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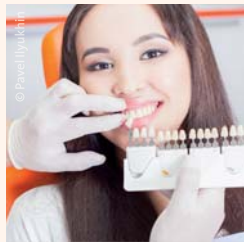
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## SHADE MEASUREMENT

A new study has compared two digital shade measurement solutions with the conventional method for colour assessment, the human eye.

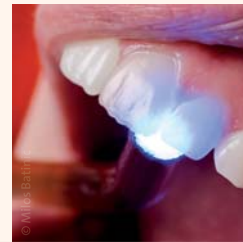
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## INTERVIEW

Prof. Martin Schimmel, Head of the Division of Gerodontology at the University of Bern, on ethical and financial issues related to implant treatment of the elderly.

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## A VERSATILE TOOL

Light is capable of many things. Swedish dentist Dr Jan Tunér on using the composite curing lamp as a phototherapeutic tool in daily dental practice.

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## Medical screening in dentistry

By DTI

**STOCKHOLM, Sweden:** Although medical screening in dental settings has been shown to be cost-effective and beneficial for patients' health outcomes, there have been no widespread implementation attempts in dental practice so far. Various studies have found that both patients and dental professionals regard such screening positively; however, the position of health authorities and organisations in this regard has not been established. Swedish researchers have thus conducted a study to elicit their views on the topic.

As associations between periodontal and cardiovascular disease and diabetes have become evident in the past, research indicates that medical screening in dentistry could be an effective component of disease prevention and enhance cross-border cooperation between dental and medical care. In order to investigate the attitudes of health authorities and organisations regarding medical screening in dental settings,



A Swedish study found varying views on the implementation of medical screening in dentistry.

Swedish researchers from Karolinska Institutet and Karlstad University interviewed 234 representatives of 13 institutions. All of the respondents received a standardised questionnaire of 18 questions concerning medical screening in dental settings and

took part in subsequent personal interviews.

The results showed 46 per cent (108) positive responses to medical screening in dental settings, 41 per cent (95) negative responses and 13 per cent (31) non-responses. Al-

though health care officials generally had a positive view of medical screening in dentistry, they reported a lack of facts concerning the scientific communities' position, guidelines and procedures on the topic.

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## Stress raises caries risk

By DTI

**SEATTLE, USA/LONDON, UK:** New research has related chronic maternal stress to a higher prevalence of cavities among children. While this is not the first study to associate maternal exposure to stress with childhood cavities, it is the first to examine the relationship using biological markers of chronic stress, an incident known as allostatic load (AL).

Caries was more common among children whose mothers had two or more biological markers of AL compared with no such markers—44.2 per cent vs. 27.9 per cent. They further identified that maternal AL was associated with socio-economic status, affecting care-taking behaviors, such as breast-feeding, dental visits, and giving breakfast daily.

"Policy that aims to improve dental health, particularly the prevalence of cavities among children, should include interventions to improve the quality of life of mothers," Dr. Wael Sabbah from the Dental Institute at King's College remarked.

## Periodontal and heart disease

By DTI

**ÖREBRO, Sweden:** Aiming to shed new light on the mechanism behind the relationship between periodontitis and cardiovascular disease, researchers from Örebro University in Sweden have cultured human

aortic smooth muscle cells and infected them with *Porphyromonas gingivalis*, a periodontal pathogen that has been found in coronary artery plaques of heart attack patients.

They found that gingipains, which are virulence factors pro-

duced by the pathogen, promoted expression of the pro-inflammatory growth factor Angiopoietin-2. In contrast, the expression of anti-inflammatory growth factor Angiopoietin-1 in the smooth muscle cells was inhibited. Altogether, the infection with *P. gingivalis* changed the expression of 982 genes in the cells tested, resulting in increased inflammation and atherosclerosis.

In combination with the observed cellular effects, the findings suggest that Angiopoietin-2 plays a role in the association between periodontitis and atherosclerosis, the investigators said.

Their research clarifies the mechanism behind the association of the two diseases and may enable researchers to find biomarkers for them in the future, concluded Boxi Zhang, a PhD student at the Department of Health and Medicine at the university.



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# Oral cells help to cure blindness

By DTI

**OSLO, Norway:** Findings from the University of Oslo give hope to individuals suffering from impaired vision due to stem cell deficiency of the cornea. Using cells harvested from the patient's mouth, researchers have been able to grow new tissue that, once transplanted into the damaged eye, helps to restore sight and eliminate pain from the cornea.

due to the high number of nerve fibres in the area.

For the last ten years, Dr Tor Paaske Utheim, an ophthalmologist and research associate at the University of Oslo, has been conducting research on utilising stem cells from the mouth in order to help patients suffering from limbal stem cell deficiency. So far, almost 250 people with the condition have undergone

most often affects people living in developing countries, it is especially important that extracted cells can be easily kept and transported, he explained. As a result, the clinician developed a special storage technology that enables the cultured tissue to be transported in a small custom-made plastic container. According to Utheim, the system allows for a completely new level of flexibility.

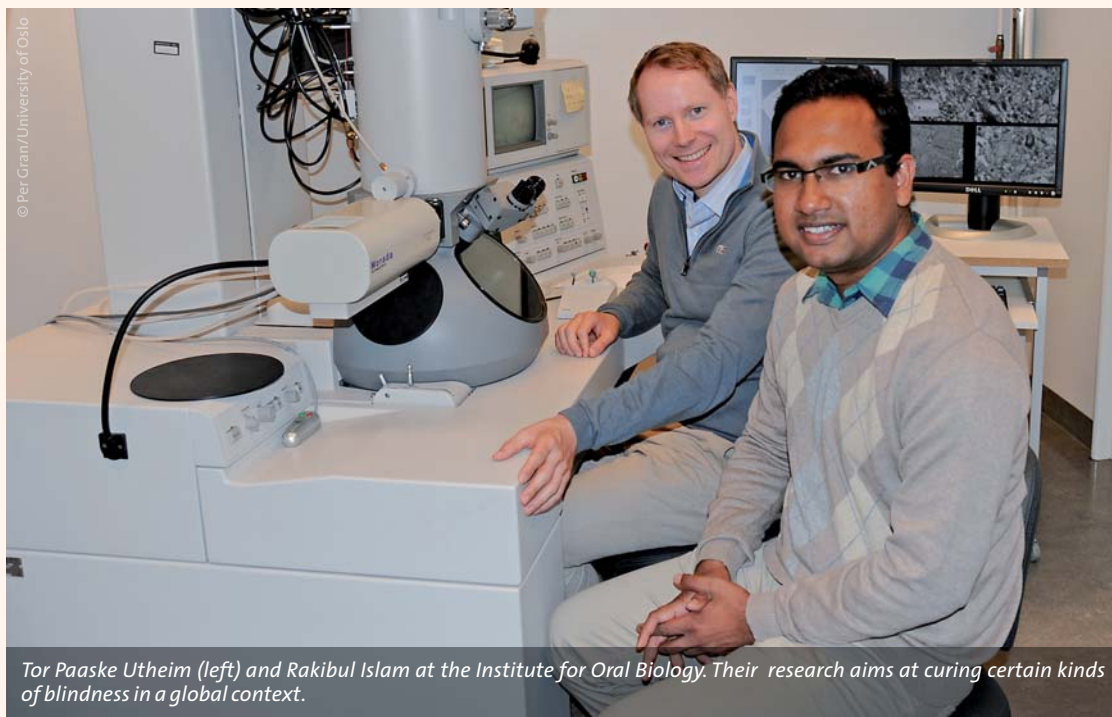
not just close to the cell culture centers," added Rakibul Islam, a PhD student from Utheim's research group.

Islam's PhD project at the Department of Oral Biology showed, among other results, that cultured stem cells retain their quintessential properties best between 12 and 16 °C. He further found that certain areas of the mouth are better suited to use in regenerative medicine than others are. "Our results show that the location from which the mucosal tissue is harvested has a striking impact on the quality of the cultured tissue," Islam said.

The group's findings illustrate the benefits of interdisciplinary efforts in research, in this case between dentists and ophthalmologists. Their results will help to simplify and streamline the clinical procedures, and therefore make the treatment more accessible than it is today, Islam concluded. The results of his PhD study have not yet been published.

Limbal stem cell deficiency can be caused by factors such as ultraviolet radiation, chemical burns, serious infections like trachoma, and various other diseases, some of which are heritable. The exact number of people affected by the disorder is unknown, but in India alone there are an estimated 1.5 million people suffering from the condition.

A summary of Utheim's findings was published in the June issue of the *STEM CELLS* journal in an article titled "Transplantation of cultured oral mucosal epithelial cells for treating limbal stem cell deficiency—Current status and future perspectives".



In individuals with limbal stem cell deficiency, the stem cells cannot renew the cornea's outermost layer. Instead, other cells grow over the cornea, resulting in the cornea becoming fully or partially covered. In addition, some patients experience severe pain, which is

treatment, involving transplantation of stem cells grown from their own mouth cells.

Utheim's research objectives further focused on optimising the storage and transport potential of the treatment. Because the disorder

"Today, cells from the mouth are cultured for use in the treatment of blindness in only a few specialized centers in the world. By identifying the optimal conditions for storing and transporting the cultured tissue, we would allow for the treatment to be made available worldwide, and

# Tooth enamel first evolved in skin

By DTI

**UPPSALA, Sweden:** Tooth enamel is the hardest substance produced by the human body. Since enamel is one of the four major tissues that make up the teeth and gives them their distinctive shiny white appearance, it comes as a surprise that a study has found that enamel most likely originated from an entirely different part of the body: the skin.

Unlike humans, who only have teeth in the mouth, certain fish species have little tooth-like scales on the outer surface of the body. In

the study, researchers from Uppsala University in Sweden and the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing in China analysed *Lepisosteus*, an ancient gar fish from North America whose scales are covered with an enamel-like tissue called ganoine.

They found genes for two of the three unique matrix proteins of enamel expressed in the genes of *Lepisosteus*'s skin, and this strongly suggests that ganoine is a form of enamel. In order to determine where the enamel first origi-

nated—the mouth or the skin—the researchers then investigated the dermal denticles on two fossil fishes: *Psarolepis* from China and *Andreolepis* from Sweden. In *Psarolepis*, the scales and the denticles of the face are covered with enamel, but there is no enamel on the teeth; in *Andreolepis*, only the scales bear enamel.

Their findings suggest that enamel in fact first evolved in the skin. Dr Per Ahlberg, Professor of Evolutionary Organismal Biology at Uppsala University, explained: "*Psarolepis* and *Andreolepis* are

among the earliest bony fishes, so we believe that their lack of tooth enamel is primitive and not a specialisation. It seems that enamel originated in the skin, where we call it ganoine, and only colonised the teeth at a later point."

The study is the first to combine novel palaeontological and genomic data in a single analysis to explore tissue evolution. The results have been published online on 23 September in the *Nature* journal in an article titled "New genomic and fossil data illuminate the origin of enamel".

◀ Page 1

According to the researchers, most participants believed that the dental workforce has the relevant professionals to implement medical screening. Dental hygienists or dental nurses were considered to be the most suitable group of professionals for the performance

of medical screening in dental settings, as medical questions could form a natural part of hygienists' health conversations with their patients.

However, the majority of participants expressed their concern that there was insufficient expertise

among dental professionals to perform medical screening. Overall, the results showed that further knowledge and guidelines, as well as additional research on implementation strategies and long-term follow-up of medical screening, are needed before medical screening can be widely introduced

in dental settings, the researchers concluded.

The research article, titled "Medical screening in dental settings: A qualitative study of the views of authorities and organizations", was published online on 19 October in the *BMC Research Notes* journal.

## IMPRINT

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# Study compares digital vs. conventional shade measurement

By DTI

**COPENHAGEN, Denmark/SKOPJE, Macedonia:** Matching the shade of the natural dentition is of great importance for achieving a good aesthetic result in prosthetic reconstructions, especially in the anterior region. Although various computer-based shade determination systems have been developed in recent years, the use of this new technology has not been widely evaluated in clinical settings. A study has now compared the reliability of two digital shade measurement solutions with the conventional method for colour assessment, the human eye.

measurement system achieved the greatest agreement for colour chroma and hue, whereas SpectroShade demonstrated the highest agreement for colour value. How-

ever, no significant differences were found between the TRIOS tool and the colour tab system and between SpectroShade and the colour tab system.

According to the researchers, the results support the use of computer-based scanning and shade measurement systems for dentistry. They concluded that further development of such systems for clinical use could be valuable for material selection and restoration design, particu-

larly in aesthetic and restorative dentistry.

The study, titled "Effectiveness of shade measurements using a scanning and computer software system: A pilot study", was published on 25 April in the *International Journal of Oral and Dental Health*.

AD



In the study, researchers from the University of Copenhagen in Denmark and the Saints Cyril and Methodius University in Skopje compared 3Shape's TRIOS shade measurement tool, MHT's SpectroShade spectrophotometric computer-based system and VITA Zahnfabrik's VITA Toothguide 3D-MASTER, a conventional colour tab system.

According to the researchers, reliable visual shade selection by the human eye can be inconsistent owing to the complexity of tooth colour and external factors, such as room lighting, patient clothing and even make-up. In order to compensate for these variables, the shade determination was performed in natural daylight, but away from windows and with no direct light. Lipstick or other factors that may affect colour assessment were removed, and patients with brightly coloured clothing were covered with a neutral cloth.

Shade determination was tested on 87 teeth in 29 patients between the ages of 22 and 62. In order to validate the various methods, two dentists selected the colour tab they considered to be the best match for each tooth and with each method. The colour tabs chosen were then evaluated pairwise.

The study found that the reliability of the computer-based systems was higher than that of the conventional visual system. The TRIOS

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# “We need to stay open-minded to new crazy ideas”

An interview with Dr Rickard Brånemark, Sweden

The concept of osseointegration has been applied to dental implants for several decades. As an orthopaedic surgeon and engineer, Dr Rickard Brånemark has continued the work of his famous father by adapting the concept to the treatment of amputees. In an recent interview with *Dental Tribune* at the EAO congress in Sweden, Brånemark explained the benefits and future possibilities of osseointegrated amputation prostheses.

**Dental Tribune:** Dr Brånemark, could you please give an outline of the development of osseointegrated prostheses?

**Dr Rickard Brånemark:** The work started by my father was the foundation of what we do in ortho-

paedics today. Using his concept, I developed new treatments for amputees based on osseointegrated implants, which I have been performing for about 25–30 years now.

Since 1998, I have mostly worked with my own companies, namely Brånemark Integration, the dental company I started with my father, and Integrum, which does all the development for orthopaedic osseointegration. However, we now also have multinational collaborations with universities in Gothenburg, Vienna, San Francisco and Chicago, and hopefully also Göttingen in the near future. As the Swedish implant system has recently been approved by the US Food and Drug Administration (FDA) for the treatment of



Dr Rickard Brånemark

prosthesis, which helps us to direct the prosthetic device in a much better way and provides feedback. This is extremely important for truly restoring function.

The main advantage of our approach compared with our competitors is that they have to use wireless technology because they do not have the means to bring wires out of the body owing to the risk of infection. However, we have this fantastic osseointegrated implant to use as a conduit so that the wires can pass through the implant system. Similar to a fibre-optic Internet connection, the wired connection in a robotic arm is much better, stable and robust.

We have already successfully treated one patient. However, our research is still in the early phase, but I think we could do amazing things in the future.

**Do you think that osseointegrated prostheses could potentially replace traditional prostheses in the future?**

This treatment would not apply to amputations of the lower leg as a result of poor circulation caused by diabetes or vascular diseases related to smoking. Such patients constitute about 90 per cent of the amputee population. However, the younger population who have been in road or war accidents or who have musculoskeletal tumours, which are more likely to occur in younger patients, will be candidates for this treatment.

amputees, I am currently establishing an orthopaedic osseointegration centre in San Francisco and am working closely with the US Department of Defense, which has many soldiers with amputations and is thus very interested in supporting our work.

**What do you consider the main challenges of this treatment?**

Anchoring something to the bone is the core of osseointegration technology and that is a fairly robust technology we have proven in millions of dental implants. However, in orthopaedics, we face additional challenges. There are, for example, no materials available today that are strong enough to withstand 20–50 years of high physical activity. Therefore, we have developed and continue to develop new materials and surfaces that better withstand the higher loads.

Another important concern is the mucosal area and skin penetration, which is maybe even more challenging. We are working with a concept very similar to the old Brånemark protocol and the bone-anchored hearing aid in that we have a smooth surface that is not an attachment. There are many groups working with attachments and, as far as I know, all have failed, especially in the orthopaedic field.

However, just like with every surgical procedure, the outcome largely depends on the skills of the surgeon too.

**For the last six years, you have also been using osseointegration in conjunction with implanted electrodes. Could you tell us more about this programme?**

Yes, we are also developing the next generation of amputation prostheses. In addition to the osseointegrated implant, we are able to attach electrodes to muscles and nerves to have a brain-controlled

If the technology continues to be as promising as it appears now, the majority of patients will opt for it—just like they now have the choice between dentures or fixed dental implants, which are much better for the patient. There will be a shift, but this will take some time. The introduction of dental implants took about 17 years; similarly, this shift could take another ten to 20 years. However, receiving FDA approval and having the system in use by the military could definitely speed up the establishment.

Overall, this treatment offers many alternatives to conventional treatments. However, there is often too much conservatism in the dental and medical fields when it comes to innovations, but I think we need to stay open-minded to new crazy ideas. This research shows what might be possible in the future. We might be able to restore sensory function of a non-existing limb, creating good artificial sensation. It also shows that the dental and the medical professions should work more closely together. As one can see, there are many synergies that could be drawn from the fields of dental and orthopaedic research in our case. The idea of translation of knowledge was also the original idea of the EAO, which has now become a purely dental meeting. This is a pity because we have to collaborate more, but maybe there will be more cross-disciplinary presentations and meetings in the future.

**Thank you very much for the interview.**

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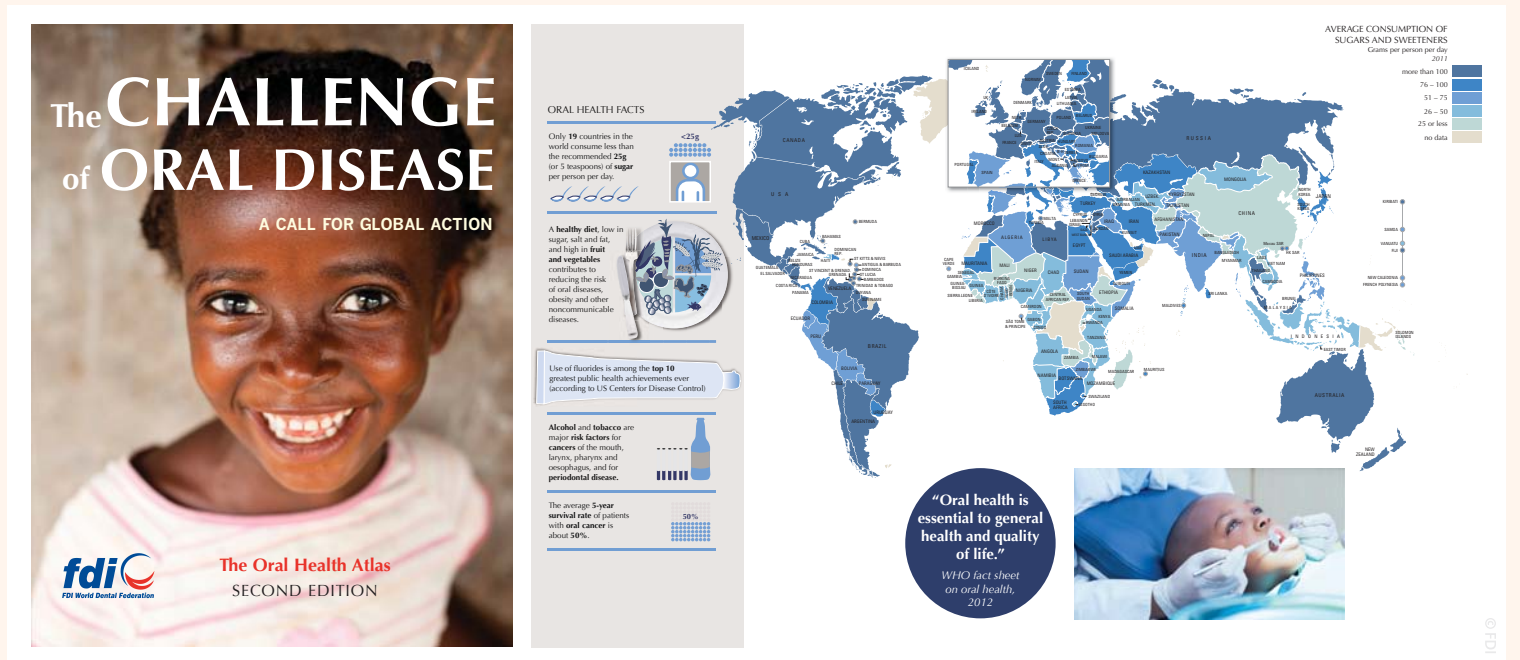
# FDI: Second edition of *Oral Health Atlas*

By DTI

**BANGKOK, Thailand:** The FDI World Dental Federation has released the second edition of its *Oral Health Atlas* at the Annual World Dental Congress (AWDC) in Bangkok in Thailand. Titled *The Challenge of Oral Disease—A Call for Global Action*, it aims to serve as an advocacy resource for all oral health care professionals and recommends strategies to address the global challenge of oral disease.

At the launch event held at the Bangkok International Trade and Exhibition Centre, Dr Habib Benzian and Prof. David Williams, the publication's editors-in-chief, presented the new edition of the atlas and spoke with DTI group editor Daniel Zimmermann about the contents of the book and the global challenge of preventing oral disease and implementing adequate oral health care worldwide.

The first edition of the *Oral Health Atlas*, titled *Mapping a Neglected Global Health Issue*, was released at the FDI 2009 AWDC in Singapore and highlighted the extent of the problem of oral disease worldwide. The second edition of the atlas provides an update of the global health challenge and reflects on policies and strategies that address the burden of oral disease, such as tooth decay, periodontal disease and oral cancer, Benzian pointed out.



so that they can better advocate for change in oral health-related policies, Williams said.

According to the atlas, only about two-thirds of the world's population have access to adequate oral health care, even though oral disease, particularly tooth decay, is among the most common human diseases. "Untreated tooth decay is the most common health condition of children across all countries, recently confirmed by the Global Burden of Disease Study looking at the burden of 281 diseases and conditions", said Benzian. "Children with severe untreated tooth decay

Dental Association and the FDI's Vision 2020 oral health initiative. The book content includes chapters and data from 30 con-

tributors, and was reviewed and edited by the two editors-in-chief. The atlas can be downloaded free of charge from the FDI website and will

be translated into the FDI's official languages of French and Spanish. These versions will be available electronically in early 2016.




The book summarises the key oral health issues based on the latest available information from various international sources, Benzian and Williams explained, including the impact of oral disease, major risk factors and inequalities in oral health, as well as oral disease prevention and management. Moreover, it aims to ensure that oral health is granted higher priority on the global health and development agendas. Written for national dental associations, health organisations, industry professionals and the general public, the atlas provides them with the means to address policy-makers, governments and local authorities based on sound facts

are impacted in their growth, have frequent episodes of pain, miss days in school and have a generally lower quality of life," he continued. They also usually have the lowest access to oral health care and preventive services, added Williams. Therefore, the two editors-in-chief hope that the second edition of the *Oral Health Atlas* will most of all serve as an advocacy tool for institutions, policymakers and dental associations in their effort to improve access to oral health care worldwide.

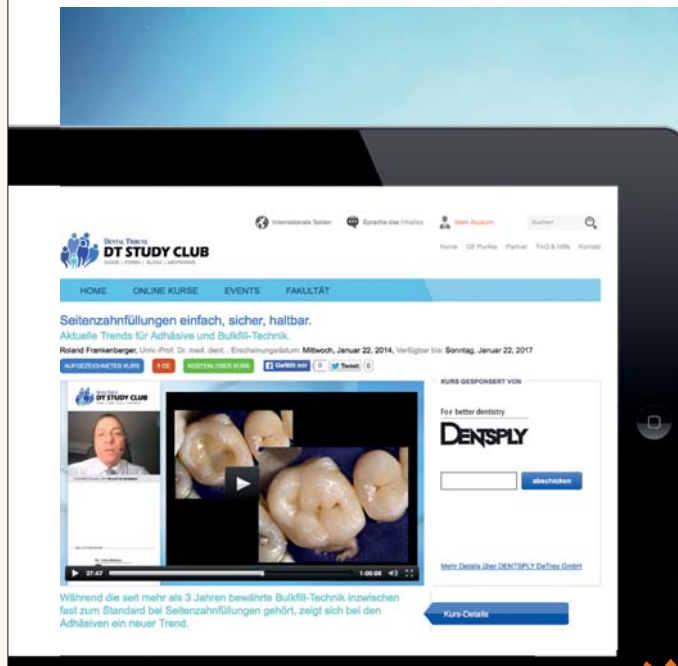
The compilation of the new edition of the *Oral Health Atlas* was supported by the Hong Kong

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# Celebrating 50 years of osseointegration

Dental implantology community celebrates 50 years of osseointegration

By DTI

**STOCKHOLM, Sweden:** From 24 to 26 September, the annual congress of the European Association for Osseointegration (EAO) was held in Sweden for the first time. Over 2,500

participants attended the organisation's 24<sup>th</sup> scientific meeting in Stockholm. The congress addressed challenges in implant dentistry in numerous symposia, workshops and poster presentations. Over the course of three days, the meeting in Stockholm

provided a thorough review of the development of clinical osseointegration over the last 50 years, while focusing on current and emerging techniques. There was also a strong emphasis on application in daily practice.

The organisers invited more than 50 experts from the Nordic countries and abroad to present their work and discuss the latest scientific findings and clinical concepts in implantology. In addition, new products and techniques were presented by leading companies in the dental industry. Overall, nearly 100 dental companies exhibited at the congress.



On the last day of the conference, EAO President Prof. Björn Klinge announced the winners of the EAO's prestigious European prizes for research in implant-based therapy. This year, the winners of the scientific awards were selected from about 600 submitted abstracts. In addition, Prof. Daniel van Steenberghe, the first President of the EAO, was awarded honorary membership at the session. Profs. Per-Ingvar Brånemark and André Schroeder are the only other honorary members of the organisation.

The congress's social programme boasted a number of special venues. The pre-congress cocktail reception on 23 September was held at the Stockholm City Hall, which is best known for hosting the annual Nobel Banquet. The Vasa Museum was chosen as the location for the gala dinner. The only preserved seventeenth-century ship in the world, the warship Vasa, which sank on her maiden voyage from Stockholm in 1628 and was salvaged 333 years later, is exhibited at the museum. This year's EAO annual congress was dedicated to the work of the late Brånemark, the father of modern implant therapy, who passed away in December 2014. On 27 September, the EAO recognised his achievements with a special symposium in Aula Medica at Karolinska Institutet in Stockholm.

The 25<sup>th</sup> scientific meeting will be held from 29 September to 1 October 2016 at the Palais des Congrès de Paris, which is located in the heart of Paris near the Champs-Élysées. It is being organised in collaboration with the French Society of Periodontology and Oral Implantology. The organisers have already announced that the programme for the 2016 congress will focus on the many aspects of treatment planning and decision-making.

The official language of the congress is English. In 2016, the EAO is pleased to welcome Japan as the guest country. Therefore, interpretation into Japanese will be available for some sessions.

Registration will open in March 2016 at [www.eao-congress.org](http://www.eao-congress.org). Abstracts in English can be submitted online from December 2015 to 1 April 2016.

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# Dental material for the next generation

Entering Nordic markets, German dental manufacturer Adentatec aims to win over customers with high quality at fair prices.

With extensive experience and expertise in the field of non-precious dental materials, high product standards and a focus on customer-oriented service, German manufacturer Adentatec lives up to its motto, "Competence in dental". Based in Cologne in Germany, the company specialises in the production and distribution of non-precious dental alloys on a cobalt-chromium and a nickel-chromium base, as well as CAD/CAM discs on a cobalt-chromium and a titanium base.

While Adentatec operates globally, it values short decision paths and personal contact, and is committed to the quality associated with German-made products. Sales Director Julia Grabensee told *Dental Tribune*. "Only when our customers are satisfied are we satisfied too," she said. All medical devices distributed by Adentatec are exclusively produced in Germany and are certified to the highest standards (CE marking and US Food and Drug Administration approval). The company is committed to the strict implementation of the quality and process requirements of DIN EN ISO 13485 and DIN EN ISO 9001 in relation to the entire manufacturing process. "It is our first priority to achieve a consistently high level of quality. Furthermore, we



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**"The Nordic market is especially interesting for us."**

of dealers here intensively. Focusing in particular on our new products System Sin and System PEEK-Blank, we hope to spark the interest of new customers who are looking for high-quality products at a fair price."

System Sin, the company's new metal powder, was first introduced at this year's International Dental Show in Cologne in March. The cobalt-chromium powder is used in the production of crowns and bridges for ceramic veneering, as well as removable dentures, via laser sintering. Spherical powder components provide good flow and sintering properties and allow the fabrication of thin and homogeneous framework structures.

Furthermore, with its newest addition, System PEEK-Blank, the company has yet another product in store for 2015. The superlight, high-performance polymer will be available in diameters of 98.3 mm and 99.5 mm, with four different sizes and two shades, white and tooth coloured, from which to choose. The material is mainly for use in the manufacture of removable dentures and is designed for high stability and ease, which are essential for comfortable wear.



The German company specialises in the production and distribution of non-precious dental alloys on a cobalt-chromium and a nickel-chromium base (left), as well as CAD/CAM discs on a cobalt-chromium and a titanium base.

strive for continuous product development and constant optimisation of production processes," Grabensee remarked.

Established in 1997, Adentatec initially distributed sandblasting material and plaster to dental laboratories all over Germany. In 2003, the German company started production of high-quality dental alloys, for which it implemented a quality management system. As a manufacturer of medical products, Adentatec has always given priority to patient health, Grabensee emphasised. Its products undergo biocompatibility and corrosion resistance tests, among others, and are manufactured from high-quality raw materials to ensure consistent quality.

The company's brand-name products, such as System KN, System MG and System NE, have long been

widely used by dental technicians. Its product range includes plaster, investment material and sandblasting material. In 2009, Adentatec expanded the range to CAD/CAM discs on a cobalt-chromium base (System NE-Blank and System Soft-Blank). The high-quality discs are available in

different diameters and heights, and can be used for all open milling systems. In 2012, the company's CAD/CAM disc on a titanium base, System Ti 5-Blank (Grade IV), was launched.

Over the last decade, Adentatec's export business has increased steadily,

resulting in more than 20 agents worldwide who represent the company's product range today. Targeting even further growth, the dental manufacturer is now aiming to enter the Scandinavian countries. "The Nordic market is especially interesting for us. We would like to enlarge our network

"What sets us apart are years of experience and expertise in the production of cobalt-chromium dental alloys," said Grabensee. In order to build strong customer relationships and reach its key audience of dental professionals, Adentatec regards it as important to attend fairs and exhibitions around the globe. In 2016, the company will be present at IDEM Singapore, IDEX, DTS, AEEDC Dubai and VIDECH Hanoi, among others.

The alloys from Adentatec are no longer an alternative to precious metals; they are high-quality dental materials offering an up-to-date technology for the next generation, according to the company. As Grabensee puts it: "We invite all dental professionals to test our dental alloys without obligations and see for themselves".



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Visit Adentatec at Swedental in Gothenburg at Booth B09:21.



# Nano-hybrid ORMOCER for the bulk-fill technique in the posterior region

A clinical case report

By Prof. Jürgen Manhart, Germany



Fig. 1: Situation before treatment: amalgam filling in tooth #46.—Fig. 2: Situation after removal of the amalgam filling.—Fig. 3: After excavation, the cavity was finished and isolated with a rubber dam.

Direct composites in posterior teeth are a part of the standard therapy spectrum in modern dentistry. The excellent performance of this form of restoration in the masticatory load-bearing posterior region has been demonstrated in numerous clinical studies. The procedure is usually carried out in an elaborate layering technique. Aside from the possibilities that highly aesthetic composites offer in the application of polychromatic multiple-layer techniques, there is great demand for the most simple and quick to use, and therefore more economical, composite-based materials for posterior teeth. This demand can be met with ever more popular composites with increased depths of cure (bulk-fill composites).

## Introduction

The range of products available in the field of direct composites has expanded greatly in recent years.<sup>1-3</sup> In addition to the classic universal composites, the enormous rise in patients' aesthetic expectations has resulted in the launch of a large

number of so-called "aesthetic composites" on the market, which are characterised by composite materials in a sufficient number of different shades and different grades of translucency and opacity.<sup>4</sup> Opaque dentine shades, translucent enamel shades, if required, body shades make it possible to achieve highly aesthetic direct restorations using the multi-coloured layering technique. They are practically indistinguishable from the dental hard tissue, and they rival the aesthetics of all-ceramic restorations. Some of these composite systems consist of more than 30 different composite materials of various shades and degrees of translucency. It is, however, essential to have appropriate experience in the handling of these materials, which are primarily used in the anterior region with a layering technique employing two or three different opacities and translucencies.<sup>4,5</sup>

Owing to their polymerisation properties and limited depth of cure, light-curing composites are

generally used in a layering technique with individual increments of no more than 2 mm in thickness. Each increment is polymerised separately, with exposure times ranging from 10 to 40 seconds, depending on the power of the curing light and colour or translucency of the composite paste.<sup>6</sup> With the materials available up until recently, thicker composite layers resulted in insufficient polymerisation of the composite resin and thus in poorer mechanical and biological properties.<sup>7-9</sup> Applying the composite in 2 mm increments can be a very time-consuming procedure, especially in large posterior cavities. Consequently, there is considerable demand in the market for composite-based materials that are simple and quick to use, and therefore more economical, for this range of indications.<sup>10</sup> In order to satisfy this demand, bulk-fill composites have been developed over recent years that, given a sufficiently powerful curing light, can be placed more quickly in the cavity, using a simplified application technique, in layers 4 to 5 mm thick

and with short increment curing times of 10 to 20 seconds.<sup>11, 12, 6, 13, 14</sup> Taken literally, "bulk fill" means that they can be used to fill the cavity in a single step/lege artis without the need for a layering technique.<sup>15</sup> With plastic restorative materials, this is currently only possible with cements and chemically activated or dual-curing core build-up composites. However, the former do not possess adequate mechanical properties for restorations that are clinically stable in the long term in the masticatory load-bearing posterior region of the permanent dentition and are consequently only suitable for use as interim restorations or long-term temporaries.<sup>16-18</sup> The latter are neither approved as restoratives nor suitable for such indications from a handling perspective (e.g. shaping of occlusal surfaces). The bulk-fill composites currently available for the simplified filling technique in the posterior region are not actually bulk materials in the true sense when examined more precisely, as the approximal extensions of clinical cavities, in particular, are gen-

erally deeper than the maximum depth of cure (4–5 mm) specified for these materials.<sup>19, 20</sup> That said, it is possible to fill cavities with depths of up to 8 mm in two increments if a suitable material is selected—and this covers the majority of defect dimensions encountered in routine clinical practice.

Most composites contain organic monomer matrices based on conventional methacrylate chemistry.<sup>21</sup> Silorane technology<sup>22-27</sup> and ORMOCER chemistry<sup>28-35</sup> present alternative approaches. ORMOCERs (organically modified ceramics) are organically modified, non-metallic inorganic composites.<sup>36</sup> Ormocers can be classified between inorganic and organic polymers and possess both an inorganic and an organic network.<sup>37, 38, 34</sup> This group of materials was developed by the Fraunhofer Institute for Silicate Research in Würzburg in Germany and marketed for the first time as a dental restorative material in 1998 in collaboration with partners in the dental industry.<sup>33, 34</sup> Since then, there has been con-

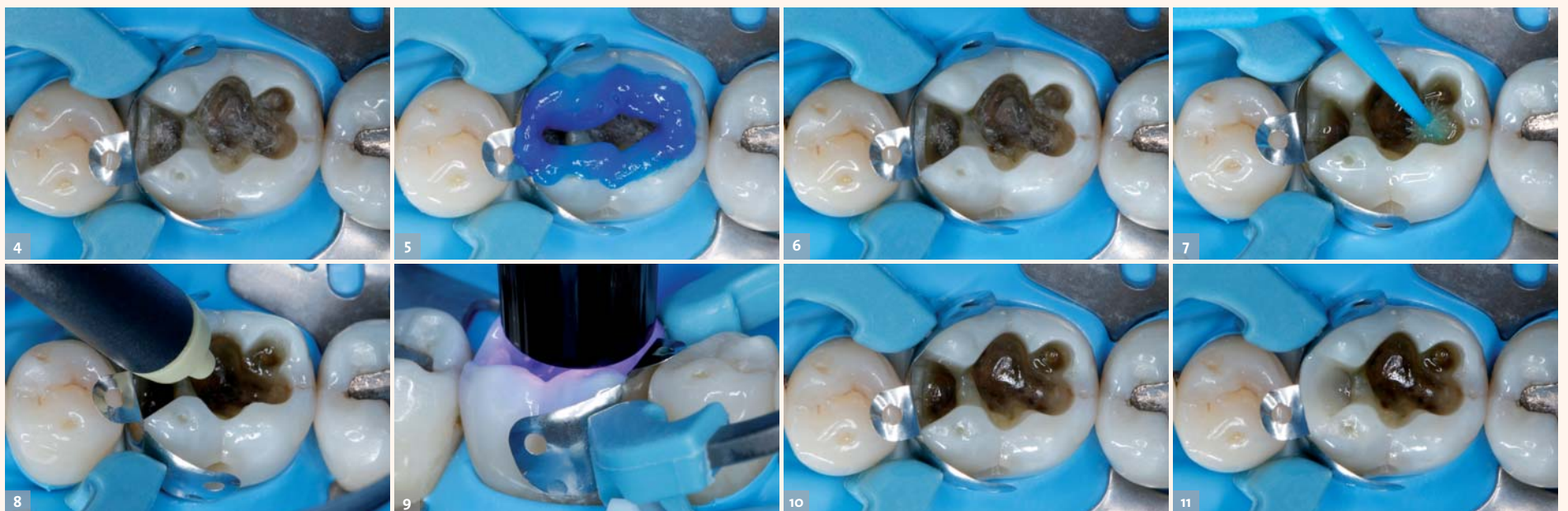


Fig. 4: Demarcation of the cavity with a sectional matrix.—Fig. 5: Selective enamel etching with 35% phosphoric acid.—Fig. 6: Situation after rinsing off the acid and carefully drying the cavity.—Fig. 7: Application of the bonding agent Futurabond M+ to the enamel and dentine with a micro-brush.—Fig. 8: Careful drying of the solvent from the adhesive system with an airstream.—Fig. 9: Light curing of the bonding agent for 10 seconds.—Fig. 10: Once the adhesive had been applied, the entire sealed cavity had a shiny surface.—Fig. 11: The first increment of Admira Fusion x-tra filled the mesial area of the cavity and shaped the approximal wall up to the level of the marginal ridge.





Fig. 12: Light curing of the restorative material for 20 seconds.—Fig. 13: Situation after removal of the matrix.—Fig. 14: The second increment of Admira Fusion x-tra filled the cavity completely.

siderable further development of ORMOCER-based composites for this range of application. However, the use of ORMOCERs is not limited to dental restoratives. These materials have been successfully employed for years in fields such as electronics, microsystems technology, plastic refining, preservation, anticorrosion coatings, functional coatings for glass surfaces, and highly resistant, scratch-proof protective coatings.<sup>39–41</sup>

ORMOCER-based dental restorative composites are currently available from two dental companies, VOCO (Admira product range) and DENTSPLY (Ceram-X). In the dental ORMOCER products to date, additional methacrylates were added to the pure ORMOCER chemistry

## Clinical case

A 47-year-old patient presented at our clinic requesting the gradual replacement of his remaining amalgam fillings with tooth-coloured restorations. In the first treatment session, we replaced the old amalgam filling in tooth #46 (Fig. 1). The tooth was immediately responsive to the cold test and the percussion test too was normal. Having been informed of the possible treatment alternatives and their costs, the patient elected to have a composite restoration with Admira Fusion x-tra using the bulk-fill technique.

Treatment started with thorough cleaning of the tooth with a fluoride-free prophylaxis paste

dam is compensated for by avoiding the changing of cotton rolls and the patient's requests for rinsing.

The cavity was then demarcated with a sectional matrix made of metal (Fig. 4). The universal adhesive Futurabond M+ (VOCO) was chosen for the adhesive pretreatment of the dental hard tissue. Futurabond M+ is a modern one-bottle adhesive compatible with all conditioning techniques: the self-etch technique and the phosphoric acid-based conditioning techniques (selective enamel etching or complete etch-and-rinse pretreatment of enamel and dentine). In this case, we chose the selective enamel etching technique, applying 35% phosphoric acid (Vocacid, VOCO) along the enamel margins

In the next step, the cavity, measured in advance with a periodontal probe (6 mm deep from the floor of the box to the occlusal marginal ridge), was filled with Admira Fusion x-tra in the area of the mesial box until a residual depth in the entire cavity of no more than 4 mm remained. At the same time, the mesial approximal surface was built up completely to the level of the marginal ridge (Fig. 11). The restorative material was cured by a polymerisation lamp (light intensity of > 800 mW/cm<sup>2</sup>) for 20 seconds (Fig. 12). The build-up of the mesial approximal surface converted the original Class II cavity into an effective Class I cavity, and then the matrix system was removed, as it was no longer required (Fig. 13). This facilitated access to the cavity with

appearance. Finally, a foam pellet was used to apply the fluoride varnish (Bifluorid 12, VOCO) to the teeth.

## Final remarks

The importance of direct composite-based restorative materials will continue to increase in the future. They produce scientifically verified, high-quality permanent restorations for the masticatory load-bearing posterior region, and the reliability of these has been documented in the literature. The results of an extensive review have shown that the annual loss rate for composite restorations in the posterior region (2.2 per cent) is not statistically different from that of amalgam restorations (3.0 per cent).<sup>43</sup> The increasing economic pressure in the health care sector has created the



Fig. 15: Shaping of a functional, but uncomplicated, occlusal anatomy.—Fig. 16: Curing the restoration. The vestibular cavity was filled in the next step.—Fig. 17: Result: finished, highly polished restoration. The function and aesthetics of the tooth were successfully restored.

(as well as initiators, stabilisers, pigments and inorganic fillers) in order to improve workability.<sup>42</sup> Therefore, it is more accurate to refer to ORMOCER-based composites.

According to the manufacturer, the new bulk-fill ORMOCER Admira Fusion x-tra (VOCO), launched in 2015, no longer contains any conventional monomers in addition to the ORMOCERs in the matrix. It features a nano-hybrid filler technology with an inorganic filler content of 84 per cent by weight. It is available in a universal shade and displays polymerisation shrinkage of just 1.2 per cent by volume and consequently low shrinkage stress. Admira Fusion x-tra can be applied in layers of up to 4 mm, with each increment being cured in 20 seconds (curing light intensity of > 800 mW/cm<sup>2</sup>). The malleable consistency and the other material properties of Admira Fusion x-tra allow the dentist to restore cavities using the bulk technique with a single material; an occlusal covering layer with an additional composite—as required when flowable bulk composites are used—is no longer necessary.

and a rubber cup to remove external deposits. As Admira Fusion x-tra is only available in a universal shade, there is no need for detailed determination of the tooth shade. After administration of local anaesthetic, the amalgam was carefully removed from the tooth (Fig. 2). After excavation, the cavity was finished with a fine-grit diamond bur and a rubber dam was placed to isolate the tooth (Fig. 3). The rubber dam separates the operating site from the oral cavity, facilitates clean and effective working, and guarantees that the working area remains free of contaminating substances, such as blood, sulcular fluid and saliva. Contamination of the enamel and dentine would result in considerably poorer adhesion of the composite to the dental hard tissue and would endanger the optimal marginal integrity of the restoration for long-term success. Additionally, the rubber dam protects the patient from irritating substances, such as the adhesive product. The rubber dam is thus an essential aid in ensuring quality and facilitating work in the adhesive technique. The minimal effort required in applying the rubber

and allowing it to work for 30 seconds (Fig. 5). The acid was then rinsed off for 20 seconds with a compressed air and water jet, and excess water carefully removed from the cavity with compressed air (Fig. 6). Figure 7 shows the application of a generous amount of Futurabond M+ to the enamel and dentine with a micro-brush. The adhesive was thoroughly rubbed into the dental hard tissue with the applicator for 20 seconds. The solvent was then carefully evaporated with dry, oil-free compressed air (Fig. 8) and the bonding agent light cured for 10 seconds (Fig. 9). The result was a shiny cavity surface, evenly covered with adhesive (Fig. 10). This should be carefully checked, as any areas of the cavity that appear matt are an indication that insufficient adhesive was applied to those sites. In the worst case, this could result in both reduced bonding of the restoration in these areas and reduced dentine sealing, which may lead to post-operative sensitivity. If such areas are found in the visual inspection, additional bonding agent must again be selectively applied to them.

hand instruments for shaping the occlusal structures in the further course of the treatment and, owing to the improved visibility of the treatment area, allowed improved visual control of the material layers subsequently applied. The second increment of Admira Fusion x-tra filled the residual volume of the cavity completely (Fig. 14). After the shaping (Fig. 15) of a functional, but uncomplicated, occlusal anatomy—which also helps to ensure rapid finishing and polishing—the restorative material was cured again for 20 seconds (Fig. 16). The vestibular cavity was filled in the next step.

After removal of the rubber dam, the restoration was carefully finished with rotary instruments and abrasive discs, and the static and dynamic occlusion adjusted. Diamond-impregnated silicone polishers (Dimanto, VOCO) were then used to give the surface of the restoration a smooth and shiny finish. Figure 17 shows the finished direct ORMOCER restoration, which reproduced the original tooth shape with an anatomically functional occlusal surface, physiologically shaped approximal contact and aesthetically acceptable

need for a simpler, faster and thus more cost-effective basic treatment alongside the time-consuming high-end restorations. For some time now, there have been composites with optimised depths of cure on the market for this purpose that can be used to create clinically and aesthetically acceptable posterior restorations using a procedure that is more cost-effective compared with traditional hybrid composites.<sup>44–45</sup> In addition to the bulk-fill composites with classic methacrylate chemistry, the range of products on offer in the field of composite adhesive materials with a large depth of cure has now been expanded with a nano-hybrid ORMOCER version.

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



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