CASE REPORT

CBCT-Assisted Treatment of the Failing Long Span Bridge with Staged and Immediate Load Implant Restoration

Case Report by Scott D. Ganz, DMD

Treating failed long-span bridges presents unique challenges for the clinician and the patient. Most patients do not want to be without teeth for an extended amount of time. In fact many patients are now aware of options which would allow for removal of the existing bridge and teeth with immediate implant placement and restoration. However, proper diagnosis and treatment planning is essential for a complete understanding of the local bone and surrounding vital structures.

A 61 year old male patient presented with pain and mobility in an existing mandibular right long span fixed bridge. A routine diagnostic work-up was completed, including periapical radiographs and study casts. The patient had a history of bruxism which may have been contributory to the root fractures and mobility of the bridge.

Radiographic loss of bone was evident around the mandibular second molar tooth which was the terminal abutment for the fixed bridge exhibiting a significant angular defect on the mesial roots [FIGURE 1]. The first bicuspid had previously been treated with root canal therapy, and appeared to be fractured from the stress of the restoration and/or recurrent decay along the margins. In order to determine the potential treatment alternatives a CBCT scan was ordered to allow complete inspection of the three dimensional bony topography, and the relationship of adjacent vital structures.
Cone Beam CT technology allows for an accumulation of data for which educated treatment decisions can be accurately determined. There are four important three dimensional views; (1) axial, (2) cross-sectional, (3) panoramic, and (4) 3-D reconstructions. Each of these views are individually important, and when assimilated will provide the ultimate overview of the patient's anatomic presentation.

The cross-sectional image is excellent for defining a slice of the mandible where the height and width of the bone can be accurately evaluated. Within an individual slice, the spatial location of the tooth and root can be appreciated [FIGURE 2]. The facial, lingual cortical, and intermedullary bone can be visualized based upon their radiopacity or gray scale density values. Nuances within the anatomical presentation can be assessed with greater accuracy than any other imaging modality.

The cross-sectional slice of the posterior molar reveals the significant bone defect surrounding the apical roots [FIGURE 3]. There was cortical bone below the root apex and the significant lingual concavity was noted. Although there was good quality bone above the location of the nerve, it was elected to extract the tooth and fill the defect with grafting material in anticipation of placing an implant after the new bone had matured.
Creating a fully interactive three dimensional reconstruction allows the clinician further insight into the patient's existing anatomical presentation. Utilizing advanced masking or segmentation allows for the various anatomical entities to be separated for improved diagnostic capabilities. The pre-existing bridge has been colorized (magenta) as have the adjacent molar and cuspid teeth (white) [FIGURE 4].

Using advances in interactive software, "selective transparency" can be applied to change the opacity of various structures to aid in the diagnosis and planning phase. Accurate placement of realistic implants is enhanced by masking the adjacent tooth roots. The path of the inferior alveolar nerve can also be fully appreciated.

Note the parallelism of the four simulated implants [FIGURE 5]. If the pre-existing restoration could not be physically removed in advance of CT/CBCT imaging and may the old occlusion found to be unfavorable, through further masking or segmentation, it is possible to build a virtual occlusion using interactive treatment planning software. “Virtual teeth” can correct discrepancies, and allow for an ideal simulated morphology.
Once the plan has been verified in all four available 3-D views a virtual template can be fabricated based upon the implant positions. Therefore, the final surgical template is only as good as the virtual plan. There are three basic CT-derived template types which can be fabricated for dental implant placement; (1) bone borne, (2) tooth borne, and (3) soft tissue borne.

Based upon the fact that there were adjacent teeth in the region it was elected to utilize a tooth borne template stabilized by the existing occlusion. The CBCT scan data was sent via email for fabrication of a stereolithographic model [FIGURE 6]. This model is a replica of the patient’s anatomy at the time that the images were acquired. The pre-existing bridge was removed via the software prior to fabrication of the surgical guide. The template adapts well to the surrounding dentition and does not require further fixation to prevent movement. The stainless steel tubes are two tenths of a millimeter wider than the manufacturers’ sequential osteotomy drills.
A novel modality pioneered by the author utilizes a CT-derived stereolithographic model-based approach to link the implant placement and the eventual restoration. Implant replicas, or analogs were placed in pre-designated implant receptors on the stereolithographic partially edentate mandible [FIGURE 7].

In order to accommodate the immediate restoration, manufacturers’ specific abutments were placed on the implant replicas. Note the inter-implant distances for proper embrasure design. A diagnostic wax-up was accomplished and a clear matrix fabricated to facilitate the fabrication of a provisional prosthesis [FIGURE 8].

Once the failed restoration was removed, the underlying fracture tooth roots could be assessed. The volumetric change in the pontic areas was assessed by comparing the facial lingual dimensions of the molar and bicuspid with the pontic area with diminished keratinized tissue. All of the planning decisions had been made prior to the surgical intervention except the design of the flap to expose the underlying alveolar ridge. To preserve the keratinized tissue, a full thickness muco-periosteal flap was required, followed by extraction of the two natural abutment teeth [FIGURE 9]. The tooth borne template was then placed over the site and assessed for fit [FIGURE 10].
As per the CT-derived plan and template, the first three implants were placed (Tapered Internal, BioHorizons Birmingham, Alabama). The implants were well fixated allowing for immediate restoration [FIGURE 11]. The posterior molar extraction socket was filled with a mineralized bone graft material (MinerOss, BioHorizons, Birmingham, AL).
The pre-fabricated four init provisional was seated and relined to fit the three anterior implant fixtures. The distal-extension cantilever replaced the missing molar. The soft tissue was sutured to allow for near primary closure as they were wrapped around the abutment projection while helping to establish embrasures.

The post-operative periapical radiograph confirms the placement of the anterior three implants and the bone graft in the molar defect. The transitional restoration was cemented retained, and left in place for more than two months.
Once the posterior molar bone graft had matured, the fourth implant was placed according to the CBCT plan. An abutment was connected, and the implant attached to the existing transitional restoration. When the fourth implant had integrated after 8 weeks in function, impressions were made and a soft tissue working cast fabricated for the laboratory process. Due to the favorable parallelism afforded by the CT-derived planning, only minor preparation was required for the implant abutments to allow for adequate clearance for the metal alloy and porcelain veneer.

The completed ceramo-metal units seen in the periapical radiographs show nice parallelism and inter-implant distances [FIGURE 15]. The emergence profile of each implant illustrates a smooth transition important to long-term maintenance. Due to the patient's bruxism, it was elected to splint the posterior three units, while the anterior, longer implant was left as a single unit.
The final glaze and porcelain characteristics of the posterior four units blend in nicely with the surrounding dentition and soft tissue [FIGURE 16]. Note the excellent adaptation of the embrasures.

CONCLUSION:

The purpose of this case presentation was to illustrate the enhanced diagnostic and treatment planning capabilities of CBCT data combined with interactive treatment planning software. The combination of careful diagnosis with proper planning aids the clinician in understanding existing bone topography, bone density, adjacent tooth roots, lingual concavities, occlusion, and the path of the inferior alveolar nerve. Once the information has been gathered, an accurate plan can be established.

This plan will then be transferred to a surgical guide, allowing for precise implant placement. In this case three initially placed implants were immediately loaded with a transitional restoration. The posterior molar tooth with resulting socket defect was found to be unfavorable for implant fixation, and therefore site development was accomplished with bone grafting. Once matured, the molar area became an excellent implant receptor site. The patient was given a transitional restoration the day of surgery, although there was a staged approach and delayed implant placement in the molar area.

This case represented one treatment alternative to replacing a failed long-span mandibular and bridge which was made possible through CBCT scan technology, interactive treatment planning software, and CT-derived surgical templates to guide the placement of the implants based upon the restorative needs of the patient.

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