Restoration of Posterior Implants:

Simple Techniques for the Restorative Dentist and the Dental Technician

Dr. Douglas Lobb, BSc, DDS

ABSTRACT

As **restorative** dentists, we understand that an intact, functioning posterior dentition is important for a patient's **long-term** enjoyment **of** chewing function, and dental health. To **achieve** that goal, lost or missing teeth have historically been replaced with various treatment modalities, such as fixed bridgework or removable partial denture prosthesis.

The success and long term predictability of implant-supported crowns and/or bridges have caused a paradigm shift in how restorative dentists treat the posterior dentition. The **objective** of this paper is to demonstrate simple yet effective techniques that minimize the amount of complex steps or armamentarium needed by the restorative dentist or dental technician. Using techniques and treatments that are similar to those that we use on a daily basis will lead to outcomes that are predictable, successful, and satisfying for the technician, the dentist, and the patient.

The discussion of these simple techniques is illustrated in a challenging case of a patient who is missing four posterior teeth, which will be restored by implant-supported single crowns.

RÉSUMÉ

En dentisterie restauratrice, nous comprenons que les dents postérieures en bon état sont importantes à la fonction de mastication à long terme et à l'hygiène dentaire du patient. Par le passé, les dents manquantes ont été remplacées soit par un pont fixe ou par une prothèse partielle.

Le succès et la prévisibilité à long terme des couronnes et/ou des ponts avec implants ont provoqué un changement de paradigme sur la manière dont les dentistes en dentisterie restauratrice traitent la dentition postérieure. L'objectif de cet article est de démontrer des techniques simples mais efficaces qui réduisent le nombre d'étapes complexes ou l'instrumentation que devra utiliser le dentiste ou le technicien dentaire. Le fait d'utiliser des techniques et des traitements qui sont semblables à ceux que nous utilisons tous les jours donnera des résultats qui sont prévisibles et satisfaisants pour le technicien, le dentiste et le patient.

Ces techniques sont illustrées dans le cas d'un patient auquel il manquait quatre dents postérieures qui ont été remplacées par des couronnes implanto-portées.

About the Author

Dr Douglas Lobb is in private practice in Edmonton, Alberta

The ability to chew and masticate food well requires an intact and functioning posterior dentition, including at least the first molars. Often, the ravages of dental disease, trauma, patient neglect, biomechanical failure, and other causes; can lead to early tooth loss. Loss of teeth, if not treated, can over time lead to drifting of teeth, over-eruption of opposing teeth, alveolar bone loss and collapse of the posterior dentition, and loss of function. The challenges to the restorative dentist are many, as we address these sometimes complex and challenging situations. Historically, treatments have ranged from no treatment, to fixed bridge prosthetics, to removable partial denture prosthetics.

Over the last half century, root form or endosseous implants have lead to a new and more viable option in our quest to replace missing teeth and restore function. Continual implant improvement in such areas as: science, biology, dental materials, implant design and surface treatment, has lead to predictable, long-term successful treatment. Implant supported crowns are often now considered to be the treatment of choice over fixed partial dentures prostheses, for the replacement of missing teeth. Implant treatment has one significant bonus over the alternative therapies; the ability to preserve alveolar bone. That being said, the consideration of implant therapy depends on having adequate quality and quantity of bone where implants are being considered.

The objective of this paper is to present techniques pertinent to the restoration of implants in the posterior region that are reasonably simple for the restorative dentist and dental technician to master, and which are similar to our everyday crown and bridge techniques. The importance of adequate and complete preliminary dental and medical examination, record taking, thorough treatment planning, and communication with the patient, dental specialists, dental technician are not within the scope of this paper but are paramount to the success of any treatment.

The objective of restoring implants or teeth is to achieve predictable results that are "functionally enduring and esthetically pleasing" (Dr. Robert Winter – personal communication). The outcome objective must be discussed in detail with the patient, restorative dentist, dental surgeon, and dental technician before treatment begins.[1]

It is the authors' experience that involving the dental technician early in the treatment phase is very beneficial both in the planning and outcome. Complete contour wax-up on articulator-mounted models provides visualization of the treatment, areas of concern or limitation, and a way to communicate with the patient and dental team. Thus we create the blueprint for the final result. The expense of a full contour wax-up is offset by the advantages of deciding on the position and placement requirements of the implant, whether bone grafting or tissue augmentation will be needed, and for constructing a surgical stent to guide implant placement. From the complete contour diagnostic wax-up, the restorative dentist has determined where the crown of the tooth needs to be. This then drives where the implant placement is needed to support the crown and the functional load. Thus the treatment is prosthetically driven, not surgically driven.

Often in the posterior region of the mouth there are anatomical structures that may limit or preclude treatment, (e.g., maxillary sinus, mandibular nerve). Inadequate horizontal or vertical bone levels may require bone grafting to aid in achieving the desired outcome for implant support. Both adequate hard and soft tissue support is necessary and if inadequate, may lead to treatment that is compromised or not feasible. Today, we know that sinus elevation bone grafting, horizontal bone grafting, and soft tissue augmentation is predictable, and beneficial. Vertical bone grafting is less predictable. The use of the full contour diagnostic wax-up allows important communication between the restorative dentist and the dental surgeon. An alternative to the complete contour wax-up in less demanding cases is to use a denture tooth or a preformed wax tooth form placed on the articulated study model.

The complete contour diagnostic wax-up establishes the proper or ideal position of the future crown; it does not tell us where the implant should be located below the soft tissues, or how the soft tissues are to be supported. The author recommends following the consensus guidelines established by the International Team for Implantology (ITI) for placement of implants in the Esthetic Zone.[2,3] These guidelines serve us well in the posterior region. The implant shoulder should be placed in the optimum mesiodistal dimension, and no closer than 1.5 mm to the adjacent tooth; orofacial dimension, being placed neither too far facially or palatally, with an ideal position of 1 mm palatally from a line drawn facially from the cemento-enamel junction (CEJ) of adjacent teeth; and coronoapical dimension with the shoulder located about 1 mm apical to the CEJ of the contralateral tooth. The goal would be an implant shoulder being placed 1.5 mm to 2 mm below the level of the gingival tissue. This will allow easy removal of cement during luting procedures. If the depth becomes much greater than 3 mm, consideration should be given to a screw retained crown, or a custom screw retained coping upon which a cemented crown or bridge retainer can be placed.

Our goal is to have an ideally placed implant shoulder that allows everyday techniques by the restorative dentist and dental technician to be utilized. Such techniques as: selecting and torque of solid abutment connectors, capturing the impression with our crown and bridge impression materials, fabricating working models with simple but precise prefabricated system components for the dentist and laboratory, and the use of conventional luting cements for provisional and final cementation. The armamentarium of instruments and components required is minimal, both for the dentist and dental technician.

The simplicity in steps from the removal of the healing cap to the final placement of a crown will be demonstrated in a case report.

Material selection

The implants and system components used in the following case presentation are by Straumann (Institut Straumann AG – Switzerland). Implants used are Regular Neck 4.1 mm diameter implants with a 4.8 mm diameter collar for premolar; and 4.8 mm wide implants with a 6.5 mm diameter collar for the molar applications. All implants are Standard Plus SLA surface treated, and placed in a single stage surgery. They are subsequently fitted with solid abutment connectors for cement retained crowns. The author will demonstrate how a solid abutment can easily be

modified both by the technician and dentist when inadequate occlusal clearance occurs.

Functional Occlusal Concepts for the Natural Tooth/Implant

There are a number of goals that we as clinicians strive for when creating harmony of our patient's functional occlusion. The importance of a stable occlusion will allow long term health for our patients and reduce destabilizing, pathologic, destructive forces. The author will briefly outline the most common functional occlusal goals, some tools, and techniques that are helpful in achieving these goals.

Functional occlusion goals[4,5]:

- All jaw movements and terminal closure must be compatible with a harmonious temporomandibular joint, (TMJ)
- Envelop of function that creates an efficient use of closing and opening movement (muscles)
- Envelop of function that does not create premature loading of the teeth – wear, mobility, temporomandibular dysfunction – (TMD)
- Maximum intercuspation that the brain can find – gnathological positioning system (GPS)
- Maximum intercuspation that is precise with bilateral, equal, intensity contacts
- All occlusal forces should be directed through the long axes of the teeth or implants
- When implants and natural teeth are located within the same arch, the teeth should contact first, then the implant prosthesis. This non-simultaneous occlusal scheme compensates for tooth movement in mixed implant-natural tooth occlusal combinations, (Dr. Chris Stevens – personal communication). The periodontal ligament has about 20µ of movement.
- All posterior teeth disocclude almost instantaneously once a mandibular excursion is commenced – canine guidance
- Cusp/fossa contact directed along the long axes of the tooth is preferred; with cusp/marginal ridge contact being acceptable. All-ceramic restorations are strongest in compressive loading, and weaker in shearing/deflection loading. A cusp/fossa occlusal contact will maximize the compressive strength of porcelain ceramics bonded to teeth, and lessen the likelihood of chipping or fracture.

The goals of functional occlusion are important for the health of the natural dentition, including implant supported prosthesis. The exploration of functional and dysfunctional occlusion is well beyond the scope of this paper. An occlusal examination is important, both pre-treatment and post-treatment, for management of occlusal forces. For completeness, a discussion for the adjustment and management of occlusal forces will be made.

The tools used by the author for occlusal markings and force assessment are shim stock 8µ (Hanel – Germany); thin articulating paper (Accufilm II, Parkell – USA); thick articulating paper 60µ, 200µ (Bausch – Germany); T-Scan III computerized occlusal analysis system (Tekscan – USA).

The author's goals in the case presentation of implant supported crowns and all-ceramic restorations are: restorations with solid interproximal contacts, cusp/fossa occlusal contact relationship, full anatomically sized teeth, with forces directed along the long axes of the tooth/implant. When implants and natural teeth are located within the same arch, the natural teeth should contact and load first, prior to the implant supported crown.

As the teeth are equilibrated, it is important to develop a smooth pathway to maximum intercuspation, while eliminating any excursive interferences. The thin articulating paper is used to mark the centric holding stops, and the thicker articulating paper to mark lateral contacts during excursive movements. All posterior teeth, including canines should have one small contact that holds shim stock during centric contact. Incisors should never hold shim stock in a maximum intercuspal position or centric occlusion. Posterior teeth and canines hold shim stock; incisors only hold articulating paper. There should be no lateral marks or streaks on the posterior teeth during excursive movements, only the canines. The best way to mark the lateral movements is to sit the patient upright and have them chew on the thick horseshoe shaped articulating paper. Chew it as if it were food. This will mark the excursive contacts during function, allowing easy viewing and adjustment.

When natural teeth and implant-supported crowns occur in the same arch, the natural teeth should hold shim stock and the implant-supported crown hold only articulating paper. This is one method in developing a delayed occlusal loading of the implant supported crown. A more effective way would be with the use of the T– Scan III, computerized occlusal analysis tool.[6,7] The forces on the teeth, arch, and implant can be measured both by the intensity of force and during a time period.

The T–Scan III also allows a continuous measurement of forces on the teeth/arch over time in centric biting or loading and excursive movements. Research has shown that clinical goals of complete intercuspation of teeth from initial contact to full contact should occur within 0.2 seconds or less; and disclusion of all posterior teeth in less than 0.4 seconds.

This instrument is a much more precise tool over the articulating papers/shim stock method.

Clinical tip: to mark occlusal contacts on glazed porcelain can be very difficult. Rub a small amount of petroleum jelly (Vaseline) on the articulating paper. This allows excellent markings on the highly polished surface.

Case Presentation

The male patient has been treated by the author since he was 8 years old. The patient presents at age 14 with oligodontia, missing maxillary and mandibular second and third molars, and microdontia, with small teeth generally and peg shaped maxillary second premolars. There are retained deciduous molars and poor occlusion.

The patient was referred for an orthodontic consultation, and subsequent orthodontic treatment. The treatment goal was to align the teeth in a class I occlusion, with tight contacts of the anterior teeth and adequate spacing for implants supporting individual crowns, and restoration of the maxillary premolars. The end result of the orthodontic treatment before the restorative phase is illustrated in Figures 1 to 6.

After four years of orthodontic therapy, the teeth were placed in the ideal position in the arch, allowing restoration of the

Figure1. Pre-treatment pan.

Figure 2. Retracted smile.

Figure 3. Right retracted.

Figure 4. Left retracted.

Figure 5. Maxillary occlusal view.

Figure 6. Mandibular occlusal view.

Figure 7. Healing caps, tooth preparations, occlusal view.

Figure 8. Mirror view left side.

Figure 9. Mirror view right side.

missing teeth and re-establishment of sound posterior occlusal function. Mounted study models were made and a full contour diagnostic wax-up was undertaken. There was concern expressed by the orthodontist about a late growth spurt; the patient was 18 at the time. This potentially could have an impact on implants place at this age frame, should a late growth spurt occur. In consultation with the patient, his parents, and the orthodontist; it was decided to proceed with the implant placement.

Because of the nature of the oligodontia and microdontia, implant site selection would be the first premolar area, bilaterally, in the maxilla. In the mandible, it would be bilaterally, in the first molar region. This would create three premolars bilaterally in the maxilla, and two first molars, bilaterally in the mandible.

In one session under local anesthesia, two Straumann 4.1 mm x 12 mm Regular Neck, Standard Plus implants were placed in the maxilla, and two Straumann 4.8 mm x 12 mm Wide Neck, Standard Plus implants were placed in the mandible (Figures 7–9).

During the healing phase of the implant integration, an occlusal adjustment was performed to stabilize the occlusal contacts and improve the occlusal relationship between the arches. The principles of functional occlusion outlined earlier in this article were followed. This is a unique case as there was little posterior occlusion as a result of missing teeth, microdontia, incomplete eruption of the maxillary first molars, and post orthodontic tooth mobility. Thus, posterior occlusal stability and occlusal contacts will be restored with all-ceramic crowns and implant-supported ceramo-metal crowns. The all-ceramic crowns will restore the small sizes of the maxillary premolars to full anatomic size, and cusp/fossa occlusion. The implant-supported crowns will restore the missing teeth, again to full size anatomical crowns in a cusp/fossa occlusion. The mandibular first molars will be smaller in size, as this relates to the smaller mesial/distal width within the arch. It is important to communicate to the dental laboratory what the desired occlusion outcomes should be.

The maxillary second premolars were restored with 360° veneer type crowns, and for the first premolars, a veneer/onlay porcelain restoration, with their respective preparations (Figures 10 and 11). The goal was to restore the teeth with the most conservative restoration that would maintain the maximum amount of tooth structure. The restorations were pressed feldspathic porcelain (GC Initial - GC E.U.) and were bonded in place with resin cement (Rely-X Unicem – 3M Espe). The maximum

Figure 10. Tooth preps left side.

Figure 11. Tooth preps right side.

amount of enamel possible was conserved, and both the porcelain and enamel were etched and bonded. The author closely observed those recommendations of Biomimetic Principles as established by Dr. Pascal Magne.[8]

During cementation, the author recommends the use of a piezoelectric or ultrasonic, plastic tipped instrument (EMS PiezonMaster 600 – EMS, Switzerland), used in the dry mode, to fully seat the restoration. Despite using minimal amount of cement, and finger or biting pressure during seating of the restoration, the piezoelectric instrument will continue to express further cement, and thus seat the restoration maximally. The author has adopted the use of the piezoelectric instrument as a protocol for cementation of all inlays, onlays and crown restorations. After 3 months, the healing caps were removed and suitably selected solid abutments were torqued into place at 35 Ncm. The goal was to restore the implants with cement retained ceramo-metal crowns. The selection for the maxillary implants was 5.5 mm long solid abutment connectors, and 4 mm long solid abutment connector in the mandibular implants (Figure 12). The torque control driver with suitable solid abutment driver was used to torque the solid abutments in place

To capture the implant location with the solid abutment connector, elastomeric

Figure 12. Solid abutment in place.

Figure 13. Impression cap and cylinder.

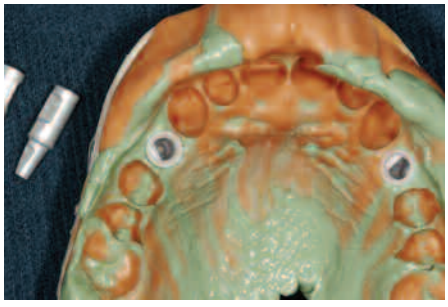

Figure 14. Impression.

impressions are made. Impression caps are first placed and it is important to ensure these caps snap in place solidly, and to hand rotate them to ensure solid seating. A positioning cylinder is next placed within the impression cap to record the flat spot on the solid abutment. A suitable, rigid elastomeric impression is made to capture the arch. A polyvinyl siloxane or polyether impression material is suitable. The author uses a light body/heavy body polyvinyl siloxane material (Affinis – Coltène Whaledent, Switzerland), (Figures 13 and 14). During the restoration phase, the support of the orthodontist and the patient were exceptional. After each change in the restorative phase, the patient would return that day to the orthodontist to have a new stabilizing retainer fabricated and placed. The retainer would stabilize and maintain the position of the teeth and prevent

Figure 15. Provisional.

relapse. This level of support and service is critical (and much appreciated) in the final success of the restorative treatment.

For the maxillary implants, custom provisionals were created using Straumann temporary copings (Figure 15). The mandibular implants were not in a high aesthetic area, thus the Straumann PEEK grey/brown protective caps were selected and provisionally cemented in place.

Clinical tip: removal of provisional cement from either implant solid abutments or prepared teeth after provisional removal is easily accomplished with the use of intracoronal bristle brushes (ICB brushes – Ultradent Products – USA). This is best done with a slow speed handpiece with water irrigation. This allows for effective removal of the provisional cement with minimal disturbance of the soft tissues.

The next phase of treatment encompasses the dental laboratory. Colour coded laboratory analogs were placed into the impression cap. A separating release agent was placed over the impression material and a flexible soft tissue material was placed around the laboratory analogs prior to pouring of the solid model (Gingifast elastic - Zhermack, Italy) (Figure16). The models were then articulated. The maxillary solid abutments were too long and the laboratory reduced their height, and fabricated a reduction coping. This reduction coping will assist the dentist in reducing the height of the solid abutment clinically (Figures 17 and 18). The author recommends the use of Razor burs (Razor carbide burs 1558RZ – Axis Dental) to reduce the titanium analogs. These burs cut efficiently without grabbing or sparking. The dental laboratory selected a precision, plastic analog to cover the solid abutment, and then proceeded to wax and cast the gold frame work. The plastic copings are

Figure 16. Model – close view.

Figure 17. Reduction coping.

Figure 18. Abutment reduction.

designed for either a crown, which has a flat anti-rotational spot, or a bridge, which has no anti-rotational feature. After casting, a self-centering pin/reamer is utilized to remove the outer lip from the gold casting. This lip was for retention of the plastic coping to the laboratory solid analog. Its removal on the gold casting allows a precise fit of the crown to the shoulder of the implant. Conventional ceramo-metal crowns and reduction copings were then returned to the dental office.

In the clinical setting, the maxillary abutments were reduced and the crowns were tried in place. The fit was confirmed both clinically and radiologically. The crowns are now luted into place with a luting cement of the dentist's choice. The author uses a resin-modified glass-ionomer cement (GC FujiCEM – GC Japan).

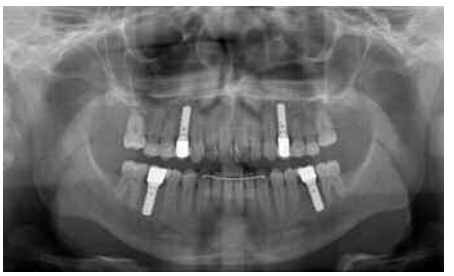

Figure 19. One year follow up pan-edited.

Figure 20. Occlusal view – final, maxillary.

Figure 21. Occlusal view – final, mandibular.

A clinical tip – mix and load the cement within the crown, then place the crown on the laboratory analog, remove and then place in the mouth. This technique expresses most of the unnecessary cement prior to placing the crown on the implant, allowing full seating with minimal cement being expressed into the soft tissue area. Again the use of the piezoelectric tip is used. Minimal use of cement retains the crown and reduces the potential of cement being left behind below the tissue where it could cause inflammation or irritation.

The implant supported crowns have been in place for over two years, and are functioning well, providing the patient with intact, functional posterior occlusion (Figures 19-21).

Conclusion

A sound, intact, and functioning posterior occlusion is important for long term dental health, proper mastication, and occlusal support for our patients. Implant supported crowns and/or bridges offer better options for our patients, for long term, predictable results than fixed or removable partial dentures. The restoration of these implants can be quite simple, utilizing minimal armamentarium and component parts. The restoration of implant supported crowns or bridges utilize techniques that are very similar to what is used every day in conventional crown and bridge treatment. With the use of a case presentation, many of these steps are demonstrated.

Acknowledgement

The author would like to thank Dr. Jim Mergaert, Edmonton, Canada for the orthodontic treatment; Mr. Rick Hirata, Crown Dental Laboratory, Edmonton, Canada for the fabrication of the crowns, and Mr. Robert Salisbury, technical representative, Straumann Canada for his assistance with this case.

References

1. Hegenbarth E, Stefan H. Esthetic Alumina and Zirconia Rehabilitation: A Team Approach to Treatment Planning and Material Selection. European Journal of Esthetic Dentistry 2007;2(4):370–88.
2. Buser D, Martin W, Belser U. Optimizing Esthetics for Implant Restorations in the Anterior Maxilla: Anatomic and Surgical Considerations. JOMI;19:43–61.
3. Buser D, Martin W, Belser U. Surgical Considerations for Single-Tooth Replacements in the Esthetic Zone: Standard Procedures Without Bone Deficiencies. In: Buser D, Belser U, Martin C, et al, ITI Treatment Guide Vol. 1. Chicago: Quintessence Publishing Co.: 2007:26–37.
4. Kois J; Functional Occlusion I: Science Driven Management. Kois Center. Seattle, WA: 2003.
5. Kois J; Functional Occlusion II: Complex Restorative Management. Kois Center. Seattle, WA: 2004.
6. Kerstein R; Disclusion Time Reduction Therapy with Immediate Complete Anterior Guidance Development: the Technique. Quintessence International 1992;23:735–47.
7. Kerstein R; Non-simultaneous Tooth Contact in Combined Implant and Natural Tooth Occlusal Schemes. PPAD 2002;13(9):751–6.
8. Magne P, Belser U. Understanding the Intact Tooth and the Biomimetic Principle. In: Magne P, Belser U. Bonded Porcelain Restorations In the Anterior Dentition. A Biomimetic Approach. Chicago: Quintessence Publishing Co.: 2002: 23–55.