State of the art implant placement and restoration through guided techniques: An 'all-on-4' clinical report

By Martin Marcus DDS, Russell Baer DDS, Nelson Lo DDS - University Associates in Dentistry, Dental Implant Institute of Chicago, Chicago, Illinois

Implant dentistry has become a well proven accepted standard of care for the single tooth, multiple missing teeth, as well as the fully edentulous arch of teeth. Constant changes are rapidly improving our ability to clinically treat patients in a more expeditious, efficient and less invasive manner. Technologies using CBCT (cone beam computerized technology) 3-D imaging, computer generated planning software, guided surgery and immediate function have benefited our patients with reduced treatment times, minimally invasive and simplified surgical techniques, reduction of post-surgical discomfort and the immediate placement of a fixed restoration.

The guided implant surgical and prosthetic technique for the All on 4 restoration of an edentulous arch has gained greater acceptance and success[1]. Its benefits are many:

- The ability to rehabilitate the completely edentulous jaw with a minimum of bone volume and avoiding in most situations bone grafting procedures[1].
- Flapless surgery which allows for the patient to experience less surgical trauma, pain or swelling[2].
- Strategically placed implants, 2 posteriorly and 2 anteriorly, with good anchorage have shown very successful outcomes[3, 4].
- Angulations of the implants allows for longer implants to be placed with cortical bone anchorage. Greater anterior-posterior spread of implants creates an ability to restore teeth back to the first molar region with the reduction of cantilever effects[5, 6].
- The prosthesis allows for the re-establishment of vertical dimension most patients have lost to either bone loss due to periodontal disease or existing old dentures.
- Primary immediate implant stabilization reducing the mechanical load by implant splinting[7, 8].
- An immediate function fixed restoration at the time of surgery due to implant stability[9].
- The immediately loaded restoration allows an easier transition for patients from a removable to a fixed restorative state.
- Simplifies the procedure for the clinician.

Clinical report

Planning

A 70 year old woman presented with a maxillary denture. The patient has been edentulous in the upper jaw for over 10 years (Fig.1). She has worn several different sets of dentures during that period of time. A preliminary evaluation of her dental and medical history was obtained. Her medical history presents with no significant contraindications for implant surgery. A treatment plan was devised utilizing guided implant surgery and the All on 4 (Nobel Biocare) protocols.

The upper denture was relined in order to fit intimately with the tissue, at a corrected occlusal vertical dimension and with a pleasing, acceptable, esthetic alignment. This will duplicate as a radiographic template.

Multiple 2-mm holes were placed into the dentures at different levels and in areas both buccally and palatally. These holes were filled with gutta percha as radio-opaque markers. (Fig. 2) An occlusal record was then taken using vinyl polysiloxane at the appropriate centric and vertical dimensions. This allowed the patient to hold the radiographic template in position during the CBCT scan and prevent movement.

Our patient was now ready for a CBCT (Gendex CB-500; DENTSPLY) scan. CBCT allows views of different objects at different densities in a 3D view. We can visualize available bone for implant placement, as well as pertinent anatomical structures such as the maxillary sinuses, the mandibular inferior alveolar nerve canal, soft tissue thickness and tooth position relative to the underlying bone[10].

A double scan technique was used[11]. The first scan was of the patient with her denture (radiographic template) and the interocclusal record. (Fig.3) The second scan was of the denture only.

The CBCT data was then formatted and transferred into a 3-demensional implant planning software program (Procera CAD Design; Nobel Biocare). Implant positions and sizes, as it relates to bone availability and associated vital structures, can be digitally evaluated and placed. Super imposing the two sets of scans allowed us to correlate the correct planned implant position in relation to the position of the denture teeth on the prosthesis. (Fig.4)

After the plan was completed, the data was transferred to a milling center to fabricate a stereolithography surgical guide and duplicate denture.(Fig.5) This guide will: 1) at the time of surgery, direct the placement of implants into the identical positions as planned for a flapless surgical approach[12] and 2) allow for creating a cast from which the interim, immediate prosthesis will be created. (Fig.6) The duplicate denture gives the technician the ability to mount the cast and shows tooth position to be duplicated into an all acrylic fixed hybrid interim prostheses. (Fig. 7) A new silicone centric occlusal record was created with the surgical guide and opposing arch. This allows proper seating of the guide at the time of surgery.

Surgery

After all our pre-surgical diagnostics and planning were completed guided implant surgery was performed. Initially appropriate pre-surgical medications were given which included antibiotics, analgesics and an antimicrobial rinse.

Local anesthetics were given ie. lidocaine and bupivacaine and the surgical guide inserted. Biting on the interocclusal record for 1 – 2 minutes allowed for tissue displacement insuring a more positive position of the guide to the planning data. Positioning and seating of the guide was confirmed. While the patient remained closed on the interocclusal record our initial step was to place the 3 pre-planned horizontal stabilization pins. This secured the guide. The interocclusal record was removed, exposing the surgical sites of the guide.

The first osteotomy was prepared, choosing one of the anterior positions. Appropriate sequencing of the tissues punch, drilling guides and twist drills were used according to the manufacturer's directions (NobelGuide; Nobel Biocare). Once the osteotomy was completed, the pre-planned implant type, length and size were placed and a template abutment inserted. This now provided the guide with additional stability from a vertical direction as well. The

Figure 1

Figure 2

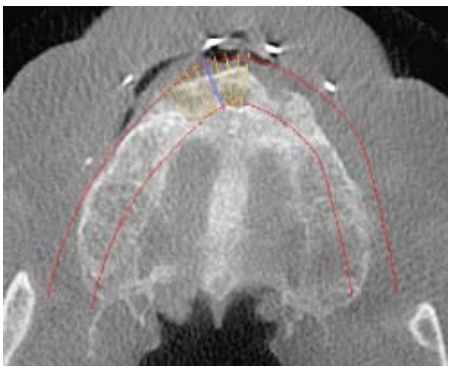

Figure 3

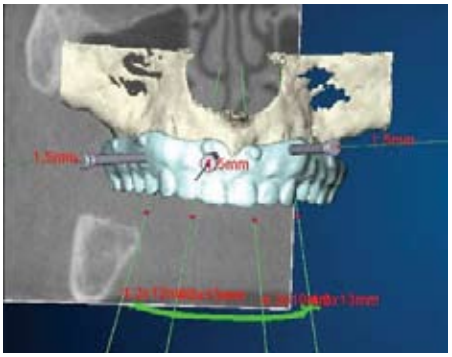

Figure 4

Figure 5

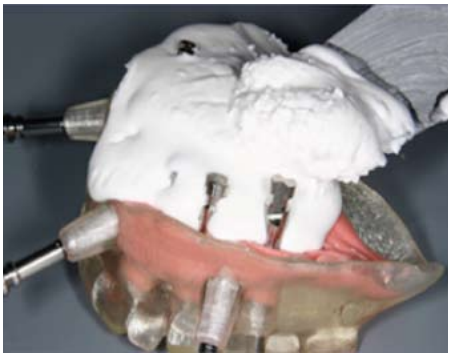

Figure 6

Figure 7

Figure 8

Figure 9

remaining three implant osteotomy sites were then prepared using the same sequential drilling protocols and the appropriate implants were placed. (Fig. 8)

After implant placement the surgical guide was removed and the 2 anterior straight multiunit abutments (Multiunit abutment; Nobel Biocare) were placed first, followed by the posterior 30 degree angled abutments (30 degree Multiunit abutment; Nobel Biocare) using a laboratory fabricated custom jig.(Fig. 8) The all acrylic hybrid prosthesis was tried in for fit and confirmed by radiographic evaluation. Occlusion and vertical dimension were evaluated and minor adjustments made as needed. The prosthesis was screwed in, access holes covered and immediate function obtained.(Fig.10)

Post-operative instructions regarding hygiene maintenance, soft diet and continued antibiotics (daily for 1 week), anti-inflammatory (ibuprofen 600mg. 3 times a day for 3 days) and antimicrobial (chlorhexidine rinse, daily for 1 week) were prescribed. Any other medications thought to be necessary, such as a narcotic for pain, would be considered at this time as well.

Restorative

After 3 months of osseointegration the restoration of a titanium reinforced fixed hybrid prosthesis (Procera Implant Bridge; Nobel Biocare) was created. The interim prosthesis was removed, tissue and implant site inspection for osseointegration were evaluated, and the following sequence of appointments were necessary for the completion of the final restoration.

1. Custom tray impression using impression transfers for the positional relationship of the implants to the ridge and each other. (Fig 11)
2. Verification jig to identify that the implants on the master cast are in the identical position as they are in the mouth. (Fig. 12)
3. Bite block records to measure the vertical and centric relation positions.
4. Wax try-in to ensure the esthetics, tooth position, phonetics and occlusion. Also this identified the spacial relationship between the correct tooth position, the ridge and the implant abutments to create a custom milled

Figure 10

Figure 11

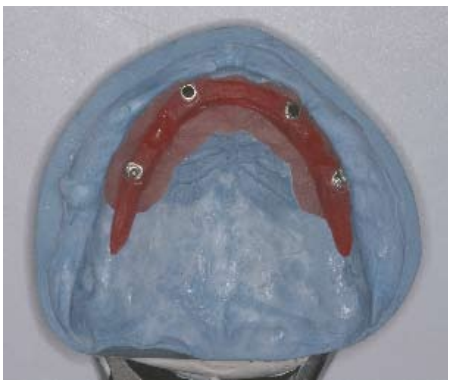

Figure 12

Figure 13

Figure 14

Figure 15

titanium bar that was milled and fit within the parameters of the prosthesis.

5. Try-in of the custom milled titanium retention bar along with the transfer of the tooth set up for final evaluation of fit, esthetics and function (phonetics and occlusion).(Fig12)

6. Delivery of the final prosthesis, minor occlusal adjustments, torquing the retention screws to 15 Ncm. and restoring the screw access holes.(Fig14)

7. Radiographic confirmation of the fit of the prosthesis to the implant abutments, implant placement and integration.(Fig.15)

Summary

Technological advancements continue to revolutionize our abilities to treat our patients in a more efficient and less invasive manner. Through CBCT dual scan data visualization of available bone, anatomical issues that may be encountered during surgery, soft tissue thickness and prosthetic tooth position may be revealed. 3-D virtual planning allows us to diagnostically plan implant sites, develop surgical guides to transfer that information intraorally and create a prefabricated, immediate function prosthesis before the patient is even in our dental chair. By using surgical guides for implant placement the implants may be placed through a minimally invasive flapless procedure, quickly, predictably and with a low level of complications. This minimizes the patient's pain, time and stress. Restoratively, we are able to bring our patients from a removable denture to a functioning fixed prosthesis immediately. Considering the advantages and benefits of implant placement and restoration through guided techniques, we can recommend this as a viable alternative to treatment for rehabilitation of the edentulous jaws. I

REFERENCES

1. MaloP., NobreM.,Lope,A. The Use of Computer-Guided Flapless Implant Surgery and Four Implants Placed in Immediate Function to Support a Fixed Denture: Preliminary Results After a Mean Follow-up Period of Thirteen Months. Journal of Prosthetic Dentistry 2007 Volume 97 Issue 6

2. CampelLD, CamaraJR. Flapless Implant Surgery; A 10-year Clinical Retrospective Analysis. Int Journal Oral Maxillofacial Implants 2002 17:271-6

3. BranemarkPI, SvenssonB, van SteenbergheD.Ten-year Survival Rates of Fixed Prostheses on Four to Six Implants Ad Modum Branemark in Full Edentulism. Clin Oral Implants Res 1995; 6:227-31

4. Mal,P, RangertB, NombreM. 'All on Four' Immediate Function Concept with Branemark System Implants for Completely Edentulous Maxilla: A 1 Year Retrospective Clinical Study. Clin Implant Dent Relat Res 2003:7 Supplement 1:588-94

5. AparicioC, PeralesP, RangertB. Tilted Implants as an Alternative to Maxillary Sinus Grafting: A Clinical, Radiographic and Periotest Study. Clin Implant Dent Relat Res 2001;3:39-49

6. KrekamanovL, KahanM, RangertB, Lindstrom,H. Tilting of Posterior Mandibular and Maxillary Implants of Improved Prosthesis Support. Int Journal of Oral Maxillofacial Implants 2000;15:405-14

7. MortonD, JaffinR, WeberHP. Immediate Restoration and Loading of Dental Implants: Clinical; Considerations and Protocols. Int Journal of Oral Maxillofacial Implants 2004;19 Supplemental 1:103-8

8. AttardNJ, ZarbGA. Immediate and Early Implant Loading Protocols: A Literature Review of Clinical Studies. Journal of Prosthetic Dentistry 2005;94:242-58

9. SchnitmanDA, WohrlePS, RubensteinJE et al. Branemark Implants Immediately Loaded with Fixed Prosthesis at Implant Placement: Ten Year Results. Int Journal Oral Maxillofacial Implants1997; 12:495-503

10. SonickM, AbrhamsJ, FaiellaR. A Comparison of the Accuracy Of Periapical, Panoramic, and Computerized Tomographic Radiographs in Locating the Mandibular Canal. Int Journal Oral Maxillofacial Implants. 1994;9(4);455-460

11. Van SteenbergheD, NaertI, AnderrsonM, Brajnovic I, Van CleynenbreugelJ, SuetensP. A Custom Template and Definitive Prosthesis Allowing Immediate Loading in the Maxilla: A Clinical Report Int Journal of Oral Maxillofacial Implants 2002;17:663-70

12. Van SteenbergheD, GlauserR, BlombackU, et al. A Computed Tomographic Scan-derived Customized Surgical Template and Fixed Prosthesis for Flapless Surgery and Immediate Loading of Implants in Fully Edentulous Maxillae: A Prospective Multicenter Study. Clin Implant Dent Relat Res. 2005;7 (Suppl 1):S111-S120