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## *Current Overview*

***Implants***
***Bone remodeling***

***Degidi M, Scarano A, Piattelli M, Perrotti V, and Piattelli A. Bone remodeling in immediately loaded and unloaded titanium dental implants: a histologic and histomorphometric study in humans. J Oral Implantol 31: 18-24, 2005.***

Bone is a dynamic and living tissue which is constantly adapting to its environment. When bone is cyclically loaded, microfractures can develop and the body responds by replacing the damaged area with new healthy tissue. The rate at which the damaged bone is replaced by healthy bone is referred to as the bone remodeling rate (BRR).

The different types of bone in the jaws display different bone remodeling rates. The lamellar bone takes longer to remodel (BRR = 1 to 5um/day) because it is more mineralized, rigid, and organized, and stronger when compared to the rapidly produced (BRR = 60um/day) weak woven bone.

In this experiment, 12 patients were restored with fixed implant-supported prostheses. All 12 patients received an extra implant in the posterior that was not to be included in the prosthesis. In 6 patients the extra implant was loaded the same day of placement, while the other 6

### *In This Issue*

**Implants** ..... **1**
**Materials** ..... **8**
**Prostheses** ..... **14**

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patients had the extra implant covered and kept unloaded throughout the healing period. The implants were later removed and evaluated histologically.

The results of the histologic evaluation showed greater cellular activity around the loaded implants than around the unloaded implants. The loaded ones showed areas of mature lamellar bone with thick trabeculae and actively secreting osteoblasts. There was also a significant level of tetracycline staining in the bone around the implant, which indicates a high level of maintained pre-existing peri-implant bone. The findings are all significantly higher in the loaded implants than in the unloaded implants, but both systems did show comparable bone remodeling rates (2um in unloaded and 3um in loaded samples). These BRR fall in the range that is indicative of lamellar bone remodeling.

This study indicates that loading the peri-implant bone stimulates bone remodeling, while also helping to preserve a greater amount of the preexisting bone. The resultant remodeling seems to happen at a similar rate in loaded and unloaded implant sites, but the loaded implant sites produce a greater percentage of lamellar bone. In conclusion, immediately loading an implant does not detrimentally affect the peri-implant bone as long as the ensuing forces are kept within a level of biological tolerance.

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***Implants***
***Donor site for bone graft***

***Carinci F, Farina A, Zanetti U, Vinci R, Negrini S, Calura G, Laino G, and Piattelli A. Alveolar ridge augmentation: A comparative longitudinal study between calvaria and iliac crest bone grafts. J Oral Implantol 31: 39-45, 2005.***

As implant dentistry continues to evolve, the need for bone of adequate quality and quantity remains a prerequisite to success. In many cases, this prerequisite can be satisfied by the placement of an autog-

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enous bone graft. But which donor site can consistently provide the highest quality bone graft?

In cases that require a significant amount of bone, the 2 most commonly utilized donor sites include the iliac crest and the calvaria. The 2 bone grafts differ in embryology, histology and mechanical properties, so it was the intention of this study to evaluate which graft material demonstrates a greater level of dimensional stability over time. 21 iliac crest grafts and 47 calvaria grafts were placed in 68 patients (36 mandibles & 43 maxillas); their levels of resorption were followed over a minimum of 10 months (mean follow-up 16.5+/-7.7 months).

The results of this study showed that the mean increase in bone levels in the maxilla (+10mm) was significantly larger than that reported for the mandible (+4mm). The calvaria grafts tend to resist early resorption and demonstrated excellent mechanical strength. At the 10 month follow-up examination the calvaria graft demonstrated an 83% survival while the iliac graft showed only a 61% survival rate. However, the difference in the survival rates was reduced to only 10% by the time of the final examinations (30 months).

In conclusion, the membranous bone in a calvaria graft can be considered superior to the endocondral bone in an iliac graft because of the calvaria's improved early dimensional stability and increased mechanical strength. The calvaria graft is a more favorable graft because the patient tends to experience less post-op discomfort. However, in many cases the patient will require a CT scan prior to surgery in order to determine an area of adequate bone thickness.

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***Wang H-L, Shotwell J, Itose T, and Neiva R. Multidisciplinary treatment approach for enhancement of implant esthetics. Implant Dent 14: 21-29, 2005.***

**Implants**
**Esthetics**

Through the years the materials and techniques used in dentistry have greatly improved the esthetics of the prostheses, but the most important component for a successful restoration is still the development of a good game plan that can be accurately executed by a team of specialists. The indications for implant dentistry have been greatly expanded by augmentation techniques that are being performed on a routine basis by dental specialists.

The augmentation of soft and hard tissues is an extremely complicated process. An orthodontist can aid in the regeneration of hard and soft tissues in hopeless teeth by means of orthodontic extrusion and eruption. The process of orthodontic eruption requires the separation of

the supracrestal fibers from the tooth and relies only on the radicular PDL fibers to stimulate bone formation in the tooth socket. Orthodontic extrusion does not require supracrestal fibrectomy because you rely on all of the PDL fibers for the regeneration of both the hard and soft tissues around the extruding root.

Surgeons are also capable of augmenting areas with deficient volumes of hard tissue, but the regeneration process is dependent upon three key fundamentals: the presence of a blood clot; preservation of osteoblasts; and maintenance of contact with the surrounding living tissue. One of the more popular bone augmentation procedures is the "sandwich" technique. It attempts to mimic the characteristics of the various layers of natural bone. The first layer of the graft is placed against the bone and consists of osseous coagulum, demineralized freeze-dried bone allograft or mineralized cancellous human allograft. These materials mimic the bone marrow and cancellous bone. The fast-absorbing first layer allows the surrounding osteogenic cells to infiltrate and regenerate an osseous scaffold.

These graft materials are structurally weak; therefore, a more rigid graft material is layered on top. The rigid graft material mimics the cortical layer in natural bone and is composed of densely packed hydroxyapatite. The graft can be further strengthened and protected from soft tissue infiltration by the placement of a membrane.

There has been a shift in restorative philosophy with the development of augmentation procedures for both soft and hard tissues. Treatment in implant dentistry is no long driven solely by the location of available tissues, but by the ideal positioning for proper form, function, and esthetics.

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***Implants***
***Functional loading***
***Soft tissue & osseointegration***

***Degidi M and Piattelli A. Comparative analysis study of 702 dental implants subjected to immediate functional loading and immediate nonfunctional loading to traditional healing periods with a follow-up of up to 24 months. Int J Oral Maxillofac Implants 20: 99-107, 2005.***

For years practitioners have feared the formation of a fibrous capsule instead of bone around an implant that was functionally loaded prematurely. Recent reports have shown that, under the right conditions (e.g., primary stability at time of placement), the immediate loading of an implant can actually be beneficial to the maintenance of soft tissue contours and the osseointegration of the implant.

This study reported an overall success rate of 99.2% for the immediately functionally loaded prostheses. All of the implants restored in the

IFL group were placed in an edentulous jaw and were splinted together by the prosthesis framework, thus improving the primary stability of the implants.

In the immediately nonfunctionally loaded group only one of the 135 implants failed (99.2% success). The INFL group consisted of partially edentulous arches. 113 implants were utilized to support fixed partial dentures while 22 implants were restored as single units. The most important factors for the success of the implants were primary stability and minimization of contact stresses (e.g., occlusal and interproximal).

The ability to achieve primary stability is of the utmost importance to the survival of any implant. This study followed and verified the standards utilized by previous studies to assess primary stability. The authors maintain that the placement torque must be greater than 25Ncm in order to proceed with immediate restoration. If resonance frequency analysis is also performed, an implant stability quotient greater than 60 would indicate an adequate level of primary stability to support an immediate restoration without the development of detrimental effects.

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***Francetti L, Del Fabbro M, Basso M, Testori T, Taschieri S, and Weinstein R. Chlorhexidine spray versus mouthwash in the control of dental plaque after implant surgery. J Clin Periodontol 31: 857-62, 2004.***

***Implants***
***Healing/dental plaque***

It is a well-accepted fact that the presence of plaque can interfere with the healing process following implant surgery. The surgical site is most susceptible to inflammation and infection in the first few days post-surgery because the surfaces of the sutures are susceptible to bacterial colonization, and mechanical debridement of the wound is difficult and painful.

In this study, 2 different delivery modalities for chlorhexidine were compared. Chlorhexidine is an oral antibiotic mouth rinse which is known to reduce the incidence of post-surgical infections. The patients in the control group rinsed twice a day with 15ml 0.12% chlorhexidine, while the experimental group utilized a spray delivery system to administer 4 sprays 0.2% chlorhexidine twice a day.

The direct spray delivery system resulted in an overall 85% decrease in antibiotic consumption compared to the traditional oral delivery system. The decrease in consumption did not decrease the overall effectiveness of the chlorhexidine. The plaque index was comparable for both delivery systems at 7 and 14 days post-surgery.

On the other hand, the staining of the remaining dentition was significantly decreased with the localized spray delivery system. In conclusion, the administration of 4 sprays 0.2% chlorhexidine directly to the surgical site twice a day is the preferred method for plaque control around a healing implant surgical site.

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***Implants Interfaces***

***Akour S, Fayyad M, and Nayfeh J. Finite element analysis of two antirotational designs of implant fixtures. Implant Dent 14, 77-81, 2005.***

In modern implant dentistry, there seems to be two interfaces that are still of concern to the restoring dentist, including: the implant-bone interface and abutment-implant interface. One of the most common problems encountered in longitudinal studies is the loosening or fracture of the retaining screw. The antirotational hex is a design element that has been incorporated into the implant design in order to stabilize the abutment and prevent screw failure.

The purpose of the current study is to compare the stress distributions of 2 antirotational designs and to evaluate their ability to prevent screw failure during cyclic loading. The 2 antirotational designs evaluated in this study included the original external hex and a trichannel internal hex. The 2 implant designs were modeled on a computer, and finite element analysis was utilized to evaluate the stress distributions.

The stress distributions for the trichannel internal hex were significantly lower than those recorded for the external hex design. The external hex recorded higher overall stresses, contact stresses, and deflection stresses; therefore, it has a greater potential for loosening and fracture of the retainer screw. The trichannel internal hex is better suited to distribute stresses because it has a greater overall contact area and rounded corners. These features avoid areas of stress concentration which could potentially result in deformation and fatigue of the surrounding components.

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***Implants Regenerated tissue***

***Fugazzotto P. Success and failure rates of osseointegrated implants in function in regenerated bone for 72 to 133 months. Int J Oral Maxillofac Implants 20: 77-83, 2005.***

In recent years the literature has thoroughly documented the success that surgeons have had augmenting both hard and soft tissues. Studies

have also reported good short-term survival rates of implants placed in regenerated tissues, but the long-term success of these implants is not well documented. This study evaluated the survival of 607 titanium plasma sprayed cylindrical implants that have been functioning between 6 and 10 years.

The results of the evaluation demonstrate success rates (97.2% in maxilla and 97.4% in mandible) that are comparable to implants placed in native host bone. The success rate of the implants appears to be independent of the nature of the bone (native host bone or grafted bone), the type of graft material (autogenous or nonautogenous), and the time of placement (placement of implant and graft at same time or delayed implant placement) as long as primary stability of the implant can be adequately achieved at the time of placement.

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***Tortamano Neto P, and Camargo L. Prospective clinical evaluation of dental implants with sand-blasted, large-grit, acid-etched surfaces loaded 6 weeks after surgery. Implant Dent 35: 717-722, 2004.***

***Implants***
***Surface changes***

Various studies have suggested that changing osseointegrated dental implant surfaces may decrease the time needed between placing the implant and restoration. The sand-blasted, large-grit, acid-etched (SLA) surface is one method used to abbreviate this time. This study tested SLA surfaces in the maxillas and mandibles of partially-edentulous patients. Surfaces were evaluated for lack of pain and other clinical syndromes, lack of peri-implantar inflammation, lack of mobility, lack of radiolucency, and suppuration.

Participants all had type 2 and 3 bones and were evaluated after implant procedure and then again at 6 weeks and 3, 6, and 12 months. Periotest measurements made at the time of surgery were lower than those taken at 6 weeks. Stability increased 0.10 each month subsequent to surgery. The mobility of implants increased and stabilized for 1 year, finally achieving the value they had at the time of surgery.

These findings suggest that the implant experiences necrosis shortly after surgery and then bone growth connects the bone and implant. Periapical radiographs revealed no bone loss on any of the 18 implants. There were no instances of implant failures. While a short loading time was given to each implant, participants had no pain and none of the implants moved. These positive results were due to successful anchorage.

The authors concluded that implants with the ITI SLA surface could be loaded after 6 weeks. Results were affected by the following: participants' good dental hygiene; implant dimensions; SLA treatment

surface; no type 4 bones; patients' overall good health; following standard protocol; and using bone areas that didn't require regeneration.

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**Implants**
**Timing after extraction**

***Chen S, Wilson T, and Hammerle C. Immediate or early placement of implants following tooth extraction: Review of biologic basis, clinical procedures, and outcomes. The Int J Oral Maxillofac Implants 19: 12-25, 2004.***

While there are some advantages to placing implants immediately after extraction, studies have suggested that immediate placement may lead to infection and a lack of soft tissue closure and flap dehiscence at extraction site. This study compared the effects of immediate and delayed implant placement.

The authors located 31 studies providing information on immediate and delayed implants. These studies showed a need for clearer definitions of implant placement, and the morphologic, dimensional, and histologic changes involved. Most of the articles detailed immediate implant treatment. Those that recorded delayed implants showed a 4 to 8 week wait after extraction to place the implant.

Some advantages to the delayed implant procedure were that sites had lower instances of infection and high area and volume of soft tissue. However, this procedure also leads to ridge resorption in buccolingual dimension. Implants should be placed 4 to 8 weeks after extraction to allow for proper healing.

Peri-impact defects linked to immediate and delayed implants may lead to regeneration. Augmentation procedures may be required at sites with HDs higher than 2 mm. Data gave no information about optimal bone augmentation procedures for such cases, but using resorbable membranes is recommended. Overall, there was no difference in the short-term survival results of immediate or delayed implants or implants in healed alveolar ridges.

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**Materials**
**Bond strength**

***Jacques P and Hebling J. Effect of dentin conditioners on the microtensile bond strength of a conventional and a self-etching primer adhesive system. Dent Mater 21: 103-9, 2005.***

Whenever a tooth is prepared a significant amount of debris is retained within the microstructure of the exposed dentin, and this is commonly referred to as the smear layer. The recent literature on dentin

bonding has shown that the smear layer plays a crucial role in bonding, yet researchers have not decided if it is better to partially or completely remove the smear layer. One would argue that the retention of the smear layer could be detrimental because it harbors bacteria, is permeable to bacterial waste products, and has a weak cohesive nature. On the other hand, complete removal of the smear layer would result in exposed dentin tubules that are permeable to fluids, a collapse of the underlying collagen matrix, and an overall increase in post-operative sensitivity.

The microstructure of the dentin at the time of bonding is dependent upon the conditioner. Most of the available bonding systems utilize an acidic conditioner, which removes the smear layer and etches the hydroxyappetite crystals. The problem with this current technology is that there is often a discrepancy between the degree of dentin penetration of the conditioner and the bonding agent. Often the higher viscosity bonding agent cannot penetrate deep into the hybrid layer. The unsupported collagen fibers can result in microleakage, flexure of the restoration, pulpal sensitivity, and ultimately failure in bonding.

The purpose of this study was to evaluate the resultant bond strength of samples prepared with different dentin conditioners. The dentin conditioners chosen for this experiment reflected different degrees of dentin surface dissolution. The dentin conditioners included a strong etchant (e.g., 37% phosphoric acid – complete smear layer removal and dissolution of hydroxyappetite crystals), mild chelating agent (e.g., EDTA – partial removal of smear layer and selective removal of hydroxyappetite crystals), and a one-step conditioner and primer (e.g., Clearfil SE Primer – partially dissolves the smear layer and hydroxyappetite crystals while at the same time it incorporates the primer into the collagen matrix).

The results of this study show that lower bond strengths are achieved with a strong etching conditioner, confirming that the increased viscosity of the primer prevents it from penetrating as deep as the etchant. The incomplete impregnation of the resin into the collagen layer leaves a defective zone of exposed collagen fibrils, which are open to degradation by the infiltration of moisture and proteolytic enzymes. The highest mean microtensile strengths reported in this study were achieved with the self-etching primer and Single Bond bonding system; the second most effective bonding combination was the 0.5 EDTA and Clearfil SE bonding system.

Both of these systems show promising results due to their capability to support the underlying collagen matrix, but a potential disadvantage of the self-etching primer system is the incorporation of the smear layer. As mentioned earlier, the smear layer contains bacteria and zones of weak cohesive strength and could potentially have a detrimental affect

on the long-term success of the restoration. Long-term clinical studies should be done on these types of materials.

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## Materials CAD/CAM

***Otto T. Computer-aided direct all-ceramic crowns: preliminary 1-year results of a prospective clinical study. Int J Periodontics Restorative Dent 24: 446-455, 2004.***

CAD/CAM systems now available allow the dentist to machine all-ceramic crowns and place them in the patient in just one appointment. Using the Cerec 3 CAD/CAM method originally introduced in 2000, feldspathic ceramic crowns were placed in 20 patients using a dual-curing composite luting agent and functional adhesive.

After 1 year there were no fractures or loss of retention. These crowns had reduced stump preparations, which may contribute to minimizing fracture due to an increase in ceramic thickness.

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## Materials Color of resins

***Haselton D, Diaz-Arnold A, and Dawson D. Color stability of provisional crown and fixed partial denture resins. J Prosthet Dent 93: 70-75, 2005.***

Color change in resins used for provisional prosthodontic treatment is an important consideration. Methacrylates (Alike, Jet, Temporary Bridge Resin, Unifast, Zeta CC) and bis-acryl resins (Instatemp, Integrity, Luxatemp, Protemp Garant, Provipont, Provitec, Temphase) were immersed in artificial saliva and artificial saliva-coffee solutions for 1, 2 and 4 weeks.

Generally, less color change was found in the methacrylate resins than in the bis-acryl resins. The most overall color change was in Provipoint, which was visually unacceptable. This material contains a comonomer to make it more fluid, which may account for the greater change in color. Alike showed the most color change in the methacrylate resins.

The methacrylate resin Zeta CC underwent the least overall color change, and the manufacturer indicated it has a very stable inorganic color pigment. Its particles are tightly compacted, giving the surface less texture than other resins.

The influence of coffee on color change, especially of bis-acryl resins, prompted the recommended action that patients stop or reduce

their consumption during the time they have provisional restorations. Other factors which may influence color such as temperature and wear, were not measured.

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***Bolhuis P, de Gee A, Pallav P, and Feilzer A. Influence of fatigue loading on the performance of adhesive and nonadhesive luting cements for cast post-and-core buildups in maxillary premolars. Int J Prosthodont 17: 571-576, 2004.***

***Materials***
***Fatigue loading/ cement***

Fatigue loading was used to evaluate the performance of a resin-based composite cement (Panavia 21) and a zinc-oxy-phosphate nonadhesive cement (PhosphaCem/C). Both cements resisted fatigue loading after 1,000,000 load cycles. However, the resin composite appeared more suitable for cementing cast posts and cores since it had a higher push-out strength and fewer irregularities, such as air bubbles in the layer between post and dentin after SEM analysis. The fatigue test was too short to determine long-term leakage effects on cement stability and therefore should not be used as a quality test.

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***Michalakis K, Hirayama H, Sfolkos J, and Sfolkos K. Light transmission of posts and cores used for the anterior esthetic region. Int J Periodontics Restorative Dent 24: 462-469, 2004.***

***Materials***
***Light/posts & cores***

Materials that mimic a natural tooth's optical properties (transmission and refraction of light) have been developed to improve esthetics. Metal posts and cores do not allow light transmission through the crown, root, or periodontal tissues, and replacing the metal post with a ceramic one may be the solution. This study investigated the light transmission of several types of posts and cores.

Three types of posts were studied: all ceramic post and core; zirconium post with castable ceramic core; and polyester-with-zirconium-fibers post and composite core. All were superior to metal posts with regard to transmission of light. The polyester/zirconium and zirconium posts had a similar appearance and seemed to provide more natural transmission of light than the all-ceramic ones. The combination of zirconium post with IPS Empress Cosmo core exhibited the best light transmission of the materials.

Zirconium posts should not be used for patients who demonstrate functional and parafunctional behavior. The strength and stiffness of the

zirconium posts can cause vertical root fractures in these patients. Further study of this issue is needed.

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## Materials Posts

***Grandini S, Goracci C, Monticelli F, Tay F, and Ferrari M. Fatigue resistance and structural characteristics of fiber posts: three-point bending test and SEM evaluation. Dent Mater 21: 75-82, 2005.***

With the introduction of carbon fiber posts in 1990, the dental profession has demonstrated a shift in restorative philosophies of endodontically treated teeth. In the past, one of the most commonly encountered failures of endodontically treated teeth was root fracture. Many believed that one of the contributing factors to the root fracture was the drastic difference in the elastic moduli of the post and root. In recent years, the resin fiber posts have grown in popularity because their elastic moduli are very similar to that of dentin, they show good adhesion to luting agents and core materials, and they are also available in tooth-colored configurations. These properties quickly made them the ideal choice to support an all-ceramic restoration in the anterior esthetic zone.

The rapid growth in popularity of the resin-reinforced fiber posts has demanded a thorough evaluation of their long-term strength. The purpose of this study was to evaluate the fatigue resistance of numerous commercially available posts and to see if there is a significant correlation between their strength and their internal configurations. This study utilized 15 samples of 8 commercially available brands of resin-reinforced fiber posts. The fatigue strength of the posts was assessed by cyclically loading the posts in a 3-point bend test. The internal characteristics, such as fiber diameter, fiber/resin ratio, and fiber direction, were assessed by means of SEM.

The results showed two brands of posts that significantly outperformed all the others. All 10 of the DT Light-Post samples survived the 2 million cycles, and only 1 of the FRC Postec samples failed. Upon SEM evaluation the only specimens not to show defects in both the longitudinal and horizontal cross-sections were DT Light-Post, FRC Postec, and Ghimas White. Despite the excellent performance of DT Light-Post and FRC Postec in both evaluations, the statistical analysis failed to show a statistically significant positive correlation between internal configuration and fatigue strength.

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***Christensen G. Post concepts are changing. JADA 135: 1308-1310, 2004.***

**Materials**
**Posts & cores**

This study reviews the use of posts and cores in contemporary practice and offers suggestions for the use of different materials. Until recently it was thought necessary to use posts and cores for any tooth endodontically treated; however, a post is not always needed. If the tooth structure is intact except for the small access hole for the endodontic treatment, a post is not necessary; there are other considerations, though, such as whether there are cracks in the coronal part of the tooth, and the amount of stress on the tooth.

In an endodontically-treated tooth in which a significant amount (more than half) of the coronal portion of the tooth remains, a post should be used. On the basis of recent studies, resin-based composite posts reinforced with fiber are recommended because they are as strong as metal, have better esthetics and are less expensive. Factors such as cracks and amount of stress should be considered in deciding whether or not to use a post; if there is doubt, it is prudent to use one. Where the coronal structure is almost completely missing after endodontic treatment, a dental implant should be more successful in the long-term.

The study concludes with a list of the various types of posts and how to use them. Suggestions: titanium alloy has good properties for metal posts; tooth-colored zirconia is exceptionally strong and rigid, but in some instances may cause cracking; fiber-reinforced resin based composite posts have many properties which make them very effective. Good techniques include: the channel for the post should not exceed 3mm from the apex; select a post that is made of fiber-reinforced resin-based composite or titanium alloy; abrade the post channel; use a bonding agent in the canal; place the post and resin composite build-up with resin cement, and ready the post and core for the restoration.

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***Paul S and Werder P. Clinical success of zirconium oxide posts with resin composite or glass-ceramic cores in endodontically treated teeth: a 4-year retrospective study. Int J Prosthodont 17: 524-528, 2004.***

**Materials**
**Posts & cores**

Ceramics are becoming more popular for fixed prosthodontics due to their aesthetic advantages. Glass fiber-reinforced resin composite posts and ceramic posts are alternatives if aesthetic qualities are required of the post system. Ceramic posts can also be combined with a ceramic core. When comparing zirconium oxide posts combined with direct composite cores to those with indirect glass-ceramic cores, both groups showed excellent esthetics for the majority of teeth in this study.

However, zirconium oxide posts with indirect glass-ceramic cores showed a much higher failure rate and a high dropout rate. The increased failure rate was attributed to a dual-cure luting resin combined with a dentin bonding agent used for cementation. Therefore, zirconium oxide posts combined with direct composite cores are a potential alternative to conventional approaches, especially in the anterior dentition.

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## Prostheses
## Comfort/support

***Visser A, Raghoebar G, Meijer H, Batenburg R, and Vissink A. Mandibular overdentures supported by two or four endosseous implants: A 5-year prospective study. Clin Oral Implants Res 16: 19-25, 2005.***

One of the most common complaints of patients in the dental office is a decrease in comfort, confidence, and chewing efficiency due to the lack of support, retention, and stability of the mandibular denture. In this prospective study 60 experienced denture-wearing patients suffering from a severely resorped mandible were randomly assigned to either group A (2-implant overdenture) or group B (4-implant overdenture). All implants were placed in the anterior mandible according to the 2-stage protocol (3 months delay until exposure).

The results of the study showed that both the 2- and 4-implant overdentures can be done predictably, with high levels of implant survival and patient satisfaction. The combined survival rate of all implants was approximately 99.9%, with only one implant lost during the healing phase. The annual marginal bone loss for group A and B was 0.32mm and 0.25mm, respectively, well within the acceptable range reported in the literature (0.6mm by Naert). The oral hygiene evaluations showed that the patients in both groups were more than capable of maintaining an adequate level of oral hygiene, and none of the implants showed a significant change in probing depths.

In terms of post-prosthetic care, the 2-implant overdenture required a greater level of prosthetic correction (e.g., replacement of clips), while the 4-implant overdenture required a greater level of surgical treatment (e.g., gingivectomy due to hyperplasia around closely-approximating implants). Overall, the 2- and 4-implant overdentures reported equal success and patient satisfaction; therefore, one can consider both as viable treatment options, with the main limitation being patient finances.

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***Attard N, Zarb G, and Laporte A. Long-term treatment costs associated with implant-supported mandibular prostheses in edentulous patients. Int J Prosthodont 18: 117-123, 2005.***

***Prostheses***
***Cost-fixed detachable vs overdentures***

Some clinicians will suggest to their patients that overdentures have a significant long-term cost due to the increased frequency of maintenance. In this study a cost analysis report was conducted, which evaluated the costs associated with mandibular fixed-detachable prostheses (hybrid) and overdentures. The study evaluated 4 groups; 2 groups of patients (1 for each treatment modality) that were treated in the late 70's and early 80's and 2 groups that were followed through the 90's until 2002.

In all cases, the patients having hybrid prostheses incurred a greater upfront cost for both the implant surgery and prosthesis fabrication. The increase in cost can be attributed to the fact that hybrids are typically supported by 5 implants, while the overdentures are supported by only 2 implants and a Dolder bar. The cost analysis applied in this study incorporated the initial cost of the treatment, time invested, and cost of maintenance into the overall cost of treatment.

As one would expect, the hybrid patients treated in the 70's incurred the greatest prosthetic, maintenance and recall costs of any other group in the study. This makes sense, since these restorations were being done before dentists really understood the stress distribution and the limitation of the materials used to fabricate the frameworks. The cost of the hybrid in the 90's dropped significantly due to the improvements in techniques and materials, but the hybrid prosthesis still requires a significantly larger investment of time and money than the overdenture. The general conclusion is that the overdenture prosthesis is a more cost-effective approach to the rehabilitation of the completely edentulous mandible; however, further studies are needed to evaluate the overall cost-to-benefit ratio and not just the overall cost.

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***Torres Leon B, Del Bel Cury A, and Garcia R. Water sorption, solubility, and tensile bond strength of resilient denture lining materials polymerized by different methods after thermal cycling. J Prosthet Dent 93: 282-7, 2005.***

***Protheses***
***Lining materials***

Resilient liners have been used for years in patients with removable prostheses to improve the comfort of the prosthesis. The flexible nature of the liner material allows the prosthesis to negotiate areas of severe undercuts without traumatizing the mucosal tissues. Resilient liners can

also improve the comfort of the prosthesis by dampening the occlusal forces being transmitted to the underlying tissues.

The complete polymerization of the liner material is an important consideration in terms of the material's dimensional stability, bond strength and flexibility. The soluble components of the resilient liner (e.g., residual monomers, plasticizers, etc.) can be leached out, while water and saliva can be absorbed; therefore, it is important to know which curing protocol will provide the most stable liner over extended periods of time.

This experiment evaluated 2 resilient liner materials: Light Liner (light cured) and Ever-soft (cured in hot water or microwave). No significant difference was noticed in terms of water sorption, but there was a significant difference in solubility between the Light Liner and the Ever-soft. This difference can be attributed to incomplete polymerization, different processing methods, and quantity of plasticizer and crosslinking agents present in the different liner materials.

The Ever-soft material cured by microwave light demonstrated tensile bond strengths that were significantly greater than all other liners tested. The Ever-soft (hot water cured) demonstrated 50% adhesive failures and 50% adhesive/cohesive failures, while the Light Liner and Ever-soft (microwaved) tended to exhibit primarily adhesive/cohesive failures.

This experiment shows that there is a significant difference in commercially-available resilient liners and that the processing method and storage medium can significantly affect the long-term properties of the material. Removable prostheses with resilient liners should not be immersed in water, but stored in a sealed, moist environment, with only the occlusal portion of the prosthesis in contact with water.

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