A systematic approach to a difficult multidisciplinary case

Dr. John F. Carpenter discusses concepts used to provide an esthetic, comfortable, and functional prosthesis in a specific case

Introduction

This report documents the failure of a recently restored maxillary anterior implant prosthesis (Figure 1). The prosthetic replacement of anterior teeth has always posed an esthetic and functional challenge to dentists.

At this patient’s initial exam, porcelain fracture, insufficient display of maxillary incisors, and a forced smile were noted (Figures 1 and 3). Porcelain fracture is a disappointment we have all experienced. A lack of occlusal harmony appeared to have played an active role in causing the anterior porcelain to fracture. Replacing just these fractured anterior crowns would be a short-term fix at best and would not correct the occlusion issues that led to failure of the current fixed prosthesis. Another interesting component of this complex restoration is the splinting of the natural teeth to implants (Figure 4). A biomechanical evaluation was needed to see if this is appropriate and even advantageous.

The importance of a comprehensive examination and a multidisciplinary approach will be discussed. The occlusal concepts utilized to provide this patient with an esthetic, comfortable, and functional prosthesis will be shared. It is essential to recognize the implications of occlusal disharmony before beginning any treatment.

The management of occlusion including a diagnostic wax-up, centric relation (CR), long-term trial provisional, occlusal equilibration and anterior custom guide table will be discussed. A step-by-step comprehensive examination, diagnosis, and definitive treatment will allow for a more esthetic restoration with greater predictability and longevity.

Case report

A 52-year-old female patient sought treatment for her chipped anterior bridge. She also expressed a wish to improve her smile, stating “my teeth don’t show enough.” (Figure 1) A complete clinical and radiographic exam was performed. The maxillary arch had been restored with a fixed anterior implant bridge that was joined to two posterior natural teeth bridges utilizing precision attachments (Figures 4, 5, 6). This maxillary restoration had only been completed 4 years previously, and mandibular teeth had been left untreated at that time. Fractured maxillary anterior porcelain and compromised anterior occlusal function was noted (Figure 3). Multiple posterior occlusal interferences were present during protrusion and lateral excursions.

Dental history disclosed that a serious car accident 29 years previously had claimed her maxillary anterior teeth, devitalized multiple lower anterior teeth, and resulted in perioral scarring. A maxillary removable partial denture (RPD) to replace teeth Nos. 5 through 11 had been worn for 25 years (Figure 7). The trauma and long-term wear of a RPD resulted in severe horizontal and vertical anterior bone loss. Even though disappointed with her current condition of fractured porcelain and inadequate esthetics, A systematic approach to a difficult multidisciplinary case

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she was extremely happy to no longer wear a RPD.

**Treatment concerns—where to start?**

It was obvious a new maxillary restoration was indicated. What concerned the author, however, was why the former restoration failed. When treating the esthetic shortcomings, the underlying functional occlusal issues need to be recognized and treated simultaneously. Fracture of porcelain due to excessive load and fatigue will occur again if this aspect of planning is inadequate. A new restoration would be needed to improve her smile but also offer greater longevity and predictability. To proceed further, the following two questions need to be answered:

1. Is it possible to create an occlusion to reduce functional risk?
2. Can proper esthetics be achieved without increasing biomechanical risk? This case required a thorough evaluation of the following four areas to allow for a proper treatment plan to be developed: smile, biological, biomechanical, and occlusal evaluation.

**Smile evaluation**

Facial assessment showed overall symmetry with the interpupillary line (Figure 1). A limited display of maxillary incisal teeth with a forced smile was present (Figures 1 and 3). Perioral scarring and a long upper lip with limited mobility were noted. To restore this patient's display of maxillary teeth would be challenging. A picture of the lips at repose showed no display of maxillary teeth and an overdisplay of mandibular incisors (Figure 8).

The starting point for the creation of a beautiful smile is the position of the maxillary incisors relative to the face and the upper lip. This assessment is made with the upper lip at rest. An average tooth display of 1–3 mm at rest is pleasing in most people. This incisal display decreases with age. This patient's display of the maxillary incisors is a negative 3 mm, resulting in an aged, toothless appearance (Figure 9).

In summary, this patient has limited lip mobility and lack of tooth display while smiling and at rest. The goal is to position her replacement teeth at the site her natural teeth would have occupied prior to her injury. Other esthetic considerations such as: gingival levels, tooth arrangement, dental midline, smile arc, width/length ratio, golden proportion, and color all must be considered, but lengthening the maxillary incisors will be our number one esthetic priority.

**Biological evaluation**

No evidence of tooth mobility or periodontal disease was noted. Tooth No. 24 requires removal due to a failed apicoectomy (Figure 6). The maxillary
posterior teeth, and associated restorations, are in good condition. The maxillary anterior prosthesis has chipped incisal porcelain and is overly proclined (Figure 10). This proclination acts as a horizontal cantilever on the three implant fixtures and should be corrected.

Three narrow 3.7 mm Zimmer implants had been placed in the tooth No. 6, 7, and 11 positions (Figures 4 and 5). These three implants appeared very healthy but were supporting seven teeth. Three adjacent pontics were present, breaking an implant prosthetic rule developed by Misch. This under-engineered error can easily be corrected by adding another implant at site No. 10. The splinting of the implants to natural teeth appears to have had no ill effect on the implants or the natural teeth. This splinting will be discussed in more detail later.

The mandibular incisor crowns are bulky, flared, and unesthetic. They are also over displayed in the patient’s smile (Figures 3 and 10) with a reverse curve due to hypereruption of the mandibular anterior incisors.

In summary, retreating the lower anterior crowns will eliminate labial bulkiness and excessive proclination and provide a level occlusal plane to restore the maxillary arch to. This will decrease the compensatory proclination of the maxillary prosthesis leading to lower stress during function. The extraction of tooth No. 24 to eliminate infection and the addition of an implant to the No. 10 site to improve support will be undertaken (Figure 6).

Biomechanical evaluation
Three anterior implants are present but were placed lingual to an ideal position. This is due to the customary maxillary anterior bone resorption palatally and superiorly after the loss of teeth 25 years previously. The facial cortical bone is very thin and resorbs very quickly after tooth loss. This patient had previously declined a blockbone autogenous graft that would have allowed for wider and better positioned implants and a standalone implant restoration. Her resulting maxillary fixed implant restorations are very facially cantilevered (Figures 10 and 11).

Esthetics and phonetics dictate that the maxillary anterior replacement teeth be placed at their pre-extracting position. This position is quite facial to the residual ridge, creating a horizontal cantilever. This created a situation from a biomechanical perspective that is weak, since maxillary anterior restorations receive forces directed from within the arch to outside the arch.

The maxillary anterior implant prosthesis is also providing occlusal anterior guidance. All mandibular excursions will place lateral forces on the prosthesis and the crestal bone support of the implants. It is well known that implants, bone, and porcelain all handle lateral forces very poorly.

The anterior maxillary crown height space (CHS) is defined as the distance from the crest of the ridge to the occlusal table. By adding length to the maxillary anterior prosthesis for esthetic improvement, the CHS will increase. CHS acts as a vertical cantilever when any lateral load is applied. Since maxillary anterior teeth are loaded at an angle during protrusion and lateral excursion, this functions as a force magnifier, increasing the risk of failure. Implants also lack a periodontal ligament, which functions as a stress absorber, worsening an already dangerous situation. This corresponding increase in force to the implants, bone, and restorations must be compensated for in the treatment plan.

Next, an investigation was undertaken to see if the splinting of this implant prosthesis to natural teeth was appropriate and if it could actually enhance the distribution of occlusal stress in this clinical situation.

Splinting of implants to natural teeth
There is extensive documentation that implants can be connected to stable teeth. Early implants had no anti-rotational features and were routinely splinted to an adjacent tooth to prevent screw loosening. The first anti-rotational abutment, the UCLA abutment, was invented in 1988, allowing for a freestanding implant restoration. This led to the philosophy that “natural teeth should never be connected to implants.” This was understandable due to the difference in mobility of a tooth and an implant. There are risks associated with connecting teeth to implants, such as implant overloading, and tooth intrusion. There are, however, situations when splinting, applied appropriately, can lead to increased predictability and better distribution of stress.

Dr. Carl Misch offers guidelines for joining implants to teeth. The primary prerequisite is the lack of mobility of natural teeth. A recent literature review and presentation of practical guidelines states “potential problems associated with tooth-implant supported prosthesis (TISP) may have been overstated.” When they compared TISP with implant-supported prosthesis (ISP), survival
tenderness to palpation, and fractured of parafunction (bruxism), muscle.

Skeletal Class I position. Evidence The molars and cuspids are in Angle’s Occlusal evaluation particular situation, is advantageous.

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By adding one implant and creating a cross-arch splinted restoration, the chance of biomechanical overload is lessened. This case meets the requirement of splinting to only non-mobile natural teeth. Lateral and torsional forces on the implants and bone will be shared with natural teeth on opposite sides of the arch, creating a beneficial arch form dynamic. A straight-line anterior restoration with little resistance to forces is avoided, and a non-mobile unit is created. The splinting of implants to teeth is controversial, but I believe in this particular situation, is advantageous.

Occlusal evaluation
The molars and cuspids are in Angle’s Skeletal Class I position. Evidence of parafunction (bruxism), muscle tenderness to palpation, and fractured porcelain was present. The patient had a mouthguard but wore it infrequently. No joint pain, clicking, deviation or limitations to opening were noted. The TMJ was load-tested under firm pressure without pain.⑩⑪⑫

The mandibular incisor edges were much higher than the occlusal plane. This occlusal plane and incisal plane discrepancy is seen in Figure 11. The supereruption of the lower incisors can be explained by the patient wearing several maxillary RPDs over 25 years. The acrylic of the RPD wore, allowing compensatory overeruption of the lower incisors. Mandibular anterior would require shortening to eliminate a step occlusion and allow for harmonious coupling with the maxillary anterior. Three options exist to shorten the lower incisor edges: orthodontic intrusion, contouring, or restorations.⑬⑭

A major concern was the patient’s existing anterior guidance did not allow the immediate disocclusion of the posterior teeth in excursive and prorusive movements. Occlusal problems can be minimized if proper anterior guidance and guided lateral excursions are established.⑮ A mutually protected occlusion was not present, leading to increased forces and stress. Occlusal instability and excessive forces can be demonstrated in multiple ways: wear facets, sensitive, hyper-mobile teeth, sore muscles, fractured restorations and failing implants. This patient demonstrated sore muscles and fractured porcelain as her telltale signs of occlusal instability.

The mounting of diagnostic models using a centric relation (CR) bite and face bow, verified the anterior guidance shortfall and demonstrated a discrepancy between maximum intercuspal position and centric relation. Multiple posterior deflective interferences and unequal holding contacts were noted. Centric relation, an anatomically repeatable position, will be utilized as a starting position to help reconstruct the damaged occlusion.⑯⑰⑱ It may not be possible to prevent a patient’s parafunction, but by improving anterior guidance, the muscle activity and forces can be lowered. From a muscular perspective, having anterior teeth contacting without a posterior tooth touching in excursive movements produces less elevator muscle activity.⑯⑰⑱②²

In summary, an occlusal equilibration needs to be performed to reorganize the existing posterior restorations. The mandibular anterior need to be shortened, and as an added benefit, will provide room to lengthen the maxillary incisors, an esthetic requirement. Since failing restorations already exist, new anterior restorations would be fabricated, thus improving anterior guidance.

Diagnostic wax-up
Next step is to return the CR mounted models to the laboratory with photos and instructions for a diagnostic wax-up. The goal is to see if in wax, esthetic and occlusal goals can be met for this patient (Figures 12 and 13).

It is important to realize that the
diagnostic wax-up only represents a “best guess” estimate of esthetics and occlusion. The esthetic and occlusal scheme will need to be created in provisional and tested in the mouth. Refinement for esthetics, speech, comfort, and the development of a discluding anterior guidance is done chairside. A mouthguard will be fabricated at case completion, but studies have shown patient compliance to be at best questionable. Therefore, the occlusal scheme developed must give the patient, at the very least, a mechanically-advantaged restoration leading to longevity.

**Final treatment plan**

1. Create new maxillary and mandibular anterior restorations with the goal of improved esthetics and occlusion.
2. The posterior restorations will be maintained but occlusally equilibrated.
3. An additional implant will be added at site No 10 to reduce stress.
4. The maxillary implant prosthesis will be connected to natural posterior teeth with precision attachments. This will provide for reduction of stress on the prosthesis, crestal bone, and implants during excursive movements of the mandibular.
5. The mandibular anterior prosthesis will be remade, shortening their incisal edges. This space will be used to lengthen and increase the maxillary incisor display. Tooth No. 24 is failing and will be extracted.
6. A long-term provisional prosthesis will be utilized to allow the new esthetics and occlusion developed in the diagnostic wax-up to be clinically tested and refined.
7. Next, communication with the laboratory is critical. The provisional must be exactly duplicated in the final restoration.

To better help the patient understand her treatment plan, a small PowerPoint presentation of her oral situation was shared with her. The diagnostic wax-up of her proposed changes was also reviewed. Time for questions and a full explanation of her financial obligations were disclosed prior to case acceptance and treatment consent.

**Treatment**

Once the treatment plan was accepted, the diagnostic wax-up and photos were sent to the laboratory. A maxillary, fiber-reinforced acrylic provisional and mandibular putty stent were requested.

At the first patient visit, the old anterior mandibular restoration was removed. Then tooth No. 24 was extracted and socket grafting performed. Utilizing a putty stent made from the diagnostic wax-up, the mandibular anteriors were provisionalized. Care was taken to ensure the incisal edges were parallel to the eyes (Figure 14). When the patient closed, an open bite and overjet were present that would be used to increase maxillary incisor length and correct their over-proclination (Figure 15).

One week later, occlusal
Continuing education

Figure 29: Transferring anterior guidance established in the provisional to the definitive restorations

Figure 30: The use of a putty index to duplicate the maxillary incisal edges established during provisionalization

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Equilibration was initiated. By utilizing a leaf gauge, posterior interferences to jaw closure were eliminated (Figure 16). Once stable posterior stops were created, the anterior occlusion could be reconstructed. An additional implant at No. 10 site was placed (Figure 6) (ScrewPlant 3.7 x 10 mm, Implant Direct™). Next the maxillary implants were temporized utilizing lab processed provisionals (Figures 17 and 18).

**Trial provisionalization**
Over the next 3 months, the esthetics and occlusions were refined. While lengthening the maxillary incisors for esthetics, it is important to not over-steepen the anterior guidance. A steep anterior guidance would increase stress to the implants and porcelain, risking breakage and failure. Acrylic was added and subtracted to the anterior provisionals chairside to obtain guidance and discclusion of the posterior teeth in as shallow a manner as possible (Figure 19).

**Phonetics**
In the process of lengthening the maxillary incisor provisionals, our patient developed a lisp. When making her “S” sounds, her mandible slid forward until the incisal edges were edge-to-edge. It is this incisal edge position that created her phonetic problem. By lengthening the maxillary incisors for esthetic improvement, her teeth began to collide during the “S” sounds, resulting in whistling (Figure 20). A small amount of space must be present to squeeze air between to create the “S” sound (22, 23, 24).

Most patients will adapt to dental changes in a few weeks; however, she did not. To correct her lisp, the upper incisors could be shortened, but esthetically, we were trying to improve their display when smiling. As an alternative, the lower incisors were shortened to eliminate the lisp, creating a slight anterior open bite when the jaw returns to MIP. This was corrected by adding acrylic to the lingual of the maxillary incisors to restore centric stops.

**Case finalization**
A full equilibration was performed to ensure CR=MIP and anterior guidance was optimized. After 6 months, the provisional restorations’ esthetics, occlusion, and phonetics were deemed satisfactory. Impressions of the provisional restorations, an occlusal bite record, and face bow were taken.

Final impressions and a CR bite were taken and sent to the laboratory. A custom implant abutment for No. 10 and metal castings were fabricated. Fit was confirmed chairside, and the precision attachments were connected with GC resin to allow the anterior implant bridge to be connected to the posterior natural teeth (Figures 21 to 24).

After soldering, metal castings were returned for try-in, bites and pick-up impressions. A leaf gauge is very helpful to prevent the lower jaw protruding forward while a bite is taken (Figure 25). A stick bite while the patient was standing was also utilized to ensure the occlusal plane will be perpendicular to the patient’s face and to avoid canting (Figure 26).

**Custom anterior guide table**
Utilizing the mounted provisional models, the laboratory technician was able to fabricate a custom anterior guide table (Figures 27 and 28). A custom guide table as demonstrated
by Dawson allows the technician to duplicate the anterior guidance established in the mouth with the provisionals. This is fabricated by the articulator guide pin moving through setting acrylic dough as excursive movements of the provisional models are made. The shape of the maxillary lingual guiding inclines and the path taken for excursive movements can be duplicated with this technique. After the custom anterior guide table is made, the working models are cross-mounted using bites previously taken. Utilizing photographs, a putty index of the provisionals, and a custom guide table, the laboratory technician has all the information necessary to fabricate the definitive restoration (Figures 29 and 30).

Delivery and completion
A bisque bake try-in was performed and returned to the lab for glazing, minor modifications, and staining. Since the laboratory technician followed the guidelines of the provisional restorations, minimal adjustments were necessary when inserting the final restorations (Figures 31 and 32). A final minor equilibration utilizing a leaf gauge was performed after insertion. The final restorations satisfied our patient’s esthetic desires while fulfilling biological, biomechanical and occlusal parameters that are essential for long-term success.

A flexguard mouthguard was constructed by Annalan Laboratory and equilibrated chairside. Posterior centrix stops (dots) and shallow anterior guidance (lines) mimicking the definitive restoration were created (Figure 33).

Discussion
Failing anterior restorative cases present many challenges. New restorations must be created that satisfy the patient’s esthetic goals, while fulfilling necessary functional rules that will lead to longevity.

The esthetic focus of this case was to reverse an aging smile. The amount of incisor display at rest, conversation, and smiling is a critical esthetic parameter. However, esthetic treatment without regard to function would have been a disaster.