. 8)**

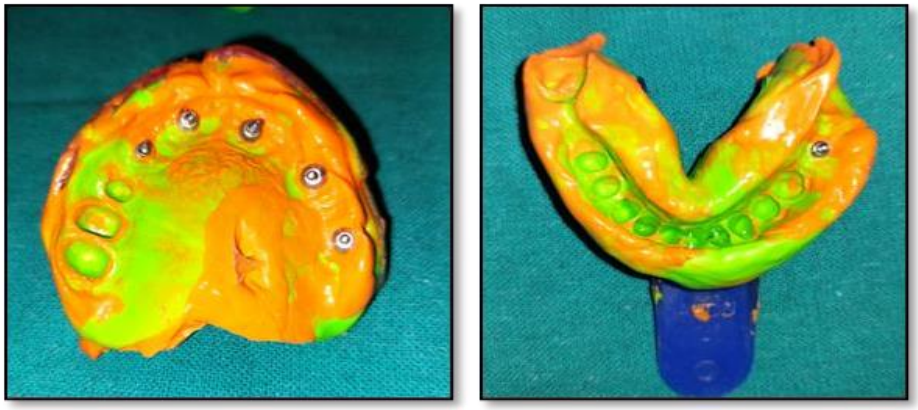

Fig. 8Implant level impression (a) maxillary arch (b) mandibular arch

After the impression was set, the guiding pins were unscrewed through the windows of the tray, and the impression was withdrawn from the mouth. Laboratory analogs were attached to the impression copings, gingival mask was applied and the impression was poured in die stone.

Following the application of a gingival mask and the attachment of implant laboratory analogs to the impression copings, the impression was poured into the die stone.

iii) **Jig verification-**

The abutments were attached to the analogs placed in the master cast and jig was made for the trial procedure. Jig was sectioned on the cast and each part was numbered to ensure error-free and hassle-free positioning of all sections.**(Fig. 9)**Jig trial was done in order to cross check the accuracy of the implant impression. Jigs were tightened in the patient's mouth and a radiograph was obtained to assess complete passive seating After passive seating was confirmed, pieces were reunited using pattern resin.**(Fig. 10)**

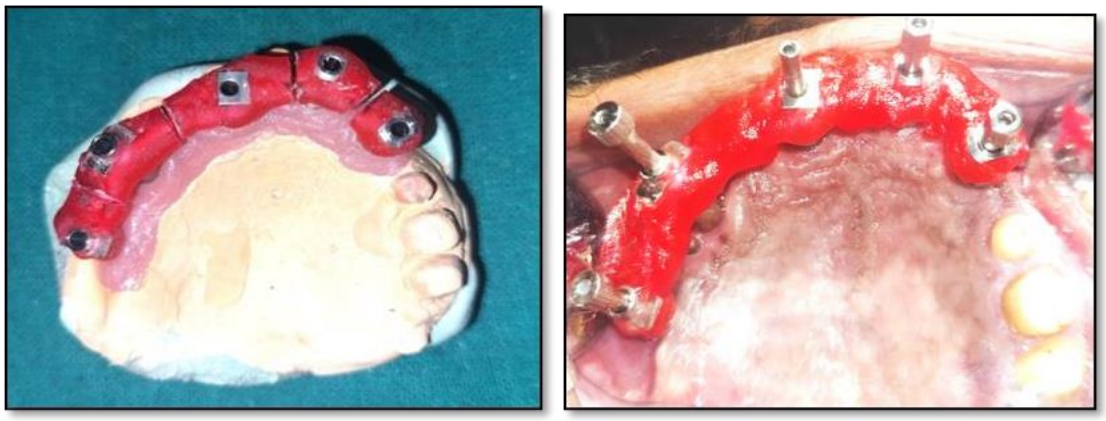

Fig. 9 Sectioned Jig

Fig. 10 Jig verification

iv) **Establishment of maxillomandibular records-**

Customized record bases were fabricated on the master cast to record the maxillomandibular relations. Wax occlusal rims were used to measure the vertical dimension of rest and occlusion by Niswonger's

method. First, a face-bow was used to mount the maxillary cast on a semi-adjustable articulator, and then the mandibular cast was related to maxillary cast using a centric record on wax occlusal rims.

v) **Designing and printing of screw retained DMLS framework-**

After teeth were positioned in the rim, try-in was completed.**(Fig.12)** This teeth arrangement served as a guide for determination of vertical height for the screw retained prosthesis. A screw retained design was intended to allow easy retrievability and maintenance. The frameworks or substructure were designed and printed via CADCAM based EXOCAD software.**(Fig.13)** The fit of 3-D DMLS metal framework was evaluated in patient's mouth, during metal try-in stage. The screws were tightened sequentially to ensure a passive fit of the framework (**Sheffield's test**).[4] A radiograph was taken to confirm **passive fit** of the prosthesis. A new

Fig. 11 Facebow transfer

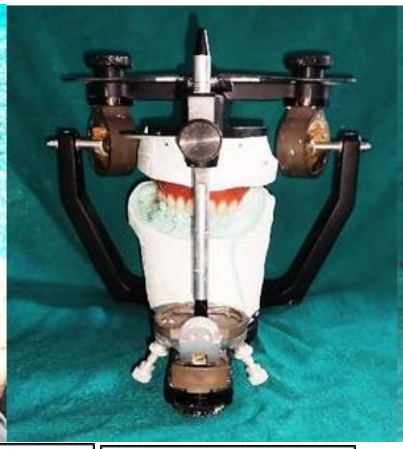

Fig. 12 Teeth arrangement

Fig. 13DMLS screw retained framework

centric relation was established using Alu-Wax, an inter-occlusal bite registration material. (**Fig. 14**)

vi) **Try-in-**

At the time of metal try-in, facial midline symmetry, smile line and incisal display were analyzed and shade selection was done.**(Fig. 15)**The corrections were communicated to the laboratory and the procured prosthesis was overlaid with ceramic without final glazing. Occlusal adjustments were done during the bisque trial, and discrepancies in shade was reported to the lab for resolution. **(Fig.16)**

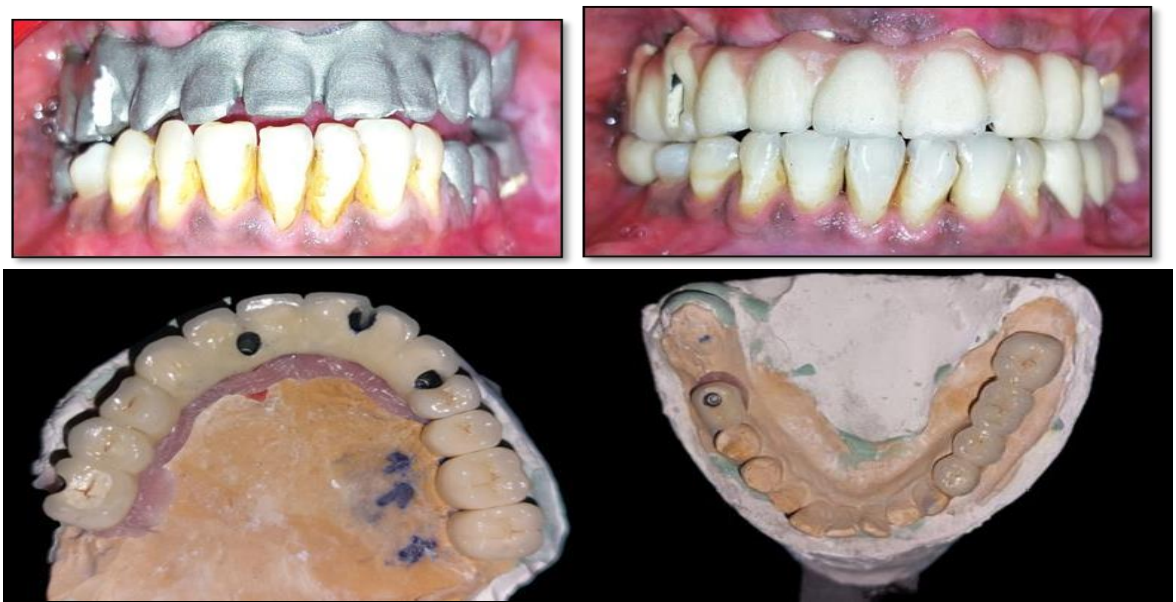

Fig. 15Metal try-in stage

Fig. 16Bisque trial stage

vii) **Delivery of the final prosthesis-**

After glazing, screw retained metal ceramic restorations were screwed on the implant fixtures using a hex, while tooth supported porcelain fused metal crowns irt 25,26,27 and bridge irt 34,35,36,37 were luted. Occlusal adjustments were done with articulating paper of thickness 25µm to eliminate all interferences [5]**(Fig. 17**) and a canine guided occlusion with posterior disocclusion during excursions was provided. Patient was quite happy with the esthetic and functional outcomes, so the screw retained prosthesis was finally tightened with the recommended torque using a hand ratchet. (**Fig.18**)

The screw access holes were sealed using teflon tape and flowable resin composite.

The patient seemed to be very comfortable and aesthetically satisfied after insertion.(**Fig. 19**) Oral hygiene instructions were reinforced and the patient was recalled for follow up, after 24hours, 1 month, 6 months. Patient did not report any complications in the subsequent appointments.

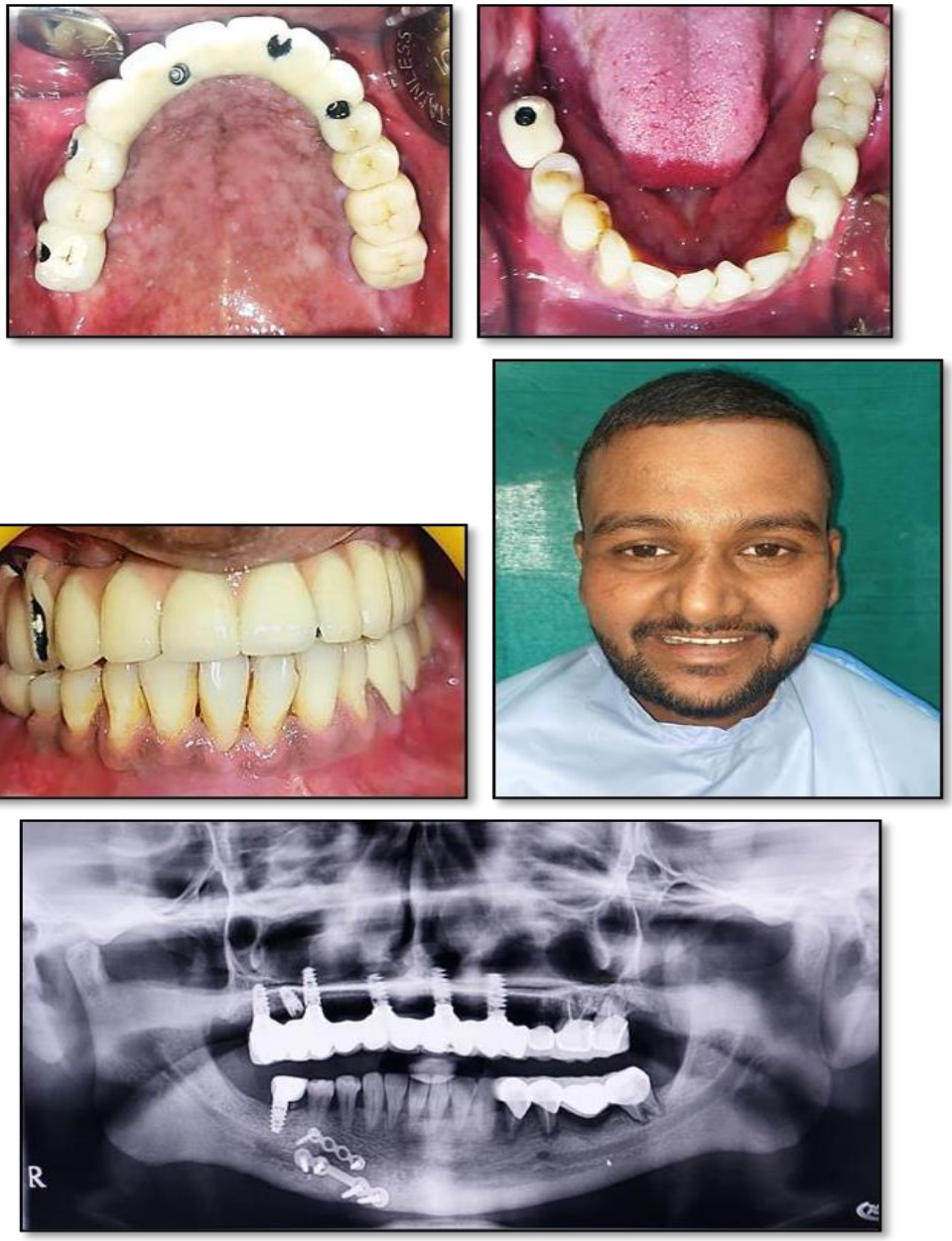

Fig. 18 DMLS screw retained final prosthesis tightened over the fixture and Dmls crown and bridge luted

Fig. 19 Patient is happy with the obtained esthetic and functional outcomes

Fig. 20Post operative OPG

Discussion

According to the literature, implant-supported FPD is a promising treatment option with consistent long-term results. De van placed emphasis on the ongoing conservation of what is left, rather than the meticulous replacement of what has been lost. In order to restore the appearance, form, and function of lost teeth as well as correct the occlusal plane, a tooth-supported crown and bridge were planned for rehabilitation. The screw-retained implant-supported prosthesis was chosen in order to facilitate retrievability and easier management of complications.[6]

The use of computer-aided design and computer-aided production in dentistry has advanced recently, and this has led to tremendous change in casting of dental alloys.[7] Metal laser sintering was developed by Dr. Deckard and Beaman. It creates the framework in a succession of thin layers that are spaced between 0.02 and 0.06 mm apart.[2] The DMLS technology yields extremely accurate and meticulous restorations that can be manufactured.[8,9] According to studies, there was a smaller marginal gap of 65 µm for laser-sintered metal crowns compared to 150–125 µm for conventionally manufactured cast crowns when it came to internal fit.[10] Therefore, this study was conducted utilizing fixed partial dentures and crowns manufactured using the DMLS approach, based on the encouraging outcomes of other in vitro and in vivo investigations for FPDs and crowns using this technique.

III. Conclusion

Provided that the patient continues to comply with maintaining good oral hygiene, there is a very good prognosis for the current course of treatment. Recent gold standard of implantology guidelines is to produce prosthetic restorations with the best possible functional and aesthetic outcomes. For a prosthetic to be therapeutically successful, a thorough pre-operative analysis based on prosthetically driven implant position, prudent material selection, prosthesis design, and appropriate maintenance with a reasonable comprehension of patient expectations and constraints is necessary. With a clinical survival rate of 95.5%, DMLS metal-ceramic fixed partial dentures have demonstrated encouraging outcomes during a 60-month observation period, suggesting improved clinical acceptance for usage in routine clinical practices.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest- There are no conflicts of interest

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