The passive abutment

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One of the main problems faced by both prosthodontists and dental technicians, with regards to implant supported dental prostheses is the problem of producing a repeatable passive fit which would eliminate the need for complex and intense laboratory procedures, usually undertaken to improve the fit of castings e.g. sectioning and soldering.

The Passive Abutment (Fig. 1) is unique to Southern Implants and has been in clinical use since 1998. It allows one to achieve a predictable passive fit of cast structures in a practical way.

The unsatisfactory fit of prosthodontic work on implants is due not only to the distortion caused by the physical process of investing, casting and sandblasting, but also from the distorting forces which develop when the casting is exposed to repeated high temperature cycles while baking porcelain. All these parameters cause the collection and entrapment of energy resulting in tensions, which are then transferred to the prosthetic screws. Consequently we have fractures of screws, destruction of the prosthesis (porcelain fracturing) and perimplantitis. Finally there is breakdown of relationship between the patient and the dental practitioner and tension among members of the implantology team as well (technician/dentist/prosthodontist/surgeon).

After years of research by Southern Implants, the first prosthetic abutment with a passive fit was presented to the dental implant market in 1994.

The philosophy of the passive abutment is innovative in the field of dental implantology and has reduced the stress experienced by the technician and the dentist, especially when it comes to the fit of the prosthesis.

By reviewing data from x-rays of patients who have dental implants with fixed prostheses, one can see marked differences between those with passive abutments and those without.

Passive fit is achieved by luting a premachined titanium interface component onto the finished cast structure and the interfacial component of the length of the span of the bridge. The titanium interfacial component is kept separate from the manufacturing of the casting and is therefore not subjected to degradation by heat cycles or de-vesting and finishing procedures as a cast-to-gold cylinder would. The integrity of the machined part is therefore maintained in the original condition.

The passive abutment kit includes a titanium ring, which will not be subject to external physical forces and is cemented to the porcelain superstructure after the aforementioned is cast and polished.

Description

The Passive Abutment consists of four components (Fig. 2):

1. Plastic cylinder - this component is incorporated into the wax-up of the structure and thus becomes part of the casting.
2. Titanium interfacial component (6 mm) - this pre-machined component forms the final interface between the casting and the implant.
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 final placement and provides a compressive force across the cement line.

Overview of use

The plastic cylinder is incorporated into the wax-up and becomes part of the cast structure. The casting may then undergo further laboratory processing e.g. ceramic firing, finishing and polishing before being assembled with the interfacial component. The titanium interfacial component is kept separate from the manufacturing of the casting and is therefore not subject to degradation by heat cycles or de-vesting and finishing procedures as a ‘cast to gold’ cylinder would.

The integrity of the machined part is therefore maintained in its original condition. The finished cast structure is assembled with the interfacial ring by luting before placement in the patient’s mouth by the dental technician. Both titanium ring as well as the prosthesis, need to be sandblasted and cleaned by air pressure and not with a ultrasonic bath.

For assembly, the titanium interfacial component is clamped to the analogue on the master model by means of the luting screw. The luting screw ensures that the interfacial component is held in full contact with the implant analogue.

The finished prosthesis is then luted to the clamped interfacial ring using a dual-cured resin cement.

In this way the resin cement serves as a space filler between the casting and the interfacial ring, thus compensating for any minor casting and finishing discrepancies, so eliminating misfit of the casting to the implant. At placement in the mouth, the prosthetic screw retains the completed prosthesis (both casting and interfacial ring together) to the implant and maintains a compressive force over the cement line. This is achieved because the prosthetic screw engages onto the casting and not onto the interfacial ring. The cement is therefore not responsible for retention of the prosthesis, but is merely a space filler.
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The luting screw is discarded.

The Application
The Passive Abutment is intended for the fabrication of implant-supported SCREW RETAINED CASTINGS (e.g., crowns, bridges, mezzo-structures, cast bars, custom posts) on one or more implants where excellent prosthetic fit is desired. The use of a burnout plastic cylinder allows freedom of choice in choosing the casting alloy. The complexity of laboratory procedures is greatly reduced when compared to complex casting procedures with gold cylinders. The Passive Abutment System is available for direct connection to all Southern Implants product ranges. Passive Abutments are also available for Compact Conical Abutments.

For direct connection to Externally Hexed, ITI, Tri-Sec, Deep Cone and Internally Hexed connection implants, both non-engaging and engaging versions are available:

1. Non-hexed (non-engaging) versions are indicated for multi implant case (bridges).
2. Hexed or engaging versions are indicated for single implant cases and multi-unit custom abutments cases.

Problems of Conventional Cast Structures
Frameworks incorporating cast to gold cylinders are very commonly used in implant reconstruction, as are castings fabricated using plastic burn-out cylinders. These castings however are subject to significant difficulties. Significant deterioration of the fit between the implant and casting occurs as a result of laboratory procedures such as:

- sandblasting of the casting - the casting is subjected to repeated high temperature cycles during casting and porcelain fitting procedures. This results in oxidation of the fitting surfaces and further deterioration of fit.

- the gold fitting surface is deteriorated by multiple “fittings” on the model, especially if the analogues are not kept clean.

The larger and more complex the casting, the greater the likely degree of discrepancy of fit. Hence, larger castings with fit discrepancies are often cut and soldered, or laser-welded. It is commonly reported that these attempts to improve the fit result in even greater fitting problems and may be amplified by porcelein techniques.

Clinical implications of misfitting implant structures
Discrepancies in fit are extremely difficult to detect clinically, if not impossible where the interface in-between implant and superstructure is subgingival. Vertical misfits will only be detected on x-ray, if the misfit exists interproximally and the x-ray beam is orientated perpendicular to the interface. If the discrepancy is in the buco-lingual plane, it will not be detected on x-ray.

Even gross discrepancies may be missed where x-ray techniques are not optimal (Fig. 4).

Most importantly, poorly fitting prostheses can result in:
- bacterial accumulation at the prosthetic/implant interface, which will result in bone loss around the implants (Fig. 5)
- mechanical strain being applied to the implant, which may result in bone loss
- poor prophylaxis of retaining screws and thus more frequent screw loosening
- disadvantageous loading of the retaining screws, resulting in screw fracturing.

The Laboratory Procedure
1. Model preparation: The appropriate analogues must be selected and the model prepared using a silicon or rubber soft tissue mask. The highly recommended use of a remov-able soft tissue mask will allow easy access to the analogues for further lab procedures and will greatly ease later assembly procedures.

2. Wax-up:
- The Titanium Ring and Waxing Sleeve are assembled on each implant analogue, using the brass equivalent of the prosthetic screw to hold them in place. (Fig. 6). Do not over-tighten, so as to avoid distortion of the plastic cylinder. The wax-up can be cut back or added to as needed.

- The wax-up is completed and sprued before removing the wax-up from the model.

3. Investing and Casting:
- The retaining screw must be removed to allow the wax-up with plastic cylinders to be lifted from the model, leaving behind the loose titanium interfacial component (Fig. 7). Standard procedures are used for invest-ing the wax-up. An appropriate casting alloy must be chosen, depending on whether a ceramic veneered bridge or cast bar is intended.

4. Refining the screw seat:
- The “crevices” in the internal ledge in the casting where the head of the screw will seat (en-gage). 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 (Fig. 8).

5. Fitting the casting to the model:
- The titanium interfacial components are secured to the analogues using the small luting screws. Do not over-tighten, as this may result in bending of the Peel luting screws breaking off. The casting can then be placed over the superstructure and the interfacial components (Fig. 9). The casting can be easily fitted and removed from the model without the need to remove and replace the luting screws. If the prosthesis needs to be screwed retainer, the model, i.e. one or more of the small luting screws can be exchanged for a prosthetic screw (the prosthetic screw serves the purpose of the prosthesis to the analogue, while the short luting screw has a smaller head and can only retain the titanium interfacial component to the analogue.)

6. Luting the prosthesis to the titanium interfacial component:
- After completing the fabrication of the prosthesis, sandblast the fitting surface of the casting and the top surface of the titanium ring. The titanium ring is best clamped to an analogue by the short luting screw for ease of handling while sandblasting. This also protects the fitting surface of the titanium ring,avoid sandblasting the polished collar of the titanium ring.

- After sandblasting, it is very impor-tant to disassemble and ultrasonically clean the following:
- the titanium interfacial compo-nents.
- the short luting screws
- the fitting surfaces of the prosthesis

- Also clean the analogues (Implant replicas) of the model by brushing with soap and water or steam cleaning to remove any debris, which may interfere with perfect seating of the interfacial components.

- Luting the prosthesis to the titanium rings will now take place on the master cast-

- attach the titanium rings to the model with the short luting screws

- apply self cure resin cement or dual cure resin cement to the sandblasted surface of all of the titanium rings.

- Refrigeration of self-cure resin cements will usually lengthen working time and ease of use on multi-unit structures.

Important: Limit the amount of resin cement being applied to the angle between the sandblasted horizontal plane and vertical plane of the titanium ring (Fig. 10). This will avoid ex cess cement extruding upwards through the screw hole in the casting and so inadvertently locking the luting screw into the cement. Definitively avoid placing any cement in the area immedi-ately around the head of the luting screw.

- Fit the prosthesis over the titanium ring and settle the prosthesis firmly into place with finger pressure to each of the components. Arch castings can be left seated under their own weight and may be amplified by porcelein techniques.

Smaller bridges or single units need to be held lightly in place by using a small luting screw in place (instead of using a luting screw), to allow cement to settle. After the appropriate prosthesis used to retain the prosthesis during cement hardening as this may lead in distortion of the multi-unit structure.

7. Finishing & Polishing:
Once resin cement has hardened, remove all luting screws and then remove any prosthetic retaining screws so that the prosthesis can be lifted from the model (Fig. 11).

Attach polishing protectors or implant lab analogs, of correct thread and count, to mimick fitting surfaces of the cemented titanium rings. Remove excess excess cement by using a sharp blade, probe or hand scal-ler. Polish the remaining cement with the edge of a rounded, less shaped rubber wheel and blend the casting into the titanium ring where needed. You will notice that the cement line is often not of constant thickness.

This variation is indicative of the extent of casting misfit, which is usually minimized by the cement space of the Passive Abutment.

Once polishing is completed, remove the protector caps or implant lab analogs (Fig.12) and replace the casting on the cleaned model analogues to in-spect and verify the quality of fit. The cement space is best cleaned from analogues using a brush with alcohol. The fit would be expected to be excel-lent in all areas.

A titanium ring can easily be removed by forcing a sharp blade into the cement line, or by punching a hole in the ring using the shaft of a lab handpiece drill applied through the screw access hole (place the bridge rings down on a folded towel for pad-ding and give the drill shall a sharp tap).

Important: As this technique re-lies absolutely on the accuracy of the master model to achieve passive fit of the prosthesis, it is vital that accurate impression techniques be used and that the quality and condition of the model and analogues be main-tained at all times.

Try-in procedures
Should it be necessary to try-in a passive abutment case (i.e. the ring is not retained to the framework) the following method may be followed:

a. Remove the passive abutments from the implants.

b. Place some petroleum jelly (“Vaseline”) or chlorhexidine gel around the head of each.
implant using a syringe with a blunt delivery tip. 

2. Place the loose Passive rings individually into position on the implants and press down into position using a flat-ended “plastic” instrument. When the rings are seated, the gel helps hold them in place. The soft tissue surrounding the rings also holds them in place quite well.

3. Place the metal structure over the rings in the mouth, taking care to align the casting properly so as to not disturb the rings.

4. Screw retain the structure by placing a few prosthetic screws in strategic places.

5. When removing the frame, take care of any rings that may drop. Some rings may be left on the removed frame while others may be left on the implants. Count the rings to make sure you have all of them.

It is an advantage of the Passive system that the fitting surfaces can be removed from the casting to avoid damage by heat cycles during the repair process and then be refitted.

Delivery of the Final Prosthesis

Once the final prosthesis is placed into the patient’s mouth, peri-apical X-rays should be taken in order to verify the positive fit onto the implants. The X-ray beam should be oriented perpendicular to the implant/prosthesis interface in order to increase the chances of detecting a potential discrepancy (misfit).

Eliminating a Miss Fit

In case that a miss fit is detected, make sure that no soft or hard tissues are interfering with the positive seating of the prosthesis. As mentioned above Passive Abutments can eliminate all discrepancies introduced into the prosthesis during the laboratory steps of the manufacturing.

If a miss fit is detected, this is attributed to one of the following reasons:

a. distorted implant impression
b. increased implant component tolerance
c. distorted plaster implant model

In order to eliminate a miss fit, a new implant impression should be taken and a new plaster implant model should be poured again. The laboratory technician is going to use the new implant model as a blueprint in order to recement the passive abutments (Fig. 15).

As a result of those actions the new radiographic examination should reveal no discrepancies to the fitting of the prosthesis onto the implants.

Conclusion

The Passive Abutment from Southern Implants allows one to achieve a predictable passive fit of cast structures in a practical way. It’s easy to use, cost effective and has repeatable results, which eliminate the need for complex and intense laboratory procedures like sectioning and soldering.

For further information, contact your local dealer or B.A. International www.bainternational.com