issn 2193-4673 • Vol. 19 • Issue 1/2023

1/23

# roots

international magazine of endodontics

industry news
Small but powerful: Microrobots may enhance endodontic treatments

technique
Vital pulp therapy —the clinical perspective

case report
Promoting natural vertical bone growth —not a myth but a reality

dti Dental Tribune International

# Elegance, Beauty, Greatness

## Buy Direct to give more to the ones you Love!

DIRECTGOLD®

24,88€/ Pre-Sterilized 6-Pack
Replacement for gold tapered
Traditional Instrument System

DIRECT® ENDODONTICS

## Buy Direct Online

## Register Now

**Save An Additional 10% The First 12 Months**

## YOU COULD SAVE THOUSANDS PER YEAR

DIRECTENDO.COM

## FREE SHIPPING ON ALL ORDERS!

DIRECTEndodontics SAS • 91 Rue du Faubourg Saint-Honoré • 75008 Paris • France

©2023 DirectEndodontics SAS® All Rights Reserved | 2023/20/02 Roots Mar.

**Steve Jones**

Co-chairman
ROOTS SUMMIT

# One step ahead

**The original online forum** for endodontics is gearing up for another ROOTS SUMMIT, and we hope that you will join us in May 2024.

The year off between ROOTS SUMMITs is when the meeting really begins to take on its character. Picking the perfect venue is only part of the fun, and this event promises a great deal of fun in addition to the incredibly high level of scientific and clinical relevance ROOTS SUMMIT has been known for since the first event in 1999. ROOTS, the premier global discussion forum for endodontics, has been around for so long because of the high level of academic integrity both of our Facebook group and at our biennial events.

Dr David E. Jaramillo, scientific chairman of ROOTS SUMMIT, is in the process of fine-tuning the programme with multiple world-class speakers. Thus far, we can confirm that we have speakers from Spain, Brazil, Israel, Japan, India, Iran and, of course, Greece. The complete details of the programme and speakers will be announced at the Dental Tribune International media lounge during this year's International Dental Show (IDS) in Cologne in Germany. Registration for the general programme will begin on 9 May this year. The workshop schedule will be completed shortly after that. The programme will have essentially the same format of every presentation being done in one room, and there will be a few small enhancements and additions.

Join us online in our Facebook group to learn how you can gain a 50% discount on registration by having your oral or case presentation accepted. We will also be having a quarterly contest with a prize of free registration for ROOTS SUMMIT if your clinical or scientific article is chosen for publication in future issues of this magazine. Details of both programmes will also be released during IDS.

As important as the programme is, the memories that are made at ROOTS SUMMIT are why people have been coming to the event for so long, some for more than 20 years! The possibilities for having a great time are endless in Greece. I know that I am planning to explore and visit at least one island. But first we will have a world-class learning experience in the wonderful event centre that we have secured, consistent with the beautiful locations we had at the Berlin and Prague summits.

We are looking forward to seeing you in Athens from 9 to 12 May 2024. In the meantime, enjoy this very informative issue of roots, in which you will find descriptions of novel preparation techniques and the use of laser and minimally invasive approaches in endodontics.

We also look forward to seeing you online at facebook.com/groups/rootsendo.

Steve Jones
Co-chairman of ROOTS SUMMIT

page 08

page 18

page 28

Cover image courtesy of DirectEndodontics (www.directendo.com).

## editorial

One step ahead 03
Steve Jones

## industry news

Leading the way in endodontics 06
COLTENE

Small but powerful:
Microrobots may enhance endodontic treatments 08
Franziska Beier

## technique

Vital pulp therapy—the clinical perspective 10
Drs Jenner Argueta & Ana Lucía Orellana

## case report

Using digital software for effective root canal therapy 14
Prof. Adj. Philippe Sleiman

A novel approach to root canal preparation: The in–out technique 18
Dr Grzegorz Witkowski

External cervical root resorption in anterior mandibular area:
Diagnosis and treatment alternatives 22
Dr Johnny Onori

Laser-assisted irrigation in endodontic treatment of a tooth
with obstructed canals 25
Dr Brenda Loh

Management of complex endodontic cases
using Er:YAG and Er,Cr:YSGG lasers 28
Drs Bartłomiej Karaś & Grzegorz Witkowski

Promoting natural vertical bone growth—not a myth but a reality 38
Prof. Adj. Philippe Sleiman

## opinion

Why is Slow Dentistry calling
for a system reform of the hiring process in dental practices? 42
Dr Huthaifa AbdulQader

Sustainability: Another great way of giving back 44
Dr Les Kalman

## manufacturer news 46

## meetings

International events 48

## about the publisher

submission guidelines 49

international imprint 50

COLTENE

# **Your** Endo Guide

Practical. Innovative. Leading the way.

**Together we'll find a way.**

For better, easier, and more reliable dentistry.
For more information scan the QR code.

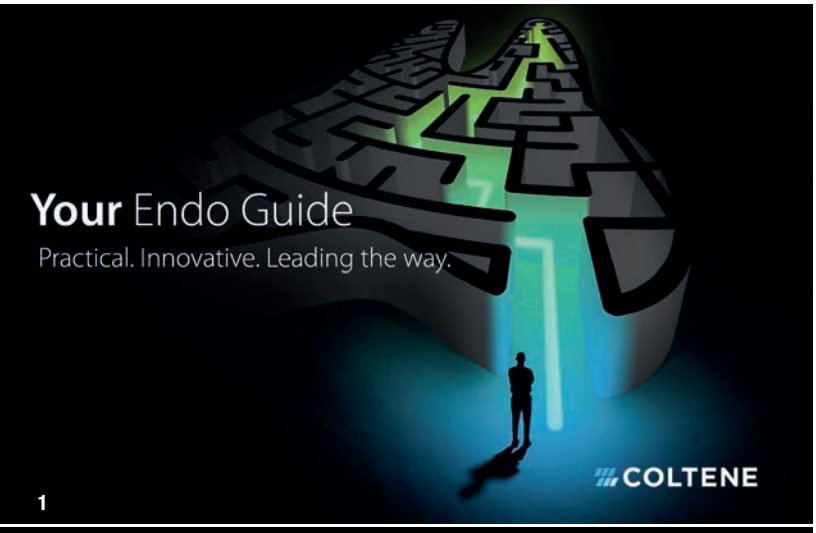
007912 0223

# Leading the way in endodontics

## As “Your Endo Guide”, COLTENE offers orientation with extensive offers

By COLTENE

**The international COLTENE dental group** intends to significantly raise its profile as an endodontic specialist. Under its new slogan of “Your Endo Guide”, it focuses on the provision of safe and efficient solutions that cover the endodontic process holistically and support endodontic experts and newcomers alike with experienced endodontic advisers and specialist training courses. At the 2022 congress of the European Society of Endodontology in Budapest in Hungary, COLTENE presented itself for the first time as “Your Endo Guide” with its comprehensive range of products and services, all true to its slogan “Practical. Innovative. Leading the way.”




1

2

3

**Fig. 1:** COLTENE, “Your Endo Guide”, shows dentists and practice teams the route through the root canal. **Fig. 2:** A systematic workflow: the overall portfolio from the COLTENE dental group effectively covers all five treatment steps. **Fig. 3:** “Your Endo Guide: the CanalPro Jeni endodontic motor embodies the idea of a faithful companion on all routes like no other product from the COLTENE endodontic range.

### “Your Endo Guide”—the practice test

With its comprehensive workflow system, COLTENE has always offered practice-oriented solutions for efficient root canal therapy. The state-of-the-art endodontic portfolio fully covers all five treatment steps: infection control, preparation, irrigation and drying, obturation and restoration. For example, the range includes extremely fracture-resistant, flexible nickel–titanium files as well as a colour-coded irrigation solution system and reliable sealers based on gutta-percha. The perfectly matched instruments and materials ensure high reliability and reproducibility in treatment. This is particularly important in endodontics with its limited field of vision and complex anatomical structures.

In this vein, COLTENE is confidently presenting its full range of products and services for efficient, state-of-the-art patient care under the slogan of “Your Endo Guide”. The international company supports dentists and practice teams worldwide with sophisticated working aids and an extensive training and further education programme with experienced endodontic advisers.

### Practical, innovative and leading the way

COLTENE has been living up to its claim of being practical, innovative and leading the way for more than 100 years. In close cooperation with leading universities as well as specialist and general practices, tailor-made solutions have been developed which integrate seamlessly into the respective treatment processes. Each product is thoroughly tested in daily use for its performance and practicality before being included in the product portfolio. The pace of innovation is set by eminent endodontic authorities such as Dr Eugenio Pedullà, who recently made root canal therapy even easier and safer with his “Jeni” endodontic motor. Like a navigation system in a car, the digital co-pilot accompanies general dentists and endodontists on their route to the apex. During this process, the motor automatically adjusts the file movement and gives an acoustic signal when irrigation is required.

**Fig. 4:** Lively interest and large crowds at COLTENE's booth at the 2022 European Society of Endodontology congress. **Fig. 5:** Happy winner: Matthijs Münninghoff, a dentist from the Netherlands, was delighted with the day's prize.

The "thinking" endodontic motor embodies the idea of "Your Endo Guide" quite literally. The COLTENE Dental Management Academy supports optimal endodontics with up-to-date workshops, webinars and specialist symposia on current trends and research results in the field of endodontics.

## Off to a flying start in autumn 2022

The endo specialists from COLTENE impressively demonstrated how "Your Endo Guide" helps dentists to take pole position at the launch of the campaign at the 2022 congress of the European Society of Endodontology, probably the most important industry event for endodontics in Europe. In Budapest, attendees were able to see the quality and efficiency of the root canal instruments for themselves at various demonstration counters. Not only could the CanalPro Jeni endodontic motor be test-driven at the congress, but with the aid of a racing simulator, brave dentists were also able to demonstrate their talent in negotiating tight curves. Like a root canal, the race track was surprisingly dynamic at times and required great skill from the test drivers to avoid involuntarily landing in the barriers and creating a false path. Among the more than 150 participants, three happy winners of the day were chosen and given a stylish remote-controlled speedster to take home.

In addition, the hands-on workshops offered proved very popular. Both Dr Sebastián Ortolani and Dr Pedullà spoke to a packed auditorium about the pros and cons of the different treatment methods. Dr Ortolani addressed the topic of optimising clinical workflows with the new reciprocating system, and the workshop participants were able to test the MicroMega One RECI files with the wireless Dual Move endodontic motor. Dr Pedullà's workshop focused on the use of the HyFlex EDM file system supported by the CanalPro Jeni endodontic motor. Here, the inventor of the novel endodontic motor demonstrated to participants how to perform safe and efficient automated root canal preparation with the aid of the digital assistance system and the special Jeni-Move. The congress programme was rounded off by a lively COLTENE and friends get-together, which encouraged networking and enabled exchange with international key opinion leaders.

In November 2022, COLTENE was again in action as "Your Endo Guide". At the annual meeting of the German Society of Endodontology and Dental Traumatology in Cologne in Germany, Dr Byron Tsivos offered a workshop titled "Automated navigation of the three Rs in the root canal: Rounding max curves—retreatment—retrieving broken files". The increasing number of revisions in particular constantly poses new challenges for the treating dentist and can be performed confidently with special remover files. The new slogan of "Your Endo Guide" was launched at the same time at the important French Dental Association congress in Paris in France and attracted numerous visitors with exciting endodontic lectures and the racing simulator.

## More milestones are planned

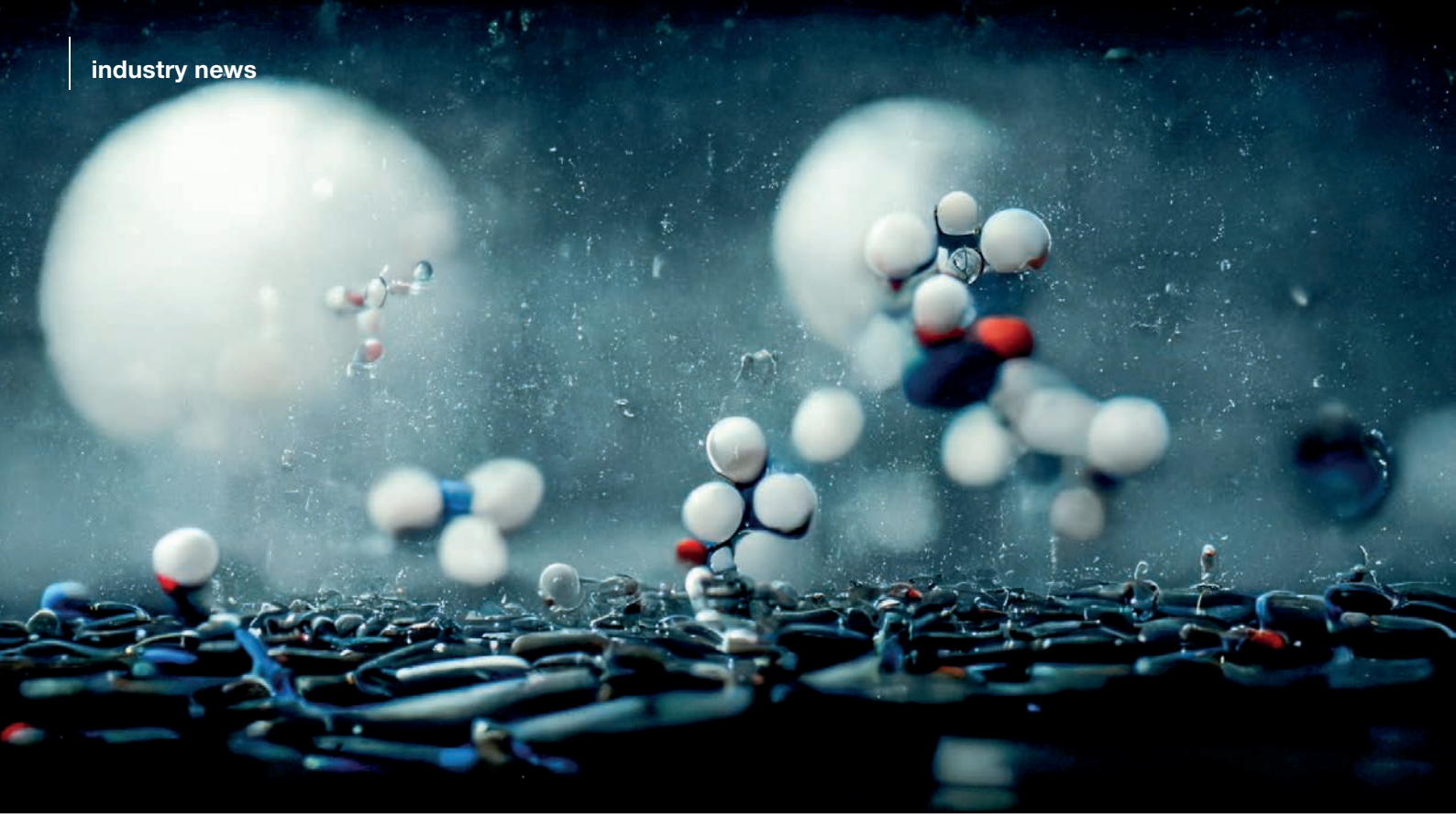
With the kick-off of the "Your Endo Guide" campaign, COLTENE is greatly looking forward to the 2023 International Dental Show in Cologne in Germany, where the next round of innovations will be presented to visitors. Based on its decades of experience in developing and creating innovative treatment concepts, the company continues to pursue its declared aim of being a reliable and innovative partner in the dental practice. Current information on the comprehensive product portfolio and the international training programmes can be accessed at any time at "Your Endo Guide" (https://coltene.group/your-endo-guide/). There, a personal COLTENE ENDO bot awaits visitors to accompany them on their endoontic journey to their favourite topic, taking an approach that is practical and innovative and leads the way.

**Fig. 6:** QR code for "COLTENE—Your Endo Guide".

## contact

**Coltène/Whaledent**
Raiffeisenstr. 30, 89129 Langenau, Germany

+49 7345 805-0, info.de@coltene.com



Research from the University of Pennsylvania has demonstrated that microrobots can access root canal surfaces that are difficult to reach, disrupt biofilms and retrieve diagnostic samples, thereby enabling a more individualised treatment plan. *(Image: © CI Photos/Shutterstock.com)*

# Small but powerful: Microrobots may enhance endodontic treatments

By Franziska Beier, Dental Tribune International

**New developments** in small-scale robotics and nanotechnology offer previously unimagined opportunities for new diagnostic and therapeutic approaches. In testing the use of microrobots for endodontic applications, researchers from the School of Dental Medicine at the University of Pennsylvania and from its Center for Innovation and Precision Dentistry have found that the robots were able to access difficult-to-reach root canal surfaces, disrupt biofilm, retrieve samples for diagnosis and even deliver drugs.

The main cause of endodontic treatment failure is incomplete root canal disinfection, resulting in endodontic infections and periodontitis. One of the reasons for this is the complex anatomy of the root canal system, making effective biofilm removal difficult, and up until now, means of diagnosing and evaluating disinfection efficiency have been limited.

The microrobotic system used in the current study is the result of an ongoing collaboration between the dental school and the university's School of Engineering and Applied Science. In a previous study, the collaboration produced a microrobotic system consisting of nanoparticles that can not only brush but also floss and rinse teeth in a single step, helping to effectively eliminate biofilm from teeth.

## Effective and precise guidance of microrobots

The researchers developed and tested two different microrobotic platforms in their recent study. For both, they used iron oxide nanoparticles (IONPs), which share catalytic and magnetic properties, as building blocks for the microrobots.

When asked about the biocompatibility and safety concerns for patients, co-author Prof. Hyun Michel Koo of the Department of Orthodontics at Penn Dental Medicine, replied: "IONPs are widely used in nanomedicine due to their minimal cytotoxicity, excellent physicochemical properties, stability in aqueous solutions and biocompatibility. Several IONP formulations have already

been approved by the US Food and Drug Administration (FDA) for parenteral administration as treatment of iron deficiency anaemia."

He added, "Our previous histopathological analysis of gingival, mucosal and other tissues, including major organs such as the liver and kidney, showed no signs of harmful effects, indicating high histocompatibility of both in-house and FDA-approved IONP formulations."

To evaluate the effectiveness of the endodontic micro-robotic platforms, the researchers conducted experiments using 3D-printed tooth replicas prepared with a biofilm containing four different endodontic bacterial species.

For the first platform, using electromagnets, the research team concentrated the IONPs in micro-swarms and magnetically controlled them to disrupt and retrieve the biofilm. Analysis of the collected sample found all four bacterial species. In addition, under the microscope, all nanoparticles appeared to have been removed from the root canal.

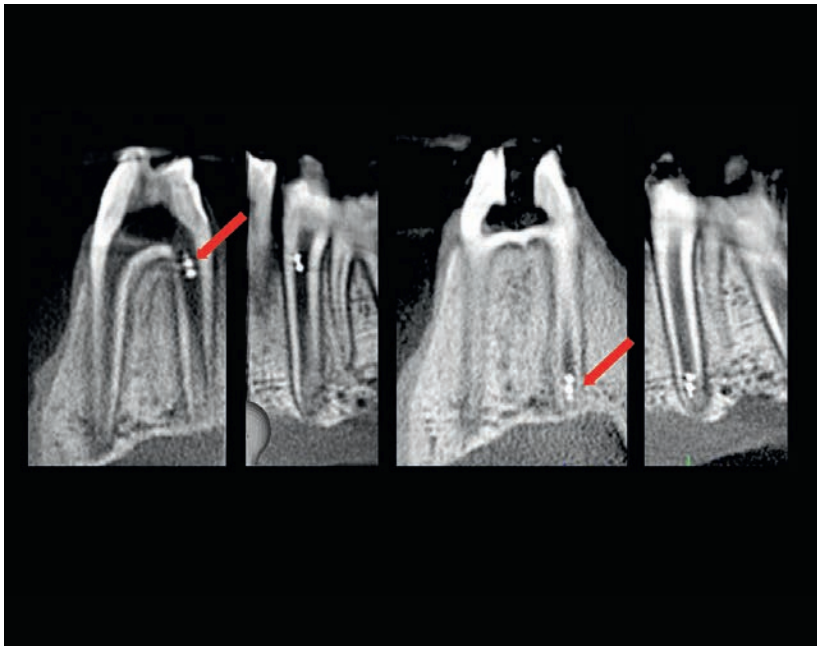
For the second platform, the research team 3D-printed miniaturised helix-shaped robots and filled them with an IONP-embedded gel. They then guided the robots within the root canal using magnetic fields and observed that they disrupted the biofilm chemically and mechanically with high efficiency. Especially noteworthy is the possibility of loading the helix-shaped robots with therapeutics for targeted drug delivery at the apical region of the root canal, where infection is in close proximity to the surrounding tissue.

"The key limitations of current endodontic strategies are threefold: lack of precision in targeting biofilms infecting the apical region and anatomical complexities of the root canal, as well as the difficulty of retrieving biofilm samples for diagnosis. To the best of our knowledge, there does not exist an approach capable of simultaneous sample retrieval and antimicrobial treatment in endodontics," commented lead author Dr Alaa Babeer from Penn Dental Medicine, on the relevance of the study findings for endodontic treatments.

"Our findings demonstrate the feasibility of using the versatility of microrobotics to access difficult-to-reach endodontic surfaces to perform biofilm killing, removal and retrieval for microbial detection in real time. Furthermore, we demonstrate the feasibility of robot tracking inside the canal using current clinical imaging modalities," he continued.

## Future fields of application and further research

The researchers envision a broad range of application for the microrobots in dentistry and general medicine.



Magnetically actuated 3D-printed robots are controlled precisely to target the apical region of the root canal uninterrupted by the surrounding periodontium as visualised and tracked by CBCT. *(Image: © University of Pennsylvania)*

According to Prof. Koo, IONP microrobots could combine several functionalities in dentistry. These include automated, hands-free brushing and flossing for effective removal of dental biofilms, which can be helpful for persons with disabilities or lacking manual dexterity to perform good oral hygiene, he said.

Based on the results of the current study findings, Prof. Koo expects microrobotic platforms "to allow precision-guided therapies to disrupt biofilms in difficult-to-reach spaces and promote soft-tissue and bone regeneration". He added that microrobots could perform delivery of drugs or living cells in different oral and craniofacial sites, ranging from deep periodontal pockets and the apical region of the root canal to temporomandibular spaces to promote healing.

For biomedical applications, Prof. Koo noted that "magnetically controlled microrobots have shown diverse applications, including anti-cancer therapy, targeted drug, gene and stem cell delivery, and minimally invasive surgery".

The study authors stated that future research may expand the possibilities for robotic application even further to the detection, treatment and removal of biofilms associated with other infectious diseases and biofouling of dental and medical devices or implants.

*Editorial note: The study, titled "Microrobotics for precision biofilm diagnostics and treatment", was published in the August 2022 issue of the* Journal of Dental Research.