Dental Tribune

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ENDO TRIBUNE
A restorative approach to Endodontics

LAB TRIBUNE
New inLab Software 22.0: Widens production range; integrates CEREC Primemill; sreamlines workflows

IMPLANT TRIBUNE
Predictable alternative to sinus lifting with tilted implants and guided surgery

ORTHO TRIBUNE
Clinicians and researchers advancing aligner orthodontic treatment together

HYGIENE TRIBUNE
The role of interdental cleaning for oral health, general health and quality of life

► Insertion A ► Insertion B ► Insertion C ► Insertion D ► Insertion E

PhD student develops program that better prepares surgeons for mandibular reconstruction



PhD student Ben Ferguson working with a simulation of a human mandibular implant generated with CAD tools, CT scans and a custom algorithm. (Image: University of Sydney)

By Anisha Hall Hoppe, Dental Tribune International

SYDNEY, Australia: Utilising CAD tools, CT scans and a specially developed computer algorithm, Ben Ferguson, a PhD student at the University of Sydney's School of Aerospace, Mechanical and Mechatronic Engineering, has developed a revolutionary program that will enable surgeons to run a full simulation of mandibular reconstruction before they attempt it. Ferguson's program simulates the physiological conditions into which a medical implant will be placed,

► Page 2

AD



◂ Page 1

allowing surgeons to tailor their device and procedure for patient-specific treatment success.

Typically, reconstruction of the jaw requires an extensive recovery period of around three months. There are many potential complications and the ever-present chance of implant failure. Newer innovations in implantology better foster bone regeneration than before, but until now, physicians have not been able to accurately predict just how well a body will respond to an implant or how well the implant will work in the given conditions.

Prof. Qing Li, Ferguson's PhD supervisor, explained how this simulator advances traditional planning for mandibular reconstruction surgery: "It is a careful balancing act. For example, an implant may need to mechanically stimulate the surrounding tissue to enhance healing, but mechanical stimulation may then increase the risk of implant failure. Our algorithms and data-driven approach help surgeons develop an optimal design without having to rely solely on intuition."

Thanks to advancements in CAD designing tools and use of high-fidelity computer-aided engineering models and some programming magic, Ferguson's program means that physicians can troubleshoot their implants and procedures long before they do any actual surgery.



PhD student Ben Ferguson (right) with project supervisor Prof. Qing Li, examining a hologram created from patient CT scans as part of a simulation for physicians to prepare for mandibular reconstruction surgery. (Image: University of Sydney)

"Nowadays, it would be unthinkable to construct a building without running an engineering simulation on it beforehand. This is the industry standard in civil engineering—the same expectation should be applied to surgery on a human being," said Ferguson.

Ferguson's biomechanical modelling tool is already being translated into clinical use through a partnership between the researchers and Prof. Jonathan Clark AM, director of head and neck cancer research at the Chris O'Brien Lifehouse cancer hospital in Sydney.

"What's really exciting about this tool and data is that they provide the opportunity to evolve the technology beyond form, to also include biomechanical modelling, which can help predict the bone tissue's response to physiological loads," said Prof. Clark.

Surgeons can fine-tune the height and angle of placement based on the scans and computer modelling for the absolute best possible outcome for implant–host compatibility, translating to fewer complications, better healing and less risk of retreatment—a win–win situation.

The report on the program, titled "Optimal placement of fixation system for scaffold-based mandibular reconstruction", was originally published in the February 2022 issue of the *Journal of the Mechanical Behavior of Biomedical Materials*.

Researchers develop shape-shifting microrobots that can brush, floss and rinse teeth

By Iveta Ramonaite, Dental Tribune International

PHILADELPHIA, Penn., US: A good oral hygiene routine requires manual dexterity and can be difficult for elderly people and people with disabilities. However, researchers from the US have recently developed a hands-free microrobotic system that can brush, floss and rinse teeth, as well as treat and remove bacteria that cause dental caries.

In their proof-of-concept study, a multidisciplinary team of researchers from the School of Dental Medicine and School of Engineering and Applied Science at the University of Pennsylvania devised surface topography-adaptive robotic superstructures made of iron oxide nanoparticles that have two unique properties. Firstly, they are magnetic, allowing their motion to be manipulated and their configuration to be controlled to form various shapes, including one that resembles bristles and another one that resembles floss. Secondly, they are catalytic and can thus activate hydrogen peroxide to create an antimicrobial rinse that can instantly kill harmful oral bacteria and degrade biofilm.

"Imagine persons with physical and medical disabilities or the elderly who do not have the manual dexterity to brush and floss. This is a major unmet need to help with their oral healthcare," co-author Prof. Hyun Michel Koo of the Department of Orthodontics at Penn Dental Medicine told Dental Tribune International (DTI).

Disrupting brushing technology

Discussing the motivation for the study, Prof. Koo told DTI that, besides facilitating toothbrushing for the elderly or people with disabilities, the researchers aimed to advance brushing technology. "The design of the toothbrush, essentially a 'bristle-on-a-stick', has remained relatively unchanged for centuries. It requires manual operation and dexterity and is not completely effective. It's a technology that has not been disrupted in decades."

The robotic system is customisable, which means that bristle stiffness and length can be easily controlled to make bristles firm enough to remove biofilm but soft enough to avoid damage to the gingiva. Additionally, the system can adapt to the unique tooth topography of the specific mouth. The robotic brush can extend, sweep with different motions, and move back and forth across space.

"All these features together provide a remarkable ability to clean teeth around the gingival margin, between the teeth and other difficult-to-reach areas, leading to complete plaque removal," Prof. Koo explained.

In light of its breakthrough innovation, the researchers are convinced that the system will "disrupt current modalities and majorly advance oral healthcare".

The researchers are currently working on further optimising the robots' motions and on introducing the innovation to dental clinics. One of the options available would be to deliver the microrobots to patients' mouths through mouth-fitting devices.

Applications beyond dentistry

Prof. Koo noted that the flexibility of the system allows it to be used in various settings, including the treatment of endodontic infections and root canal disinfection. Additionally, the system offers applications beyond dentistry. "The microrobots can be adapted to remove biofilm infecting medical devices, such as orthopaedic implants and catheters, or those clogging waterlines and contaminating other surfaces," Prof. Koo concluded.

The study, titled "Surface topography-adaptive robotic superstructures for biofilm removal and pathogen detection on human teeth", was published online on 28 June 2022 in *ACS Nano*, ahead of inclusion in an issue.

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Part 3: Sustainable dentistry in 500 words or more



In this six-part series, Dr Sanjay Haryana will write about different aspects of sustainability in dentistry in short. (Image: anncapictures/Pixabay)

By Dr Sanjay Haryana

SINGAPORE: In this third article on sustainable dentistry, sustainable procurement will be covered. The definition of procurement is obtaining goods and services, not the actual transaction, more the plan or the strategy surrounding the process of buying goods and services. Adding sustainability to procurement aims to minimise any harm to environment, economy and society during the full life cycle of the product, from cradle to grave.

According to the United Nations Development Programme, sustainable procurement can be described as "making sure that the products and services we buy are as sustainable as possible, with the lowest environmental impact and most positive social results".[1] A more complete description by Duane et al. is "a process whereby organisations meet their needs for goods, services, works, and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, while minimising damage to the environment",[2] which is in line with the three legs of sustainable development—environment, economy and society—described by the United Nations in its Report of the World Commission on Environment and Development: Our Common Future.[3]

To be build a sustainable dental practice, it is essential to establish the coming change with management and take advantage of the trickle-down effect, the spreading of attitudes and behaviours through the core of the organisation. Even though we often speak about teamwork and team dentistry, remember that dentistry is a hierarchical profession and not having the dentists on board will result in an uphill struggle. A crucial part of this change is creating a sense of urgency within the dental team. The team members must understand why the change is necessary, feel responsible regarding their role and feel inspired to take part in this sustainability journey. Allocate the responsibility to a member of staff who has a passion for sustainability, who feels ready to tackle the challenge and can stand his or her ground internally and externally, as not everyone accepts change easily. Taking full advantage of and capitalising on this task requires time, education and top-level support. A recommended read is "Environmental sustainability: Measuring and embedding sustainable practice into the dental practice", which applies Harvard Business School Professor of Leadership John Kotter's eight steps in the context of a dental practice.[4]

To make sustainable procurement more manageable, divide it into buying less, wasting less, and switching to products and services with a lower carbon footprint. Start with a big and easy win, a task that leads to a great impact, requires little effort and minimises interruption to the day-to-day practice, for example switching to green energy. According to Duane et al., 15.3% of all greenhouse gas emissions in the UK's dental National Health Service came from energy usage, heating and cooling being responsible for the majority of the emissions. Going green is an important step towards a sustainable dental practice, in combination with reviewing energy efficiency, such as insulation, double glazing and other energy waste considerations.[2] These actions will lower emission as well as the cost for the overall business.[5]

Stock management is a key element for a dental practice and is a skill that involves balancing cash flow, storage space and access to necessary material. The aim is to buy just as much as you need at the best price possible, but there is a temptation to buy through promotions, for instance buy four, but pay for three. In many cases, these products have an expiry date and the reality becomes buy four, pay for three and use two. Bulk buying products with expiry dates should be avoided, but if this is done, make sure what to expect in terms of the expiry dates. Is it a year, a month or a week?

Creating a comprehensive digital workflow, from checking in patients, covering digital aid for clinicians, to cashing out, has a large impact on emissions and waste reduction. A staggering 65%–75% of all dental waste is related to analogue radiographs, such as lead foil and solutions required in the developing process[6]. Another culprit in restorative dentistry is impressions, especially silicone impression. Silicone impressions are fossil-based and can be recycled or downcycled today, which means that the silicone loses its properties each time. Usually, it is melted down to oil to be used in different industries as a lubricant. However, investing in a digital scanner can eliminate most silicone used in the dental practice, resulting in a large environmental impact, less postage and transport, and no need for storage space for models.

How do we decide on what products and services to procure in terms of sustainability? There are different methods of measuring the environmental impact, but a life cycle assessment (LCA) is commonly used.[7] It measures a product's emission from sourcing of the raw material throughout the whole life cycle until incineration and can be used to compare products' environmental impact within the same category. An LCA does not have to take working conditions or ethical values into consideration, which is an important part of sustainable procurement—caring for people's well-being throughout the whole life cycle of a product. A word of advice is to always consult the clinicians who will be affected by decision. They should be involved in the process; if they are not, there is the risk of ending up with material that will be unused, which defeats the purpose.

What complicates procurement is that dental professionals use hundreds, if not thousands, of different products in a dental practice. Instead of reviewing every manufacturer, shift the responsibility to the suppliers, like dental wholesalers. Make sure that they only offer products that are ethically sourced and offer data for comparing the environmental impact, like LCA or similar methods. The dental suppliers in turn must demand the same thing from their suppliers and so on. By working in these incremental steps, dental professionals can have a positive impact on the world by making demands and subsequently make informed choices.

To summarise, whatever the procurement strategy, it should never harm the patient or clinical staff or lower the quality of treatment and should always be produced in an ethical manner. As a dental professional, you can always fall back on the principle of "first, do no harm" to environment, economy or society.

Sustainable procurement tips and advice:

- Assign a non-clinical team member the responsibility.
- Respect the hierarchy and get clinicians on board before switching material.
- Use green energy and let your patients, suppliers and local community know.
- Create a clear policy regarding material with an expiry date; do not overbuy.
- Create a digital workflow.
- Let the dental wholesaler work for you. Create a set of green requirements that the wholesaler needs to fulfil. Remember you have the buying power.
- Do not be shy; brag. Get and display certificates of your green achievements.

Editorial note: In this six-part series, Dr Sanjay Haryana will give an overview of different aspects of sustainability in dentistry. A list of references is available from the publisher.

About the author:
Dr Sanjay Haryana is an Education and Odontology Specialist at TePe Oral Hygiene Products.

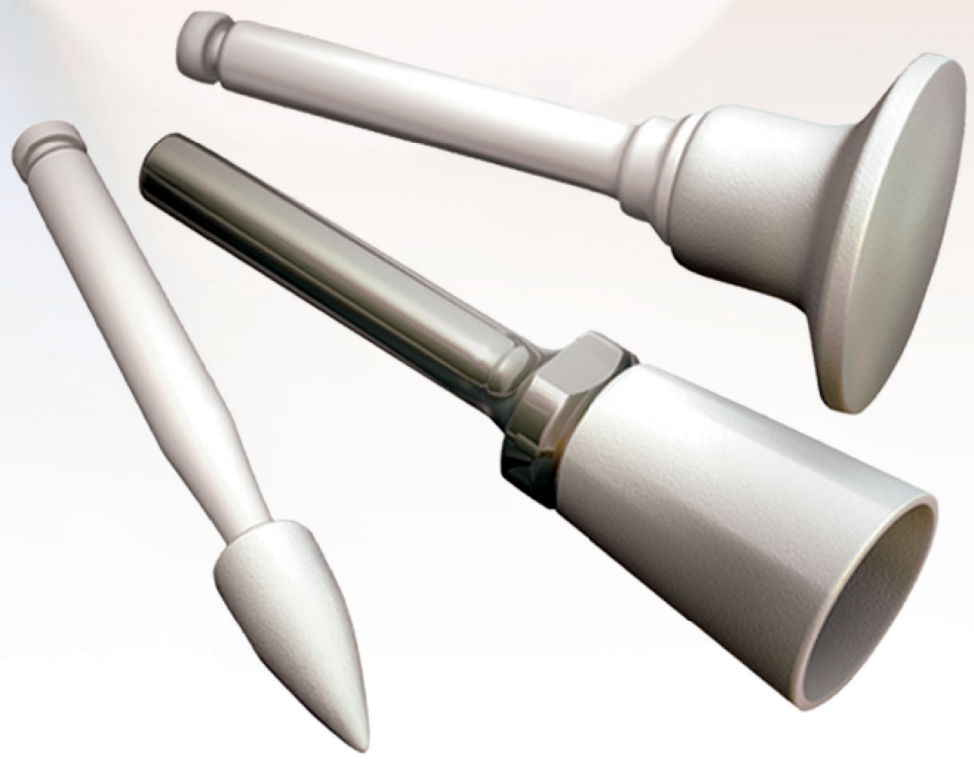
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Discover next-generation ultrasonics

By Mectron S.P.A.

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Micropiezo – new compact and essential design, maximum ergonomics: reduced fatigue for the operator

Align Technology announces collaboration with EAS

By Dental Tribune International

OPORTO, Portugal: Align Technology has announced a new collaboration with the European Aligner Society (EAS) at the society's summer meeting that took place on 1 and 2 July in Oporto. The collaboration is aimed at elevating education standards in orthodontic aligner therapy.

Align Education has developed orthodontic development programmes which include advanced and master's plan programmes for continuing education in clear aligner therapy with Invisalign aligners. EAS recognises these programmes, which are compliant with the European Board of Aligner Orthodontics (EBAO) clinical guidelines and objectives.

Dr Tommaso Castroflorio, president and director of education of EAS, commented: "EAS established the European Board of Aligner Orthodontics to certify the expertise, skills, attributes and comprehensive knowledge of orthodontics, with an emphasis on orthodontic aligner treatment, through certification and periodic re-evaluation and by encouraging the achievement and maintenance of diplomate status."

He continued: "A suitable candidate is to be committed to the advancement of orthodontic aligner treatment, to lifelong learning and to a lifetime of ethical practices. Furthermore, EBAO aims to dignify the art and science of orthodontics and to elevate the quality of orthodontic care by promoting high-standard evidence-based practice in orthodontic aligner treatment and encouraging research in this field. EBAO also collaborates with other entities and organisations to improve the whole profession of dentistry."



By meeting the education standards established by the European Aligner Society and its certification body, the European Board of Aligner Orthodontics, a newly announced collaboration between the society and Align Technology will prepare orthodontists for the EBAO Clinical Master certification and recognise their expertise and experience in treating complex cases. (Image: Guilherme Ariga GUI WOOK/Pixabay)

Align will be advocating its educational programmes as preparation for the EBAO Clinical Master certification. During these development programmes, Align will share guidance on the five-case submission required for the EBAO clinical programme examination.

In addition, the Invisalign system was the focus of a number of presentations at the EAS summer meeting. For instance, expert Dr Pedro Costa Monteiro lectured on Invisalign treatment of mandibular advancement in Class II patients. He explained: "During the last four years, I have treated more than 100 young patients with Invisalign clear aligners. Based on my experience, I can say that growing patients and Invisalign clear aligners are a great match. The skeletal effect of precision wings and the stability after treatment make the Invisalign system my first choice for Class II growing patients. In this session, I will be sharing my tips and tricks for the best results using the new enhanced precision wings."

Align hosted an in-depth course presented by Zelko Relic, executive vice president and chief technology officer at Align Technology, and Dr Ramón Mompell, an orthodontist in private practice in Madrid in Spain who uses aligners and a combination of aligners and various auxiliary methods in most of his patients. Together, the speakers held a practical session focusing on complex teen cases, during which delegates will learn how to maximise their results with the Invisalign system by mastering 3D controls and to optimise their time using ClinCheck Live Update.

Align also sponsored the welcome reception, which took place at the world-famous Ferreira port cellars.

More information about the EAS summer meeting can be found at www.eas-aligners.com/2nd-summer-meeting-porto-2022.

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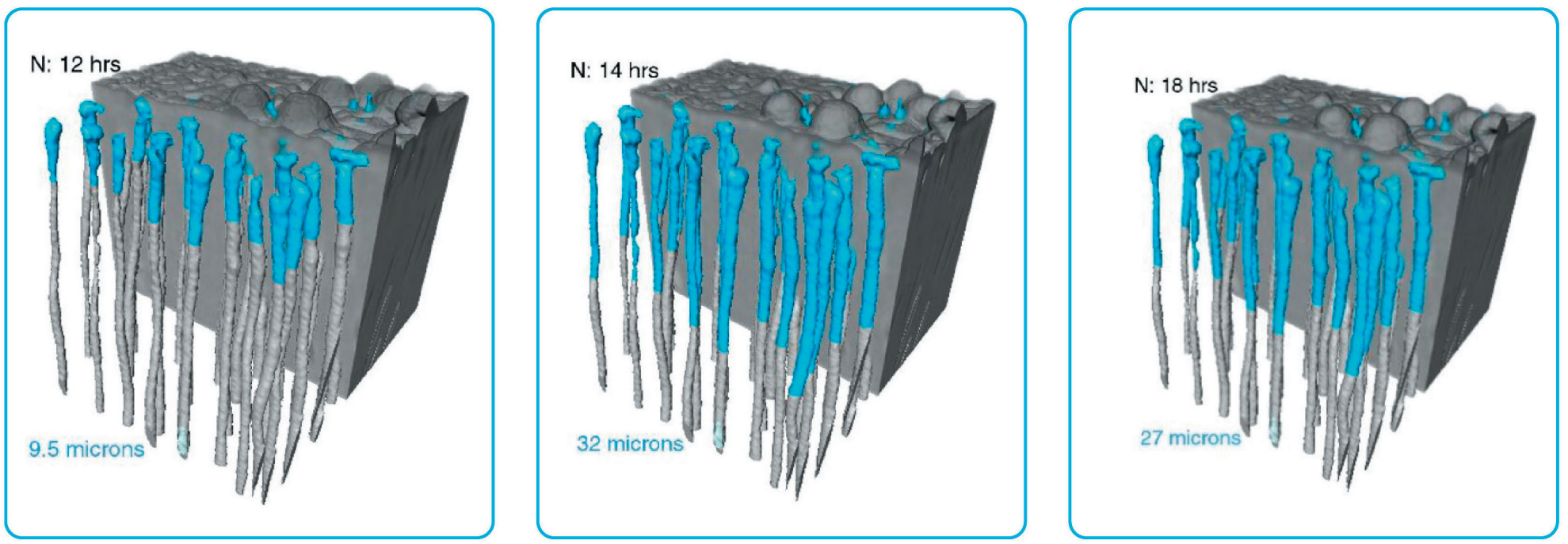
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Visualisation of average occlusion depth (µm) in vitro in dentine specimens treated with NovaMin (N) based toothpaste formulation of Sensodyne Advanced Repair and Protect Deep Repair (containing 5% NovaMin).[4]

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[†]vs previous Sensodyne Advanced Repair & Protect

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What is a synchrotron?



- Stadium-sized machine which is an extremely powerful source of X-rays, 10 trillion times brighter than medical x-rays.[8]
- High-energy electrons travel around the giant ring, to produce the X-rays, emitted as beams[9]
- Allows visualisation of the structure of matter down to the atomic level[8]

European Synchrotron Radiation Facility in Grenoble

New formulation offers targeted occlusion

Tubule occlusion from top down (surface) imaging

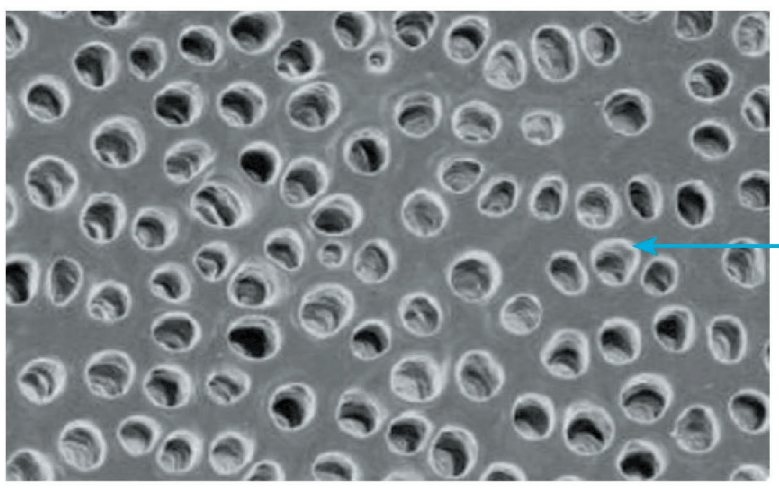


Figure 1. Dentin samples prior to treatment highlight exposed tubules[6]

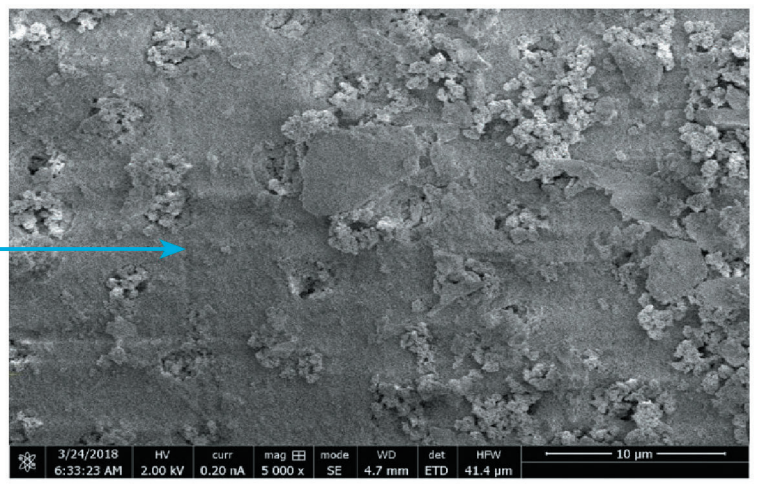


Figure 2. Dentine treated with Advanced Repair and Protect Deep Repair showing top down occlusion which appears targeted and protrudes from the surface of the tubules.[5]

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