Researchers bite into spinal cord injury rehab

Daniel Zimmermann
DTI

HONG KONG/LEIPZIG, Germany: In recent years, dental stem cells have increasingly been investigated for their use in medical applications, including the re-habilitation of lost or damaged biological functions. Scientists from the Nagoya University in the Nagasaki Prefecture in Japan have reported that they could possibly help to repair injuries of the spinal cord, leading to a cause of paralysis and disability.

Having transplanting human dental pulp stem cells into lab rats with severe spinal cord injury (SCI), they found that the animals regained significantly more limp function than through a transplant of human bone marrow stromal cells or skin-derived fibroblasts. According to the researchers, the cells not only inhibited the death of nerve cells, but also promoted the regeneration of severed nerves and replaced lost support cells with new ones, two main factors essential for functional rehabilitation.

“Spinal cord injury often leads to persistent functional deficits due to the loss of neurons and glia and to limited axonal regeneration,” they stated in the study published in the Journal of Clinical Investigation last week. “Our data demonstrate that tooth-derived stem cells may provide therapeutic benefits for treating SCI through both cell-autonomous and paracrine neuroregenerative activities.”

Investigating different types of stem cells for their potential in SCI rehabilitation has a long track record in science. This September, for example, researchers from the Medical College of Wisconsin reported that they had begun to implant dental pulp neurons into SCI patients. The Nagoya study is the first to have shown a rehabilitation effect in SCI cases with stem cells derived from dental tissue.

Classified by the grade of impairment, SCI can have mild to severe effects on patients, including total loss of biological function. Common therapies include surgery, long-term physical therapy and other rehabilitation efforts.

Award given to Specialist Dental Group

Specialist Dental Group has won a “Promising Brands” award at this year’s Singapore Prestige Brand Award organised by the Association of Small and Medium Enterprises (ASME) and the country’s largest Chinese-language newspaper Lianhe Zaobao. The annually trophy recognises up and coming brands in the city state that have been developed and managed effectively through various branding initiatives.

Prior to the winning the SPBA, Specialist Dental Group was already selected as one of three finalists for “Best Healthcare Experience” at the Singapore Experience Awards for the second year in a row.

Founded in 1979, the group has grown into one of the largest multi-speciality dental practices in Singapore employing dental specialist who offer treatment in areas such as prosthodontics, orthodontics, periodontics, oral maxillofacial surgery and paedodontics. According to SDG, their signature treatments include dental implants, braces, Invisalign, gum treatment, oral surgery, crowns/veneers and dentistry for children.
Early osseointegration to hydrophilic and hydrophobic implant surfaces in humans

Prof. Niklaus P. Lang
Switzerland

The surface characteristics of titanium implants influence the rate and degree of osseointegration. Moderately rough surfaces such as SLA® have demonstrated superior bone-to-implant contact (BIC) than surfaces such as plasma-sprayed (TPS), Al2O3-blasted or machined surfaces. Chemical modification, such as with the hydrophilic SLActive® surface, can further enhance the osseointegration process.

In investigations comparing osseointegration with various implant surfaces, data are available from human studies, and the healing sequence of the early osseointegration process in man and how it compares to the process seen in other in vivo investigations is relatively unknown.

The aim of this investigation, therefore, was to evaluate the rate and degree of osseointegration at two different implant surfaces (SLA® and SLActive®) during the early phases of healing in a human model.

Materials and methods

A total of 49 specially designed titanium implants (length 4 mm, outer diameter 2.8 mm) with either a SLA® or SLActive® surface were placed in the tromolar region of 28 healthy volunteers. A healing cap with an internal screw assembly was attached to the coronal part of the implant. After submerged healing periods of 7, 14, 28 and 42 days, the implants were removed using a specially designed trephine, which removed the implant and circumferential tissue of 1 mm thickness.

Histological sections were prepared and histometric analyses performed for amounts of new bone, old bone, bone-debris, soft tissue and BIC.

Results

Healing was uneventful at all sites. Of the 49 implants placed, 50 were available for histologically the osseointegration analysis of amounts of new bone, old bone, bone-debris, soft tissue and BIC.

SLActive® implants exhibited a greater rate and degree of osseointegration than SLA® implants. The osteocoating was noted to have been complete with SLActive® in humans, but almost complete with SLA®.

Conclusions

Similar healing patterns were observed for both SLA® and SLActive® implants. Osseointegration (BIC) was greater after 14 days and significantly greater after 20 days for SLActive®. The rate of osseointegration was substantially slower (approximately double the healing time) in humans than that observed in animal studies. This is the first study to demonstrate histologically the osseointegration process with SLActive® in humans.

Table 1: Percentage of BIC after 7, 14, 28 and 42 days.

<table>
<thead>
<tr>
<th>Healing periods in weeks</th>
<th>7 days</th>
<th>14 days</th>
<th>28 days</th>
<th>42 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLActive®</td>
<td>61.4</td>
<td>48.34</td>
<td>41.02</td>
<td>32.4</td>
</tr>
<tr>
<td>SLA®</td>
<td>56.6</td>
<td>52.75</td>
<td>51.02</td>
<td>37.7</td>
</tr>
</tbody>
</table>

Fig. 1: Light micrograph of the implant-tissue interface at a SLA® surface after 28 days (arrows indicate new bone).— Fig. 2: Light micrograph of the implant-tissue interface at a SLActive® surface after 28 days (arrows indicate struts of woven bone trabeculae extending from old bone, or OB, towards the implant surface).

Fig. 3: Light micrograph of the implant-tissue interface at a SLA® surface after 42 days (arrows indicate new bone).— Fig. 4: Light micrograph of the implant-tissue interface at a SLActive® surface after 42 days (arrow indicates struts of woven bone trabeculae extending from old bone, or OB, towards the implant surface).

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Contact Info

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Philippines comes out tops in DENTSPLY Asia Student Clinician Competition

This is the first time that a Filipino dental student has won the annual competition. During a first attempt to win the trophy in 2009, representatives from the Southeast Asian country only finished third place. As the winner, Calbaquinto will become a member of the Student Clinician American Dental Association and receive travel funding to represent the International Association for Dental Research South-East Asia division at next year’s session of the American Dental Association in San Francisco, university officials said.

This year’s competition was held in conjunction with the 25th Convention of the International Association for Dental Research and 22nd Annual Meeting of the South East Asia Association for Dental Education in Singapore and joined by winners of national student clinicians competitions held in countries like Malaysia, Singapore, Vietnam and Indonesia.

The report published by the Australian Institute of Health and Welfare (AIHW) in Canberra gathered information from surveys conducted and managed by the Australian Research Centre for Population Oral Health. It also found that over two-thirds of adults in the country had to pay for various dental treatments out-of-pocket, despite having insurance and nine per cent had to pay for their dental expenses fully.

The results could fuel demands for the creation of a universal Denticare scheme by the Green party, who made improved access to dental care a condition for a coalition with the Labor party in last year’s federal elections. Both parties have clashed repeatedly over the issue in the last twelve months.

As a basic commitment, the government recently announced that it would provide additional funding of AUS$55 million (US$56 million) for dental care next year and set up a National Advisory Council on Dental Health in order to develop recommendations on the reform of the deficient public dental health care system. Prior to that, Labor angered its coalition partner with plans of scrapping dental funding from its 2012 budget entirely.

According to the AIHW report, almost 50 per cent of adult Australians had untreated tooth decay in 2006. It also found that every second teenager had cavities in their permanent teeth at the age of 15.

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Dr Young-Guk Park

A specialty cemented in biology

The ultimate goal of any orthodontic treatment is to obtain better aesthetics of the dentition and the face, and the health of the periodontium. TMJ and longevity of the dentition throughout life by means of accurate diagnosis and merchandising treatment upon malocclusion and dento-facial disharmony. Bringing all these propositions together requires discipline and conceptual orthodontic planning. The orthodontic practitioner may be the differences that are frequently observed in the outcome of orthodontic treatment between patients with similar malocclusions but different biological responses.

Principles of orthodontic biomechanics are usually taught with the help of a patient case, consisting of artificial teeth embedded in wax. This set-up ignores entirely the biological aspects of orthodontic treatment. However, in the clinical setting, living patients are one of the most powerful and mechanical forces mobilise the teeth. These movements result from the development of strains in dental and para-dental tissues, followed by modelling and remodelling of these tissues.

In some patients, systemic conditions may exist, evoking complications such as root resorption, dehiscences and fenestrations of the alveolar bone. Hence, clinical orthodontists must be viewed as a specialty cemented in biology, all the way down to the molecular level. As a clinical profession, it must be based also on a profound knowledge of medicine, biology, physiology, and pathology.

The usual rate of tooth movement by conventional protocols of mechanotherapy is approximatel y 1 mm per month. The suggested minimal intervention, surgically assisted orthodontics is a minimally invasive peri-orthodontic procedure without flap elevation. However, it accelerates tooth movement with an enhanced turnover rate of biological structures. This smile is clinically expedient with sound biological foundation, and makes the orthodontic outcome more stable and less prone to complications. It has elucidated the evidence that minor surgical procedures by orthodontists lead to accelerated rates of tooth movement with im- pa- surity, and enhanced the rate of bon- and periodontal tissue recovery, thereby shortening the duration of treatment.

Clinical orthodontics has seen innovation of technology and increasing use of digital dentistry as these applications have brought cutting-edge technology to diagnosis and treatment. Laser scanning, structure photo-imaging, and surface image analysis have almost superseded the stone model in the clinical environment. In addition, these technologies enable clinicians to achieve an intended treatment re-sult through individual custom app-la-nances made possible by robotics that allow sophisticated individ-ual tooth positioning, a procedure that was not possible with conven- tional preformed appliances.

These diverse technologies bring the prospective adjustment in fundamental features of the conventional treatment, and con-sequently improve the accuracy of the orthodontic correction.

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4 Opinion

A leap for endodontics

The single most important development that was a giant leap for endodontics is micro-computed tomography, by giving us a 3-D view of the area in which we have to work. Without this technology, the basis for many endodontic procedures was just empirical. For example, enlarging the root canal three sizes beyond the first file that binds, or arbitrarily deciding the final api-cal size with tapered rotary use- d during hand instrumentation does not have any scientific basis at all.

The work of Prof. Marco A. Versiani on the root canal anatomy project has provided us with valuable information on the complex anatomy that has demystified many old con- cepts. Now we know that all root canals are curved, apical diameters are not as small as perceived, and root canals do not have large tapers.

Regenerative endodontics, though in the infant stage, can hold significant implications for the management of necrosis of immature teeth. This applies to the advances in tissue engineering and regenerative processes in the pulp-dentin complex.

Multiple studies have shown that continued root develop- ment can be accomplished after disinfection of the root-canal system, evoked bleeding inside the canal, and restoration of the coronal seal. These treatment protocols can result in radi-o- graphic and clinical evidence of healing and subsequent root development that has been attributed to regeneration of tis-sue.

Until recently, the clinical presence of stem cells in the canal space after this procedure had not been proven. New findings by Tyler W. Lovelace et al. demonstrated that the evoked bleeding step in regenerative procedures triggers the signifi-cant accumulation of undiffer- entiated stem cells in the canal space, where these cells might contribute to the regeneration of pulpal tissues. Future develop- ments may further expand the application of these tissue-engineering prin-ciples, which have the potential to revolutionise the field of endodontics.

The use of lasers in endodontics may be common procedure soon with a number of applica-tions in access preparation, root- canal shaping, and decontami-nation of the root-canal system. The improved technology has introduced endodontic fibre-tips and tips of a calibre and flexibil- ity that permit access into canals 0.1 mm from the apex. Laterally emitting conical fibre tips were found to be safe under defined conditions for intra-canal irradiation without harmful thermal effects on the periodontal appar-atus.

The EndoVac irrigation sys-tem (Discus Dental) is one of the best things that has happened to endodontics in recent years. While sodium hypochlorite is the only endodontic irritant capable of significantly eliminating the biofilm associated with en-dodontic infections, it has ten-tancy to cause catastrophic tissue damage when extruded.

With EndoVac, fortunately, it can now be safely delivered to..."it is heart-warming to see that recent developments in endodontics can maintain the tooth in a functional state.”

Harmonic teeth, muscles and joints

Dr Sushil Koirala

Since I have been involved in cosmetic dentistry, the field has been dominated by the Hollywood concept of wide and symmetrical white smiles regardless of age, sex and ethnicity. Cosmetic orient-ation has also been influenced for many years by fashion and the me-dia that have been encouraging clinicians to compromise biologi-cal function in favour of the cos-metic desires of the patients.

Fortunately, public taste in smile aesthetics is moving towards the nature-nurturing concept and the one-for-all smile design con-cept is slowly fading. Nowadays, an increasing number of clinicians are adopting a customised smile design approach that respects pa-tients’ actual needs, age, sex, ethni-city and functional needs.

With an increased awareness of ethical cosmetic dentistry on a global scale, clinicians are be-coming much more aware about the loss of biological function in the treatment they are providing. It has been very encouraging to see that during the recent IFED-meeting in Brazil, many of the specialists have adopted concepts like minimally invasive cosmetic den-tistry (MID), which they are ap-lying in their own practice. With this in mind, I can clearly foresee that in the years to come cosmetic den-tistry will fully merge with the MID concept and treatment protocols that promote healthy, functionally balanced and aesthetic smiles.

With new digital diagnostic and restorative tools, accuracy and the period necessary for treatment are becoming important factors in cosmetic dentistry. Treatment us-ing high magnification and good illumination combined with digi-tal case documentation could be- come mandatory clinical protocol in the years to come.

Another area of change will be case finishing. Currently, the field focuses primarily on micro-aesth-etic components and restoration of optical properties, shape, propor-tion, texture, and surface and mar-gin finish. With the recognition that functional factors like individual tooth contact forces and timing, which are key to achieving a functionally balanced bite. This lack of force finishing in cosmetic dentistry can result in frequent restora-tion fractures or myofascial pain dys- function syndrome, a condition that often occurs after treatment.

Cosmetic dentists will most likely adopt the force finishing concept in their finishing protocol.

Harmonic teeth, muscles and joints (TMJ) will be the most important criteria by which to evaluate clinical success in cosmetic dentistry. The value of function will be much better understood by cosmetic dentists so that the MID harmony will be implemented to promote naturally pleasing and functionally balanced smiles.

As far as restorative materials are concerned, the field will see a rising demand for healing effects, for example, to prevent hard and soft tissue loss. Restorative techn-ologies will also more likely move towards direct restorative processes.

It is difficult to predict what technologies will shape the field of cosmetic dentistry in the future, but in my view, technology in general will be more focused on decreasing the loss of biological function, while minimising financial costs and time spent on treatment. It will be crucial to have practitioners with a clear vision to achieve overall health, function, aesthetics and positive psychologi-cal impact after treatment.
Ban on HIV dentists in the UK could be lifted

According to latest news reports, HIV-positive dentists and doctors in the UK could soon be allowed to practise again, provided they are taking anti-retroviral drugs and are being monitored, British media report. The newspaper The Independent, the UK Department of Health is to announce that the automatic ban on dentists and doctors with HIV carrying out procedures that might potentially lead to blood contamination could soon be lifted.

The possible regulation change comes after a study of the evidence presented to the Chief Medical Officer Dame Sally Davies, which concluded that the risk of transfer during any medical procedure is now negligible and the likelihood of any infection to be as low as one case every 2,400 years.

The prohibition, which has been in place for 20 years, forbids health workers in the UK who are infected with HIV to perform exposure-prone procedures. Hospitals and dental surgeries have long followed a “don’t ask, don’t tell” policy with regard to HIV positive practitioners, sources in the medical profession told the newspaper. They believe that—regardless of the emotive nature of HIV—the policy can no longer be justified on public health grounds and that it is therefore clearly discriminatory.

LONDON, UK: HIV-positive dentists and doctors in the UK could soon be allowed to practise again, provided they are taking anti-retroviral drugs and are being monitored, British media report. According to newspaper The Independent, the UK Department of Health is to announce that the automatic ban on dentists and doctors with HIV carrying out procedures that might potentially lead to blood contamination could soon be lifted.

The newspaper has learnt that ministers are planning to hold a consultation before Christmas to obtain views from across the medical and dentistry professions, as well as from experts and members of the public. A final decision will probably be made in 2012.

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To the Editor

Re: “Editorial: Use of botox is a medical procedure” (Dental Tribune Asia Pacific Vol. 9, No. 11, page 4)

Pretty well everything about dentistry was covered at a basic level to enable graduation, just as medical practitioners graduate with very basic information. The test for medical and dental practitioners is how conscientiously they pursue CPD throughout their careers. If the dental or medical practitioner has attended approved courses in botox therapy, and has taken the subject seriously, there should be no problem with him/her administering botox. I’m a dental practitioner, and choose not to administer botox for cosmetic purposes. Currently, I would regard myself as requiring further information and training before using it in any form. However, I feel confident that under the right tutors I would acquire the skills required quickly. My colleague is very experienced and is “only a general dentist”, but he has spent considerable time and money to acquire the necessary education, training and competence. Use of botox is a medical procedure. Dentistry is a medical specialty. Dentists are more than competent to administer botox if trained properly.

Dr Martin Edwards, 01 Dec. 2011

Secondly, the detailed anatomy of the mid-face, orbit, upper face and neck is not covered in dental training at a level sufficient for the safe use of botox—I don’t know where you went to dental school but I was trained A LOT on head and neck anatomy. I completed a dermatology rotation in my residency. The pharmacology coursework taught me to evaluate new drugs, not just memorize the properties of existing drugs. Cosmetic dentistry and cosmetic medicine don’t overlap? Get a grip; your arguments are very weak.

Dan, 01 Dec. 2011
LEIPZIG/HEIDELBERG, Germany: The spirit of General Patton is greeting patients at the door. Only a few metres away from the hospital room where one of America's most famous war heroes regrettably died in 1945, Lieutenant Colonel Cathleen Labate has just begun her daily shift. The dental provider from New Hampshire is one of almost 100 army dentists currently serving in the Europe Regional Dental Command (ERDC) at the Nachrichten Kaserne in Heidelberg, a small German town idyllically situated along the edge of the Odenwald forest. There she is jointly responsible for the oral health of several hundred soldiers and their family members in the surrounding Army communities.

Labate was recently assigned to another Army dental clinic in Vicenza in Italy. Prior to that, the descendant of German-Italian immigrants worked in private practice in the US for almost 20 years. The oral health of soldiers she sees at the base on a daily basis is often better than those of the patients she treated during her career as a dentist in rural America. Consequently, the most common procedures here are regular dental exams and emergency work like the removal of the periodontal abscess of a retired army officer who has just left her office. “Generally speaking, the oral health of people in the military is good,” she says. “Although I have to admit that missions like those in Iraq and Afghanistan can seriously take their toll on soldiers’ teeth.”

Colonel William R. Bachand could not agree more. The 58-year-old Commander of the ERDC has been with the Army Dental Corps for more than 32 years. In stressful situations like armed conflicts, he says, oral hygiene quickly declines with every single soldier. Along with the high intake of acid and sugar-rich fluids, especially in hot climates like Afghanistan, this negligence often leads to major dental problems, a phenomenon that Army dentists experienced in earlier conflicts like Korea or Vietnam. At the beginning of the last two engagements in Iraq, for example, statistics showed a 30 per cent increase in returning soldiers with signs of rampant caries or gingivitis.

Bachand currently commands over 20 army dental clinics, spread over US bases in Germany, Italy and Belgium. Worldwide, the military employs over a thousand dental officers in three major regions—the US, Europe and the Pacific. Before he took command of the ERDC front Colonel Randall Ball last year, Bachand served as the commander of the Pacific Regional Dental Command in Hawaii, a post very different in many aspects to that in Europe.

“In the Pacific you have a smaller population but huge distances to cross between each base and clinic,” he says. “In Europe, everything is conveniently reachable at a driving distance.”

Bachand’s scope of duty could soon become even smaller, as the US Army is in the process of significantly pulling back troops from Europe. According to the latest plans of the US Department of Defense, over 4,000 soldiers are to be relocated to the US mainland over the next two years. For the ERDC, this would mean the closure of several clinics and the relocation of dental personnel. In Germany, the clinics in Heidelberg and nearby Mannheim in particular will be closed by 2013, a process that comes with numerous challenges, says Bachand.

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“This transformation will be complex because owing to the closure of Army bases, large numbers of soldiers are moving within Europe. In addition, we’ll have to minimise job losses of our civilian
contractors like German dental technicians we usually hire from the nearby areas,” he tells Dental Tribune.

Serving for more than 100 years

Dentists have always been part of US military forces. Before Congress signed the bill for the establishment of a commissioned Dental Corps in 1911, dentists and other health care professionals had been working for the Army on a contract basis since the Revolutionary Wars of the 18th century. Full financial and operating autonomy, however, was not achieved until 1977 when the dental command was finally separated from the medical service, a command structure that had previously led to low morale and retention rates amongst dental officers.

Nowadays, the dental service in Europe alone has an annual budget of US$18 million, of which the most part is spent on personnel and dental equipment. In terms of dental supplies, the Army rides the patriotic train, with all chairs being provided solely by US manufacturers like A-dec and Pelton & Crane. Long-term contractor Henry Schein also just closed another exclusive US$172 million contract with the service for 2012.

Most army dentists enter the service through the Health Professions Scholarship Program, a competitive one-to-four-year paid educational programme available for several medical-related posts throughout the military forces. Others are directly recruited by the Army, including many older dentists who often want to do a last service for their country.

According to Bachand, the Corps is currently short a few hundred officers worldwide, despite the fact that Army dentists are much on par with their civilian counterparts and enjoy several advantages like paid education or a concise career development plan. Each year, for example, the Army provides them with 30 hours of continued education and even sends specialists back to the States for conferences like the recent annual congress of the American Dental Association in Las Vegas.

Despite the more stable lifestyle, switching places with dentists in the civil world does not seem to be an option for Bachand anymore.

“What I like especially about military dentistry is the group practice approach and the possibilities to really focus on the clinical needs of every individual patient. Even though we have to be responsible financial stewards, we do not have to worry so much about the business aspects in regard to specific treatment for patients,” he concludes. “I would never trade that experience.”

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After explaining the basic physics of the laser and its effects on both bacteria and dental surfaces, the second part of this article series will analyse some of the most important research in the international literature today and the new guidelines for the use of lasers as a source of activation of chemical irritants.

**Laser-assisted endodontics**

**Preparation of the access cavity**

The preparation of the access cavity can be performed directly with Er:YAG lasers, which can ablate enamel and dentine. In this case, the use of a short tip is recommended (from 4 to 6 mm), with diameters between 600 and 800 µm, made of quartz to allow the use of higher energy and power. The importance of this technique should not be underestimated.

Owing to its affinity to tissues richest in water (pulp and carious tissue), the laser allows for a minimally invasive access (because it is selective) into the pulp chamber and, at the same time, allows for the decontamination and removal of bacterial debris and pulp tissue. Access to the canal orifices can be accomplished effectively after the number of bacteria has been minimised, thereby avoiding the transposition of bacteria, toxins and debris in the apical direction during the procedure. Chenzir et al. demonstrated that bacteria are killed during cavity preparation up to a depth of 500 to 600 µm before the radiated surface. Moreover, Erbium lasers are useful in the removal of pulp stones and in the search for calcified canals.

The Erbium:YAG (Er:YAG) laser weapons have received FDA approval for cleaning, shaping and enlarging canals. A few studies have reported positive results for the efficacy of these systems in shaping and enlarging radicular canals. Shirol et al. used an Er:YAG laser system with a conical tip with 80% lateral emission and 20% emission at the tip to enlarge the canals using H2O and energy at 10 Hz, obtaining cleaner dentinal surfaces compared with traditional rotary techniques.26 In a preliminary study on the effects of the Er:YAG laser equipped with a microscope with radiolisation of 200 to 400 µm, Kedel et al. found that the laser has good capabilities for enlarging and shaping in a faster and improved manner compared with the traditional method. The SEM observations demonstrated a uniformly cleaned dentinal surface at the apex of the canal.27

**Fig. 5**

Localisation to 1 mm from the apex of the fibre and tips of the near and medium infrared lasers. The preparation of the canals and NITI instruments is still the gold standard in endodontics today. In fact, despite the recognised ablative effect of Erbium lasers,28,29 2.780 and 2.940 mm on hard tissue, their effectiveness in the preparation of root canals appears to be limited at the moment and does not correspond to the endodontic standards reached with NITI technology.32 However, the Erbium, Chromium YSGG (Er,Cr:YSGG) and Nd:YAG lasers are useful in the removal of pulp residue and well-cleaned dentinal surfaces compared with traditional rotary techniques.26

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Stabholz et al. presented positive results of treatment performed entirely using an Er:YAG laser and endodontic lateral emission microprobes.27,30 Ali et al., Matsuka et al. and Jabbari et al. used the Er,Cr:YSGG laser to prepare straight and curved canals, but in these cases, the results of the experimental group were worse than those of the control group. Using the Er:Cr:YSGG laser with 200 to 250 µm tips at 2 W and 20 Hz on straight and curved canals, they concluded that the laser radiation is able to prepare straight and curved (less than 10°) canals, while curved (more than 10°) canals, the use of a short tip is recommended (from 4 to 6 mm), with diameters between 600 and 800 µm, made of quartz to allow the use of higher energy and power. The importance of this technique should not be underestimated.

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Stabholz et al. presented positive results of treatment performed entirely using an Er:YAG laser and endodontic lateral emission microprobes.27,30 Ali et al., Matsuka et al. and Jabbari et al. used the Er,Cr:YSGG laser to prepare straight and curved canals, but in these cases, the results of the experimental group were worse than those of the control group. Using the Er:Cr:YSGG laser with 200 to 250 µm tips at 2 W and 20 Hz on straight and curved canals, they concluded that the laser radiation is able to prepare straight and curved (less than 10°) canals, while curved (more than 10°) canals, the use of a short tip is recommended (from 4 to 6 mm), with diameters between 600 and 800 µm, made of quartz to allow the use of higher energy and power. The importance of this technique should not be underestimated.

Owing to its affinity to tissues richest in water (pulp and carious tissue), the laser allows for a minimally invasive access (because it is selective) into the pulp chamber and, at the same time, allows for the decontamination and removal of bacterial debris and pulp tissue. Access to the canal orifices can be accomplished effectively after the number of bacteria has been minimised, thereby avoiding the transposition of bacteria, toxins and debris in the apical direction during the procedure. Chenzir et al. demonstrated that bacteria are killed during cavity preparation up to a depth of 500 to 600 µm before the radiated surface. Moreover, Erbium lasers are useful in the removal of pulp stones and in the search for calcified canals.

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this wavelength has no affinity and therefore no ablative effect on hard tissue. Decontamination is performed at the end of the traditional endodontic preparation as a final means of decontaminating the endodontic system before obturation. An optical fibre of 200 µm diameter is placed 1 mm from the apex and retracted with a helical movement, moving continuously for five to ten seconds (according to the different procedures). Today, it is advisable to perform this procedure in a canal filled with endodontic irrigant (preferably, EDTA) to reduce the undesirable thermal morphological effects.9–11

Using an experimental model, Scoop et al. demonstrated the manner in which lasers spread their energy and penetrate into the dentinal wall, showing them to be physically more efficient than traditional chemical irrigating systems. Specifically more efficient than traditional wall, showing them to be phy-

Ongoing studies are evaluating the efficacy of a new laser technique that uses a newly designed both radial and tapered stripped tip for removal of not only the smear layer, but also bacterial biofilm.11 The results are very promising. The Er:YAG lasers with “end firing” tips—frontal emission at the end of the tip—have little lateral penetration of the dentinal wall. The radial tip was proposed in 2007 for the Er:Cr:YSGG, and Gordon et al. and Schoop et al. have studied the morphological and decontaminating effects of this laser system (Fig. 6).10–11 The first study used a tip of 200 µm with radial emission at 20 Hz with air/water spray (34 and 28 %) and dry at 10 and 20 µl and 20 Hz (0.2 and 0.4 W, respectively). The irradiation times varied from 15 seconds to two minutes. The maximum bactericidal power was reached at maximum power (0.4 W), with a longer exposure time, without water in dry mode and with a 99.71 % bacterial eradi-

Decontamination with medium wavelength laser

Considering its low efficacy in canal preparation and shaping, using the Er:YAG laser for decon-
tamination in endodontics requires the use of traditional techniques in canal preparation, with the canals prepared at the apex with ISO 25/30 instruments. The final passage with the laser is possible thanks to the use of long, thin tips (200 and 520 µm), available with various Er:YAG instruments, allowing for easier reach to the working length (1 mm from apex). In this methodology, the traditional technique is to use a helical movement when retracting the tip (over a five- to ten-second interval), repeating three to four times depending on the procedure and alternating radiation with irrigation using com-

The 3-D decontamination of the endodontic system with Er:YAG lasers is not yet comparable to that of the newer Er,Cr:YSGG lasers. The thermal energy created by these lasers is in fact absorbed primarily on the sur-

dation of the dentinal wall. The thermal energy has little and varying affinity of these wavelengths for hard tissue. The diffusion capacity, which is not uniform, allows the light to reach the endodontic irrigant (preferably, EDTA) brought about a more or less uniform, allows the light to reach the hard tissue. Due to the low and varying affinity of these wavelengths for hard tissue.

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The need to take advantage of the thermal effect to destroy bacterial cells, however, results in changes at the dentinal and periodontal level. Its important to evaluate the best parameters and explore new techniques that reduce the undesirable thermal effects that lasers have on hard- and soft-tissue structures to a minimum.

Morphological effects on the dentinal surface

Numerous studies have investigated the morphological effects of laser radiation on the radicular walls as collateral effects of root canal decontamination and cleaning performed with different lasers. When they are used dry, both the near and medium infrared lasers produce characteristic thermal effects (Figs. 7 & 8). Near infrared laser (Nd:YAG)-characterized morphological changes to the dentinal wall: the smear layer is partially removed and the dentinal tubules are primarily closed as a result of melting of the inorganic portion of dentinal tubules. Re-crystallization bubbles and cracks are evident (Figs. 8-12). Water present in the irrigation solutions limits the thermal interaction of the laser beam on the dentinal wall and, at the same time, workthermally activates a smear layer and the water vaporizes. With a medium infrared laser (target chromophore) with its specific action (dissecting or chelating). The radiation at the near infrared laser—diode (2.5, 5, 15 Hz) and Nd:YAG (1.5 W, 808 nm, 15 Hz)—performed in this study, the solution produces a better dentinal pattern, similar to that obtained with only an irrigant.

Radiation with NaOD or chlorhexidine produces a morphology with closed dentinal tubules and used. There is evidence of ledge cracks, areas of superficial melting and vaporisation of the smear layer.

A typical pattern arises when dentine is irradiated with the Erbium laser in the presence of water. The thermal damage is reduced and the dentinal tubules are open at the top of the peri-tubular more calcified and less ablated areas. The inter-tubular dentine, which is richer in water however, is more ablated. The smear layer is vaporised by radiation with Erbium lasers and is mostly ablated. Shoup et al., investigating the variations of temperature on the radicular surface in vitro, found that the standardised energies (100W, 15Hz, 1.5W) produced a measured increase in the core of only 5.5 °C on the periodontal surface. Moritz proposed these parameters as the international standard of use for the Erbium laser in endodontics, claiming it as an efficient means of canal cleaning and decontamination (Figs. 11-16). Even with Erbium lasers, it is advisable to use irrigating solutions. Alternatively, NaOD can be utilised during the terminal phase of laser-assisted endodontic therapy with a resulting dentinal pattern, with fewer thermal effects. This represents a new area of research, using laser-assisted endodontics. Various techniques have been proposed, such as laser-activated irrigation (LAI) and photon-initiated photoacoustic streaming (PIPS).

Photo-thermal and photochemical phenomena for the removal of the smear layer

George et al. published the first study that examined the ability of lasers to activate the irrigating liquid inside the root canal to increase its action. In this study, the interdental space, the tips of both the laser systems—Er:YAG and Er,Cr:YSGG (400 µm diameter, both flat)—were investigated. The lateral flow of the irrigating solution and the collapse of the molecules of water in the irrigating solutions used.

Hmud et al. investigated the possibility of using near infrared lasers is highly effective in minimising the thermal effects on the dentine and the radicular surface. In a recent study, Madaio et al. concluded that the main role of activation as a strong modulator of the reaction of NaOCl. During a rest interval of three minutes, the consumption of available chlorine increased significantly after LAI compared with PUI or CI.

Photoinitiated photoacoustic streaming

The PIPS technique presupposes the use of erbium laser (Powerlase AT/HT and Light-Walker AT, both Forus) and its interaction with irrigating solutions (ETI or distilled water). The technique uses a different mechanism from the preceding LAI. It exploits the photoacoustic and photochemical phenomena exclusively, which result from the use of subablative energy of 20 mJ at 1515 Hz, with impulses of only 50 µJ. With an average power of only 0.5 W, each impulse interacts with the water molecules at a peak power of 400 W, creating expansion and successive “shock waves” and leading to the formation of a powerful flow of fluids inside the canal, without generating the undesirable thermal effects seen with other methodologies.

The study with thermocouples applied to the radicular apex found revealed only a 1.2 °C thermal rise after 20 seconds and 1.5 °C after 40 seconds of continuous radiation. Another considerable advantage was derived from the insertion of the tips into the root canal, the direct entrance to the root canal and without the problematic insertion of the tips into the root canal or 1 mm from the apex required by the other techniques (LAI and CI). Newly designed tips (12 mm in length, 250 to 400 µm in diameter and with "radial and striped" terminals) are used. The final 5 mm are with a microtip to achieve subablative emission of energy compared with the frontal tip. This mode of energy emission minimises the thermal effect of the laser energy when, at subablative levels, delivery with very high peak power and a short duration (500 W) produces powerful "shock waves" and vaporisation of the smear layer. In a later study, the authors also verified the safety of using these tips showing that the treatment caused a rise in temperature of 50 °C in the intra-canal irrigant solution but only of 4 °C on the external radicular surface. The study concluded that irradiation activated near infrared lasers are used efficiently in minimising the thermal effects on the dentine and the radicular surface. In a recent study, Madaio et al. concluded that the LAI technique, using lower irrigation times (four times) produces a 3.5 °C thermal rise on the periodontal surface. Hmud et al. also investigated the hypothesis of a minimally invasive surgical technique in Rome. He can practises endodontics in the last 20 years has been directed towards minimising the thermal effects on the dentinal walls, using lower power in the presence of chemical irrigants. EDTA has proved to be the best solution for the LAI technique that activates the liquid and increments its chelating capacity and cleaning of the smear layer. The use of EDTA and NaClO in minimising the thermal effects on the dentinal walls, using lower power in the presence of chemical irrigants. EDTA has proved to be the best solution for the LAI technique that activates the liquid and increments its chelating capacity and cleaning of the smear layer. The use of NaOD and NaOCl is promising,
Laboratory-fabricated ceramic in- and onlays and tabletopt offer dental technicians the possibility to design a detailed morphology and create a life-like shade design. In this sense, they are a good alternative to direct restorations of posterior teeth with composite resin. This article will discuss the fascinating possibilities offered by IPS e.max Press and IPS e.max Ceram (Ivoclar Vivadent) for the fabrication of all-ceramic inlays.

With IPS Empress 2 and the IPS Empress layering ceramic from Ivoclar Vivadent, I discovered a special all-ceramic system seven years ago. Back then, the company was praising the highly aesthetic results that dentists were able to achieve with this system, particularly with regard to shade design in single crowns, as well as in- and onlays. I was interested to find out for myself and so I tested the system.

Although the material generally met my expectations, I found that its strength was still not optimal for the fabrication of inlays and onlays. Great care had to be taken while sand-blasting the thin restoration margins in order to prevent them from breaking. The entire processing therefore became rather time-consuming. However, this problem did not stop me from continuing to work with the material, as the aesthetic results made all efforts worthwhile.

Meanwhile, the IPS e.max Press lithium disilicate (LS2) glass-ceramic ingots provide dental technicians with a range of materials that allows them to meet all requirements in terms of mechanical properties and aesthetics. Chipping, as it tended to occur under time pressure, is a thing of the past, thanks to an outstanding strength of 400 MPa.

The IPS e.max Press range comprises five ingot types with different translucencies. I currently use the LT, HT and Impulse ingots for inlays and onlays (LT = low translucency, HT = high translucency).

Shade determination
Shade determination is crucial in the fabrication of ceramic restorations. I usually take the canine as a reference, as this tooth shows a very high dentine portion. In this clinical case, an LT ingot in the shade B3 was selected owing to the size and depth of the lesion (Figs. 1 & 2).

The shade of the cervical area of the tooth was B3, and a brighter shade was selected for the cusps (B2). I wanted the restoration to show a shade saturation from the inside. Owing to the depth of the defect, an LT ingot with lower translucency and a life-like brightness value and chroma was selected instead of an HT ingot. An inlay of this size might have shown a greenish shade effect if an HT ingot had been used.

After the shade group had been determined on the basis of the canine, all following work steps were completed within this shade group, in this case shade group B. To illustrate this, the canine in this case had the shade B5; consequently, all the work was planned to lighten up or darken this shade according to the specific requirements.

To document this patient case, two different approaches were pursued. On the one hand, a cut-back IPS e.maxPress framework was layered with IPS e.max Ceram, and on the other hand, a fully anatomical inlay was pressed and characterised during the glaze firing.

The layering technique
At the beginning, residues of the investment material were removed from the framework with glass polishing beads. Owing to the excellent strength of the LS2 material, the risk of restorations breaking at the margins is very low.

After the sand-blasting, glaze liquid was applied in a thin layer and dentine powder in the same shade as the ingot was sprinkled onto the framework. This procedure improves the bond between the layering ceramic and the LS2 material and additionally creates a “diamond effect” under incident light (Figs. 3a–d).

The layering diagram applied after stain firing was fairly straightforward. The B2 for the cusps, some Opal Effect 2 (OE2) between the cusps towards the central fossae (depth effect) and some Transpa Incisal (TI1) to imitate the anatomy of the posterior tooth. This layer, however, was restricted to 0.2 mm below the final restoration outline in order to leave some room for OE4 material, which is capable of reflecting light to some extent and, therefore, used often to imitate the whitish effect seen on the cusps (Figs. 3a–d). After the layering and another firing cycle at 750 °C, I focused on the design of the surface textures, which I

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created with rotary grinding instruments and sealed by means of a glaze firing conducted at 715 °C. Finally, the restoration was polished with rubber polishers and a diamond paste (Fig. 6).

The staining technique
All morphological properties of this molar, including the surface texture, were already designed in the wax-up. After the ceramic inlay had been pressed and divested, the surface was slightly ground and the contact points and the occlusion were checked (Fig. 7).

The same stains as the ones used in the layering technique were applied and subsequently fired in a stain and characterisation firing (Figs. 8a & b). It is advised not to apply the stains too excessively in order to prevent a mirror effect. If too much material is applied, the light is reflected from the restoration surface and cannot penetrate it. As a result, the desired translucency cannot be achieved.

The shape and the marginal adaptation were checked with silver powder before and after the glaze firing. Finally, the restoration was polished to a high gloss with a rubber polisher and diamond paste (Fig. 9).

Comparison
Both restorations were tried in intra-orally and showed a nearly perfect marginal fit. As a consequence, the restoration that was actually to be cemented into place had to be selected on aesthetic criteria. The monolithic structure and the fact that only pressed LS2, the strongest pressable ceramic tested to date, was used would have been a reason to use the stained restoration (Fig. 10).

With regard to mechanical and functional properties, this restoration would have been first choice; however, it did not show the desired translucency. When the two restorations were compared, the layered restoration clearly showed a superior shade effect (Fig. 11), and thus was permanently seated (Fig. 12).

Conclusion
IPS e.max Press and Ceram in combination with an adhesive cementation protocol represent a valuable asset for dental technicians. The system allows the fabrication of highly aesthetic inlays with an excellent strength and many advantages for patients and clinicians alike, thus providing a highly attractive alternative to direct inlay restorations.
The problem of white spot lesions
A new method for remineralisation post-orthodontic treatment

Deminerlised white spot lesions occur frequently after orthodontic treatment. Some teeth are more prone to demineralisation, typically the maxillary lateral incisors and the mandibular canine teeth. The disto-gingival area of the labial enamel surface is the area most commonly affected (Fig. 1). In the first few weeks after removal of the fixed appliances, there is a reduction in white spot lesion size and appearance, possibly due to the action of saliva (Fig. 2).

Various treatment methods have been proposed to assist the process of remineralisation. It is important to note that fluoride should not be used in high concentration, as it tends to prevent demineralisation and can lead to further unsightly staining. Low concentrations of fluoride, however, may assist remineralisation, such as those found in casein calcium phosphate materials. Additionally, stimulation of salivary flow by chewing sugar-free gum is helpful.

This article will describe a revolutionary new approach to the cosmetic treatment of white spot lesions (Figs. 3). With Icon, a microinvasive technology from German manufacturer DMG, demineralised enamel can be filled and reinforced without drilling or anaesthesia (Figs. 4 & 5).

One of the reasons that earlier approaches to the treatment of white spot lesions have fallen short is that fluoride therapy is not always effective in the advanced stages, and the use of restorative fillings usually sacrifices significant amounts of healthy tooth structure. Instead of adopting a wait and see approach, Icon has been shown to arrest the progress of early enamel lesions up to the third of dentine in one simple procedure (Fig. 6), without unnecessary loss of healthy tooth structure.

In the procedure described here, the surface area of the white spot lesion is eroded with a 15 % HCl gel, which opens the pore system of the lesion. This is then dried with ethanol, followed by the application of Icon onto the lesion with the application aid. The extremely high penetration coefficient enables it to penetrate into the lesion pores. Excess material is then removed, and the material is light-cured. The total treatment time should be about 15 minutes (Fig. 7).

The cosmetic treatment of cariogenic white spots in one visit can be very appealing, especially to young patients and their parents (Figs. 5a & b). No drilling or anaesthesia is required and those patients who have already demonstrated poor compliance with their brushing can be treated earlier. I would recommend that clinicians try the Icon product when attempting to remineralise white spot lesions post-orthodontic treatment. This is not just minimally invasive dentistry; it is microinvasive dentistry.

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Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7
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