The Procera Abutment — The Fifth Generation Abutment for Dental Implants

• **Brian K.S. Kucey,** B.Sc., DDS, MS.Ed., FRCD(C), FACP •
• **Darrel C. Fraser,** RDT, CDT •

Abstract

The Brånemark dental implant has undergone progressive development in terms of both the implant body itself and the components connecting the implant to the prosthesis. Many screw and abutment designs have been developed, with various degrees of success. About 15 years ago, CAD (computer-assisted design)–CAM (computer-assisted manufacture) technology was introduced to dentists. More recently CAD–CAM has been used in the manufacture of abutments for implants. This article reviews currently available techniques for creating the Procera custom abutment (Nobel Biocare, Göteborg, Sweden) and outlines appropriate applications for this type of implant.

MeSH Key Words: *dental abutments; dental implants; dental prosthesis design*

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The Brånemark dental implant has undergone progressive development in terms of both the body of the implant itself and the components connecting the implant to the prosthesis.[1-4] Early components designed for complete arch restorations featured small gold screws, which permitted the restoration to be removed by the dentist (Fig. 1), but these components had limited adaptability for single-tooth restorations. Attempts at esthetic restorations often required ridge lapping (Fig. 2), unless implant placement was ideal. Repeated loosening of the gold screws resulted from the application of forces exceeding the retentive potential of the screws and meant increased maintenance by the dentist. Many abutment and screw designs, such as the UCLA abutment[5,6] and the DIA Anatomic Abutment,[7,8] have been introduced, with various degrees of success. Mechanical stabilization of the abutment — referred to as countertorquing — to avoid transmission of torque transfer to the implant–bone interface while the abutment screw is being tightened, could not be achieved with these abutments, thereby preventing the application of the original Brånemark protocols.

NobelPharma (now Nobel Biocare, Göteborg, Sweden), introduced the CeraOne abutment in 1990 for single-implant restorations, incorporating external countertorquing capability and improving the design of the gold screw.[9,10] With this development, the emphasis moved from retention of the restoration via a screw to cementation of the restoration. This was a welcome advance, although significant shortcomings persisted. More experienced clinicians often preferred to use a custom-made abutment to retain the cemented restoration.[11-13] Significant expansion of the restorative emergence profile was often required to ensure that adequate soft-tissue contours were created and maintained in the restoration (Fig. 3).

In 1990, NobelPharma developed the Procera system based on computer-assisted design and manufacture (CAD–CAM) technology.[14-16] Implant abutments created with the Procera system were introduced in 1998. These abutments were designed to allow the use of an internal countertorque device to protect the implant–bone interface while the abutment screw is tightened. The external surface could now be modified as required by the restorative dentist. The modified screw design makes insertion of the head of the screw drivers easier. The countertorque device has been improved to fit different sizes of implants and different lengths of abutments. These features allow the use of traditional crown and bridge techniques for the fabrication of the restoration and make it retrievable if an appropriate cement is employed on a preparation with adequate taper.

This article reviews the currently available techniques for creating the Procera custom abutment, and outlines appropriate applications for this type of abutment. Particular attention will be paid to the complications associated with using this technique.

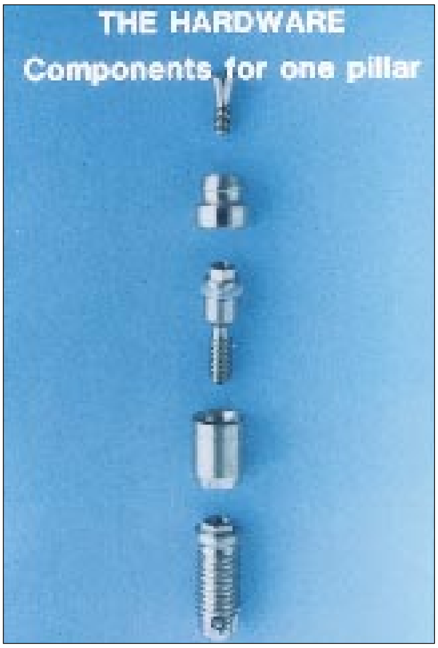

Figure 1: *The original Brånemark implant components.*

Figure 2: *Unhygienic and mechanically unfavorable design.*

Figure 3: *CeraOne restoration on the left; conventional crown on the right.*

Figure 4: *Procera CAD–CAM design image.*

Technique

1. An impression is made to record the position of the implant in 3 dimensions. Nonrepositionable impression copings are used to create an accurate master cast requiring the use of an open-tray impression technique, preferably with a custom tray.
2. A replica of the implant (analog) is secured to the impression coping, and a soft-tissue cast is created and articulated.
3. The laboratory technician then proceeds in one of 2 ways, as follows.

Procera CAD–CAM Technique

A screw with a graduated pin for determining height of the abutment is placed in the replica of the implant on the master cast to allow the technician to visually align the computer image with the master cast (Fig. 4). The design software permits alteration of the body angle, height, width and taper of the abutment. The gingival margin height, width and emergence angle can be modified. The software has a limiting feature that prevents the operator from designing an inadequate abutment. The completed abutment design, represented on the screen as a wire mesh, is transmitted electronically to the production facility, where it is milled from a solid block of titanium. The implant is delivered to the technician within 4 days. The wire mesh design of each implant abutment is stored by the laboratory in a data file that can be recalled and used as a starting point for future cases.

Although designing the abutment is faster than building it up in wax (as described below), this technique has several drawbacks, as follows:

- It is impossible to relay exactly the implant position from the master cast to the computer, and final milling of the titanium abutment is usually required. The milling can be done either by the laboratory or the dentist.
- Procera CAD–CAM abutments must be designed with 4 surfaces in cross-section (mesial, distal, buccal, lingual), resulting in a round to modified square shape. Because some natural teeth have roots that are triangular in cross-section (e.g. maxillary central incisors), further modification of the Procera abutment may be required.

Figure 5: *Wax-up cylinder, ready for scanning.*

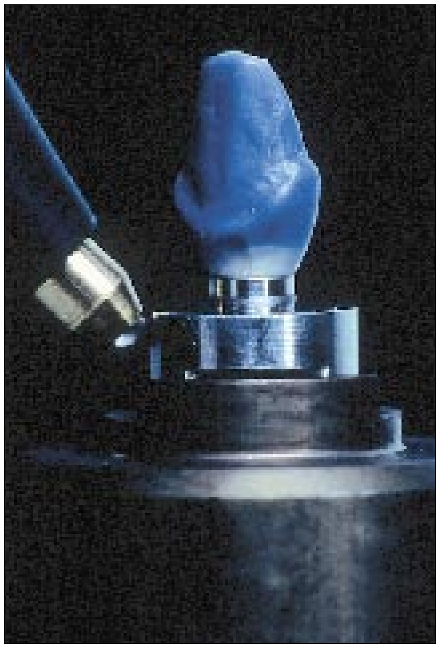

Figure 6: *Verification of Procera abutment fit.*

- The abutment shape cannot be checked by the technician or the dentist before fabrication, so remakes may be necessary.
- If one abutment of a multi-unit construction is misaligned, all the abutments must be modified to ensure draw.

The CAD–CAM software can only be used to design abutments for regular-platform (RP) Nobel Biocare implants (3.75-mm diameter implants). The wax-up kit, which can also be used for RP implants, must be used for narrow-platform and wide-platform implants.

Rotation of single crowns, which is especially likely on cylindrical abutments, is prevented by the rise and fall created in the gingival margin to follow soft tissue contours. A buccal or labial alignment groove should be incorporated in the abutment to assist in proper positioning of the restoration and to afford a channel to vent cement excess.

Waxed-up Custom Abutment with Procera Scanning Technique

A machined base cylinder is screwed to the implant analog, and wax is applied to build the abutment to full contour (Fig. 5). The waxed abutment is cut back and checked for position and shape; the amount of space available for the restoration is also verified. The gingival finish line commonly follows the soft tissue contours, rising from the buccal or lingual to the proximal, as it would on a conventional crown preparation. The pattern is removed from the master cast and positioned in the Procera scanner to digitize the waxed abutment. The resulting wire mesh design is reviewed on a monitor and sent by e-mail to the production facility as in the CAD–CAM technique.

4. Often, the abutment must be modified before construction of the provisional restoration. The abutment and the provisional restoration are delivered to the surgical or restorative dentist. The abutment is inserted and its appropriate positioning on the implant checked visually or by radiography (Fig. 6). While the abutment screw is torqued, a countertorque is used to prevent the application of excessive forces to the implant–bone interface. The access hole for the screw is filled with a small pledget of cotton, which is positioned over the screw head, and the remainder of the chamber is filled with a light-cured, soft-setting composite resin such as Clip 97 (VOCO, Cuxhaven, Germany) (Fig. 7).
5. The final contours must be examined carefully to ensure that the provisional restoration will be completely seated. The occlusion is evaluated and adjusted as required to remove initial contact and eliminate isolated excursive mandibular movements. The temporary restoration is then cemented with a provisional cement such as Temp-Bond (Kerr Manufacturing Company, Romulus, MI) (Fig. 8).
6. After adequate maturation of the soft tissue, the provisional restoration is removed, and a retraction cord is placed to obtain a final impression using standard crown and bridge impression techniques. In some instances alteration of the finish line of the metal abutment may be desired if there has been excessive shrinkage of the soft tissue. Jemt has demonstrated that hypertrophy of the soft tissues has been reported up to 2 years after implant placement.[17] Care should be taken to prevent excessive subgingival margin placement, as this greatly complicates removal of the cement.
7. The final restoration is inserted, carefully adjusted and positioned with provisional or final cement (Figs. 9 and 10). Annual re-evaluations are recommended to maintain optimum implant loading.

Discussion

Use of Procera technique to create custom implant abutments offers significant improvements over previous methods of implant restoration. In all of the machining techniques, tolerances are established between components to ensure complete seating of the abutment on the head of the implant and to provide good adaptation of the countertorquing device. Slight rotation or movement of the abutment is commonly observed during torquing. This represents movement of the abutment hex interface during preloading of the screw, as described by Binon and McHugh.[18] Because of this movement, the final restoration should be constructed from a

Figure 7: Procera abutment screw access hole filled with "clip."

Figure 8: Acrylic provisional crown cemented with temporary cement.

Figure 9: Final restoration (labial view).

Figure 10: Final restoration (lingual view).

new final impression of the completed abutment, particularly when multiple abutments are being used.

Occasionally, the emergence profile of the abutment may result in contours that impinge on the proximal bone and prevent complete seating of the abutment. Abutment position needs to be carefully examined by radiography before the abutment screw is torqued. In addition, adequate space must exist for maintenance of the gingival tissue between the teeth. It is suggested that a minimum of 2 mm of horizontal space between abutments or between an abutment and the adjacent tooth is required to maintain adequate tissue health. If this space is not present after placement of the final abutment, the clinician must modify the abutment at chair-side and adjust the provisional restoration.

The location of the finish lines must be discussed in detail with the dental technician. For a surgical-impression technique, the finish lines must be approximated, since the gingival tissues are reflected away from the implant. On the buccal, finish lines positioned 1 mm below the gingival crest of adjacent teeth will usually be adequate. The lingual margins can be equigingival with the adjacent teeth. The locations of the interproximal margins should undulate coronally on mesial and distal aspects so as to be approximately 0.75-1.0 mm subgingival.

As much time as possible should be allowed for gingival maturation (at least 6 weeks to 3 months or longer) before a final impression of the abutment is obtained. Nonetheless, the gingival finish line and soft tissues may need to be modified.

Conclusions

The Procera abutment is the state-of-the-art implant abutment for restorations supported by single or multiple Brånemark implants. Conventional cementation minimizes the stress to multiple-unit restorations, and lateral set screws can be used for retention if desired.

Problems with inventory of components, incorrect selection of abutments, poor tissue contours and angulation can be avoided or greatly reduced. Concerns about dissimilar metals and about interfaces between machined and cast components are eliminated.

Implants can be placed in their ideal positions, the change in coronal angulation in the restoration being achieved by the custom-made abutment.

Implementation of this technology requires experience with premachined implant components to ensure the maintenance of high standards of restorative excellence.

Operator experience with direct impressions of the implant itself and not only a supragingival abutment is essential.

There is potential for complications from incomplete removal of cement.

With the development of the custom abutment, implant dentistry has come full circle, and the complex myriad of components has been vastly reduced. Because the process of restoring dental implants is now closer to that for restoring natural teeth, we can expect even more use of dental implants to replace missing teeth in the future. ❖

Dr. Kucey is the founder and mentor of the Alberta Implant Seminar and Alberta Implant Centres headquartered in Edmonton and Calgary. His company Canadian Implant Seminars has co-sponsored surgical and prosthetic courses with Nobel Biocare.

Mr. Fraser is a dental technician in Edmonton, Alta.

Correspondence to: Dr. Brian Kucey, 273 Bonnie Doon Centre NW, edmonton, AB T6C 4E3. E-mail: bkucey@ais.ab.ca.

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