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Digital approach for rehabilitation of the maxillary arch with implant-supported fixed prosthesis- A case report

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Abstract

Due to increased awareness about implants and its advancements, young and middle-aged patients often resort to fixed treatment options rather than removable as better function and aesthetics can be achieved with the same. Complete maxillary rehabilitation with implants has become a viable treatment option for patients with badly damaged dentitions.

Because of the number of variables that affect both the aesthetic and functional aspects of the prosthesis, implant rehabilitation of the edentulous maxilla remains one of the most difficult restorative challenges. This clinical report aims to present the complex rehabilitation of such a borderline case ,in which implants were placed at different angles and directions. To ease the prosthetic steps, complete digital workflow was considered. To manage the angulations, multiunit abutments were used and final implant supported screw-retained fixed prosthesis was given.

Keywords: Implant, implant supported fixed prosthesis, edentulous maxilla, maxillary rehabilitation, digital workflow, multiunit abutments, scan body, aesthetics.

Introduction

Brane mark et al. described the predictability of successful Osseo integrated implant rehabilitation of the edentulous jaw, ushering in a new era of edentulous

management.[1] Edentulous maxilla presents with various co - Morbi ties, along with impairment in mastication, phonetics and aesthetics. The sequelae are not just physical, but also affects the social, emotional and psychologic well-being of an individual.

For the rehabilitation of edentulous arch, either conventional complete dentures, implant-retained removable prosthesis (over dentures) or implant supported fixed prosthesis are the available treatment modalities. They have become well-accepted treatment option with long term successful outcome. Whether the restoration in fully edentulous patients should be removable or fixed, depends on the number of implants used. Other factors which determine type of the prosthesis include the remaining amount of bone, lip support, lip line, soft tissue condition, the amount of inter-occlusal space, opposing dentition and the patient's demands and dexterity to maintain the prosthesis.

While considering any of these options, it is of paramount importance to plan prior. It includes the diagnostic wax-up process, and digital planning using cone-beam computed tomography.[2]With the com bination of these methods, a prosthetically driven approach should be followed to avoid complications. The final prosthesis design must be in mind before the implants are placed and that only determines the number of implants and distance between them. And it must be conveyed to the surgeon to ensure that there is sufficient restorative space for different prosthetic designs, suitable implant angulation, and minimum cantilevers.

The aim of this article is to describe a case of mutilated dentition in which nine endo-osseous implants were placed and restored with implant-supported fixed prosthesis, utilizing digital workflow thereby overcoming certain technical challenges that came in the way.

Case report

A 58-year-old female patient came to PG department of prosthodontics with the chief complaint of multiple mobile teeth in upper arch and wanted complete replacement through fixed prosthesis. There were multiple missing teeth and the teeth present were either root stumps or periodontally compromised as shown in the OPG (Figure 1). The 3-unit fixed PFM bridge in the anterior region was also mobile with secondary caries and periodontal disease.

Figure 1: pre-operative orthopantomogram (OPG)

It was planned to extract all the root stumps and mobile teeth. Only the left lateral incisor, canine and right last molar were the firm teeth in the arch were retained for provisional immediate denture. (Figure 2) A provisional immediate denture was given to the patient till the proper healing of the bone after extraction was done. (Figure 3)

Figure 2: intra-oral occlusal view after extraction

Figure 3: provisional immediate denture in-situ with the help of provisional denture, certain treatment planning factors pertaining to the case were evaluated:

1. Smile line – High (Figure 4)
2. Lip support – sufficient lip support was present therefore; fixed prosthesis was planned (Figure 4&5)
3. Ridge position – nearly ideal, not much resorption (Figure 2)
4. Crown height space – 10-12 mm sufficient for conventional screw retained porcelain-fused prosthesis. (Figure 5)
5. Opposing dentition – natural teeth (Figure 6)

Figure 4: high smile line in denture

Figure 5: without denture

Figure 6: natural opposing dentition

Implants were planned according to the predetermined arch form of final prosthesis.

Predetermined Arch form dictated by final prosthesis – Ovoid (Figure 7)

- 3 implants in the premaxilla – Bilateral canine and unilateral in central incisor region to minimize cantilever forces
- Bilateral two/three posterior implants in premolar and molar region was planned to compensate for increased force factors and to improve arch form [3]

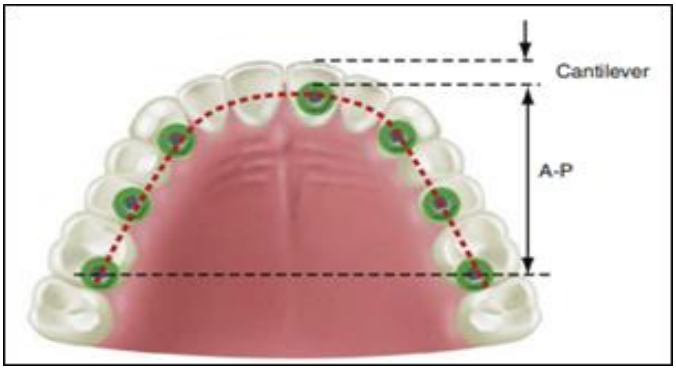

Figure 7: treatment plan according to ovoid arch form: 3 implants in premaxilla, at least four posterior implants to form an arch, a-p- anteroposterior distance.

(COURTESY: Misch's Contemporary Implant Dentistry / Randolph R. Resnik, 4th Ed)

The steps in the rehabilitation of the case are mentioned below:

1. Implant planning through Cone beam computed tomography (CBCT) was done (Figure 8)

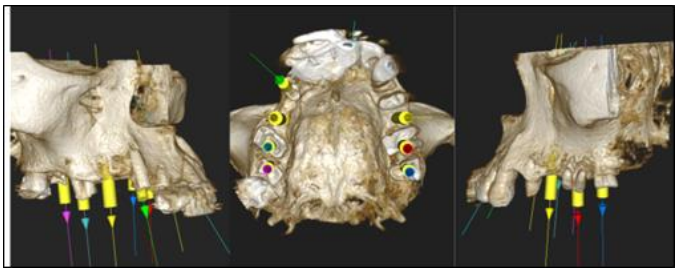

Figure 8: Implant planning on CBCT

Implant placement

9 endosseous implants (ARDS Implants, Israel) were placed in the department of surgery with a free hand protocol. The two anterior teeth retained were also extracted and immediate implants were placed during the surgery. (Figure 9)

Figure 9: OPG After implant

Second stage surgery

After implant placement and evaluation of the bone quality, it was decided that a conventional loading protocol will be followed. Therefore, after 4 months when osseointegration was achieved through radiographic analysis , second stage surgery was done and healing abutments were placed. One left posterior implant was decided to be submerged/ sleeping. (Figure 10)

In the meantime, A new transitional denture was made and relined with soft liner which contained pickups of the healing abutments thereby, aiding in retention. (Figure 11)

Figure 10: Placement of healing.

Figure 11: Relined transitional.

Multiunit abutment placement

To correct implant angulation, compatible multiunit abutments (Noris Medical Ltd, Israel) were placed. Straight, 17 º and 25º angle abutments were used.

Fig 12: Angle corrections with multi-unit abutments

Digital impression with intraoral scanner

To minimize discrepancy, it was decided to make a digital impression. Over the multiunit abutments, intra oral scan bodies (ISBs) (PEEK scan bodies, Noris Medical Ltd, Israel) were screwed and digital impression was made through intraoral scanner (Trios, 3Shape, Copenhagen, Denmark), from one side of the arch to the other. (Figure 13) Impression was achieved in a very short time and sent to the laboratory in STL file format. (Figure 14) Over it, digital lab analogs were placed to achieve a digital model.

Figure 13: Multiunit PEEK scan bodies placed

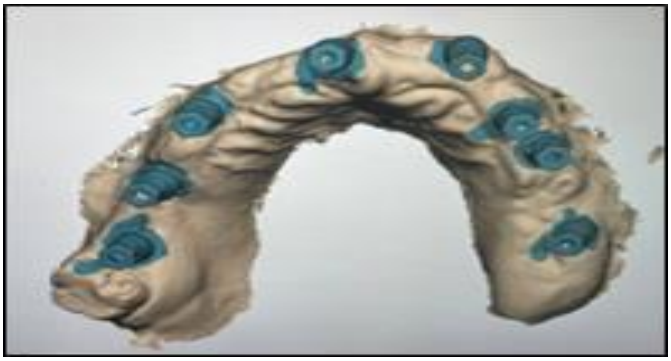

Figure 14: Digital impression in STL format

Jig verification

To check the accuracy of the impression, A verification index for the prosthesis was fabricated with pattern resin (GC pattern resin, GC America, Alsip, IL, USA) connecting the Ti base abutments (Noris Medical Ltd, Israel). It was found to be passive fitting and accurate. (Figure 15 & 16)

Figure 15: Jig verification index

Figure 16: OPG with Jig in place

Jaw relation.

Occlusal vertical dimension was established and centric relation records were made with record bases, occlusal rims, and inter-occlusal bite registration material,

Figure 17: Jaw relation

Provisional acrylic prosthesis insertion

Provisional PMMA prosthesis was made and inserted to check if the patient was comfortable at altered vertical dimension. (Figure 18) Shade matching, aesthetics and phonetics were evaluated, and the patient's acceptance was obtained at the trial insertion appointments. One screw test was done to confirm that the prosthesis was passive fitting.(5)

Figure 18: Provisional prosthesis in-situ

Final prosthesis insertion

As per treatment planning, a screw retained porcelain fused-to-metal implant supported prosthesis was planned.

The metal frameworks were fabricated in the dental labo ratory through CAD-CAM. Bisque trial was done and evaluated clinically, verifying the midline, occlusal plane, vertical dimension of occlusion, and centric relation.

The prosthesis was in harmony with patient's existing habitual occlusion (group function). Passive fit was again evaluated with one screw test. Final prosthesis was fitted and occlusion was verified using articulating paper sequentially (100µ ,40µ and 12µ articulating papers, Bausch, Germany).

Pink ceramic was incorporated in anterior region as the patient had high smile line. (Figure 19)

Figure 19: Final prosthesis in-situ

Insertion and maintenance

At delivery, the abutments (Ti bases) were screwed in and torqued according to Manu facturer's recom mendation. The fit was verified with the OPG (Figure 20, 21, 22) and one screw test. Screw access holes of prostheses were sealed with polytetrafluoroethylene strips and then filled with shade A2 composite resin. Following delivery, instructions on how to use and maintain the prostheses were given to the patients. The use of super floss (Oral-B, Inc, Iowa City, Iowa, USA) and a water jet (Braun Oral-B Oxyjet MD 15, Frankfurt/Main, Germany) to clean underneath the prostheses was explained.

Figure 20: OPG after Final prosthesis

Figure 21: Post-operative extraoral front profile and lateral views, smile line in normal smile

Figure 22: Smile line on exaggerated smile

Discussion

Various factors must be considered keeping in mind patients functional and aesthetic demands also rather than merely considering bone available for implant placement. The biomechanics of restoring edentulous maxilla with implants are complex and must be well-understood before attempting to rehabilitate the same. The healing after extraction is highly variable, presenting with variable bone quality. Depending on the bone availability, various options like end osseous implants with or without grafting, short implants or cortical implants (zygomatic and pterygoid) are available. In this case, rehabilitation with end osseous implants were planned as sufficient bone height and width was present.

To rehabilitate with either fixed or removable prosthesis, following treatment planning factors have been considered:

1. Aesthetics and patient desires
2. Type of support
3. Amount of resorption and interarch space.
4. Number of implants
5. Implant distribution
6. Economics. [6]

Essentially with the edentulous maxilla there are two categories of prosthesis, fixed and removable. Fixed prostheses included metal ceramic restorations or hybrid dentures supported by implants. The framework in these restorations can be milled titanium, DMLS -Cobalt-Chromium, casted metal, PEEK milled, or G-CAM with Titanium bases. The superstructure can be ceramic, layered composite or acrylic.[7] Mode of retention can be either screw retained or cement retained.

The removable category includes implant supported overdentures and implant retained & tissue supported overdentures. A removable prosthesis can be secured by different methods including, bar and clip, magnet, ball attachments or the use of a precision milled or spark eroded components. [8]

With the advent of digitalization, such a complex case was easily and accurately managed. Advantages being less cumbersome and time-consuming and the drawbacks being expensive and associated learning curve. Digital technology usage on edentulous patients is a complex procedure. To capture the correct implant position with a digital impression it is necessary to use a specific transfer post called an intra-oral scan body (ISB).It becomes a difficult task while scanning for edentulous arches due to lack of reference points leading

to overlapping and distorted images. Therefore, in edentulous arch impressions, it becomes necessary to use an ISB design which can be easily scanned by the IOS, can be manipulated by the operator and is comfortable to patient.[9]In this case, one single posterior was retained so it acted as a reference point and helped in scanning.

Gimenez et al. contended that scanning larger edentulous areas significantly affected both linear and angular measurements, which can be imputed to the accumulative error of the stitching process.[10] In contrast, various studies have confirmed that digital impressions can be used for the fabrication of full-arch implant-supported prostheses, providing a satisfactory passive fit.[9,11] Nonetheless, A jig verification was done to check the accuracy of impression and passivity.

One more important objective of full arch or long span implant-supported fixed prosthesis is to provide passivity in the fit. Perfect passive fit is achieved when the opposing surfaces of the implants and the framework intaglio are in maximal spatial congruency, without strains in the components after tightening of all screws.[12] It can be achieved easily with cement retained prosthesis. But it has other disadvantages like lack of retrievability, maintenance problems and more chances of peri-implantitis due to excess cement while cementation. It is difficult to achieve passive fit with screw retained prosthesis at implant level due to difference in angulations.

As a solution, multiunit abutments over implants can be used to provide passivity. Added advantages are better maintenance, retrievability and reduced interactions of screwing/ unscrewing at implant level, reducing the chances of periimplantitis. In full arch implant supported prosthesis, it is almost always advisable to use multiunit abutments for the above-mentioned reasons.

Therefore, it is of utmost importance to understand the individual factors and plan accordingly. Each case presents with its own complexities and it can be easily managed with various advances in implantology, be it in impression making or in prosthetic components.

Conclusion

With the increased predictability of success of fixed implant supported prosthesis along with increased awareness, patients' demands towards aesthetics and function have drastically increased. Rehabilitation of maxilla is one of the most challenging endeavours facing the restorative dentist. It is very important to understand the biomechanics of implant supported fixed prosthesis before attempting to perform it.

Aesthetics is a major cause of failure, going through a lengthy expensive treatment only to achieve a result which is aesthetically inferior to a complete denture can be hugely dis appointing. Therefore, every step needs to be strategically planned and attention to detail is important. When all sequences of treatment are executed appropriately, implant supported rehabilitation of the edentulous maxilla is one of the most gratifying procedures.

Abbreviations

IOS– intraoral scanner

ISB – intraoral scan bod

CAD-CAM- computer aided designing and computer aided manufacturing

STL – Standard tessellation language

CBCT - Cone beam computed tomography

OPG – Orthopantomograph

PMMA – Polymethyl methacrylate

Ti- titanium

DMLS- Direct metal laser sintering

PEEK- Polyether-ether-ketone

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