New coating for implants could prevent premature failure

A team of MIT chemical engineers has developed a new coating for implants that could help them better adhere to the patient’s bone, preventing premature failure.

The coating, which induces the body’s own cells to produce bone that fixes the implant in place, could also be used to help heal fractures and to improve dental implants, according to Hammond and lead author Nisarg Shah, a graduate student in Hammond’s lab.

Artificial hips consist of a metal ball on a stem, connect- ing the pelvis and femur. The ball rotates within a plastic cup attached to the inside of the hip socket. Similarly, artificial knees consist of plates and a stem that enable movement of the femur and tibia. To secure the implant, surgeons use bone cement, a polymer that resembles glass when hardened. In some cases, this cement ends up cracking and the implant detaches from the bone, causing chronic pain and loss of mobility for the patient.

“Typically, in such a case, the implant is removed and replaced, which causes tremendous secondary tissue loss in the patient that wouldn’t have happened if the implant hadn’t failed,” Shah says. “Our idea is to prevent failure by coating these implants with materials that can induce native bone that is generated within the body. That bone grows into the implant and helps fix it in place.”

The new coating consists of a very thin film, ranging from 100 nanometers to one micron, composed of layers of materials that help promote rapid bone growth. One of the materials, hydroxyapatite, is a natural component of bone, made of calcium and phosphate. This material attracts mesenchymal stem cells from the bone marrow and provides an interface for the formation of new bone. The other layer releases a growth factor that stimulates mesenchymal stem cells to transform into bone-producing cells called osteoblasts.

Once the osteoblasts form, they start producing new bone to fill in the surrounding loss of mobility for the patient. Such a coating would be helpful in preventing that from occurring,” Shah says.

It takes at least two or three weeks for the bone to fill in and completely stabilise the implant, but a patient would still be able to walk and do physical therapy during this time, according to the researchers.

The MIT team can control the thickness of its film and the amount of growth factor released by using a method called layer-by-layer assembly, in which the desired components are laid down one layer at a time until the desired thickness and drug composition are achieved.

The researchers are now performing animal studies that have shown promising results: The coatings lead to rapid bone formation, locking the implants in place.

Dental implant firm files for bankruptcy

According to reports, Voxelogix Corp, a seven-year-old US teeth-replacement company, has filed for bankruptcy protection in San Antonio.

President of the corporation and dental specialist, Dr Stephen Schmitt, who replaces missing and damaged teeth, said the company had been “hurt” by the down economy in the last few years. As a result it “lacked the financial resources it needed to grow”.

The company was part of the emerging field of digital dentistry that uses three dimensional models and other computer-designed aids to improve teeth replacement. While full replacement costs at Voxelogix started at about $40,000, the company said its treatment can result in lower costs compared to conventional dental methods.

The report stated that Voxelogix filed for bankruptcy protection Tuesday under Chapter 11 of the bankruptcy code, meaning it can seek reorganisation. Schmitt said he was uncertain, however, if it would return to business.

XiVE - now on Facebook too

Implant System Fan-page provides a platform for users. Exchange mutual experiences, ask for tips from colleagues or find out about innovative concepts – now, the XiVE implant system makes this possible for its users on its own Facebook fan page.

A centre stage of the XiVE fan page are all the topics around implantology: What new practical concepts are there? What new tips can colleagues give for issues of primary stability or immediate loading, for instance? These are only some of the aspects that interest practitioners and that they would like to discuss. The new XiVE fan page provides a platform for just this purpose.

You can share your own experience with the implant system – the XiVE Xperience

Nobel Biocare Catalog 2012 available online

Nobel Biocare has released its new Product Catalogue 2012 with up-to-date content, illustrations and detailed product information.

The new Nobel Biocare Product Catalogue 2012 is an informative and fundamental reference point for navigating through Nobel Biocare’s comprehensive assortment of products and solutions. The updated catalogue allows for accurate and efficient ordering of all Nobel Biocare’s implants, prefabricated and individualized prosthetics, and components for guided surgery.

Highlights of the new product catalogue include: Recently launched products such as NobelClinician Software for digital diagnostics and treatment planning now also for Mac, NobelActive 5.0 for safe implant placement in areas with limited space, and NobelReplace Conical Connection and NobelReplace Platform Shift designed to optimize aesthetic outcome through enhanced soft tissue preservation while maintaining the benefits of the well-proven tapered implant body.

XiVE – with colleagues on the fan page.


You can share your own experience with the implant system – the XiVE Xperience...
A 59-year-old male patient was looking for a new fixed restoration for his maxilla. His case history showed no general disease. The patient had been fitted with telescopic model casting prostheses in the maxilla and mandible.

Owing to the periodontally insufficient anterior residual teeth in the maxilla (teeth #12, 11, 21 and 22), the prosthesis could no longer be supported. After losing the residual teeth, the patient wanted a fixed implant-based restoration of the maxilla.

The residual teeth of the mandible showed the following findings. Tooth #48 was impacted and displaced. Tooth #45 showed mobility (Grade 3) and was periodontally insufficient. The anterior residual teeth #33 to 43 presented with increased probing depths on the canine teeth and increased mobility (Grade 2).

The treatment strategy for the maxilla included, as a first step, a conservative periodontal therapy of the anterior residual teeth for strategic preservation and fixation of the existing prosthesis until implant insertion.

Afterwards, the residual teeth were removed and a bilateral sinus floor augmenta-
tion was performed in a two-stage procedure. Following 3-D planning, eight endosseous implants were inserted with the CAMLOG Guide System in a flapless procedure, and the prosthetic restoration was realised using a telescopic bridge.

In the mandible, tooth #45 was removed and the other teeth were treated with con-
ligned. Teeth #43 to 35 received re-veneering of the removable denture.

In order to ensure accurate transferability, the fixation must be performed under radiological control in the identical position as the one for the implantation.

The planned minimally invasive flapless procedure for implant insertion requires a unique fixation for the preparation of radiological materials. The fixation is facilitated by temporary implants in a suitable position.

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Fig 16: Transversal view at 14

Fig 17: Transversal view at 13

Fig 18: Transversal view at 12

Fig 19: Surgical template with ball retention elements at positions 21, 15 and 25 for stable positioning of the template during drilling procedures. Careful cleaning and disinfection are mandatory before placement.

Fig 20: Ball retentions on temporary implants for stabilisation of the temporary prosthesis, fixation of the scan template during cone-beam scan and positioning of the surgical template during the drill procedure.

Fig 21: The gingival punch is guided through the sleeves into the mucous membrane. The punch has no depth stop.

Fig 22: A scalpel is used to cut out and remove the punched gingival islands after removing the template.

Fig 23: Guided insertion through the sleeves utilising the CAMLOG Guide insertion tool.

Fig 24: Implants in first quadrant in situ. Depth stops on the surface of the sleeves.

Fig 25: Guided insertion through the sleeves utilising the CAMLOG Guide insertion tool.

Fig 26: The sleeve dimension allows for bone-condensing and bone-spreading procedures through the sleeve (here, osteotome for vertical bone condensation).

Fig 27: Mounted lab analogues together with the insertion posts are secured to the sleeves with wax. The lab analogues are fixed into the plaster cast.

Fig 28: Long-term temporary appliance in situ. Depth stops on the sleeve of the surgical stent.

Fig 29: Long-term temporary appliance cemented in situ in terms of early treatment eight weeks post-op.

Fig 30: The surgical template is set back on its fabrication model. The analogue plaster reamers are used to create the cavity for the lab analogue through the sleeve.

Fig 31: Impression with closed impression posts.

Fig 32: Mounted lab analogues together with the insertion posts are secured to the sleeves with wax. The lab analogues are fixed into the plaster cast.

Fig 33: Mounted lab analogues in place. The transfer of the analogue into the correct position through the sleeve of the surgical stent.

Fig 34: A 0.5mm thick thermoformed splint is drawn over the abutments. The thermoformed copings perform the space-making task for passivation when cementing the interim restoration.

Fig 35: Radiographical situation two years after loading.

Fig 36: Impressions with closed impression posts.

Fig 37: CAD/CAM-fabricated zirconia abutments bonded to CAMLOG Esthetic inset abutments.

Fig 38: Radiographical situation before treatment.

Fig 39: CAD/CAM-fabricated zirconia abutments after one year in function.

Fig 40: CAD/CAM-fabricated zirconia abutments after one year in function.

Fig 41: Occlusal view two years after final prosthetic restoration.

Fig 42: Occlusal view before treatment.

Fig 43: Radiographical situation before treatment.

Fig 44: Radiographical situation two years after loading.

Fig 45: Impression with closed impression posts.

About the author

Dr Claudio Cacaci is a specialist in oral surgery and implant dentistry. He studied at the Dental School in Munich and worked in the Department of Maxillo-Facial Surgery and the Department of Oral Surgery and Implant Dentistry in Munich. In 1997, he founded a private dental clinic with Dr Jan Hajtó in Munich. In 1998, he established the Private Training Centre for Implant Dentistry (F.I.O.I.) in Munich. He is the founder of the Munich Study Group for Implant Dentistry and a member of various national and international study groups and dental associations. Dr Cacaci is author of the book Check-list – Implantology and contributing author of the book Manual of Oral Implantology. Since 2009, he has worked in a group practice specialising in implantology and periodontology in Munich.
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Keep it safe and simple

Dr Armin Nedjet examines the principles of Champions

For almost two decades, MIMI®, the Minimally Invasive Method of Implantation, has been known as a beneficial, patient-friendly and periosteum-protecting surgery surgical method. (Don’t confuse the MIMI® method with Mini implants, which are made from titanium, grade five, and have an implant diameter that is smaller than 2.9mm). The Champions® implant system, which is inserted according to MIMI®, has been very successful in recent years. However, this implant system can also be inserted according to the classical implantation method, and if necessary, augmentations can be performed. The implants themselves are made from titanium, grade four, by a well-known German manufacturer. The surface of the Champions® are made from the best material on the market, according to several studies in Germany, for example at the university clinic in Cologne, and the United States.

The principle of Champions® is KISS "Keep It Safe & Simple"! and last year, more than 50 000 Champions® implants were inserted in German dental clinics/offices. The Champions® implants have proven to be reliable and beneficial. Their price-performance ratio and innovative features (such as the cementable "Prep-Capa" and the two-piece Champions® (R)Evolution® implants), as well as the efficient surgical and prosthodontic procedures they employ, are unbeatable.

Primary stability at a torque of 40Ncm can be achieved with a one-piece 3.5mm-diameter “Classic” Champions® implant (slightly conical end), with the 3.5mm-diameter “New Art” Champions® or with 3.5mm-diameter two-piece Champions® (R)Evolution® implants.

According to recent clinical studies, the old argument, “The more titanium in the bone, the better it is”, has been proven wrong. In fact, the peri-implant nutrition plays a major role. There are very few complications associated with the MIMI® treatment, which is very beneficial for patients: thanks to MIMI®, the periosteum, which nourishes the bone, is very well protected.

In some cases, you can extract teeth that cannot be peri-odontally preserved and insert implants in the same session. Patients with one-piece Champions®/implants, for example for single front teeth, are provided with a fixed temporary restoration before the final prosthodontic restoration is fitted eight weeks after implantation. If there are more than four fixed teeth/implants, the final prosthodontic restoration can even be fitted within the first 14 days post-surgery and splinted/passively fitted (eg with Implantlink Semi). In the two-to-eight weeks post-surgery, the one-piece implants must be stabilised against micro-movements in order to ensure the transition from Primary Osseointegration Stability (POS) to Secondary Osseointegration Stability (SOS). This phase is very critical: when fitting fixed prostho-dontic restorations, the temporary restorations should not be removed in the second to eight weeks post-surgery.

When two-piece Champions® (R)Evolution® implants are inserted, the implants can be transferred to Secondary Osseointegration Stability independently from temporary restorations without any problems. Two-piece Champions® implants are indicated for smaller units (one- three teeth), and one-piece Champions® are indicated for larger units (four or more implants/teeth). Dental surgeons prefer to work with two-piece Champions® (R)Evolution® implants since they can avoid many of the problems associated with temporary restorations. The whole treatment (without the need of special high-tech material) is easily affordable for most patients.

According to recent clinical studies, the old argument, “The more titanium in the bone, the better it is”, has been proven wrong’
Laser-Lok 3.0 is the first 3mm implant that incorporates Laser-Lok technology to create a biologic seal and maintain crestal bone on the implant collar. Designed specifically for limited spaces in the aesthetic zone, the Laser-Lok 3.0 comes with a broad array of prosthetic options making it the perfect choice for high profile cases.

- Two-piece 3mm design offers restorative flexibility in narrow spaces
- Implant design is more than 20% stronger than competitor implant
- 3mm threadform shown to be effective when immediately loaded
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Introducing the Laser-Lok® 3.0 implant

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gued that implants should always have an inter-implantary distance of two-three mm or of two-three mm to adjacent teeth, this has been proven wrong by hundreds of studies and long-term documented cases. When the implants have achieved primary stability, bone does not have to first grow on the titanium. Thanks to the MIM® technique, bone remains well-nourished. There-

Therefore, you only need an inter-implantary distance of one mm and a distance of 1mm to the adjacent teeth.

Patients need to be well informed about all aspects of implant treatment, including the benefits of one-piece implants for single tooth gaps. Temporary restorations and cements should be fitted to avoid lateral shear forces and micro-movements in the first two to eight weeks post-surgery, and patients should be aware of the importance of their compliance with their dentist’s instructions. The case described is an example of how successful and reliable immediate implantation can be if special techniques and materials, which protect the periosteum, are applied.

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‘Patients need to be well informed about all aspects of implant treatment, including the benefits of one-piece implants for single tooth gaps’
Ridge preservation and GTR with a xenograft and resorbable collagen membrane

Prof Nart provides a case study

The most predictable way to maintain the width, height and position of the alveolar ridges is to perform ridge preservation at the time of tooth extraction. This procedure requires an intra-socket osseous graft and the use of a membrane and should reduce the morphological changes in alveolar bone (Lekovic et al. 1998; Wang et al. 2004). In a six-month animal study, Araújo and Lindhe demonstrated that the placement of a biomaterial in an extraction socket may modify the remodelling and ridge resorption that occurs following tooth extraction. They observed that there was an average of 55 per cent of ridge resorption in natural healing and only 12 per cent in the grafted sites (Araújo & Lindhe 2009).

The materials and the surgical techniques in use today simplify ridge preservation before implant placement and enable clinicians to ensure the functional and aesthetic outcome of the implants and subsequent restorations more predictably. Various natural and synthetic bone graft materials are available for the clinician to use for ridge preservation. Bone grafts in general are divided into four major categories: autogenous, allografts, xenografts and alloplasts. Although the gold standard is the autogenous graft, studies have proven the reliability and functionality of using either an allograft or xenograft, which avoids the creation of an additional surgical site for bone harvesting. In addition, there is rapid resorption of autografts, which is much slower with mineralised allografts or xenografts (Artzi et al. 2000; Vence et al. 2004; Imanaka 2006).

The use of barrier membranes has become a standard of care in guided bone regeneration and for alveolar ridge preservation and/or augmentation. The membrane excludes fast growing cells - epithelial and connective tissue cells...
While enabling mesenchymal progenitor cells to proliferate and to differentiate into osteoblasts. When this surgical technique was established initially, membranes made of expanded polytetrafluoroethylene (ePTFE) were used. Although clinical and experimental studies found excellent treatment results using ePTFE membranes, wound healing complications with infection sequelae arose following the exposure of membranes. Therefore, clinicians and researchers have advocated the use of biodegradable barrier membranes (Grelln et al. 1995).

There are two main materials used to manufacture biodegradable membranes: collagen derived from an animal source and synthetic materials. The ability of collagen to promote progenitor cell adhesion, chemotaxis, homeostasis and physiological degradation, along with its ease of manipulation and low immunogenicity, makes it an ideal barrier material (Botham et al. 2004).

Successful regeneration is possible, provided that cell exclusion and space maintenance prevails for the time needed for repopulation of the site with progenitor cells. This period may vary between three to 12 months for bone regeneration in edentulous areas. The structural integrity of implanted biodegradable barrier membranes needs to be preserved for an adequate period to allow maturation of the newly formed tissue under the membrane-protected space.

The purpose of the present case report is to evaluate clinically and histologically a ridge preservation following tooth extraction. Case study

A 40-year-old female patient was selected for this case report. Other than localised periodontal disease around a right temporary mandibular second molar, she had no systemic disease. The patient was referred for extraction of this molar. The reason for the extraction was type III mobility and the radiological image.

Surgical treatment

Following administration of local anaesthesia (4 per cent articaine and 0.001 per cent epinephrine), the tooth was elevated and an atraumatic extraction was performed. A full-thickness mucoperiosteal flap was elevated to expose both the labial and the lingual aspects of the alveolar ridge. The extraction socket was then curetted to remove all the soft tissue. A combined two- and three-walled bony defect of 6 and 5 mm and a fenestration of the buccal plate were observed (Figs 3 & 4). A ridge preservation technique was performed using a xenograft material and a double layer of resorbable collagen membrane.

Figs 3 & 4, Images of the combined two- and three-walled bony defect of 6 mm and 5 mm, and the fenestration of the buccal plate.

Figs 5 & 6, A ridge preservation technique was performed using a xenograft material and a double layer of resorbable collagen membrane.


The aim of this case report is to evaluate guided bone regeneration after tooth extraction with a xenograft material. The use of a bone substitute can avoid bone harvesting from a donor site, thus reducing patient discomfort post-operatively. In a randomised clinical study, Barone et al. (2008) compared extraction-only treatment to ridge preservation with xenograft (cortico-cancellous porcine bone) and collagen membrane. Seven months after tooth extraction, a greater horizontal width reduction of the residual alveolar ridge (8.1mm versus 6.5mm) in the extraction-only group was observed. A reduction of vertical ridge height was also observed. These findings were in agreement with previous studies (lasella et al. 2005). Deproteinised bovine bone has proven to be a highly biocompatible and osteo-conductive material that acts as a natural scaffold for bone formation, and has a low inflammatory response or fibrous encapsulation of particles. The specimen was fixed in a solution of 10 per cent neutral buffered formalin, then dehydrated in ethanol and embedded in methylmethacrylate resin. Finally, the section was stained with basic fuchsin and toluidine blue, and was observed with an optical microscope at 200 x and 400 x magnification.

Clinical and histological analysis (Figs 14 & 15)

Clinically, xenograft particles were well integrated into the alveolus, and the regenerated area was easily distinguishable from the original bone tissue. The new bone formed was firmly attached to the particles of xenograft. The histological analysis revealed no inflammatory response or fibrous encapsulation of particles of the graft material. All samples showed new bone formation with the newly formed bone strongly adherent to the bone graft particles.

Discussion

The use of a bone substitute can avoid bone harvesting from a donor site, thus reducing patient discomfort post-operatively. Relaxed patients. Easy treatment. Improved post-operative healing. Is this all just wishful thinking? Actually, it’s stress-free – and at your fingertips. Both the SIROLaser Advance and the upgrade-ready SIROLaser Xtend offer you all the benefits of modern laser dentistry. For periodontology, endodontics, surgery … the list goes on! Enjoy every day. With Sirona.

Figs 11 & 12. A bone biopsy specimen was harvested in the area previously regenerated using a bone trephine drill

Figs 14 & 15. All samples show new bone formation with the newly formed bone strongly adherent to the bone graft particles

Fig 15. Implant placement

The patient was given 600mg ibuprofen every eight hours for the first four days and 500mg amoxicillin every eight hours for the first seven days and 10ml 0.20 per cent chlorhexidine gluconate rinses for 30 seconds twice a day (1-0-1) from the day of the operation until day 14 after surgery was prescribed. A toothbrush with extra soft bristles was recommended using a bone trephine drill. A bone biopsy specimen was harvested in the area previously regenerated. Following the biopsy, the planned implant was placed (Figs 11–13). Following local anaesthesia as described above, a crestal incision was done and a full-thickness flap was raised in preparation for implant placement (Fig 10). A bone biopsy specimen was harvested in the area previously regenerated using a bone trephine drill. Following the biopsy, the planned implant was placed (Figs 11–15). The specimen was fixed in a solution of 10 per cent neutral buffered formalin, then dehydrated in ethanol and embedded in methylmethacrylate resin. Finally, the section was stained with basic fuchsin and toluidine blue, and was observed with an optical microscope at 200 x and 400 x magnification.

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Often times, compromises have to be made when developing impression materials. Because normally the rheological properties of stability and good flow characteristics would stand in each other’s way. DMG’s Honigum overcomes these contradictions. Thanks to its unique rheological active matrix, Honigum yields highest ratings in both disciplines. We are very pleased to see that even the noted test institute »The Dental Advisor« values that fact: Among 50 VPS Honigum received the best »clinical ratings«.

Table I: Histological and histo-morphometric evaluation of the xenograft as an alveolar bone graft material.

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>Membrane Type</th>
<th>New Bone (%)</th>
<th>Residual Particles (%)</th>
<th>Connective Tissue (%)</th>
<th>Inflammatory Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No</td>
<td>46.3</td>
<td>30.1</td>
<td>22.8</td>
<td>Minimum</td>
</tr>
<tr>
<td>16</td>
<td>Collagen</td>
<td>26</td>
<td>18</td>
<td>–</td>
<td>25% dry</td>
</tr>
<tr>
<td>35</td>
<td>Collagen</td>
<td>25</td>
<td>20</td>
<td>30</td>
<td>No</td>
</tr>
<tr>
<td>24.5</td>
<td>Collagen</td>
<td>–</td>
<td>24.5</td>
<td>–</td>
<td>No</td>
</tr>
<tr>
<td>35.6</td>
<td>Collagen</td>
<td>25.6</td>
<td>35.4</td>
<td>34.1</td>
<td>Connective Tissue</td>
</tr>
</tbody>
</table>

The efficacy of a xenograft as an alveolar bone graft material may be the result of a combination of factors: its osteo-conductive capacity, the increase of mineral content in the grafted area necessary for bone formation and its density in order to provide stability to the graft and to persist for many months (Barone et al. 2008; Artzi et al. 2000).

The histological analysis revealed that in all samples there are residual particles of the xenograft, including studies at nine months (Artzi et al. 2000). According to studies, the volume of residual bone graft material may vary between 16 and 50 per cent. The volume of new bone formation varies between 25 and 46 per cent (Table I).

Histological and histo-morphometric studies have observed that the formation of new bone and the resorption of the xenograft particles is a slow and gradual process. In a nine-year study of a sinus elevation with a xenograft, Traini et al. (2007) observed an increase in bone formation over time, a decrease in the marrow spaces and a slow resorption of the biomaterial. Sartori et al. (2003) presented a case of a sinus augmentation with a xenograft and histo-morphometric evaluation after ten years; he observed that the absorption of the xenograft is slow but constant. He saw a resorption of 3.6 per cent per year for the first two years and a significant decrease in the next eight years, with an average rate of resorption of 0.58 per cent per month.

According to several studies, once the xenograft is in contact with mineralised bone, it acts similarly to the host bone, providing a biologic support for dental implants (Haas et al. 1998). The success of implants placed in regenerated areas of up to 40 per cent of xenograft residual particles seems to be similar to those placed in native bone (Carmagnola et al. 2003).

Conclusion
The ridge preservation technique limits hard-tissue resorption following tooth extraction. A xenograft with a resorbable collagen membrane has been proven to be a clinically successful means of restoring a bone defect. The histological examination confirmed the presence of newly formed vital bone almost completely surrounding xenograft particles throughout the biopsy samples.

Editorial note: A list of references is available from the publisher.

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