

# Nobel Biocare NEWS

Information for the Osseointegration Specialist

Issue 1/2017



## "The best decision I ever made!"

The All-on-4® treatment concept can help you change people's lives for the better.

When she was in her early thirties, Deborah Concepcion, from Florida, in the United States, began to encounter the decalcification of the enamel in her teeth. One after another, her teeth began to fracture and fragment, resulting in repeated extractions. She was facing the consequences of a hereditary disorder that got progressively worse.

By Deborah Concepcion

Losing teeth had a huge impact on my life. As one tooth after another failed, I ended up biting and chewing with just my front teeth.

Naturally, I didn't want to smile, which affected me socially. It is very difficult to be missing teeth when you're so young. My self-esteem fell dramatically and I found myself reluctant to have close-up conversations with people—even people I knew well. No close-up selfies or group shots for me!

My dentist made me aware of implants, but I learned that, in some cases, the normal process for a single dental implant restoration could extend to between 3-6 months, which wasn't an option for me.

Then a friend of mine, who was working with a couple of specialists in south Florida, Drs. Anthony G. Sclar and Juan D. Cardenas, told me that they were experts in a procedure that might be just the thing for me. She said that it was called the All-on-4® treatment concept.

### First impressions

I couldn't help but be a bit skeptical at first. Could I really have a full set of teeth again that would look just like my real teeth—maybe better—and be able to smile without hesitation? As I learned more about the All-on-4® treatment concept, however, I became convinced: This was absolutely the perfect solution for me. I really did not want to wear dentures at my age. As it turned out, I wouldn't have to.

→ continued on page 3.



## Understanding the Biology and Mechanics of Immediate Placement

Beginning an exclusive three-part series

There is hard science behind the immediate placement and loading of implants.

By Frederic Love

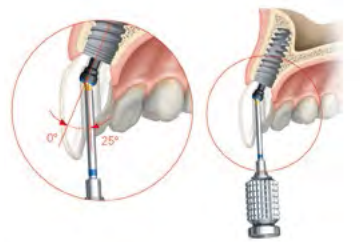
Dr. Jill A. Helms is a professor in the Department of Surgery at Stanford University. She carries out research in the field of regenerative medicine, collaborating with experts

in bioengineering, materials science, physics, and with colleagues in the life sciences.

On these pages, in the year ahead, she will be explaining why immediately placed implants routinely succeed. She will report on what we know about the biological and mechanical environments surrounding the implant and discuss innovative approaches to overcome challenging obstacles. Start reading on page 12! <

### In this Issue

- 2** Tips and Techniques:  
The synthesis of esthetics, health and structural stability – the advantages of using the Angulated Screw Channel (ASC) abutment system



- 9** Free Online Course:  
A new approach to All-on-4® treatment concept training has been developed for every category of dental professional.



- 10** And an e-book too!  
How to make the most of the All-on-4® treatment concept.



- 11** Dr. Kenji W. Higuchi:  
A behind-the-scenes look at the origin and development of what may be the next big thing in implant dentistry.



## From the President



Hans Geiselhöringer, President of Nobel Biocare and Dental Imaging

When Prof. Paulo Malo and Nobel Biocare teamed up to pioneer the All-on-4® treatment concept in 2000, its efficacy was assailed by many. Now, with more than 12 years of scientific validation and hundreds of thousands of patients treated, the early-adopters who trusted in the solution are continuing to participate in a revolution in patient care.

There are now 34 clinical studies on the All-on-4® treatment concept featuring >2400 patients and >9250 Nobel Biocare implants. Make no mistake, imitations may abound, but they completely lack this level of scientific evidence.

Today, those who were our most vocal detractors are now trying to catch up—but it's too late. The next generation of the All-on-4® treatment concept is already here.

With specially designed implants and restorative components, we are taking an already efficient workflow to the next level to shorten prosthetic protocols and procedures significantly—saving up to an hour of chair time.

With an estimated 3.6 billion people with missing teeth worldwide, All-on-4® can help—and so can you.

Read more about how you can get involved with All-on-4® on the following pages. The potential to improve quality of life is great, and so is Nobel Biocare's focus on putting you in the position to succeed. <



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# The Synthesis of Esthetics, Health and Structural Stability

The advantages of using the Angulated Screw Channel (ASC) abutment system

An honored lecturer on the international dental meeting circuit, Dr. Chandur Wadhvani is a prosthodontist in private practice in Bellevue, Washington, USA. An adjunct assistant professor at Loma Linda University's School of Dentistry, he is also affiliate faculty at the University of Washington School of Dentistry in Seattle. He has written the first evidence-based textbook dedicated solely to implant cementation and frequently contributes to *Nobel Biocare News* with tips and techniques.

By Dr. Chandur Wadhvani

There are many reasons why the cement-retained implant restoration gained popularity over the last few years, which can be attributed to esthetics, ease of use and familiarity with cementation techniques. However, Pauletto, Gapski (see references) and others reported that cement excess was problematic; then Wilson's study established a positive relationship between excess residual cement and peri-implant disease.

Surveys on cements used for implant restorations indicated a diversity in material selection, application technique and volume. This suggested a lack of conformity and understanding of cement usage within the dental profession. To overcome the cement problem, it became evident that improved understanding was required for cement material selection, abutment design and the determination of cement margin depths. Even with the very best intentions, however, the residual excess cement can lead to disease affecting the health of the implant/tissue interface and remains a dominant risk factor.



**Figure 1.** Failed, removed implant, cement extrusion is noted on multiple threads.



**Fig. 2.** (A) The anterior teeth present a challenge to the screw-retained restoration unless an Angulated Screw Channel (ASC) abutment is used. (B) In cases where the surgical placement is less than ideal, the ASC may help limit further compromise to the site.

The association of residual excess cement and peri-implant disease has resulted in the need to re-examine alternatives such as the screw-retained implant crown. For many implant systems, the ability to use a screw-retained implant restoration is limited to regions where the screw access channel emerges in an esthetically "safe" site.

Usually the anterior maxilla and mandible present the greatest challenges, as the long axis of the implant often

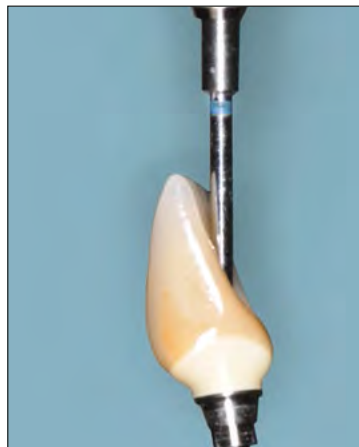
## T&T

### Tips and Techniques

projects through the proposed incisal edge or even facial to the final restoration. (Fig. 2A.) Occasionally, when the surgeon places the implant in a compromised site—or the implant is inappropriately placed—the traditional screw-retained implant restoration may seem to provide more of a challenge than a solution (Fig. 2B).

### ASC saves the day

An innovative solution to the off-axial implant is the Angulated Screw Channel (ASC) abutment system developed by Nobel Biocare (Fig. 3). With the ability to alter the screw channel up to 25 degrees it eliminates the need for cementation in the vast majority of cases like these.



**Figure 3.** The ASC shows the angle redirection of the screw access channel.



**Fig. 4.** (A) Even with shallow margins and minimal cement, the elimination of cement extrusion still presents a clinical challenge (B).

The ASC provides for an active synthesis of health, esthetics, and excellent structural and mechanical abutment joint stability.

### Health:

With use of the ASC abutment system, cement extrusion into the fragile peri-implant soft tissues is eliminated. The ASC puts an end to the insult of cement fluid pressure and unset chemicals from the cement material.

It also gets rid of the potential for foreign bodies being pushed around the implant site, which can jeopardize implant health (Fig. 4). In addition, the use of zirconia abutment superstructures in combination with titanium bases provides optimized materials for biocompatibility and health.

### Esthetics:

With the ASC, the screw access channel can be projected away from high-esthetic-risk areas and placed appropriately at a variety of different angulations. CAD/CAM design enables the restorations to be efficiently designed and quickly manufactured at Nobel Biocare's production facilities (Fig. 5). Milled zirconia is highly esthetic, thus especially useful at the soft tissue emergence site.

### Mechanical Stability:

CAD/CAM utilization (Fig. 6 A–C) allows for optimized screw access site planning, and the machining of components provides a precise, dedicated connection, optimized for the implant-abutment joint. As with all implant-to-abutment connections,



**Fig. 5.** The Nobel Biocare CAD/CAM software allows ideal screw access site to be planned, then machine fabricated.



the optimized passive fit results when these surfaces are in intimate contact and forces distributed universally. Casting abutments cannot always provide even connection joint contact, as they are often inadvertently damaged through cleaning and polishing which alters the consequent fit (Fig. 7). When this occurs, the joint connection may fail, with screw loosening or even failure of the implants as a result.

continued on page 3.



**Fig. 6.** (A) The screw access from Fig. 2A has been redirected using the ASC abutment and crown (B), producing a pleasing natural appearance thanks to a screw-retained implant restoration (C).



## Science matters

### 10+ years and counting

**Excellent biological and technical long-term outcomes for zirconia abutments.** (Ekfeldt et al., *Clinical Oral Implants Research*. 2016 Sep; doi: 10.1111/clr.12975)

This retrospective study confirms the technical and biological excellence of zirconia abutments for single-implant restorations over more than 10 years of function. It investigated the clinical outcomes of 30 NobelProcera customized zirconia abutments in 23 patients, with a minimum of 10 years' follow-up. Restorations were either one-piece with veneering porcelain baked directly onto the screw-retained zirconia abutment (n=16) or a cemented alumina crown (n=14). No fracture and only clinically insignificant chipping was observed.

Peri-implant mucosa covered the crown-abutment connection around all but four restorations. The peri-implant bone level after 10 years showed only minor changes from placement ( $-0.26\text{mm} \pm 0.6$ ). Patients and dentists alike were extremely satisfied with the esthetics (significantly correlated) and function of the single-implant restorations.

→ [www.ncbi.nlm.nih.gov/pubmed/27663724](http://www.ncbi.nlm.nih.gov/pubmed/27663724)

### Superior micro-stability

**NobelProcera shows a reduced implant-abutment micro-motion.** (Karl and Taylor, *Int J Oral Maxillofac implants*. 2016 Aug; doi: 10.11607/jomi.5116.)

Large micromotion at the abutment-implant interface increases the risk of screw loosening and joint instability, and can potentially alter the size of the microgap. This study showed significantly lower mean micromotion for NobelProcera CAD/CAM titanium implant abutment assembly prior to cyclic loading compared with all other tested products ( $p \leq 0.001$ ) in-vitro.

Furthermore, mean micromotion for NobelProcera abutments was not significantly altered ( $p=0.463$ ) by cyclic loading (100,000 cycles; 100 N) indicating a low settling effect. In this regard, NobelProcera performed better than Straumann CAD/CAM Zirconia and Dr. Ihde Dental implant-abutment assemblies, both of which had significantly reduced micro-motion after cyclic loading ( $p < 0.05$ ).

The authors suggest high-quality abutments like NobelProcera remain close to their position at insertion and thus provide a higher stability and lower risk of screw loosening compared with the other products.

→ [www.ncbi.nlm.nih.gov/pubmed/27525518](http://www.ncbi.nlm.nih.gov/pubmed/27525518)

### Bone gain with creos xenoprotect

**Head-to-head comparison of bone-gain dynamics with creos xenoprotect and Bio-Gide in dehiscence defects.** (Wessing et al., 2016 Sep; EAO Paris)

This ongoing prospective, multi-center RCT compares the clinical performance of creos xenoprotect (CXP) and Bio-Gide (Geistlich) collagen membranes for the treatment of dehiscence defects. Both membranes facilitated bone growth during the six months of healing. Defect height at re-entry reduced by 81% for creos xenoprotect and 62% for Bio-Gide. The maximum membrane exposure rate observed at week three was 8.7% with creos xenoprotect compared with 16.7% with Bio-Gide. Although differences between the two brands were not significant, creos xenoprotect showed a trend toward higher bone gain and a lower membrane exposure rate. Clinical results with creos xenoprotect to support implant placement in dehiscence defects were not inferior to the standard Bio-Gide. Studies with larger sample sizes may validate that the previously reported superior in-vivo results of creos xenoprotect (Bozkurt et al. 2014, Dahlin et al. 2015) are clinically relevant.

→ [www.dentalcongressposters.com/eao2016/wessing.pdf](http://www.dentalcongressposters.com/eao2016/wessing.pdf)

## "Truly, the best decision I have ever made!"

The one and only All-on-4® treatment concept



continued from page 1.

A plan was laid out and explained to me, we scheduled the surgery, and after the procedure was carried out as planned, I left the clinic with new teeth in place the very same day. Although having a full set of teeth in my mouth in just one day was extraordinary, for me, the best of all was the recovery.

### More than a pleasant surprise

When I saw my smile for the first time, I was in a state of shock. A few moments went by, and then the tears started rolling down my cheeks as I remembered what life used to be like.

I used to smile without thinking about it, engage in conversation spontaneously, and generally feel poised and self-assured. I had regained my smile, but more importantly, I knew that I was about to reclaim my confidence.

Talk about quality of life! Without question, the All-on-4® treatment concept has transformed my daily life for the better. I find myself getting up and getting dressed earlier because I enjoy being more presentable. I no longer feel awkward in certain situations; thanks to the implants, I'm avoiding fur-

ther bone loss; and I can eat and enjoy foods that I missed when my dental health was in decline.

To anyone considering dentures today, my advice is: "Don't even think about it! Call your local specialist for a professional consultation about the All-on-4® treatment concept instead."

From my experience, there is nothing to be anxious about, and it

will change your life. Aside from becoming the mother of my two boys, my new teeth are the best gift I have ever received. <

→ More to explore!

To register for online training now, or to download the e-book, please visit: [nobelbiocare.com/all-on-4course](http://nobelbiocare.com/all-on-4course).



**The All-on-4® treatment concept** has the potential to dramatically transform an edentulous patient's quality of life. Deborah Concepcion says that as nice as it was to regain her smile, it was even better to regain her self-confidence.

## The Synthesis of Esthetics, Health and Structural Stability



continued from page 2.

### Structural components

Titanium alloy abutment bases provide the most accurate fit with machining tolerances readily controlled. Abrasive wear, i.e., the release of titanium metal into the peri-implant tissues from the inside of the implant, is not an issue.

The zirconia abutment, with its well-designed circumferential wall strength, is held through the abutment screw, optimizing the ceramic's ability to withstand forces that have been seen to fracture non-titanium base abutments.

### Conclusion:

The benefits of the ASC abutment system are numerous, reflecting a multiple symbiosis of engineering ingenuity and biocompatible materials, and allowing for the combination of good esthetics and excellent health.

The author wishes to acknowledge and personally thank the following dental laboratories for their assistance with this material: Avots Dental laboratory, Nakanishi dental laboratory and Myron Choi. <

→ More to explore!

For the complete references to his article please visit: [nobelbiocare.com/news](http://nobelbiocare.com/news)



**Figure 7.** An actual case: Note cast abutment has been damaged through routine laboratory procedures.



# The Peri-implant Junctional Epithelium

A remarkable tissue that defends the implant/tissue interface from foreign invaders

Next to the success of osseointegration, the long-term survival of oral implants depends on defending the strategically important interface between the sulcus, populated with bacteria, and the underlying tissues. New insights about the *de novo* formation of the junctional epithelium and the attachment of its cells on the abutment reveal that there is still room to improve the barrier seal towards the oral cavity, thereby improving long-term success.

By Dr. Peter Schüpbach

Coronally, close to the sulcus, the junctional epithelium (JE) is 15 to 30 cell layers wide and narrows towards the apical part of the tissue. The coronal two thirds of the JE is composed of two strata, the basal layer facing the connective tissue and the suprabasal layer facing the implant surface.

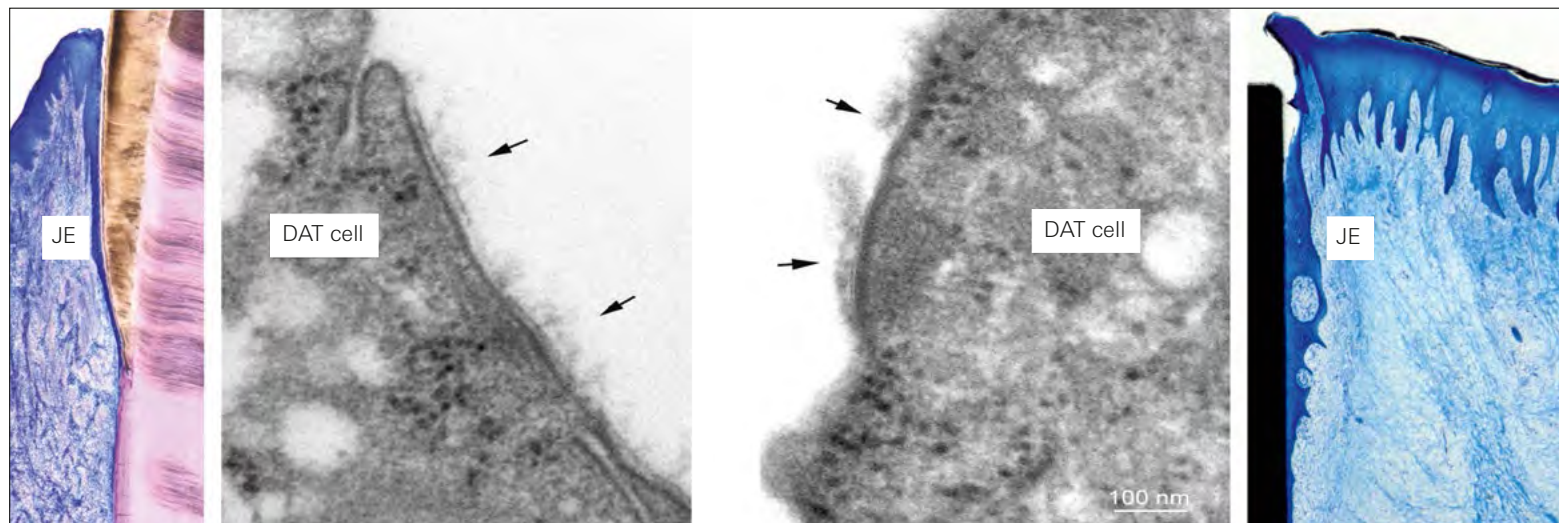
The cells of the basal layer exhibit a cuboidal shape and form towards the connective tissue a basal lamina with desmosomes. The innermost suprabasal cells facing the implant or abutment surface are flat cells, oriented parallel to the surface. They are also called DAT cells (Directly Attached Cells). The apical one third of the JE is composed of only two-cell layers and ends at its apical termination in a one-cell layer of DAT cells.

Human studies have demonstrated that the structure and function of the JE surrounding implants correspond in many ways to that around natural teeth (Lilienberg et al, 1996; Bosshardt and Lang, 2005; Schüpbach and Glauser, 2007).

## Epithelial attachment apparatus

It is commonly accepted that the sealing interface between the tooth and the junctional epithelium is formed by the epithelial attachment apparatus, which consists of a basal membrane and hemidesmosomes (2003; Bosshardt and Lang, 2005; Schüpbach and Glauser, 2007).

However, a minipig study comparing the peri-implant tissues around titanium and zirconia abutments (Schüpbach et al, in prepara-



**Figure 1.** Human studies have demonstrated that the structure and function of the junctional epithelium (JE) surrounding implants correspond in many ways to that around natural teeth. Directly attached cells (DAT) revealed the presence of a basal membrane and hemidesmosomes but only in the apical third of the junctional epithelium.

tion) revealed that only DAT cells in the apical one third of the JE showed a basal lamina with hemidesmosomes. In the coronal two-thirds, focal contacts were observed ex-

## R&D

### Research and Development

pressed as plaque-like organelles upon short, goblet-shaped cellular projections (not shown, as not yet published). This is in accordance with a study of Steflik et al (1988). They concluded that such initial contact would be followed by a more parallel arrangement of the cells to the abutment surface.

In addition, our own scanning electron microscopic evaluation of JE DAT cells attached to both titanium and zirconia, as well as PEEK surfaces, showed pseudopodia of JE cells firmly attached to the abut-

ment surface and a direct, fusion-like contact of cell projections with the substrate.

Also, it should be noted that the role of integrins and cadherins during cell migration and attachment to the surface is not yet completely understood (Larjava et al, 2011).

The adhesive strength of epithelial cells to an implant seems—next to the well-known basal membrane and hemidesmosomes—to depend on less described focal contacts, and cell-metal fusion. Further ultrastructural studies are needed in order to gain a more exact understanding of, and to find ways for improvement of, cell attachment and thus the barrier function of the JE.

## Regeneration of the JE

A new JE must be regenerated *de novo* when placing an implant in an edentulous jaw or following a flap or punch approach which completely removes the junctional epithelium.

Berglundh et al (2007) showed in

*“JE defends the implant/tissue interface from bacteriological invaders.”*

— Dr. Peter Schüpbach

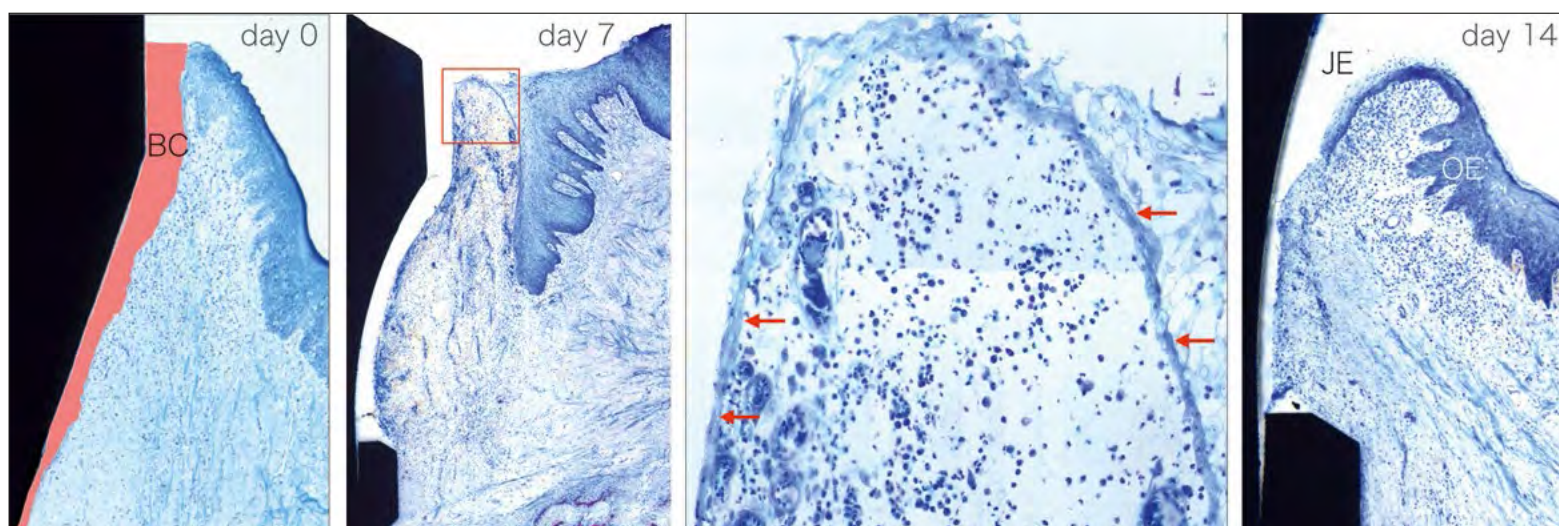
a dog study that immediately following implant placement, a coagulum occupied the implant-mucosa interface. A study of our own showed that at day 7, the blood clot was replaced by an inflammatory tissue presenting numerous neutrophils and small capillaries, in particular near the abutment surface to support the wound area with oxygen.

The wound area was bordered by a thin layer of epithelial cells. Thereby, at day 7, an initial mucosal seal against the oral cavity was formed. Around day 14, an initial short JE was evident, formed by the cell divisions of basal cells of the keratinized oral epithelium.

Cell divisions of basal cells in the newly formed short JE were leading to suprabasal cells (Fig. 2). At three

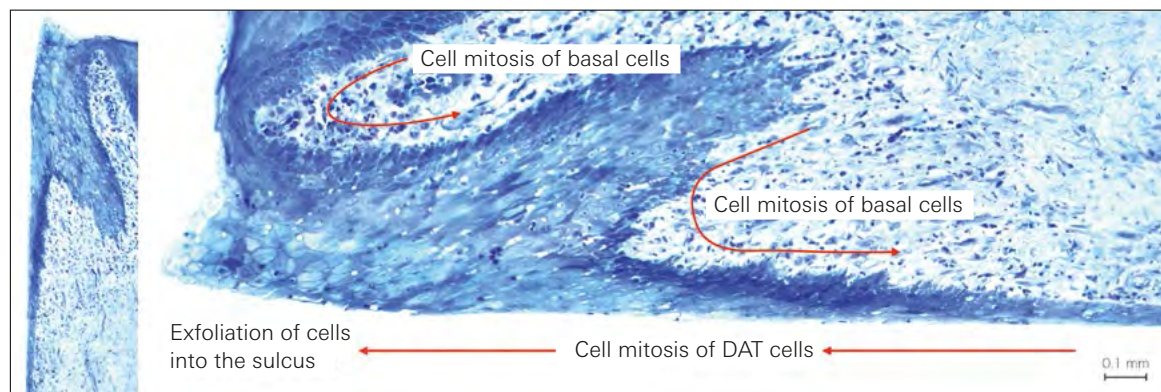
to four weeks, the JE proliferated further apically and occupied now up to 50% of the peri-implant soft tissue interface (Fig. 3). The apical proliferation of the JE around a metallic surface was completed between 6 and 8 weeks. This was confirmed by a human study conducted by Tommasi et al (2013). This is in contrast to the regeneration of a JE following gingivectomy, which was completed following 21 days (Sculean et al, 2014). It is important to be aware that the formation and maturation of the barrier function around transmucosal implants requires 6-8 weeks of healing.

Flap surgery often results in small clefts between tissue and the implant or abutment. This also may contribute to a delay in healing. Based on

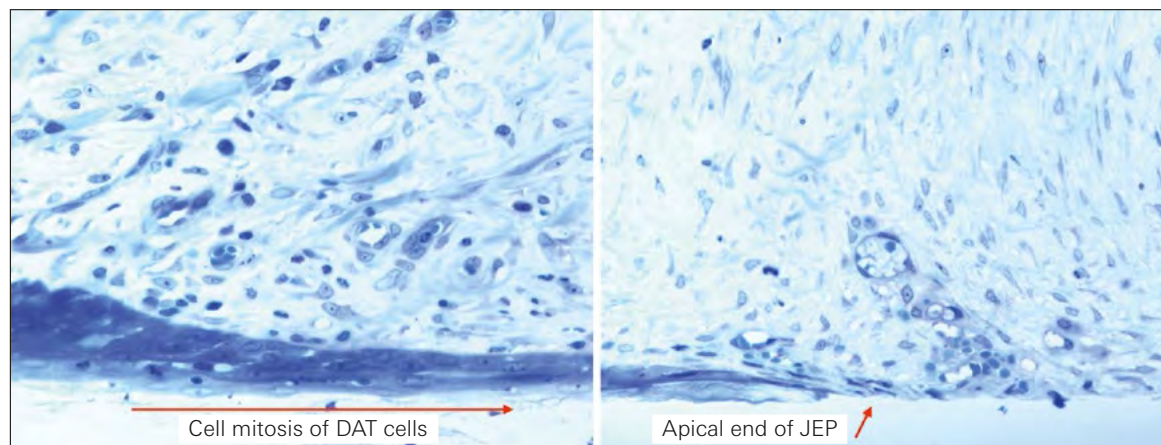


**Figure 2.** Following implant installation, a blood coagulum (modified image at the left) occupied the implant-mucosa interface. At day 7, the blood clot was replaced by an inflammatory tissue with neutrophils and capillaries. The wound area was bordered by a thin layer of epithelial cells (red arrows). Around day 14, a short JE was evident formed by cell divisions of basal cells of the keratinized oral epithelium.

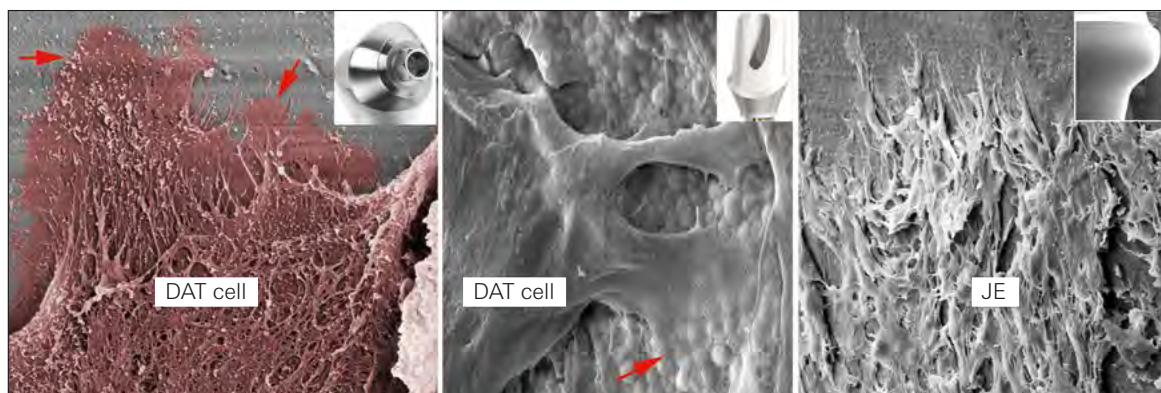




**Figure 3.** The JE is a highly dynamic tissue in terms of the cell divisions of the basal cells leading to the apical proliferation of the epithelium. As directly attached cells (DAT cells) are also capable of mitosis, a funneling effect towards the sulcus was evident, resulting in the exfoliation of cells into the sulcus.



**Figure 4.** The apical one-third of the JE is composed of only two cell layers and ends at its apical termination in a single-cell layer of DAT cells. In contrast to the situation around natural teeth—where the apical migration is stopped by the Sharpey's collagen fibers of the connective tissue—the mechanism that stops the further apical proliferation of the JE around implants remains unknown.



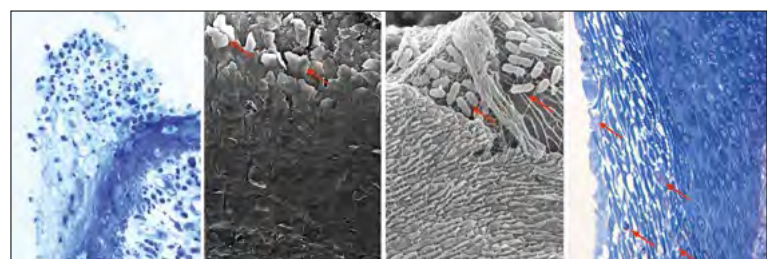
**Figure 5.** Scanning electron microscope (SEM) micrographs of attached DAT cells adhering to both titanium (left), zirconia (middle), and PEEK healing abutments (right), showed fusion-metal contacts of DAT cells with the substrates (red arrows) and also depicted the presence of thin pseudopodia attached to the substrate, which indicates that in addition to the well-described epithelial cell attachment by hemidesmosomes, other—not yet well-determined—mechanisms could be involved in cell attachment.

limited available data, the flapless approach revealed increased vascularity, and resulted in less inflammation and early re-epithelialization, provided that the diameter of the soft tissue punch was smaller than that of the implant.

### Dynamic aspects of the JE

The turnover rate of the JE cells is exceptionally rapid. In nonhuman primates it is about five days, approximate-

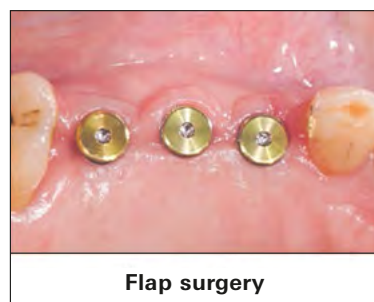
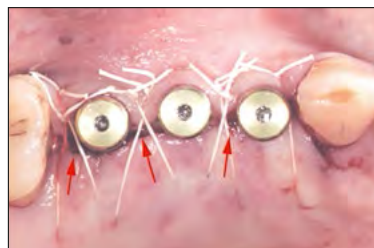
ly twice the rate of the oral gingival epithelium (Skougaard MR, 1970). While cell mitosis occurs in both basal and suprabasal cells, the exfoliation of cells into the oral cavity occurs at the bottom of the sulcus. Because of the rapid cell divisions and the fact that the area covered by daughter cells in the junctional epithelium is much larger than the area through which JE cells desquamate, a strong funneling effect towards the sulcus can be observed.



**Figure 6.** The exfoliation of JE cells (red arrows in second image from left) results in an effective removal of bacteria adhering to JE cells (red arrows in second image from right). In addition, a specialized feature of JE cells is to exhibit widened intercellular spaces, thereby providing a pathway for neutrophils (red arrows in the image to the right).

### Antimicrobial defense

The funneling effect described above represents the first barrier of anti-



**Figure 7.** Flap surgery often results in small clefts between soft tissue and the implant or abutment (red arrows) which may result in a delay of the healing, whereas a flapless approach tends to result in rapid healing, provided that the diameter of the punch is below that of the implant-abutment.

icrobial defense. Rapid desquamation of cells and effective removal of bacteria adhering to JE cells (Fig. 6) is an important part of the antimicrobial defense mechanisms.

The specialized feature of JE cells to exhibit widened intercellular spaces—thereby providing a pathway for neutrophils—represents a second step of antimicrobial defense. Approximately 30,000 neutrophils migrate per minute through the JE of all human teeth into the sulcus or into the potential space between an implant and an abutment (Schiött and Löe, 1970). This flow rate will increase during inflammation. In addition, active antibacterial substances are produced in the JE cells, such as defensins and lysosomal enzymes. It must be kept in mind, however, that these defense mechanisms can be overwhelmed, leading to the conversion of the JE into a pocket epithelium. The latter is regarded as an initial step in the progression from mucositis to peri-implantitis. <

→ More to explore!

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## Upcoming Events

**Meet Nobel Biocare at events around the world. These professional gatherings provide a great opportunity for catching up with the latest innovations and scientific research.**

**24th Malaysian Dental Association Scate**  
January 13–15  
Kuala Lumpur, Malaysia

**Vision 21**  
**National Association of Dental Laboratories**  
January 19–21  
Las Vegas, NV

**APP**  
January 20  
Mexico City, Mexico

**Massachusetts Dental Society**  
**Yankee Dental Congress**  
January 25–29  
Boston, MA

**AEEDC**  
7–9 February  
Dubai, UAE

**Osteology**  
17–18 February  
Barcelona, Spain

**CDS – Chicago Dental Society**  
**Midwinter Meeting**  
23–25 February  
Chicago, IL

**LMT Lab Day Chicago**  
24–25 February  
Chicago, IL

**ADI Team Congress**  
2–4 March 2017  
London, UK

**Pacific Dental Conference**  
9–11 March  
Vancouver, Canada

**AO – Academy of Osseointegration**  
**Annual Meeting**  
15–18 March  
Orlando, FL

**SIDP International Congress**  
16–18 March  
Rimini, Italy

**IDS**  
21–25 March  
Cologne, Germany

**SEPES Primavera**  
March 31–April 1  
Madrid, Spain

**ICOMS**  
March 31–April 3  
Hong Kong

**AACD**  
April 18–21  
Las Vegas, NV

**8th Scientific Meeting of Japan**  
**Academy of Digital Dentistry**  
April 22–23  
Kanagawa, Japan

**AP – Academy of Prosthodontics**  
**Annual Meeting**  
April 25–29  
Sarasota, FL

→ More to explore

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# Make the Right Choice for Your Patients

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By Jim Mack

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The color runs right through the material, so the final esthetic result remains uncompromised from beginning to end. This means that you can offer great esthetics and strength without changing your daily routine.

## Esthetics and function from a new angle

Significant risks are associated with excess cement. By choosing a screw-retained solution you can avoid these risks completely—even the adapter is mechanically retained.

With a NobelProcera Angulated Screw Channel (ASC) Abutment, you can optimize esthetics, occlusal function and instrument access by placing the screw access hole anywhere between 0° and 25°, all within a 360° radius. The pick-up function and secure hold of the innovative Omnigrip Screw-driver turns the apparently impossible into a self-evident treatment option.

## Solutions that your patients will recommend to others

Your reputation is only as good as the restorations you deliver. NobelProcera can help you build a solid reputation based on precision-engineered components such as the NobelProcera Implant Bars that open the door to the All-on-4® treatment concept.

All NobelProcera solutions can help you steer clear of risks that might lead to implant failure; and each is produced from top-quality materials, providing the esthetic results that patients are proud to recommend to friends and family alike. <

## The importance of precise fit

We approach the development of each product with advanced engineering, specialized manufacturing strategies and tooling, as well as thorough verification and validation. The result of these efforts is exceptional product quality.



NOBELPROCERA CROWNS AND BRIDGES

- Choose from full-contour or directly veneered restorations depending on the clinical need.
- Reduce the risk of porcelain chipping with CAD-designed full-contour zirconia restorations.
- Predictable: high-quality materials, straightforward procedures and precision-engineered results.
- Excellent value for money.





### NOBELPROCERA ABUTMENTS AND IMPLANT CROWNS

- Choose abutments in zirconia or titanium and full-contour zirconia implant crowns.
- Reduce risks caused by excess cement with options that are 100% cement-free.
- Benefit from restorative flexibility with the option to angulate the screw channel—no need to compromise on esthetics or occlusal function.
- Work quickly and easily with the Omnigrip screwdriver.



### NOBELPROCERA IMPLANT BRIDGES AND IMPLANT BARS

- Choose anything from cost-effective bars to high-end solutions like zirconia implant bridges.
- Restore at implant or abutment level.
- Offer premium fixed solutions that provide stability and comfort.
- Take your pick from a wide range of fixed-removable bar types for a variety of clinical situations.
- Offer precision-manufactured solutions that provide predictable results and are designed to last.



“The plant in Mahwah really impressed me. Quality assurance there is outstanding. After every step in the production process, they carry out a precision review. Rigorous accuracy is maintained at the level of a few microns. The resulting precision of the copings, abutments, bridges, and implant bars in titanium and zirconia leaves nothing to chance—which means that I feel nothing but confidence.”

**Luc Rutten**  
Master Dental Technician  
Belgium

180

Staff on-site

$$p = \frac{F_a * \cos(\rho) * \cos(\frac{\alpha}{2})}{d_m * \pi * l * \sin(\rho + \frac{\alpha}{2})}$$

### PRECISE FIT ENSURES LONG-TERM PERFORMANCE

The NobelProcera interface is designed for a precise fit between abutment and implant. Although not always visible to the naked eye, third-party components can create misfits and may result in system failure leading to clinical complications and remakes.

Formula above: Joint compression (p) depends on a number of variables such as preload (tensile force  $F_a$ ), friction angle ( $\alpha$ ) and contact length (l). Small changes in any of these parameters can lead to extreme load and stress conditions, which can cause implants to fracture.



### ESTHETICS AND FUNCTION FROM A NEW ANGLE

NobelProcera ASC (Angulated Screw Channel) Abutment.



### FULL CONTOUR, FULL STRENGTH, FULL ESTHETICS

NobelProcera solutions in high-translucency multilayered zirconia.



### PEACE OF MIND WITH EXTENSIVE WARRANTY\*

\*We offer a lifetime warranty for implants, including implants not from Nobel Biocare, when a NobelProcera or Nobel Biocare prefabricated restoration is used. In the unlikely event of material breakage or defects, NobelProcera restorations are backed by a comprehensive five-year product warranty. For details see warranty program at [nobelbiocare.com/warranty](http://nobelbiocare.com/warranty).

### MAHWAH BY THE NUMBERS



2000

NobelProcera restorations produced daily

70

Industrial milling units

60

Countries served



### FIND OUT MORE

Check out our full offering of prosthetic solutions. Scan the QR or visit: [nobelbiocare.com/nobelprocera](http://nobelbiocare.com/nobelprocera)



# Revealing the Secrets of the State-of-the-art

Two recognized authorities present premier program for learning the ins-and-outs of the All-on-4® treatment concept.

**Free e-training sees two leading All-on-4® treatment concept educators share insights based on a decade of clinical collaboration.**

**D**r. Saj Jivraj, an experienced prosthodontist, and Dr. Hooman Zarrinkelk, a board-certified maxillofacial surgeon, have been educating clinicians, and delivering full-arch rehabilitations to their patients using the All-on-4® treatment concept for more than a decade. Now, in partnership with Nobel Biocare, the two clinicians have developed a free, three-hour online training course that explains the protocol and essential principles that support this proven approach.

*Nobel Biocare News* caught up with them to find out more about the training, and how it can benefit dental professionals.

## How has the All-on-4® treatment concept impacted your practice?

**Dr. Saj Jivraj:** I finished my prosthodontic residency program in 2002, and I was well-trained in all the principles and practice of treating compromised patients with dental implants. For my patients without bone, we'd talk about bone grafting.

## Q&A

### Questions and Answers

This usually involved harvesting bone from the hip.

Today, my team and I treat 98% of the edentulous patients using graftless procedures. Obviously, this is a huge advantage for the patients. With the All-on-4® treatment concept—and zygomatic implants—we're able to provide patients with fixed, functioning teeth the same day.

**Dr. Hooman Zarrinkelk:** Bone grafting was core to my surgical education. I've seen patients from all over the world who have undergone bone grafting. I have firsthand experience of the results and the cost to the patients' lifestyle and pocket. By eliminating those things and treating patients with the All-on-4® treatment concept, I see a dramatic increase in the number of patients I treat.

It's night and day. The important thing is that the net outcome for the patient is the same, even though one approach is much more complicated

and involved, so why not do the simpler procedure? That is the paradigm shift in my thinking and approach.

## What motivated you to develop an online course for the All-on-4® treatment concept?

**Jivraj:** The reason for doing something online is to enhance education in general. Hooman and I had been running All-on-4® treatment concept hands-on courses where doctors would come in, listen to lectures and see a live surgery. Unfortunately, we were only able to reach a very small segment of the population, because of the travel involved.

The online platform allows us to have a wider reach. It allows convenience for the end user, and it's a very nice way to convey a lot of practical information quickly.

**Zarrinkelk:** As we have traveled and spoken to many clinicians, I sense there is still a tremendous amount of uncertainty and confusion when it comes to treatment planning for the terminal dentition, and the edentulous and atrophic edentulous patient.

That was certainly the case for me in the past, but I overcame this by changing the way I think and plan through a simplification of the thought process. Our primary motivation was to show the audience this simplified process and to share our experiences.

## What were your key objectives when developing this online course?

**Jivraj:** The key objectives were to try and present the subject matter in a very simple way that clinicians could relate to. Having gone through the experience ourselves, we wanted to deliver something that is practical, usable, and inspires the person watching to go to the next level.

**Zarrinkelk:** Our key objective has always been to share and educate. The online course is a perfect medium for the interested clinician to learn, at their convenience, all the things that we sometimes had to learn the hard way. The objective was to really share the key parameters that clinicians need to know and satisfy in order to successfully treat patients with the All-on-4® treatment concept.

Obviously there are variations on how you accomplish things, but we wanted to show that you can't skip or miss these key points. We're not holding anything back; we've put ev-



**There's a new way to discover the essentials of the All-on-4® treatment concept.** Learn from the experts! Nobel Biocare is now offering a new, free, web-based course. The training was developed together with online hosts Dr. Hooman Zarrinkelk (left) and Dr. Saj Jivraj (right), who have worked and taught together on All-on-4® treatment concept cases for ten years.

everything out there. If these details aren't understood or taken into account, clinicians may have difficulties when they perform their own procedures. And nobody wants that.

## Can you describe what the online course covers?

**Jivraj:** The content is step-by-step: from initial diagnosis, which is critical, to delivering the final restoration to the patient. Every step requires attention to detail, and what we tried to do in this course is provide these details, ensuring clinicians master one step before going to the next one.

**Zarrinkelk:** We designed this course to be all-encompassing. We wanted to show our approach to treating edentulous patients or those with a terminal dentition. We also wanted to simplify treatment planning for this class of patients.

The course outlines the critical elements that make the All-on-4® treatment concept work, which clinicians must follow. If they don't, they might create problems that are going to be hard to deal with. After watching this online course, clinicians will have a solid understanding of the points that they should be aware of for patient treatment.

## What can clinicians expect to gain by completing the course?

**Zarrinkelk:** In one word, "simplification." We hope that after watching this course video from start to fin-

ish, clinicians pick up some very important points that they would never get from a book or a manual. With this online program, clinicians can learn not only what the literature says about the protocol, but also all the little details that make the protocol work. Ultimately, clinicians will gain insight into our simplified approach to treating complex patient situations.

**Jivraj:** The course gives clinicians a good theoretical background in the All-on-4® treatment concept: all the necessary steps for rehabilitating a patient. Once again it's theoretical information. People watching this course should seek out hands-on experiences before implementing the concept in their practice.

## What obstacles can this course help clinicians to avoid?

**Jivraj:** The online course will educate clinicians to identify the patients that they can diagnose, plan, and treat using the All-on-4® treatment concept. The diagnosis must be "spot on" for this procedure to be successful.

**Zarrinkelk:** We really want this to be an essential tool for the entire team. We want them to see beyond the obstacles of treatment planning and execution. They should see that by changing their thinking process, as we did, they can also overcome the obstacles and treat more patients.

We simplify the approach and walk them through the complete

procedure, from start to finish, giving them those key points to avoid problems. There's always going to be variations in patient anatomy and medical conditions that the team will have to deal with, there isn't a book that covers everyone.

## Why is the All-on-4® treatment concept needed in modern clinical practices?

**Jivraj:** My feeling is that the All-on-4® treatment concept will become more and more commonplace, because it's a great way to treat patients in the simplest way possible, with the fewest implants possible, providing a long-lasting, high-quality end result.

**Zarrinkelk:** There's an increasing demand for it. We have a lot more patients that are living longer and they don't want to live with dentures. It's an important concept because it helps many patients that were previously considered untreatable or refused treatment because of the complexity of traditional approaches for the treatment of edentulous, atrophic or terminal dentition patient classifications.

## Why is collaboration between the entire treatment team critical when working with the All-on-4® treatment concept?

**Zarrinkelk:** The way I look at it, it's really difficult to be good at everything involved in the treatment of these patients. That doesn't mean





# Free Online Course

Expert education, no travel required!

**For those who are looking to learn more about the evidence-based All-on-4® treatment concept, a new free online course offers a way to build knowledge that's essential for a successful start with this proven protocol.**

By Michael Stuart

The All-on-4® treatment concept has been around for nearly two decades. In that time, it has been used to treat hundreds of thousands of edentulous and soon-to-be edentulous patients. It offers unique advantages over traditional treatment options for both patient and clinician and is backed by 34 clinical studies published in peer-reviewed journals featuring over 2400 patients.

The new All-on-4® treatment concept online training from Nobel Biocare has been developed for surgeons and restorative dentists alike, as well as general practitioners looking to develop their understanding of this established concept.

The perfect complement to hands-on and classroom training, the free



three-hour online course introduces the concept and covers the key considerations, from diagnostics to planning, implementation and follow-up. Given the variety of topics covered, the content is relevant for anyone involved in the treatment process.

The training has been developed with Dr. Saj Jivraj, a leading prosthodontist, and Dr. Hooman Zarrinkelk, an experienced, board-certified oral and maxillofacial surgeon, who host the videos that make up the course. As colleagues in California, US, the two experts have been successfully treating patients with the All-on-4® treatment concept for ten years, and are experienced educators in the required techniques.

## A comprehensive overview

While the course is not intended to be a substitute for face-to-face learning, it still provides a comprehensive overview of the key steps within the All-on-4® treatment concept protocol.

The course begins with an introduction to the concept and its principles as well as the biomechanics and science behind its efficacy. The introduction also includes a presentation by Dr. Malo, the inventor of the concept, on its evolution. From there, participants are walked through seven key diagnostic factors and key considerations for selection of the prosthetic solution.

Recommendations for the preoperative prosthetic, surgical and postoperative workflows are presented before critical restorative and surgical issues to take into account are reviewed. The

course concludes with a section on the successful implementation of the All-on-4® treatment concept in the dental practice, with advice on patient communication and practice marketing.

In addition, course attendees can access modules on graftless solutions for severe bone resorption, possible complications when utilizing graftless approaches and guided surgery for the All-on-4® treatment concept.

## Life-changing results

For Dr. Jivraj, the advantages for the patient are what make developing proficiency in the All-on-4® treatment concept a rewarding achievement for implantologists. "Patients have the option to receive fixed temporary teeth the same day," he explains. "It truly is a life-changer for many out there and gives the clinician great satisfaction."

This is echoed by co-trainer Dr. Zarrinkelk, who recommends learning the All-on-4® treatment concept for its impact on a clinician's day-to-day work. According to Zarrinkelk, "Obtaining the knowledge and skills to perform the All-on-4® treatment concept will transform your practice by removing the typical obstacles patients face when considering full-mouth rehabilitation."

On successfully completing the online course, participants will earn three CE credits and receive a certificate from Nobel Biocare. <

→ More to explore!

To register for the training now, or for more information, please visit: [nobelbiocare.com/all-on-4course](http://nobelbiocare.com/all-on-4course).

continued from the previous page.

→ there are not those that can do it all, but for the typical clinician it may be difficult to achieve competence in all aspects.

This is a clinically demanding procedure. It is simple in the sense that patients are treated quickly and simply, but it's a very demanding procedure both in the prosthetic and surgical phases. Our goal should always be to provide the patient with the best possible outcome our individual skill set offers—whatever that may be—and involving a team is the best way to do that in my opinion.

**Jivraj:** Teamwork is crucial: the patient must receive the best of everyone's skills in order to complete the treatment efficiently, predictably and

quickly. Surgeons do surgery best. Prosthodontists and restorative dentists are trained at providing esthetic, functional teeth. My recommendation to the novice is to assemble a very strong team that includes a surgeon, a prosthodontist or restorative dentist and a very capable laboratory technician.

## What advice do you have for clinicians just starting out with the All-on-4® treatment concept?

**Jivraj:** My single piece of advice is they get adequately trained. This is not a single tooth, it's a full mouth. Patient expectations, as well as fears, are high.

Having adequately trained individuals, in my opinion, is key to the success of the procedure. They have to seek out the appropriate learning

pathway. When they do, they'll have happier patients.

**Zarrinkelk:** My biggest piece of advice is they have to get it into their minds that this is a three-dimensional concept, not just four implants placed next to each other. Details and fine points must be known that can be easily missed, ruining the whole process if not followed.

They should read as much as they can. And practice as much as they can with people who have done it, learning all the little details and tricks. <

→ More to explore!

To register for the training now, or to download the e-book, please visit: [nobelbiocare.com/all-on-4course](http://nobelbiocare.com/all-on-4course).

# Moving Forward

## More than 15,000 dental professionals now on FOR.org



After its three-year anniversary during the Nobel Biocare Global Symposium in New York City last June, the Foundation for Oral Rehabilitation (FOR) is pleased to announce that it has reached another key milestone: the FOR community now consists of 15,000 users worldwide.

According to Ursula Stocker, FOR's Executive Director, "Both the encouraging feedback and engagement from our users and the advice and relevant content provided by our Expert Faculty have been key in helping FOR become the educational and treatment support provider of choice it is today. It has been a joint effort, and we are thankful for everyone who has supported us along the way."

Not yet part of the FOR community? Sign up to benefit from a free subscription to the full content:

→ [www.for.org/en/user/sign-up](http://www.for.org/en/user/sign-up)

## FOR launches new treatment guidelines for single missing teeth

Following up on their 2015 Consensus Conference on the rehabilitation of single missing teeth, FOR has recently launched its second set of treatment guidelines, this time focusing on implant-based rehabilitation of the single edentulous space. Comprised of 118 articles and authored by 30 world-renowned experts, the guidelines offer comprehensive, science-based recommendations for all phases of treatment. These are especially relevant to clinicians looking to begin with implant dentistry.

Through these treatment guidelines, FOR reinforces its commitment to support practicing clinicians worldwide who wish to offer cutting-edge, thoroughly researched treatment options to their patients.

The treatment guidelines can be accessed free of charge at:

→ [www.for.org/en/treat/treatment-guidelines/single-tooth](http://www.for.org/en/treat/treatment-guidelines/single-tooth)

## Choose from over 250 video lectures on FOR.org

Since FOR's inception in 2013, its video gallery has become one of the most frequently visited pages on FOR.org. Both the diversity of topics covered and the possibility of accessing video lectures from world-renowned experts anytime, anywhere, are highly valued by FOR users. From soft tissue management and esthetic rehabilitations to single tooth replacement and zygomatic implants, the video gallery offers educational material for all levels of experience and every member of the dental team.

Following the success of the Nobel Biocare Global Symposium last June, FOR is uploading new videos each month from the general sessions at the event, making them available to clinicians around the world who could not attend the symposium.

You can access the FOR video gallery of the scientific knowledge presented during the Nobel Biocare Global Symposium 2016 in New York at the following URL:

→ [www.for.org/en/learn/videos](http://www.for.org/en/learn/videos)



# "A step forward for the zygomatic approach"

Reduced treatment times and costs increase treatment acceptance.

Working and living in Alicante, Spain, Dr. Rubén Davó is a trailblazer in the field of zygomatic implant treatment. Here, he tells *Nobel Biocare News* about the evolution of this advanced approach, its advantages and his experiences with the new NobelZygoma implant.

By Michael Stuart

For Dr. Rubén Davó, routine patient care encompasses dento-facial deformities, guided surgery, and the rehabilitation of patients with atrophied bones and quality-of-life issues. He is a member of the faculty at the Barcelona University Hospital, lectures worldwide, and provides international educational courses and programs at *Instituto Davó*.

**Michael Stuart:** Dr. Davó, you have been involved with zygomatic implant surgery from the very beginning. How did this approach first develop?

**Dr. Rubén Davó:** I started implementing a zygomatic approach back in 1999, working together with Professors P-I Brånemark and Chantal Malevez. At that time, we didn't have a predictable solution for the severely atrophic maxilla, and we were confident zygomatic implants could be the answer. The results we saw were outstanding from the start.

Five years later I began combining zygomatic implant placement with Immediate Function. This was actually the focus of my PhD dissertation, which was one of the first publications in the world on Immediate Function with zygomatic implants. A couple of years later, we started with the quad zygoma concept using four zygomatic implants, this time utilizing Immediate Function from the beginning.

**Stuart:** What are the main patient benefits associated with zygomatic implant treatment?

**Davó:** For the patient, the benefits are enormous. Previously, for patients with severe maxillary resorption, grafting was unavoidable. The zygomatic approach, which rarely includes grafting, can reduce treatment times and costs, which in turn can increase treatment acceptance. After zygomatic treatment the improvement in quality of life is dramatic.



**Dr. Rubén Davó's PhD dissertation** was entitled, "Immediate function in atrophic maxilla using zygomatic implants." Since then he has become a internationally renowned expert on the subject.

Before the treatment, these patients are orally handicapped, which can lead to a lot of psychological, social and functional problems. In my experience, after the treatment, quality of life can return to normal. It's remarkable.

**Stuart:** Nobel Biocare is building on 25 years of success in zygomatic implants with the introduction of the NobelZygoma implants. What have your experiences been with these new options?

**Davó:** I have already performed many cases with the NobelZygoma implant and completed them with a high success rate. I think it is a very good implant as it offers more opportunities to adapt the position of the zygomatic implant to the different anatomies we see in our daily practice, and thus to the needs of the patient.

With the surface of the implant, I now have threads just where I need them. I have been finding that it is beneficial to have parts of the implant surface that are unthreaded. I also feel that you have a little more stability with the new tapered apex.

In a study my team and I presented as a poster at the 2016 EAO Congress in Paris, we followed thirteen patients who were each treated using NobelZygoma implants. Some patients required just one zygomatic implant, others up to four. In total, we assessed the clinical outcome of 33 NobelZygoma implants and the patients were followed for at least six months. During this observation period, we saw a 100% success rate,

with no implants failing and all provisional prostheses remaining stable.

Overall, I think the new NobelZygoma implants are a step forward for the zygomatic approach, offering opportunities to place the implants in different positions, and, in my opinion, to help ensure primary stability.

**Stuart:** For a clinician who is looking to begin with zygomatic implant placement, what is the best way to start with this advanced procedure?

**Davó:** It is very important to attend specialized courses. Nobel Biocare offers many such courses, I run a cadaver course with Professor Chantal Malevez, for example, but there are many more. Attending a good course is essential, even for very experienced maxillofacial surgeons.

There are many very important details to consider in order to ensure a successful outcome. You have to respect the protocol and adhere to it strictly—especially at the beginning. If you follow the protocol and use high-quality implants like NobelZygoma, you will be on course for delivering a successful treatment. <

→ More to explore!

Davó R, Syed H, Vicente G V, Pons O. Clinical outcome of 33 immediately loaded NobelZygoma 45° (new design). (2016), Implant Therapy Outcomes, Surgical Aspects. Clin. Oral Impl. Res., 27: 256. doi:10.1111/clr.254\_12958.

## In Brief

### Have a story to share?

The lives of millions of patients around the world have been changed for the better as the result of the routinely successful osseointegrated implant therapy first made possible more than fifty years ago by Professor Per-Ingvar Brånemark and his team in Sweden. These patients' individual stories about increased quality of life and improved self-confidence—often shared by word of mouth between friends, family and acquaintances—make it abundantly clear why implant-based restorative dentistry has found such widespread acceptance.

The patients have spoken. Now it's your turn to convey what osseointegration has meant for your profession. The editors of *Nobel Biocare News* would like to hear from you. Let us know how solutions from Nobel Biocare have revolutionized your practice so we can spread the good news!

→ [news.editors@nobelbiocare.com](mailto:news.editors@nobelbiocare.com)

### Peri-implantitis overdiagnosed?

As Professor Tomas Albrektsson pointed out in the most recent issue of *Nobel Biocare News*, bone remodelling and bone loss occur for very different reasons. In a new *Scottish Dental Magazine* article (that provides one hour of Continuing Professional Development credit), three other authorities on the subject have weighed in on the topic.

Dr. Pierluigi Coli, Dr. Kevin Lochhead and Professor Lars Sennerby point to a clear risk of overdiagnosis of disease (i.e., peri-implantitis) when using traditional periodontal diagnostic techniques in conjunction with dental implants. They suggest that "using periodontal indices to monitor dental implant health may not only be unnecessary but in many circumstances may result in patients receiving treatment that they don't need."

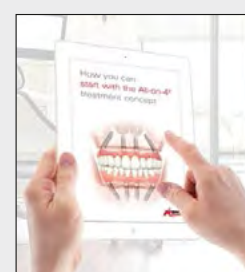
The authors clearly demonstrate that, from a morphological point of view, the tooth and the implant represent two different entities, which cannot be directly compared. The former is the result of millions of years of evolution and is built-up by highly differentiated and specialized tissues. The latter is osseointegrated into the bone as the result of a foreign body reaction, which results in soft and bone tissue interfaces consisting of lowly differentiated scar tissues. Read more and take the CPD-accredited quiz in the Nov/Dec issue of the *Scottish Dental Magazine*.

→ [www.sdmag.co.uk/issue-pdfs/](http://www.sdmag.co.uk/issue-pdfs/)

### Download your free e-book today!

Would you like to feature the All-on-4® treatment concept as an appealing alternative for your patients? Nobel Biocare is now offering an e-book that will help you get started!

This e-book will help you to identify eligible patients and provide you with treatment planning strategies too. It also covers common challenges—



and how to avoid them—and includes tips and techniques from experts illustrated by real-life clinical cases.

The All-on-4® treatment concept is a cost-efficient, graftless solution that provides patients with a fixed full-arch prosthesis—based on two straight anterior implants and two implants tilted up to 45° in the posterior—on the day of surgery. For patients meeting the criteria for the immediate loading of

implants, this well-proven concept provides Immediate Function via a fixed provisional bridge. Start with this e-book, then follow-up with an online course! (See pages 8-9.) To order directly:

→ [info.nobelbiocare.com/int/en/all-on-4-ebook](http://info.nobelbiocare.com/int/en/all-on-4-ebook)



# The Trefoil Concept: Genesis of a Project

A look behind the scenes at the origin and development of what may be the next big thing in implant dentistry

**Dr. Kenji W. Higuchi is a Diplomate of the American Board of Oral and Maxillofacial Surgery. He is widely respected in academic circles and recognized as an early pioneer in the field of osseointegration. Dr. Higuchi has authored or co-authored 36 publications in the implant literature and has lectured internationally for the past 30 years. He holds Fellowships in the American Association of Oral and Maxillofacial Surgeons, the American and International Colleges of Dentists, and the Academy of Oral-Facial Rehabilitation. He is also the driving force behind the highly anticipated Trefoil concept.**

By Dr. Kenji W. Higuchi

At the recent Nobel Biocare Global Symposium in New York, the Trefoil concept was introduced to an international audience. This treatment approach offers the possibility of same-day rehabilitation of the edentulous mandible or a failing dentition in the lower jaw with a definitive implant supported prosthesis. The use of an innovative compensation mechanism incorporated into a prefabricated framework, which allows adjustment to a precision fit on three implants, makes the Trefoil concept unique.

## To help fellow human beings

I was fortunate to have experienced a long and close relationship with Professor Per-Ingvar Brånemark. Since

attending the first international training course in August 1982, I had the privilege of collaborating with P-I for over 32 years.

On the occasion of his 70th birthday in Gothenburg, he made the following observation: “The concept of osseointegration has developed into as much a philosophy as a technique for rehabilitation.” (P-I Brånemark, May 3, 1999.)

## R&D

### Research and Development

Over several decades I observed P-I and Barbro Brånemark travel the globe in order to provide care to hundreds of patients suffering from acquired or congenital cranio-maxillofacial defects, something they did without direct financial compensation.

Their humanitarian motivation was inspired by a compassion “to help fellow beings.” From the beginning, Brånemark exhibited an empathetic sensitivity for the edentulous patient, whom he considered comparable to an amputee.

Brånemark recognized the high global incidence of edentulism and the universal problem of affordability for implant rehabilitation. In 1999, as a potential solution for this predicament—as well as an expression of the philosophy of osseointegration—he introduced Novum, which was the forerunner and progenitor of the Trefoil concept.

Initially Brånemark referred to Novum as the “China Bridge” imag-

ining the large number of patients throughout the world who could benefit if costs and duration of treatment were reduced. Novum was a pioneering landmark using immediate loading of implants combined with analog-guided surgery.

Favorable short-term results of implant and prosthesis survival rates were reported by multiple centers; however a concerning incidence of post-surgical prosthetic complications was also documented. These restorative problems, coupled with the unforgiving nature of the surgery, resulted in a decision by Nobel Biocare to discontinue Novum in 2007.

## Early thoughts on Misfit

Professor Brånemark emphasized the absolute need for precision in the Novum system. Guided implant placement is associated with varying degrees of implant misalignment, which interfered with the effective use of prefabricated frameworks in the past.

Based upon positive clinical results with over 70 patients treated using the Novum procedure in my private practice and similar experiences from other surgeons—including Dr. Ruben Rosenberg in Santiago, Chile—it became clear that the unforgiving surgical requirements of Novum and the high incidence of post-surgical restorative problems being reported were often related to misfit between the prefabricated framework and the three misaligned implants.

The dental implant literature documents that screw loosening and screw and framework fracture occur at a higher rate as a consequence of misfit. It was my belief that if a standardized mass-produced adjustable framework could be devised in conjunction with updated component design changes, the goal of providing more affordable full-arch implant-supported treatment could be realized.

## The Trefoil concept: collaborative innovation

Over a four-year period, 2012-2016, the Trefoil team implemented an intense process of collaborative innovation, which included multiple engineers and clinical specialists. The Trefoil team focused on rectifying the deficiencies of Novum using engineering and clinical technology not available in the mid-1990s.

By the early spring of 2015, the present Trefoil framework with three internal compensation mechanisms was developed and tested over a peri-



One of Per-Ingvar Brånemark's oldest and closest associates,

Dr. Kenji Higuchi, provides the readers of *Nobel Biocare News* with some personal insight on how the Trefoil concept was conceived and developed to meet the needs of edentulous patients—patients who otherwise might not be able to benefit from implant-based dental restoration.

od of 70 weeks. This groundbreaking adjustable framework has the capability of correcting meaningful horizontal, vertical and angular misalignment of the three implants placed with guided surgery to achieve a precise fit.

This collaborative development required three years of bi-weekly meetings during which 25 framework iterations and over 100 component design changes were evaluated.

An international 5-year multicenter post market trial commenced in April 2016. By the end of December 2016, completed enrollment of 90 patients in the study is anticipated. To date, excellent early results have been reported in this prospective long-term study.

The use of innovation is the lifeblood of any medical device company and necessary for the advancement of healthcare. A successful innovation involves a new idea, device or method and must satisfy specific needs of the market. In the field of implant rehabilitation, the most common roadblock to proceeding involves the high financial cost of care. This reality of life has re-

stricted the number of patients able to afford treatment.

The Trefoil concept embodies the Nobel Biocare objective, “to treat more patients better,” by offering a reduction in cost using a simplified clinical workflow, a standardized prefabricated framework, and minimized componentry that reduces treatment time.

## A brand-new approach

The Trefoil concept was conceived and developed to extend the benefits of osseointegration to a new patient population. The Trefoil concept is not intended to replace any of the current edentulous solutions presently available, but offers a more affordable premium alternative for an entirely new patient population instead.

Appropriate clinical treatment should involve patient-specific planning. This concept is consistent with the “philosophy of osseointegration” and our common healthcare goal of addressing the needs of the many. <



**The need is enormous.** Imagining the large number of potential patients throughout the world who could benefit if the length of time and the costs of implant-based treatment could be reduced, Per-Ingvar Brånemark initially referred to Novum—the precursor to Trefoil—as the “China Bridge.” Supporting the Novum product range first, and now the Trefoil concept, Nobel Biocare has been instrumental in realizing Brånemark’s dream from the very beginning.



# The Biological Environment Of Immediate Placement

Part one of a three-part series: “Understanding the Biology and Mechanics of Immediate Placement”

**Working with Liao Wang, Xibo Pei, and Yan Wu at the Stanford University Department of Surgery, Professor Jill A. Helms has been studying what happens around immediately loaded implants. In this, the first of a three-part series, Dr. Helms discusses our best current understanding of the biological environment into which implants are placed.**

By Professor Jill A. Helms

As times change, regimens change as well. Immediate loading was once considered a biologically untenable treatment. Today we know, however, that it can indeed succeed.

We'll discuss the immediate implant itself in the next issue of *Nobel Biocare News*. For now, let's start with the site in which an immediate implant is placed: an extraction socket.

Trained originally as a periodontist, I rather enjoyed looking at the data related to this subject when we first generated it. The bone-tooth interface is a good place to begin because this will become the bone-implant interface.

Taking a close look at this interface, the first thing one notices is the periodontal ligament (PDL), which is a fibrous tissue, easily verified at high magnification.

In this article, I'm only going to be writing about healthy conditions. I recognize that's not what one usually faces in the clinic, but that's what we can study right now in a laboratory, and such a model provides a great deal of insight into the processes that collectively lead to osseointegration.

## Versatile structure

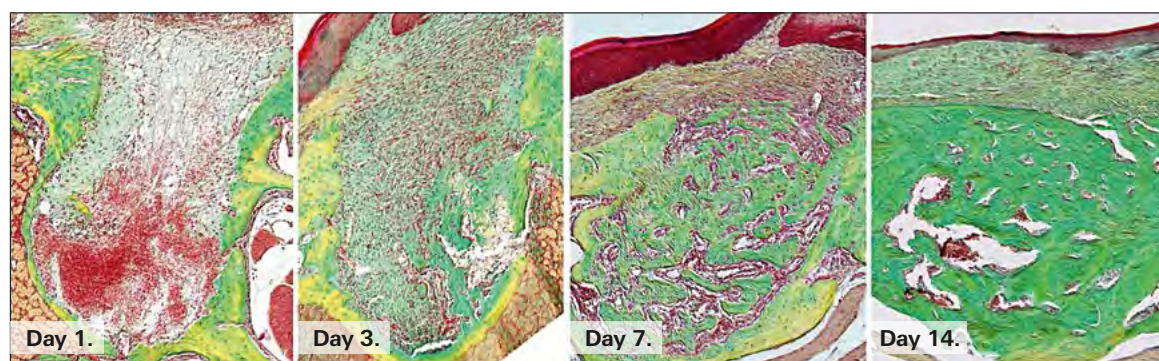
Because the PDL is a fibrous tissue, it is capable of distorting in response to force. If one subjects a tooth to a lateral force, orthodontic or otherwise, this fibrous tissue elongates on one side of the tooth and compresses on the other. It holds up very well when elongated because it's fibrous.

The PDL is also capable of compressing—sometimes to the point where it actually “ankylosizes”—but I'll return to that in a moment.

First, the group studied what happens to the PDL immediately after a tooth is extracted. Using an antibody to a protein called Periostin, which identifies PDL cells, we followed the fate of the PDL in an extraction socket.

The image to the right shows a very low magnification view of an extraction site—this is just one root—yet the amount of PDL that's left behind is impressive, to say the least. Something like two-thirds of the socket is surrounded by PDL.

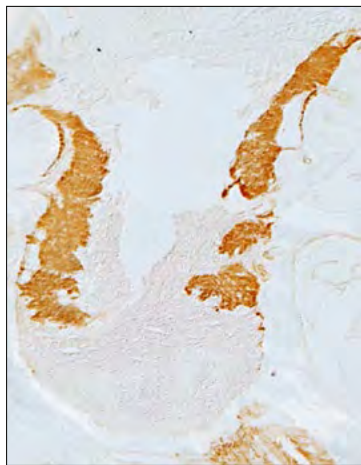
Now I know that a lot of clinicians go in and curette out this tissue—which makes sense if the tissue is dis-



**The PDL contributes to bone healing.** The extraction socket filling in: one, three, seven and fourteen days after extraction.

eased—but let me explain what happens to the PDL if the tissue is healthy.

In a case where we haven't inserted an implant yet, the histology demonstrates that the fibrous PDL tissue that has been left behind curls up. Because



**Used as a marker,** the periostin indicates the amount of PDL remaining in the extraction socket immediately after the removal of the tooth.

the cells still express periostin, however, we know that we are still observing PDL. Sequential imaging over three days post-extraction shows a gradual change in the architecture of the PDL. The cells still express periostin, but in the following days, the PDL turns into bone. It mineralizes.

Our research shows that this is the fate of the PDL in many pathologic conditions—for example when you have ankylosis.

Ankylosis occurs because the PDL is no longer under tension, and it ossifies. For an immediately loaded implant, this is very good news, because the PDL contributes significantly to the amount of bone that forms in the extraction socket.

The series of images above are (left to right) from one day, three days, seven days and fourteen days after extraction. One can see how the socket fills in and the PDL is contributing directly to bone healing.

When we ask whether the healing

rate of an extraction socket is faster than the rate of bone formation in an osteotomy, the answer is a resounding: “Yes!”

When we compare an extraction socket with an osteotomy, and quantify the amount of bone that forms in each, we repeatedly measure significantly more in the extraction socket than in the osteotomy.

What this tells us, unambiguously, is that extraction sockets heal faster than osteotomies. That means that if you are going to immediately place an implant in an extraction socket, you have an environment very conducive to robust bone formation.

One very important caveat: If the PDL is diseased, the cause of the infection obviously ought to be removed before proceeding with implant placement. Our ongoing research is now focused on understanding how periapical and periodontal disease impacts the immediate placement of implants. <



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