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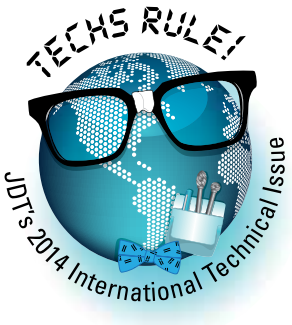


By Robert Schneider, DDS, MS, FACP, and Danny Roberts, CDT

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# Prosthodontic Rehabilitation of the Maxilla Following Severe Facial/Dental Trauma:

## *Coordinated Treatment Planning for a Successful Outcome*

Cranial and facial trauma is a devastating injury. The rehabilitation of this type of patient is at the least very challenging requiring a multidisciplinary medical/dental/dental technology team. The team is responsible for addressing the immediate issues of trauma but also in the planning of future rehabilitation, not only of the pan-facial fractures but also replacement/restoration of the damaged oral hard and soft tissues.



Dental treatment has advanced so that today, osseous grafting, implant placement laser assembled titanium and CAD/CAM technology allows the successful and predictable treatment outcome for the majority of these types of patients.[1-6] A multidisciplinary approach to a patient's surgery and prosthodontic rehabilitation will be presented utilizing a laser assembled titanium prosthesis framework wrapped in injection molded and heat polymerized acrylic resin. Following many years of utilization, this technique has proven superior to the previous use of waxing and casting metallic frameworks in regards to time and accuracy. In addition there is less chairside time by the prosthodontist and relative ease of fabrication by the dental technician. It includes an excellent, predictable, easily retrievable, functional and esthetic restoration for the patient. CAD/CAM designs are also a potential option, however a laser assembled titanium framework was selected and will be discussed for the advantages and disadvantages in this situation.

A 62-year-old female was transported to the University of Iowa Hospitals and Clinics, Emergency Treatment Center (ETC) from her local rural hospital with facial and dental trauma. She reportedly was working with one of the horses she raises on a ranch when the full grown horse charged her and hit her in the face with it's head, she fell down but was not trampled. She suffered injuries to the right side of her face and maxilla. No cranial, ophthalmic or cervical injuries were discovered. Examination in the ETC indicated facial abrasions, temporomandibular joints were normal, multiple missing teeth (Nos. 2-8), Nos. 9 and 10 mobile with significant gingival lacerations and oral bleeding in addition to a through-and-through laceration to the right corner of her mouth. She also had bleeding from both sides of her nostrils and experienced tenderness on the bridge of her nose. A maxillofacial CAT scan was ordered and the appropriate specialists called.


The maxillofacial CT showed massive dental trauma with tooth fractures and several avulsions (**Figures 1 and 2**). One tooth was positioned anterior to the right maxillary sinus. There were several sinus and nasal bone fractures. Several loose teeth were removed and the lacerations repaired. She was appointed with oral and maxillofacial surgery and maxillofacial prosthodontics 10 days later for root tip removal and oral antral fistula closure along with prosthodontic treatment planning. At that appointment it was determined more healing was necessary before fabrication and insertion of a provisional removable partial denture on an interim basis (**Figure 3**).

**Figure 1**
CT scan from the emergency room showing an anterior tooth displaced into the patient nose.

**Figure 2**
CT scan from the emergency room showing molars and other teeth displaced into the maxillary sinus.

**Figure 3**
Frontal view of the patients smile at the initial prosthodontic appointment following removal of the teeth from the base of the nose and maxillary sinus.

Following approximately two months healing, a maxillary acrylic resin provisional removable partial denture was fabricated and delivered to the patient. Due to the tooth and alveolar trauma it was determined several more months of healing was required prior to any significant alveolar ridge augmentation procedures to provide a sound base for dental implant placement (**Figure 21**).

The patient successfully wore the provisional restoration for several months during additional oral healing. An anterior iliac crest bone graft was then placed inside and lateral to the right maxillary sinus to provide adequate bone volume for future dental implant placement (**Figure 22**). The provisional RPD was modified with soft tissue conditioner two weeks after the graft procedure for the patient to wear for esthetics only.

Mounted diagnostic casts were fabricated for evaluation and as a reference source following the extractions and healing period. The patient stated she would prefer a fixed restoration if possible following the surgery which was discussed and would be implant retained following satisfactory healing. The mounted casts were evaluated with input from the dental technician and it was determined there was adequate interarch space for an implant supported fixed partial denture and it was also determine via the diagnostic wax-up the number and placement of the dental implants in addition to fabrication of a restrictive surgical implant placement guide, again with the assistance of the dental technician.

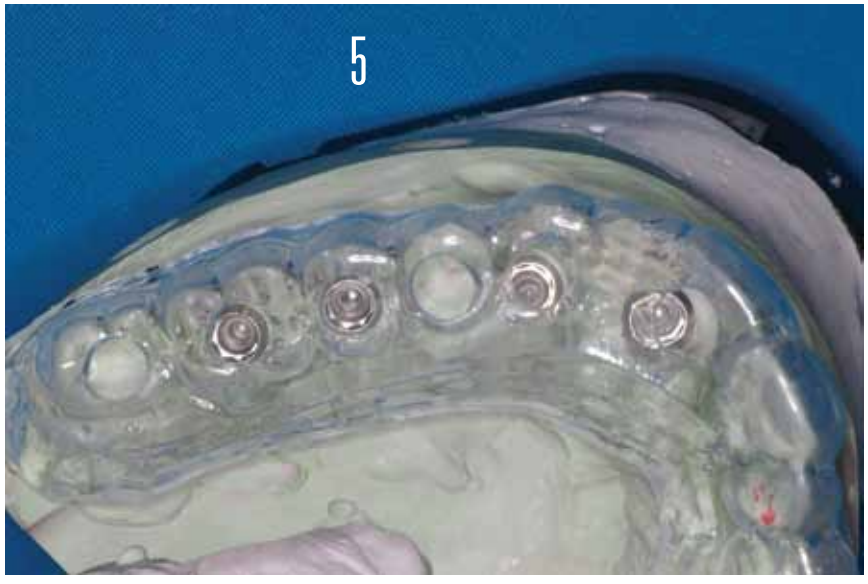
The decision was made that four dental implants would provide adequate support for a screw-retained fixed partial denture processed in injection molded/heat polymerized acrylic resin. A porcelain fused to metal restoration could have also been fabricated, however the authors most often prefer processed acrylic resin

**Figure 4**
Intraoral view of the healed implant placement.

**Figure 5**
Occlusal view of the surgical guide, illustrating the requested implant placement. Additional choices were given in the event the bone graft was inadequate in the initial requested areas.

**Figure 6**
View of the verification index fabricated on the master cast with titanium components joined with autopolymerizing acrylic resin for intraoral try-in. This index serves to verify the accuracy of the master cast final impression and eliminates the need for a framework try-in when it fits accurately intraorally.

**Figure 7**
Occlusal view of the removable wax try-in and trial base on the master cast.



for this type of reconstruction due to ease of adjustment, reparability, lack of abrasiveness to the opposing occlusion, relative ease of fabrication, cost effectiveness and the possibility of requiring removal/modification of the prosthesis.

The guide was fabricated and the four transmucosal dental implants placed (Straumann) following a five month healing period after the hip graft procedure (**Figures 4 and 5**). The implants allowed to heal for three months before making final impressions. Final implant level impressions were made with a custom tray and polyvinyl siloxane impression material to be mounted on the articulator with a facebow.

A verification index was fabricated in the laboratory for intraoral try-in to confirm the accuracy of the master cast (**Figure 6**). Following the verification process and accurate mounting of the master casts the dental laboratory completed the accurate tooth arrangement on the master cast trying to as closely as possible duplicate the patient's provisional RPD tooth position. Following confirmation of accuracy of the wax prosthetic tooth arrangement by the prosthodontist and the patient, the wax-up and master cast was sent to the dental laboratory for fabrication of a laser assembled titanium framework (**Figures 7 and 8**). CAD/CAM is a popular available option, however the prosthodontist author treats patient with atypical restorations that are frequently not amenable to CAD/CAM design with today's software or milling capabilities.

The dental technician fabricates a facial putty matrix of the tooth position on the indexed maser cast to begin fabrication of the titanium framework with the appropriate manufacturer's components (**Figure 9**). In this situation a titanium provisional component was utilized for the maxillary right central, to allow

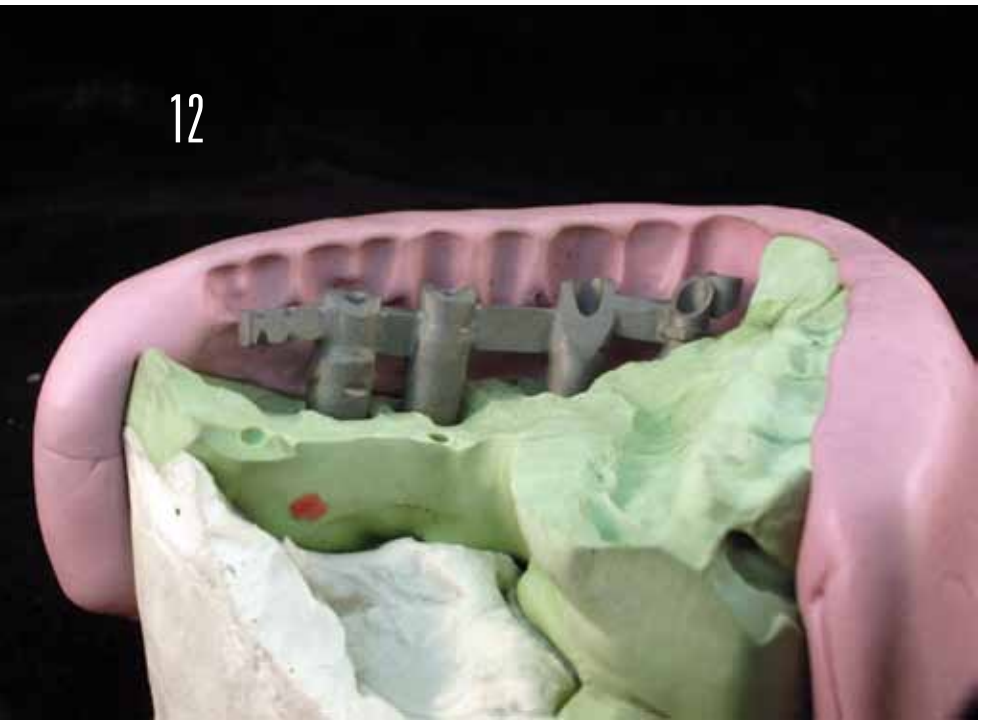


**Figure 8**
Frontal view of the patient's smile at wax try-in. The wax try-in allows the patient to evaluate esthetics and phonetics and allows the prosthodontist to evaluate facial support, occlusion and other factors.

**Figure 9**
Putty matrix of wax up fabricated by the dental technician following acceptance by the patient.

**Figure 10**
Titanium components placed on the master cast and parallel milled prior to laser assembly.

**Figure 11**
The milled components with the matrix to evaluate proper clearance and support for the acrylic resin and acrylic resin prosthetic teeth.



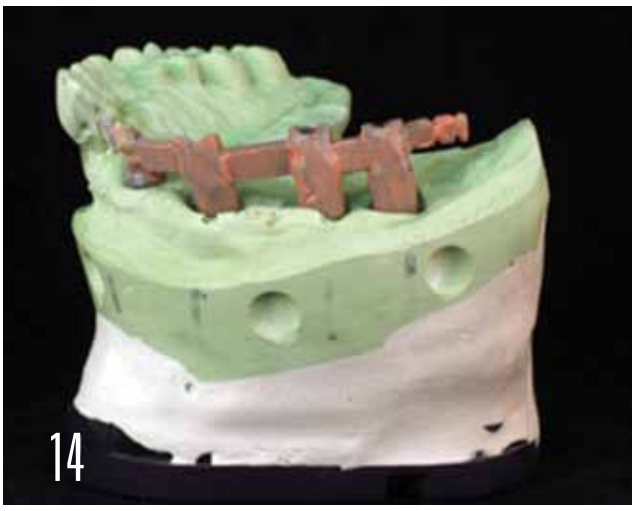



**Figure 12**
The assembled framework aluminum oxide blasted with the putty matrix for final clearance evaluation. Note void free welds between the milled components and connecting components.

**Figure 13**
Framework ready for application of opaque.

**Figure 14**
Opaque added to the frame to block-out the grey color of the metal under the pink acrylic resin.

more room for acrylic resin support and adequate space for the prosthesis tooth. Titanium milling cylinders with more bulk were utilized for the right cuspid and premolar/molar area implants. This allowed the technician to optimize the space need for the acrylic resin prosthesis and provide 2mm of space for materials support in addition to 3mm-4mm of occlusal clearance for the acrylic resin prosthetic teeth (**Figures 10 and 11**).

Each bar post is prepared and paralleled on the master cast using a mill. The pre-milled bar stock is cut to the appropriate length and welded using a series of steps to prevent any deficiencies or warping of the bar to the milled abutments. When the bar has been welded with a passive fit, no rocking and adequate weld strength it is blasted with aluminum oxide and a metal primer is applied to enhance the acrylic resin adherence to the bar (**Figures 12-14**). The teeth are attached to the bar using the previously fabricated putty matrix with wax and the occlusion verified on the articulator. If metal show through is anticipated, a metal pink opaque may be applied. Careful attention to the wax up was made to ensure matching gingival recession/contours to the natural left side maxillary central incisor (**Figure 15**). The occlusal access holes were carefully prepared and the prosthesis attached to the analogs for processing (**Figures 16 and 17**). The screw access holes are slightly filled with wax, leaving a small dimple prior to being sprued and invested for injection mold processing of the final prosthesis. Following processing and deflasking, the technician only needs to use a round bur to remove the acrylic resin to access the retaining screws. Finishing and polishing is relatively minimal meaning a significant time savings in the laboratory (**Figure 18**).

At completion, the prosthesis was delivered from the laboratory for insertion. The design was followed exactly as requested with a high-water gingival design and gingival contours matching the existing left side maxillary teeth. The healing caps were removed, abutments torqued to appropriate levels and the prosthesis put to place passively (**Figure 19**). The occlusion was checked intraorally along with a clinical remount procedure to verify accuracy of the occlusal relationship. The patient was given oral hygiene information and the appropriate hygiene instruments such as end tufted brushes, floss and written instruction were provided to her along with the procedures demonstrated for her.

A panoramic radiograph taken at delivery was utilized to verify accurate fit of the framework and to serve as a baseline evaluation for alveolar bone

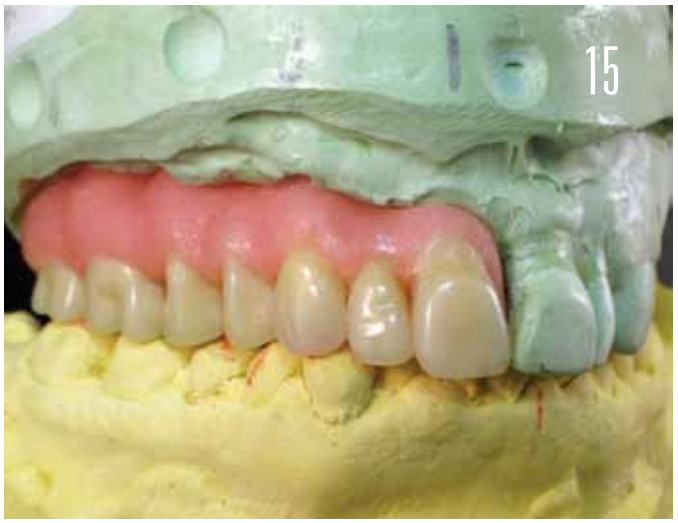




**Figure 15**
Completed wax-up on the framework duplicating the soft tissue contour on the maxillary right central to the maxillary left central as per the patient's request.

**Figure 16**
Occlusal view of prosthesis retaining screw access holes, showing excellent implant placement.



**Figure 17**
The completed wax-up attached to the laboratory analogs prior to sprue placement and flasking for processing with an injection method for less chance of distortion of the framework and less acrylic resin dimensional distortion.

**Figure 18**
Completed acrylic resin prosthesis on master cast for verification of occlusion.

**Figure 19**
Intraoral view of prosthesis at delivery appointment.

**Figure 20**
Frontal view of the addition of acrylic resin to the midline to reduce the size of the midline gingival space as per the patients request. This was completed at the one month recall appointment.



**Figure 21**
Panoramic radiograph taken at the initial appointment showing inadequate bone level in the area of the maxillary sinus due to the previous trauma. This reinforced the necessity of the addition of significant amount of bone to the area of proper implant placement and stability. A diagnostic wax-up provided the restorative team information on the location and volume of necessary bone graft.

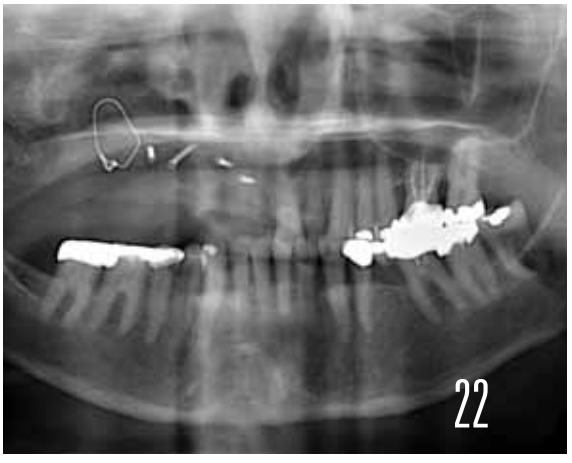



**Figure 22**
Panoramic radiograph taken following the placement of anterior iliac crest hip graft placement in the right posterior maxilla. Graft stabilizing screws and wires are seen.


**Figure 23**
Panoramic radiograph taken on the day of delivery of the completed prosthesis. This shows an intimate and accurate fit of the framework and excellent bone levels supporting the prosthesis. This radiograph will also serve as a baseline for future radiographs for bone level evaluations.

levels around the implants for future comparison at recall (**Figure 23**).

At the recall appointment the patient was doing well but requested additional pink acrylic resin be added to the midline papilla area to decrease the size of the gingival defect (**Figure 20**). The bridge was removed and acrylic resin added to the patient's satisfaction.

This patient has been followed without complications for nearly two years and is very pleased with the esthetic and functional outcome (**Figure 24**). She continues on routine recall and the alveolar levels have remained at a consistent level. The prosthesis is showing no signs of wear or screw loosening with no repairs or concerns.

CAD/CAM design and milling of the prosthesis was considered, however in our team discussion it was decided that a laser assembled and milled prosthesis was the technique of choice. The authors frequently utilize the CAD/CAM and milled type of frameworks with very good outcomes, however in the prosthodontic authors experience there are limitations to the available CAD/CAM software that does not allow the optimal framework design with the trauma/cancer or tumor patient routinely treated in the clinic.

Complex facial trauma is a very challenging and rewarding aspect of today's prosthodontic practice. The multi-disciplinary treatment team can lead to a very predictable, functional and esthetic outcome for the reconstruction of facial and oral trauma. Use of this technique eliminates the framework try-in resulting in fewer appointments for the patient and more efficient use of laboratory time. The dental technician is a member of this team and must have an in-depth knowledge of dental implants, surgical outcomes, dental biomaterials, esthetics, occlusion and laser

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**Figure 24**
Patient's smile.

assembly procedures. Advancement in dental technology is proceeding rapidly and it is critical all members of the team become knowledgeable in these procedures and modification of traditional treatment concepts. **JDT**

## Acknowledgement

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