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 Ni-sarg Shah, a graduate student in Hammond’s lab.

Artificial hips consist of a metal ball on a stem, connecting 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 spaces surrounding the implant, securing it to the existing bone and eliminating the need for bone cement. Having healthy tissue in that space creates a stronger bond and greatly reduces the risk of bacterial infection around the implant.

“When bone cement is used, dead space is created between the existing bone and implant stem, where there are no blood vessels. If bacteria colonise this space they would keep proliferating, as the immune system is unable to reach and destroy them. 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, Voxellogix 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 Schmidt, 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 Voxellogix started at about $40,000, the company said its treatment can result in lower costs compared to conventional dental methods.

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

XiVE - now on Facebook too

Implant System Fanpage 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 Experience – with colleagues on the fan page. And at the same time, you can discuss unique patient cases, current scientific insights or exciting insights from your own everyday practice. In addition, there are photos and news from events and advanced training sessions, along with videos on the XiVE fan page that can be accessed by the users any time.

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, prefabriculated 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.
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 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 augmentation 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 conservative periodontal therapy. The mandibular posterior teeth were replaced and realigned. Teeth #43 to 33 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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For more on the benefits of Atlantis™ screw- and cement-retained solutions, visit www.astratechdental.co.uk.

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A complete list of references is available from the publisher.

'"The thickness of the mucous membrane can be measured by fitting the radio-opaque tooth along the plaster surface"

"Cemented based on prosthetic requirements (functional, aesthetic). A bone-anchored and prosthetic-oriented scan can be taken under radiological control owing to the unique fixation of the scan template using the interim implants."

The thickness of the mucous membrane can be measured by fitting the radio-opaque tooth along the plaster surface.

The distance from holding sleeve to bone surface must not exceed 3.5mm.

CAD/CAM was used to fabricate the bridge framework from a fibre composite (Everest C-Temp, KaVo) and veneered with an acrylic material. For passivation of the design, proven electroplating was used. Custom CAD/CAM-fabricated zirconia abutments were selected.

Conclusion

The original goal of the prosthetic reconstruction was a fixed bridge restoration. Owing to the hygienic and functional training phase with the long-term temporary appliance, the patient opted for a removable bridge.

The accuracy and simplicity with which the implants can be inserted in prosthetically correct or anatomically difficult situations is increased significantly by virtual 3D implant planning using CBCT or CT in combination with the guided implant bed preparation and implant insertion. Implant therapy is thus facilitated.

The drilling sequence in the CAMLOG Guide System is different from other systems. While in a conventional drilling sequence, the pilot drill is advanced to the final implant length, the drilling sequence guided by the CAMLOG Guide first starts with the shorter pilot drill (length six mm).

To guide all drills by the sleeve geometry from the start, the drilling sequence is performed in succession from the nine to the 11mm drill and finally to the 15mm drill (maximum implant length).

The CAMLOG Guide offers a sleeve system. As opposed to multi-sleeve systems, a single sleeve inserted into the surgical template is adequate for guidance during all drilling sequences and implantation procedures. The implants can be inserted through the sleeves...

Editorial note: The case was first published in C Mairoana & M Beretta (eds.), Manual of Oral Implantology (Edizioni Italia Press, 2010) and is reprinted here with kind permission.

A complete list of references is available from the publisher.
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 stabilization 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_Resected implant locations 26 and 27

Fig 24_The template is mounted again. Start of the CAMLOG Guide drilling sequence with the pilot drill, followed by drills of the appropriate lengths depending on the implant length (region 23).

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_Implants in first quadrant in situ. Depth stops on the surface of the sleeves

Fig 28_Post-op panoramic radiograph

Fig 29_Healing after one week post-op. The patient had neither complaints nor post-op swelling

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_Implant positions on the plaster cast

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_Cast with 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_Long-term temporary appliance in the articulator

Fig 36_PEEK abutments in situ

Fig 37_Long-term temporary appliance cemented in situ in terms of early treatment eight weeks post-op

Fig 38_Impression with closed impression posts

Fig 39_CAD/CAM-fabricated zirconia abutments bonded to CAMLOG Esthetic inset abutments

Fig 40_CAD/CAM-fabricated zirconia abutments after one year in function

Fig 41_Veneering work

Fig 42_Occlusal view before treatment

Fig 43_Radiological situation before treatment

Fig 44_Occlusal view two years after final prosthetic restoration

Fig 45_Radiological situation two years after loading

About the author

Dr Claudio Caraci 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 Caraci 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 3.0mm-diameter “New Art” Champions® or with 3.5mm-diameter two-piece Champions® (R) Evolution® implants. Implants with a larger diameter (approx 4.5mm or 5.5mm) should only be used if primary stability of the 3.0mm-diameter condensers or of the mentioned implants cannot be achieved at 30/40Ncm.

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 periodontally 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 prosthodontic 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® (R) Evolution® 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.

• Figs 1-3: Case Study
Tooth 34 and tooth 56 of the 50-year-old patient could not be preserved. After local anaesthesia, the teeth were gently extracted, and one-piece Champions® were inserted. You can see the bone “plateau” between the previous tooth roots in the bifurcation area. This type of immediate implantation has many advantages, just one surgery session is necessary, and in the long term, there is no loss of soft or hard tissue.

• Figs 4-7
With the bone condensing conical triangular drills, we pre-
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guessed 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 MIMI® 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. Temporarily restorations and cements should be fitted to avoid lateral shear forces and micromovements 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.

‘Patients need to be well informed about all aspects of implant treatment, including the benefits of one-piece implants for single tooth gaps’

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**About the author**

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Ridge preservation and GTR with a xenograft and resorbable collagen membrane

Prof Nart provides a case study

Histo logical investigations have described the healing of extraction sockets (Amler et al. 1960). Tooth extraction results in a loss of alveolar bone volume, both horizontally and vertically owing to resorption. The greatest amount of bone loss happens in the horizontal dimension and occurs on the facial aspect of the ridge. There is also a loss of vertical ridge height, which is most pronounced towards the buccal area. As alveolar bone is a tooth-dependent structure, the normal post-extraction healing is resorptive. Because the crest of the buccal bone is composed of bundle bone, this remodelling results in vertical reduction of the crest (Araújo & Lindhe 2005). The majority of the dimensional alterations of the alveolar ridge (two-thirds) takes place during the first three months following extraction, and an average of 40 per cent of original height and width is expected to be lost after three years (Lekovic et al. 1997; Schropp et al. 2003).

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 outcomes 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 autogenous grafts, which is much slower with mineralised allografts or xenografts (Artzi et al. 2000; Vence et al. 2004; Imakawa 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


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*Screws are not included *Analogues are not included

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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 (Ialessia 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 osteo-induction potential 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.

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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.

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Table 1: Histological and histo-morphometric evaluation of the xenograft as an alveolar bone graft material.

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>Membrane</th>
<th>New Bone (%)</th>
<th>Residual Particles (%)</th>
<th>Connective Tissue (%)</th>
<th>Inflammatory Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artzi, 2003</td>
<td>9</td>
<td>14</td>
<td>60</td>
<td>28</td>
<td>Minimum</td>
</tr>
<tr>
<td>Levine, 2004</td>
<td>4</td>
<td>16</td>
<td>26</td>
<td>26</td>
<td>25% slight</td>
</tr>
<tr>
<td>Barone, 2003</td>
<td>7</td>
<td>20</td>
<td>35</td>
<td>30</td>
<td>No</td>
</tr>
<tr>
<td>Cardaropoli, 2003</td>
<td>4</td>
<td>24.5</td>
<td>15</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>Lai, 2009</td>
<td>4-6</td>
<td>25.6</td>
<td>35.4</td>
<td>34.1</td>
<td>Ossification finished</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. 2006).

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 23 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, Trani et al. (2007) observed an increase in bone formation over time, a decrease in the narrow 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. 2005).

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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