Cast Framework Design For Fixed Prosthodontics Supported By Biotes Osseointegrated Implants

By Thomas J. Balshi, DDS, FACP, and Nancy Fox

Thomas J. Balshi, DDS, FACP is a graduate, Temple University School of Dentistry; Post Doctural, Temple University Prosthodontic Residency, Certified in Fixed Partial Prosthodotics; Diplomate, American Board of Prosthodontics; Fellow, American College of Prosthodontists; Member, American Academy of Crown and Bridge Prosthodontics; Member, American Dental Association; Scientific Program Chairman of The Joseph E. Ewing Dental Study Group; President, Pennsylvania Prosthodontic Association (Pennsylvania Section of the American College of Prosthodontists); Associate Clinical Professor, Department of Fixed Partial Prosthodontics, Temple University School of Dentistry; Founding Director, Institute for Facial Esthetics; Fort Washington, Pennsylvania.

Dr. Balshi has published many articles in journals, and has recently participated in the International Congress on Tissue Integration in Oral and Facial Reconstruction conducted in Brussels, Belgium. He has contributed to Public Education for Dentisry, through interviews for newspapers, magazines and presentations of many lectures and clinics.

With conventional "dental" fixed partial dentures using natural teeth as abutments, the periodontal ligament permits microscopic amounts of movement to occur when the fixed prosthesis is inserted. The ability of the periodontium to adapt or compensate is a great advantage in the fabrication of conventional fixed bridge work castings. It is this movement or adaptation which frequently compensates for the microscopic movements apparent in the working cast removable die system.

Microscopic discrepancies of this nature, however, are not acceptable with an osseointegrated fixture supported prosthesis. The unyielding stability of the osseointegrated fixture requires absolute casting accuracy.

Since there is no cement used in securing the final prosthesis onto the implants, the casting accuracy must produce a metal-to-metal connection, or margin which fits flush in all aspects to the implant. If any inaccuracies occur, the torque applied to the individual fixture when the prosthesis is screwed into place may be sufficient to create stress fractures in the bone adjacent to the implant surface. For the same reason precise occlusal systems must also be employed. An osseointegrated implant can lose its integration if the laboratory procedures have the slightest inaccuracies. When osseointegration is lost, the fixture should be removed. This may make the fixed prosthesis unserviceable.

The Biotes system of osseointegrated root analogues consists of three components *(Figure 1)*:[3]

1) the titanium fixture (implanted in bone)

2) the titanium abutment cylinder which connects to the osseointegrated fixtures and extends through the mucosal tissues into the oral cavity and

3) the "gold" cylinder which becomes an integral part of the fixed prosthesis and is the component that connects the prosthesis to the abutment connector. *(Figure 2)*

Working from a solid, uncut master cast with brass analogues of the abutment connector, the technician will use a variety of materials to fabricate the framework pattern.

Before starting the pattern fabrication, a matrix of the previously arranged denture teeth wax try-in is made to hold the teeth in their specific position without the use of a wax base. *(Figures 3A & 3B)*

The long steel laboratory screws are adjusted to the correct occlusal length and lubricated with petroleum jelly. The working cast should also be lubricated with petroleum jelly. The gold cylinders are then screwed to the brass abutment analogues.

A substructure pattern is begun by placing Duralay* around each gold cylinder and also by forming a "chimney" like sleeve around each of the steel screws. *(Figures 4A & 4B)* Duralay provides strength and rigidity to the pattern wax-up. The cylinders and chimneys are also connected with a rigid duralay bridge. A space of approximately 1 to 1½mm should be left at the base of the gold cylinder *(Figure 5)*. This allows the prefabricated surface finish of the gold cylinder to remain undisturbed. The smooth surface is important for ease of final polishing of the cylinder and for future cleansing and plaque control.

When the duralay is hard, remove the screws and check for "rocking" or movement of the cylinders. If "rocking" is detected, cut and repeat the procedure.

U-SHAPED CASTING

The next step is to apply a thin layer of relief wax onto the soft tissue ridge of the work cast. Begin to build the distal cantilever by using inlay wax or duralay to form the hollowed U-shaped base of the substructure. *(Figure 6)*

Strength in the design of the framework is critical to the longevity of the restoration. Make the wax connection between the cantilevered section and the distal aspect of the gold cylinder as thick as possible. The greatest potential for metal fatigue and framework fracture exists in this area.

Under the cantilevered section clean the relief wax from the ridge, and smooth the gingival area so that only the center touches the ridge. This design permits better oral hygiene.

A distinct finishing line (*see Figure 6*) for the acrylic is necessary. It should be located at the point where the substructure base begins to turn occlusally. A retention groove (*see Figure 6*) is carved inside, near the finish line.

Again, replace the matrix with the denture teeth in place using the reference grooves on the working cast. The denture teeth may be held in place on the matrix with sticky wax. The teeth and matrix provide a reference for the length, width, and height of the remainder of substructure pattern to be waxed.

Continued, page 35.

Continued, page 32.

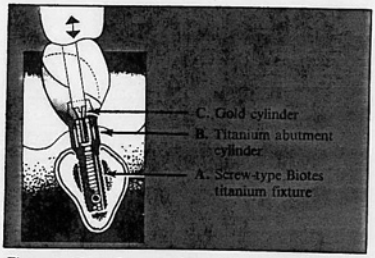

Figure 1—Tissue Integrated Prosthesis is composed of: a) a screw-type titanium implant in bone, b) the abutment, c) gold cylinder with prosthesis.

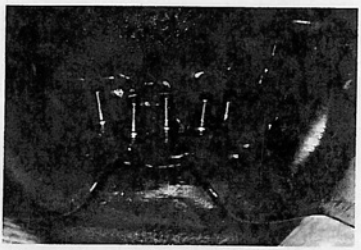

Figure 2—A clinical view of the abutment cylinder and gold cylinder in place in the mandibular arch. Gold cylinders become part of the final prosthesis.

Figure 3A—Silicon bite registration material is used fo the tooth arrangement matrix.

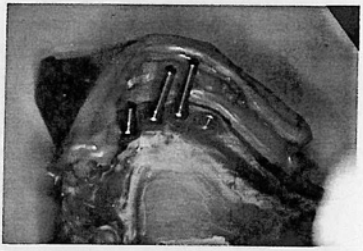

Figure 3B—Silicone index in position illustrates the space available for the substructure casting.

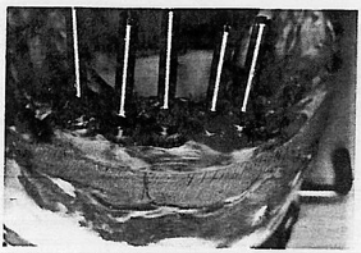

Figure 4A—Duralay is applied to each gold cylinder.

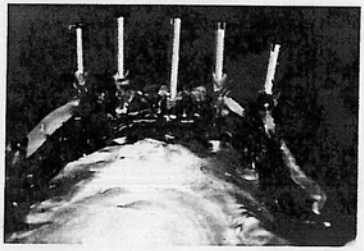

Figure 4B—Either Duralay or wax forms the chimney around the long laboratory working screws.

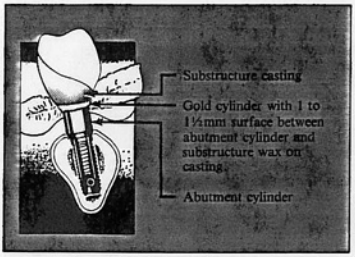

Figure 5—The cervical 1 to 1½mm of the gold cylinder is maintained free of the pattern fabrication material.

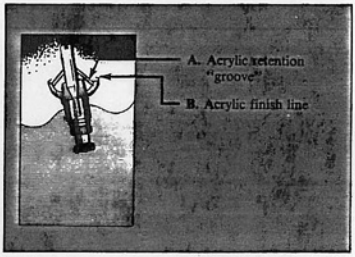

Figure 6—Diagramatic illustration of "U-shaped" substructure base. a) acrylic finish line, b) acrylic retention groove placed near the finish line.

The remainder of the substructure pattern is designed to provide maximum rigidity and strength, based on the engineering principles of truss design *(Figure 7)*. A triangular network of wax tubes connected to the U-shaped substructure base permits the final framework to have maximum strength while minimizing the bulk of precious metal in the casting. In the cantilever section, use the zig-zag truss or A-shaped arch with the center strut for maximum strength. Additional L-shaped struts, connecting the distal abutment with the first retention loop will give extra support to this crucial area.

The interproximal areas should be as smooth as possible on the tissue approximating side. Remove any excess wax from the cylinders.

Frequently the mandibular framework requires a labial extension beyond the U-shaped base to adequately support the denture teeth cantilevered in the anterior region *(Figure 8)*.

Placement of the retention loops or beads is easily decided by referring to the position of the denture teeth in the matrix. Place loops, coated with beads interproximally, connecting them to the chimneys wherever possible.

Sprue the pattern with eight gauge wax wire or plastic sprues. Invest with high-heat multi-purpose phosphate bonded investment following manufacturer's directions precisely.

After the investment is completely set, a medium heat burn out (1200°F) is required for a minimum of one hour.

Castings should be made with either a high gold content alloy or a substitute alloy with a melting temperature in the range of 1890–1920°F.

Non-precious alloys should be avoided. They generally require higher burnout and casting temperatures. Efforts to use these alloys have detrimentally affected the gold cylinders, *(Figure 9)* with pitting, heavy oxidation, and even loss of gold cylinder integrity.

When finishing and polishing the metal framework, an extra set of brass abutment replicas should be screwed to place on the underside of the casting. These will protect the margins of the gold cylinders.

Fit is essential to distribute occlusal forces evenly to the osseointegrated fixtures. Before prosthesis completion, the casting is generally tried in the mouth to insure an accurate fit. If the fit is not accurate, the framework should be sectioned and an appropriate solder index made.

Soldering can be done with a laboratory gas/oxygen torch following standard crown and bridge procedures. Again the prosthesis should be tried in the mouth until accuracy is proven. The fit may be checked clinically as well as radiographically *(Figure 10)*.

When the prosthodontist is satisfied with the casting fit, the prosthesis may be completed *(Figures 11A & 11B)*. The prosthesis is fastened to the abutment cylinders using small gold screws.

In conclusion, osseointegration provides the dental profession with a new avenue of treatment for fully or partially edentulous patients. This new

Continued, next page.

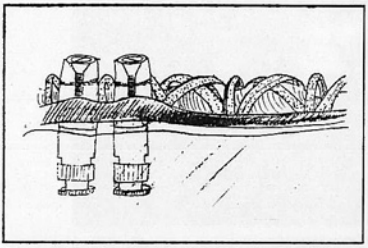

Figure 7—Truss design provides framework with maximum strength.

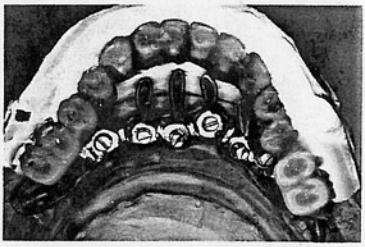

Figure 8—Gold labial extension loops support the cantilevered anterior teeth.

Figure 9—Non-precious alloys requiring high casting temperatures may affect the gold cylinders.

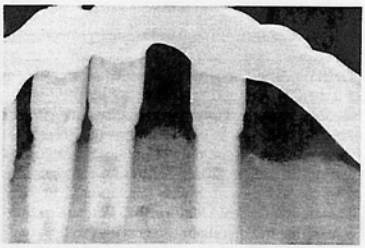

Figure 10—Radiographic examination is used to check the casting accuracy.

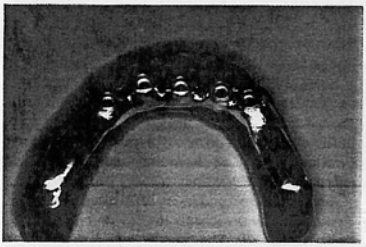

Figure 11A—Final tissue integrated prosthesis showing polished gold substructure framework.

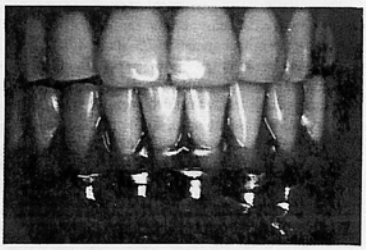

Figure 11B—Tissue integrated prosthesis securely fastened in the mouth.