

Prosthodontics

NEWSLETTER

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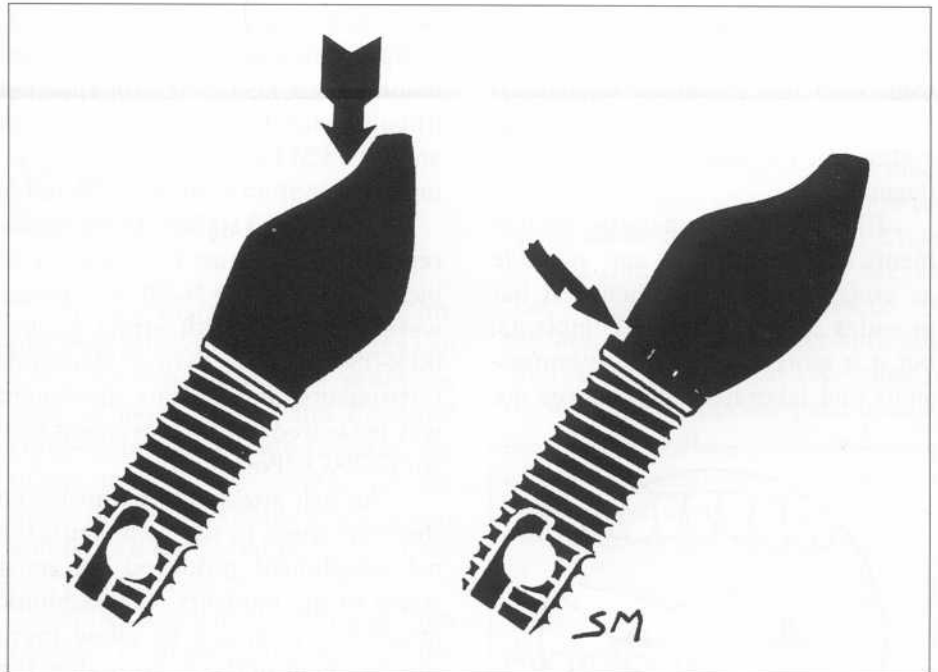
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In a study of fracture strength of abutment/implant connections, a force was applied at an angle of 135° (large arrow) to artificial crowns that were cemented to implant abutments until failure of the connections occurred (small arrow). (See *Fracture Strength of Implant-abutment Connections*, back page.)

Current Research in Implant-supported Prosthodontics

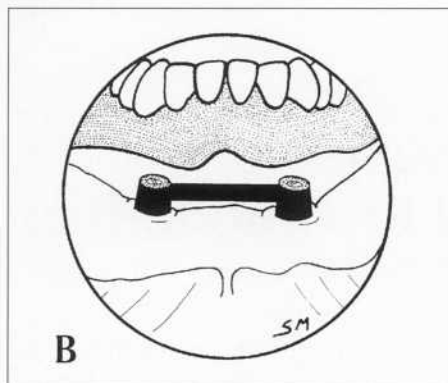
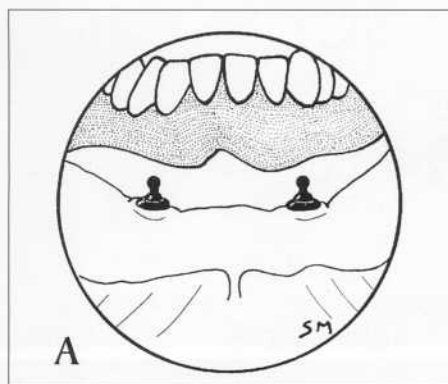
Osseointegrated dental implants have been used in North America for >20 years. This area of dental practice is still progressing rapidly, with hundreds of research papers published annually. This issue of *Prosthodontics Newsletter* reviews recent literature related to implant-supported prosthodontics.

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Attachment Methods for Implant-supported Overdentures

A mandibular implant-supported overdenture with 2 supporting and retaining implants in the canine regions is a cost-effective approach to overdenture care for a patient who is maladaptive to a conventional mandibular complete denture. Three popular attachment systems can be used with this 2-implant design: (1) ball or stud attachments, (2) bar/clip systems or (3) magnetic attachments (Figure 1).

The stud and magnetic attachments are freestanding and available as prefabricated components. A bar provides splinting of the 2 implants, but it is more costly because impressions and laboratory procedures are



required. However, if splinting improves stress distribution, the added cost can be justified.

A recent *in vitro* study by Tokuhsa et al from Kyushu University, Japan, evaluated stress distribution and denture-base movement for these 3 different methods of attachment. Two root-form ITI implants (Straumann) were embedded in a model of a mandibular edentulous ridge in the canine regions. A mandibular overdenture was fabricated and retained with: (1) ball/plastic female attachments (Straumann), (2) a keeper (Platon)/magnet (Hicolex slim G780, Hitachi) system and (3) a CM bar with a metal-clip attachment system (Cendres & Métaux).

Forces were applied to the molar region of the denture in 5-Newton (N) increments from 0 N–50 N. Stresses were measured with strain gauges (KFR-05-120-C-11, Kyowa Electronic Instruments) and denture movement was measured with a movement sensor (3SPACE, Polhemus).

The ball attachments transferred the least stress to the 2 implants; the bar attachment produced the most stress in the implants. The magnetic attachments tended to allow more displacement of the denture than the other 2 attachment systems.

Comment

The magnetic attachments provided the least stability of the 3 attach-

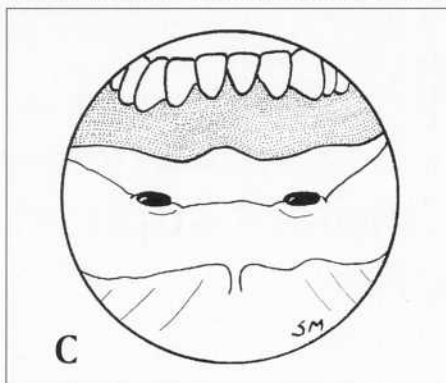


Figure 1. When 2 implants support and retain mandibular overdenture, ball attachments (A), a bar attachment (B) or magnets (C) can be used as retainers.

ments studied. These attachments may not be well accepted by some patients, especially when the natural contours of the edentulous ridge do not contribute to denture stability.

Ball attachments provided reasonable stability and produced less stress. Perhaps the favorable stress distribution was attributable to the plastic female components. The bar system incorporated a 10-mm metal female clip. If plastic clips, which are commercially available in 5-mm lengths, had been used, stress patterns for the bar may have been similar to those seen with the ball attachments.

In this study, the bar did not appear to offer any advantage when stress distribution and denture-base movement were considered. However, the implants were optimally placed in the *in vitro* model. Compromised implant placement, commonly seen clinically, could alter the stresses. With less-favorably positioned and aligned implants, stresses would likely be different, and splinting of the implants with a bar might have produced a beneficial effect.

Tokuhsa M, Matsushita Y, Koyano K. In vitro study of a mandibular implant overdenture retained with ball, magnet, or bar attachments: comparison of load transfer and denture stability. Int J Prosthodont 2003;16:128-134.

Implant Prosthodontics To Replace Posterior Teeth

Successful clinical trials involving the restoration of totally edentulous mandibles by using implant-supported prosthodontics led to the use of implant-supported fixed partial dentures (FPDs) to restore posterior teeth in partially edentulous patients. Several short- and medium-term fol-

low-up studies have indicated promising results. Nevertheless, few studies have reported long-term results.

The charts of 130 patients treated from 1983 through December 2001 were reviewed by Attard and Zarb from the University of Toronto. All patients were treated with posterior FPDs supported by Brånemark dental implants (Nobel Biocare AB, Göthenburg, Sweden). Included were 432 implants supporting multiple missing teeth for 174 edentulous spaces.

Twenty-eight implants failed during the study, and 5 implants were not used to support an FPD (left covered by soft tissue). Nineteen of the 28 failures occurred early, before prosthetic connection. The remaining 9 implants failed after loading. Three of these implants fractured, and 6 lost their osseointegration.

Implant diameter and history of chronic medical conditions influenced the failure rate of individual implants. At 5 years, the survival rate recorded for 5-mm diameter, wide-platform implants was 76.3% compared with 94% for regular diameter implants. Patients with chronic medical problems recorded an 8.8% failure rate compared with a 4.8% failure rate for medically healthy patients. Active smokers and those with a history of smoking did not experience a higher failure rate when compared with nonsmokers.

Comment

The rate of failures with the wide-platform implants was approximately 6.3 times greater than the rate experienced with regular implants. Other clinical studies have also reported higher failure rates with the 5-mm wide-platform implant design that was used in this study. These wide-platform implants had machined threaded surfaces. Several other studies of wide-platform implants with rougher surfaces reported better success rates.

Although the reasons for the higher percentage of failures with the wide-platform design are unknown, the authors speculated that either the surface characteristics of the threads or the implant design might have been the cause. This study highlights the value of clinical trials to test any new implant design before the implant becomes commercially available.

Attard NJ, Zarb GA. Implant prosthodontic management of partially edentulous patients missing posterior teeth: the Toronto experience. J Prosthet Dent 2003;89:352-359.

Accuracy of Implant Impressions

Fitting discrepancies with implant-supported fixed prostheses can contribute to mechanical problems such as loose screws and fractured components. Improving the accuracy of the impression procedure will enhance the accuracy of the working cast and reduce the potential for an ill-fitting prosthesis in the mouth.

Burns, a private practitioner from London, et al evaluated in vitro the accuracy of implant impressions made with stock trays vs custom trays. Impressions of implant analogs in an aluminum typodont were made with stock trays (Size 12 Solo trays, Davis Healthcare Services Ltd.), closely fitting custom trays made with Palatray LC material (Heraeus Kulzer, Wehrem, Germany) and custom trays made with a spacer and the same material.

Casts were made from type IV gypsum (GC Fujirock EP; GC Europe, Leuven, Belgium), and standardized reference bars were used to evaluate the accuracy of the casts. Gaps were measured with a traveling microscope.

There was no difference in the accuracy recorded for the casts made with the 2 types of custom trays, but the casts made from impressions in stock trays were less accurate than those made with custom trays.

Comment

The major difference between the stock trays and the custom trays was rigidity. The stock trays were less rigid than the custom trays, and perhaps some flexing of the trays occurred during the impression procedures, allowing distortion of the impressions. Nevertheless, the distortion appears to have been minimal.

The mean error for the casts made from stock trays was 23 μm , and the errors for the custom trays were 11 μm and 12 μm . Clinical studies suggest that vertical-fit discrepancies of <60 μm are difficult to detect clinically. Therefore, the clinical relevance of these numbers appears questionable.

Burns J, Palmer R, Howe L, Wilson R. Accuracy of open tray implant impressions: an in vitro comparison of stock versus custom trays. J Prosthet Dent 2003;89:250-255.

Accuracy of Implant Frameworks

The conventional method of fabricating frameworks for implant-supported prostheses involves gold-alloy casting techniques. Frameworks can also be milled from pure titanium by using Procera technology (Nobel Biocare; Göthenburg, Sweden).

Takahashi and Gunne from Umeå University, Sweden, evaluated the fit of 19 frameworks for implant-supported prostheses, 14 made with the Procera system and 5 made with the traditional gold-alloy casting method. A silicone impression material was used to record the gap between the

Next:

- Clinical complications in prosthodontics
- Outcome of 4 post-and-core systems
- Problems with implant-supported overdentures

Our next report features a discussion of these issues and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.

implant abutments and framework cylinders, and the discrepancies were recorded with a microscope. The mean discrepancy for the Procera frameworks was 26.9 μm ; the mean for the cast gold frameworks was 46.8 μm .

Comment

These results suggest that perfectly fitting frameworks are not possible with any of the available techniques, and that milled frameworks might fit better than cast frameworks. The clinical relevance of these differences in fit is unknown. Also, these frameworks were evaluated on the casts. The misfit of the frameworks intraorally is likely to be greater than the discrepancies recorded on the casts because of inevitable errors in the impressions and casts.

Takahashi T, Gunne J. Fit of implant frameworks: an in vitro comparison between two fabrication techniques. *J Prosthet Dent* 2003;89:256-260.

Fracture Strength of Implant-abutment Connections

Failure of the abutment/implant connection was a persistent problem in the past with single implant-supported crowns. However, improved understanding of biomechanics along

with design changes in the abutment, screw and implant components have reduced the occurrence of connection problems.

Strub and Gerds from Albert-Ludwigs University, Germany, tested the fracture strength and failure mode of the abutment/implant connection for 5 different combinations. The 5 combinations were: (1) Steri-Oss implant/Novostil abutment, (2) Steri-Oss implant/Anatomic abutment, (3) Steri-Oss implant/straight HL abutment, (4) IMZ Twin plus implant/Esthetic abutment and (5) Osseotite implant/Hexed gold UCLA abutment.

Abutment screws were tightened according to manufacturers' recommendations, and artificial crowns were cemented to the abutments with Panavia 21 cement (Kuraray). There were 16 specimens for each group. Half of the specimens were artificially aged in a simulated chewing machine and simultaneously thermocycled. The remaining specimens and all specimens that survived the dynamic loading in the chewing simulator were statically loaded under compression until failure.

Two specimens in group 1 and 1 specimen in group 4 failed in the artificial chewing machine. With static loading, connections for groups 1 and 4 failed at significantly lower loads than those recorded for the other connections.

Comment

Groups 1, 2, 3 and 5 were externally hexed implants, and the implants in group 4 incorporated an internal hex. Some dentists have advocated internally hexed implants for single implant-supported crowns, but these IMZ Twin plus implants did not perform better than the externally hexed systems. Furthermore, the necks of all implants in group 4 distorted as a result of the static load testing. It is better for the screw (which can be replaced) to deform or fracture at failure because a distorted implant would almost certainly become nonrestorable.

Strub JR, Gerds T. Fracture strength and failure mode of five different single-tooth implant-abutment combinations. *Int J Prosthodont* 2003;16:167-171.

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