1/2 point CDT documented scientific credit. See Page 32.

By Gary Morris, DDS, MS, Tony Prestipino, CDT, and Carl Drago, DDS, MS, FACP

Southern Implants' Novel Passive Abutment: Clinical and Laboratory Procedures for Fabricating a Screw-Retained Fixed Partial Denture

INTRODUCTION

Endosseous dental implants were introduced into North America by Branemark et al in 1982.[1] The initial treatments involved edentulous patients treated with mandibular fixed tissue integrated prostheses and maxillary complete dentures. Treatment has evolved over the past 40 years to include partially edentulous patients with single and/or multiple fixed and removable restorations.

Abrahamsson et al performed a laboratory experiment where dental implants were placed into five beagle dogs with an unloaded protocol.[2] Three months after placement, abutments were connected to the implants; at six months plaque control was initiated. Once per month during the plaque control period, the abutments on the right side were removed, cleaned, and re-attached to the implants. This occurred five times. The contra-lateral abutments were not removed and served as controls. The animals were sacrificed one month after the last re-connection. The findings indicated that the dis- and subsequent re-connections of the abutment components of the implants compromised the mucosal barriers and resulted in more "apically" positioned zones of connective tissue. The additional marginal bone resorption observed at the test sites following abutment manipulation may be the result of tissue reactions initiated to establish a proper "biological width" of the mucosal-implant barrier.

Kim et al (2019) studied the biologic responses to transitional areas of dental implants, the implant/abutment interface.[3] They reported that soft tissue implant/abutment seals affected the soft tissues around implants. In external connections, micro-mobility between abutments and implant hex components, resulting from machining tolerances, can negatively impact soft tissue seals, potentially leading to microbial invasion. Internal connection implant/abutment connections induce strain on the surrounding bone via implant wall expansion that translates from masticatory forces. Kim et al considered this strain to be advantageous because it increased the amount and quality of peri-implant bone.

Bressan et al studied the effects of repeated abutment changes on peri-implant tissue stability.[4] Eighty patients were treated with single implant crowns or fixed dental prostheses (FDPs); abutments were removed at least three times. Bressan et al concluded that three year post-loading data showed that repeated abutment disconnections significantly increased bone loss (0.43 mm), but this difference may not be considered clinically relevant.

Jemt et al described a new technique (1999) to fabricate one-piece, implant-supported titanium frameworks with a computer numeric-controlled (CNC) milling technique and compared the fit of these frameworks with conventional cast prostheses.[5] They reported no significant differences were found between the two groups. The three-dimensional distortion of the cylinders in the completed prostheses ranged from three to 80 microns; no passive frameworks were observed. More distortion was observed in the horizontal plane (x and y axes) as compared to the distortion in the vertical direction (z axis). Jemt et al concluded that the precision of fit of the first CNC-milled prostheses presented comparable fits to conventional cast frameworks.

In 2003, Ortorp et al performed a similar study and reported that CNC frameworks showed statistically better fit and precision compared to conventional castings.[6]

This case report will illustrate the clinical and laboratory steps using Southern Implants' Passive Abutments for a screw-retained, three-unit FDP.

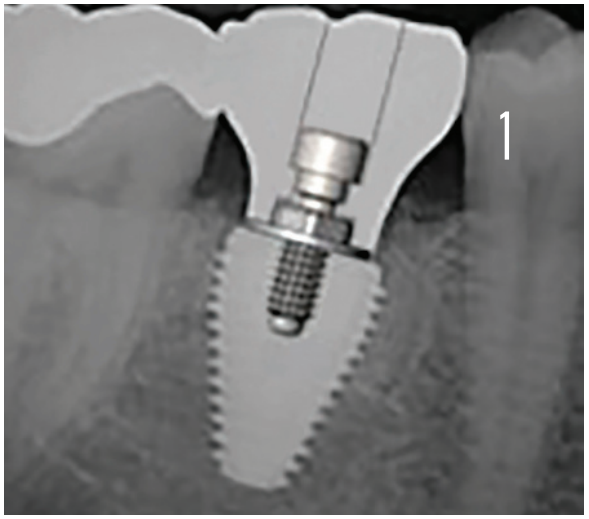


Figure 1
Radiograph/illustration that demonstrates a passive abutment on an implant restorative platform; the passive abutment was cemented to the implant crown in the laboratory.

Figure 2
Illustration of the four components of the passive abutment.

Figure 3
Pre-operative radiograph of the failing five-unit fixed dental prosthesis (FDP) in the mandibular left quadrant. This prosthesis was scheduled for removal; the missing teeth would be replaced with a three-unit implant retained fixed dental prosthesis.

IMPLANT COMPONENTS (PASSIVE ABUTMENTS)

Southern Implants (Irene, RSA) manufactures Passive Abutments for predictable, passive fit of implant superstructures for cast restorations. The Passive Abutment concept achieves a predictable passive fit of castings in a practical and repeatable way and may eliminate the need for complex and intensive procedures to improve the fit of castings e.g. sectioning and soldering of frameworks (**Fig. 1**).

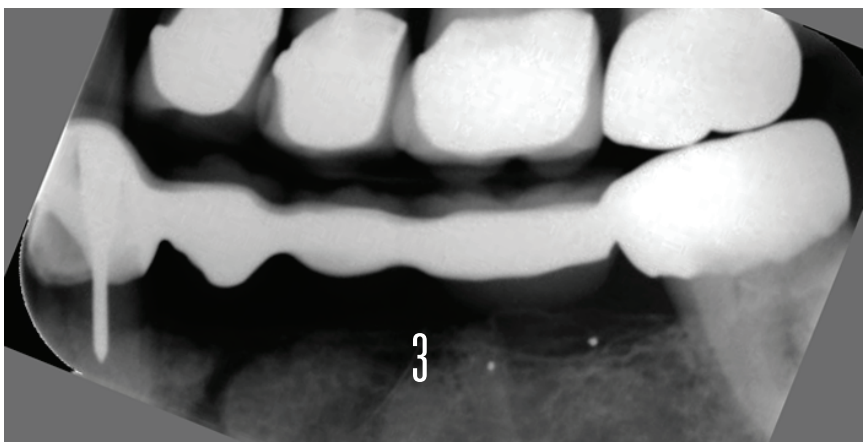
Passive fit is achieved by luting pre-machined titanium interface components to definitive prostheses on laboratory master casts. No additional clinical steps are required.

Passive Abutments consist of four components (**Fig. 2**):

1. **Plastic cylinder** — this component is incorporated into wax patterns of the frameworks and becomes part of the castings. It is not needed for milled structures.
2. **Titanium interfacial component** — this pre-machined component forms the definitive interface between castings and implants.
3. **Luting screw** — this small screw is used to clamp the interfacial component onto the laboratory analogue during the process of luting the casting onto the interfacial component.
4. **Prosthetic screw** — this screw retains the completed prosthesis to the implant at insertion and provides a compressive force across the cement line.

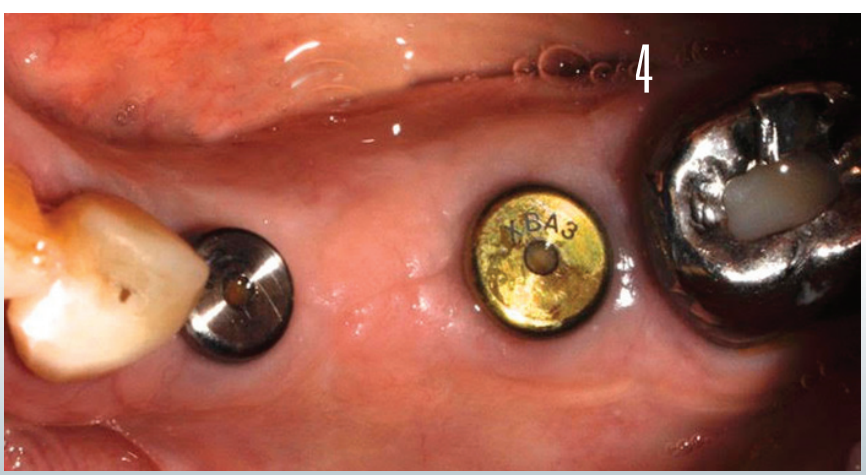
CLINICAL/LABORATORY CASE REPORT

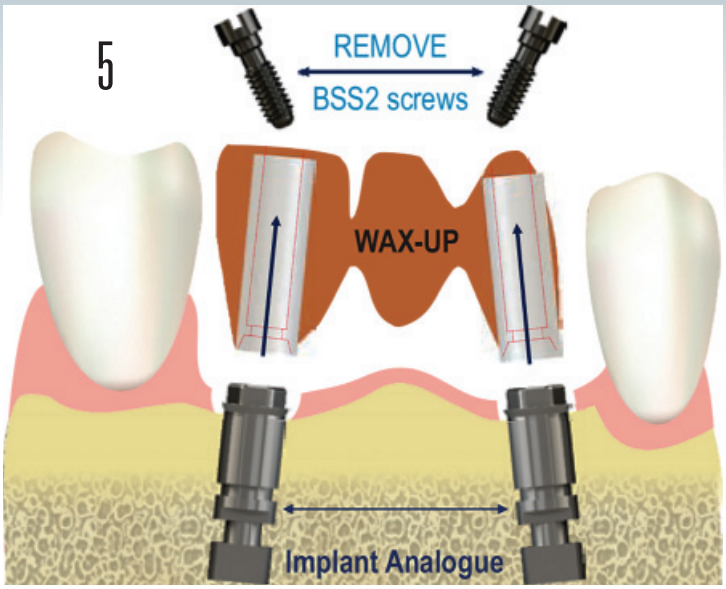
An 86-year-old male presented to the first author with a chief complaint that included a failing, tooth-supported FDP in the mandibular left quadrant (**Fig. 3**).



The treatment plan included removal of the existing tooth supported FDP (#18-22), new crown restoration for 22, two implants in the areas of 19 and 21, and a three-unit FDP to replace teeth 19, 20, and 21. The canine was treated endodontically. An unloaded healing protocol was used. The implants integrated over the next three months and healing abutments were placed (**Fig. 4**).

Figure 4
Clinical image with healing abutments in place on two implants in the mandibular left posterior quadrant.





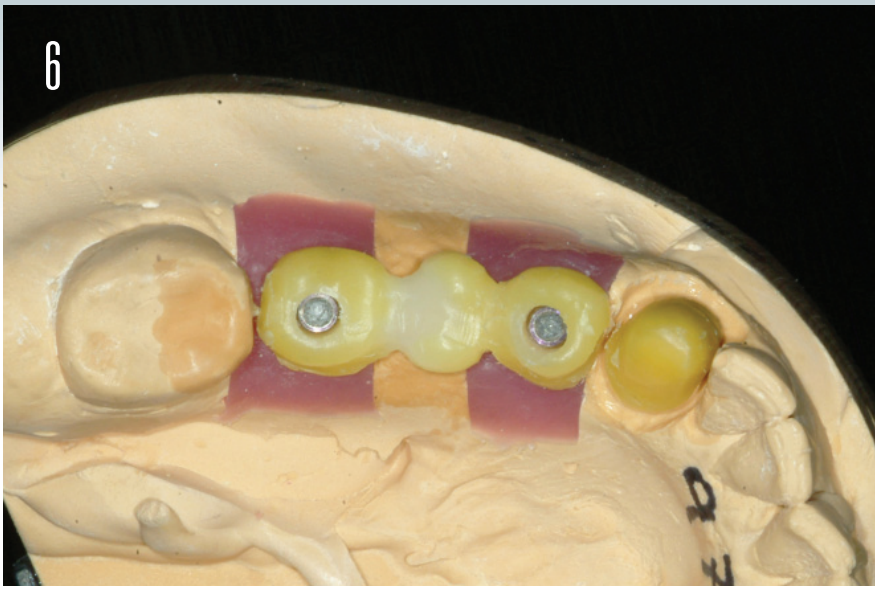
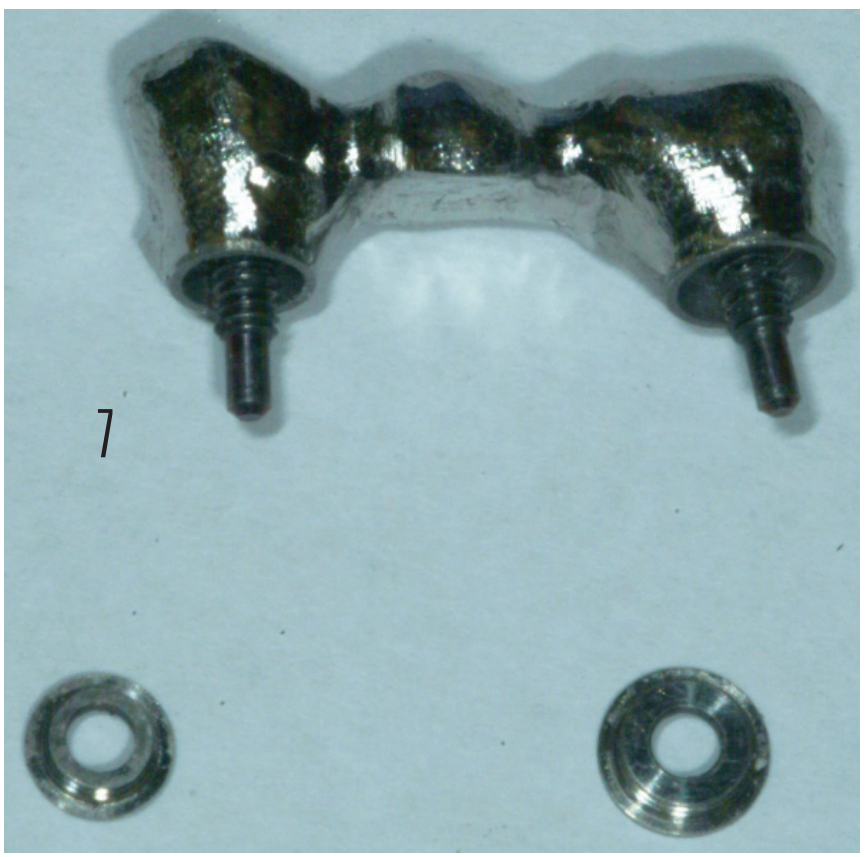


Figure 5
Illustration of a FDP wax pattern prior to removal from the cast.

Figure 6
Laboratory occlusal image of the FDP wax pattern prior to removal from the cast.

Figure 7
Laboratory images of the cast FDP; the titanium ring interfaces were not part of the casting (bottom of image).



Implant level impressions were made, and a master cast was poured in conventional fashion. The removable soft tissue moulage allowed easy access to the implant analogues for lab procedures.

The Titanium Ring and Waxing Sleeves were assembled on each implant analogue, using brass laboratory prosthetic screws. The manufacturer cautions laboratory technicians to not overtighten these screws; overtightening will distort the plastic sleeves. The waxing sleeves were modified for use as FDP retainers (**Figs. 5-6**). The wax patterns were completed, sprued, invested and cast in conventional fashion. (Security, [51.5% gold, silver-free porcelain dental alloy], Jensen Dental, North Haven, CT).

The retaining screws were removed from the wax pattern prior to removal from the master cast; the titanium interfacial components were not included in the wax pattern (**Fig. 7**).

The screw seat is the internal ledge in the casting where the screw head seats. The cast surface of the screw seat will likely be rough due to the casting procedure and must therefore be refined using special hand-held reamers (LT18-2.4, LT18-2.6 or LT18-2.8, Southern Implants North America). The correct diameter of reamer must be chosen. This is an important step to ensure proper seating and tightening of the prosthetic screws.

The titanium interfacial components were secured to the analogues using the small luting screws (**Fig. 8**). Do not overtighten, as this may result in the head of the PEEK luting screws fracturing.

The casting was placed over the secured interfacial components. The casting was fitted and removed from the cast without removing and replacing the luting screws. Since this prosthesis was going to be screw-

retained, two small luting screws were exchanged for the prosthetic screws. The prosthetic screw secured the prosthesis to one analogue, while the short luting screw had a smaller head and retained the titanium interfacial component to the analogue. PEEK screws have 1.22mm hexes broached deep into the screws. It also helps to remove the screw if cement does not totally lock the screw in position (**Fig. 9**).

After completing fabrication of the prosthesis, the fitting surfaces of the casting were sandblasted; the occlusal surfaces of the titanium rings have retention grooves and may be sandblasted at the technician's discretion. If sandblasting is not done to the titanium rings, they must be clamped to the analogues by the short luting screws. This also protected the fitting surfaces of the titanium rings. The polished collars of the titanium rings were not sandblasted. The titanium interfacial components, the short luting screws, the fitting surfaces of the prosthesis were disassembled and ultrasonically cleaned.

Luting of the prosthesis to the titanium rings was done on the master cast by attaching the titanium rings to the implant analogs with the short luting screws; self-cure resin cement was added to the sandblasted surface of the titanium rings (GC FujiCEM™, GC America Inc., Alsip, IL) (**Fig. 10**).

It is critical to limit the amount of resin cement applied between the sandblasted horizontal and vertical planes of the titanium rings. This avoids excess cement extruding upwards through the screw holes in the casting and inadvertently locking the luting screws

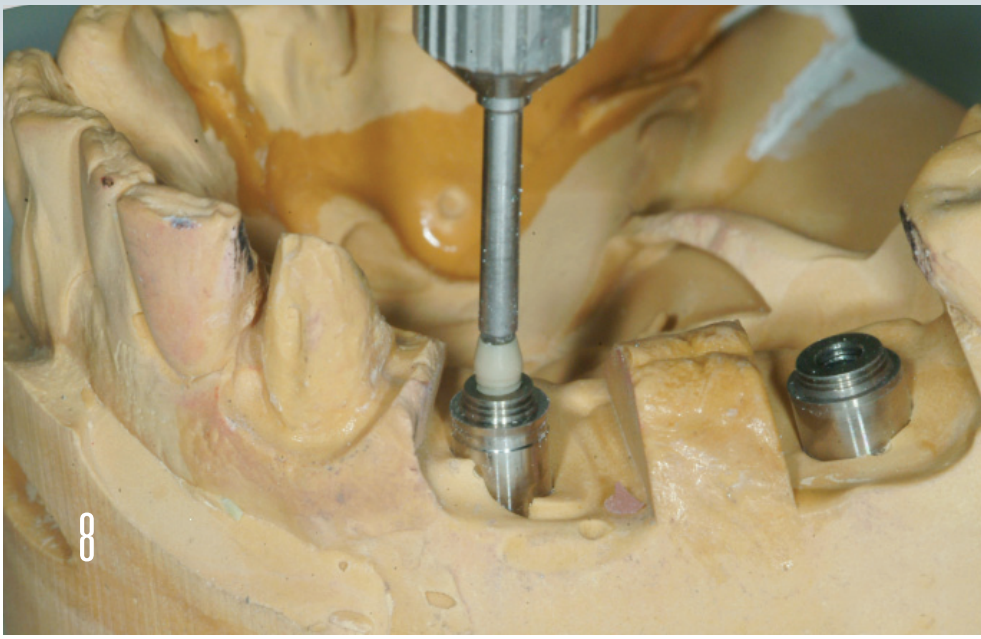


Figure 8
Laboratory image of a hand driver screwing the anterior luting screw to place. This screw held the titanium ring in place during cementation of the rings to the casting.

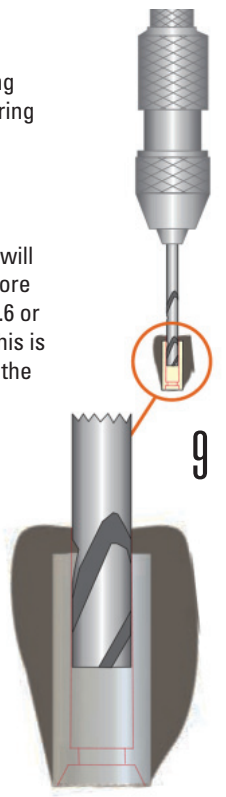


Figure 9
The screw seat is the internal ledge in the casting where the head of the screw seats. The cast surface of the screw seat will likely be rough due to the casting procedure and must therefore be refined using special hand-held reamers (LT18-2.4, LT18-2.6 or LT18-2.8). The correct diameter of reamer must be chosen. This is an important step to ensure proper seating and tightening of the prosthetic screw.

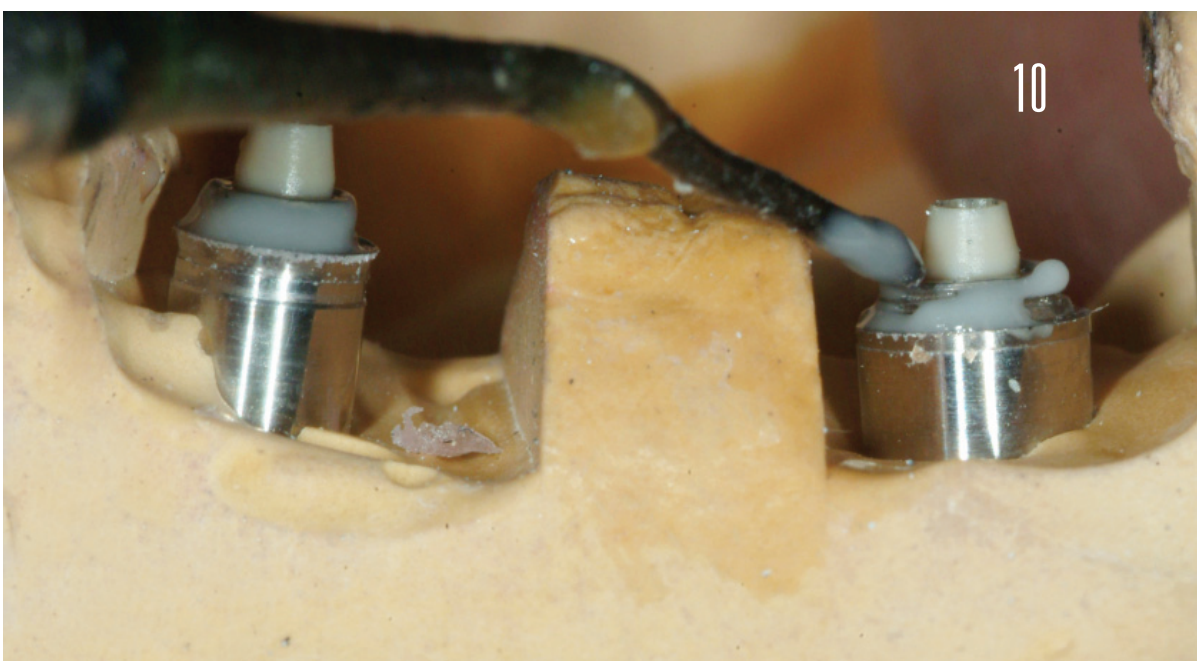


Figure 10
Laboratory image of cement being placed onto the occlusal aspect of the titanium rings on the master cast prior to cementation of the casting to the rings.

into the cement. Avoid placing cement into the area immediately around the heads of the luting screws. The prosthesis was fitted over the titanium rings and held firmly to place with finger pressure to extrude excess cement. The three-unit FDP was held lightly in place by using one prosthetic screw in place to allow the cement to harden (**Fig. 11**).

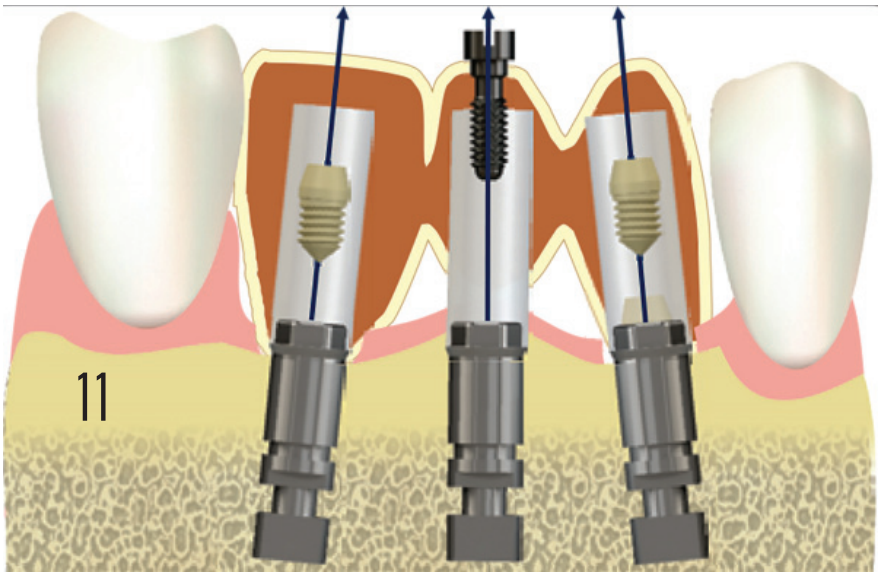


Figure 11
Illustration of a FDP held in place by using one prosthetic screw in the middle retainer and luting screws in the distal retainers.

FINISHING AND POLISHING

Once the resin cement hardened, the luting screws were removed, and the prosthesis was removed from the cast. Polishing protectors of the correct diameter to each of the fitting surfaces of the cemented titanium rings were placed. Excess extruded resin cement was removed with a hand scaler. The cement line was polished with a fine edged, lens shaped rubber wheel and blended into the casting/titanium ring where needed (**Fig. 12**). The cement line was not even between the components. This variation is indicative of casting misfit and has now been corrected by the cement space of the passive abutment. Once polishing was completed, the polishing protectors were removed, and the prosthesis was prepared for shipment.

If the fit was not satisfactory, the offending titanium ring may be removed, cleaned, and re-cemented to the prosthesis as required. A titanium ring can easily be removed by forcing a sharp blade into the cement line, or by punching out the ring using the shaft of a lab handpiece drill applied through the screw access opening (place the bridge rings down on a folded towel for padding and give the drill shaft a sharp tap).

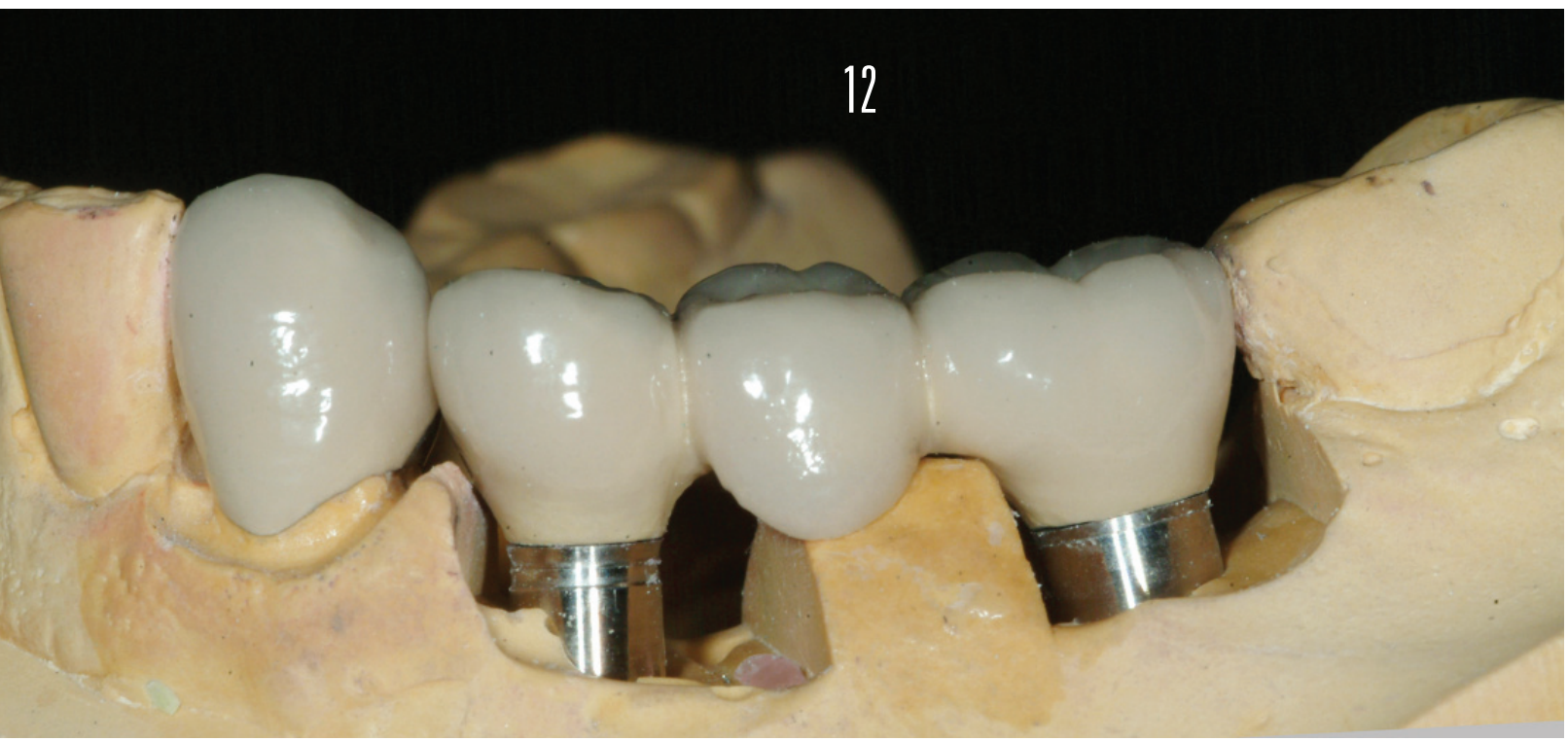
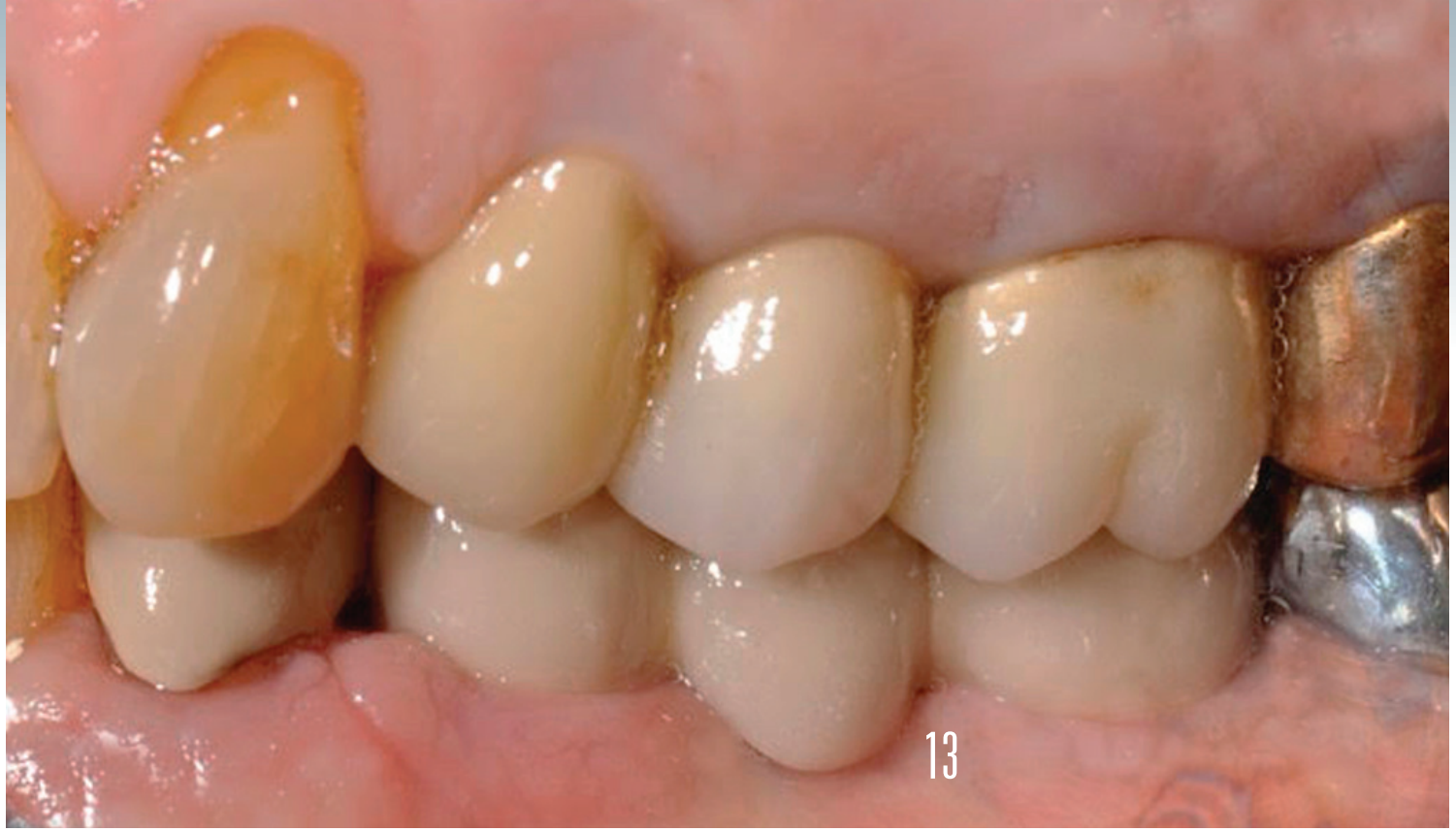


Figure 12
Laboratory image of the FDP in place on the master cast prior to shipment.



CLINIC INSERTION

The patient was seen by the first author where the healing abutments were removed, and the prosthesis went to place without incident (**Figs. 13-14**).

SUMMARY

In review, this paper presented the laboratory and clinical steps associated with a novel passive abutment system that allows for precise machined

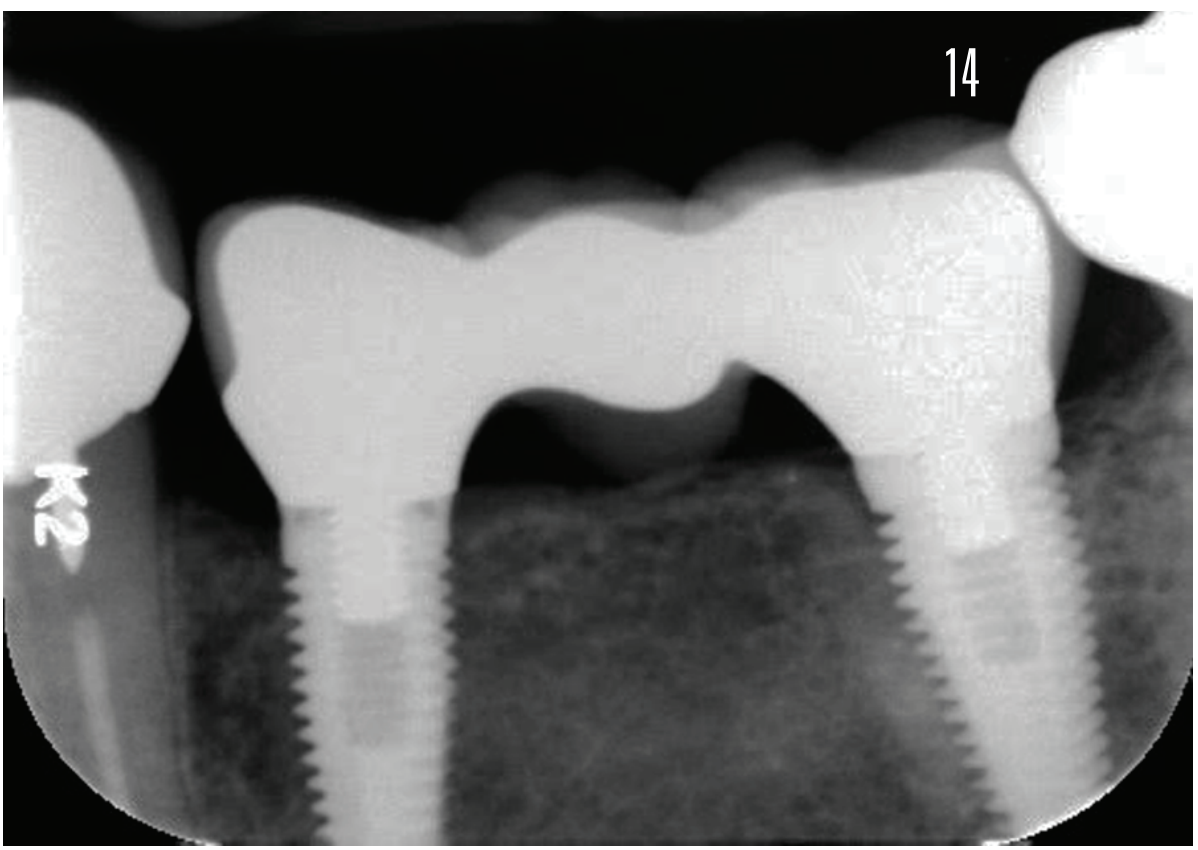


Figure 13
Clinical image with the FDP in place; the patient was in centric occlusion.

Figure 14
Post-insertion radiograph of the FDP in place.

interfaces between cast implant restorative components and implant restorative platforms. This should result in fewer biologic and mechanical complications for patients and clinicians. **JDT**

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Dr. Morris completed his undergraduate studies at Indiana University in Bloomington, Ind. He received his dental degree from the University of Illinois at Chicago and completed his residency in Prosthodontics at the UMKC College of Dentistry in Kansas City, Mo. He is an Adjunct Clinical Assistant Professor at Southern Illinois University, School of Dental Medicine. Prior to this appointment he was a Clinical Assistant Professor at the University of Illinois, College of Dentistry. He is a member of the American College of Prosthodontists, Academy of Osseointegration, ADA, ISDS, CDS and the Chicago Academy of Dental Research. Dr. Morris is the president of the Illinois section of the American College of Prosthodontists. Dr. Morris has lectured extensively both nationally and internationally on implant prosthodontics and has authored or co-authored numerous articles and book chapters related to dental implants. Dr. Morris maintains a private practice, limited to prosthodontics and restorative dentistry, in Buffalo Grove, Ill. In his spare time, he enjoys traveling with family, scuba diving and waterskiing.

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Mr. Prestipino completed the dental technology program at Northern Virginia College and received additional specialized training from the Pankey Institute. He is a member of the National Association of Dental Laboratories, the Academy of Osseointegration, the Northern Virginia Implant Society and the Northern Virginia Dental Society. Mr. Prestipino is a patent holder, published author and lectures throughout the country on implant dentistry. He has provided student and staff support at the University of Maryland. Mr. Prestipino is the President of Artifex Dental Laboratory located outside of Washington, DC.

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REFERENCES

1. Branemark PI. Osseointegration and its experimental background. J Prosthet Dent 1983;50:399-410.
2. Abrahamsson I, Berglundh T, Lindhe J. The mucosal barrier following abutment dis/reconnection. An experimental study in dogs. J Clin Periodontol 1997;24:568-72.
3. Kim JJ, Lee JH, Kim JC, Lee JB, Yeo IS. Biological responses to the transitional area of dental implants: material- and structure-dependent responses of peri-implant tissue to abutments. Materials (Basel) 2019;22:72.
4. Bressan E, Grusovin M, D'Avenia F, Neumann K, Sbricoli L, Luongo G, Esposito M. The influence of repeated abutment changes on peri-implant tissue stability: 3-year post-loading results from a multicentre randomized controlled trial. Eur J Oral Implantol 2017;10:373-390.
5. Jemt T, Back T, Petersson A. Precision of CNC-milled titanium frameworks for implant treatment in the edentulous jaw. Int J Prosthodont 1999;12:209-15.
6. Ortorp A, Jemt T, Back T, Jalevik T. Comparisons of precision of fit between cast and CNC-milled titanium implant frameworks for the edentulous mandible. Int J Prosthodont 2003;16:194-200.

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