Project for improved root canal therapy launched

By DTI

ROSTOCK, Germany: In Germany, about 7.5 million root canal therapies are carried out annually. With the help of an innovative system, it may soon be possible to carry out ultrasonic preparation of the root canal and to monitor the condition of the file during treatment. In addition, protection against thermomechanical overloading will prevent the instrument from breaking.

Research teams from Rostock, Dresden, Leipzig and Lemgo in Germany have begun a new project aimed at improving root canal therapy. Sponsored by the German Federal Ministry of Education and Research’s (BMBF’s) funding programme Twenty20—Partnership for Innovation, and the smart3 consortium, members of the medical faculty at the University of Rostock and the Fraunhofer Institute for Ceramic Technologies and Systems are working together on the project.

“We are pleased to have strong partners at our side in this project and are working very closely and in an interdisciplinary way with them. We are counting on great benefits for our patients,” emphasised Prof. Emil Reisinger, dean and scientific director of the medical faculty at the University of Rostock. The aim of the IPUCLEAN joint research project is the development of a piezoelectric ultrasonic cleaning system to support root canal therapy with rotating super-elastic files made of shape memory alloys.

“The joint project is intended to improve the treatment process and patient safety during root canal therapy in the medium term—at the same time ensuring and increasing the quality of the treatment results achieved,” said Prof. Rainer Bader, head of the FORBIOMIT research laboratory for biomechanics and implant technology at Rostock University Medical Center.

The project is being funded by a BMBF grant of more than €1 million. The research is being supported by Komet Dental, Werner Industrielle Elektronik and Zahntechnik Leipzig.
Strategies for the treatment of extremely curved root canals

By Dr Bernhard Bengs, Germany

One of the major challenges in endodontics is the enormous complexity of root canals. Among other things, a large number of difficulties must be overcome in terms of the number, position, possible branches and curvatures of the canals. Case studies are used to demonstrate how predictable treatment results can be achieved in adverse anatomies too.

The aim of root canal preparation is the complete removal of all vital and necrotic tissue, infected canal wall dentine, foreign matter and root filling material. Adequate chemical disinfection should be made possible and shaping should allow root-wall obturation of the canal system. As early as 1974, Herbert Schilder published guidelines on this topic, which have virtually remained unchanged, including the creation of a continuously conical canal shape from the access cavity to the apex, respecting the course of the root canal and maintaining the position of the apical foramen at a size as small as practicable.

In the presence of very pronounced curvatures, especially abrupt or even S-shaped curvatures, it can prove extremely difficult to implement these guidelines. The angle of curvature is not the only factor here, the length of the distance after the curvature is also decisive for the success of the instruments. As the degree of difficulty increases, the risk of step formation, splitting and instrument fracture quite naturally increases.

Treatment planning

Initial information is provided by the preoperative radiographic image. In complex anatomies, such as those that often occur in the posterior region, a CBCT scan provides valuable information on 3-D curvatures and the confluence of canals. This information is extremely important for treatment planning, as it allows the dentist to determine a strategy regarding the instruments to be used and canal preparation in advance. For example, very narrow, strongly curved roots should, if applicable, be prepared with a smaller ISO size or a smaller taper, since even very flexible nickel-titanium (NiTi) files systems become extremely stiff afterبع增 dimensions, which entails unwanted transportation or even strip perforations as risks. Each case should be considered individually to allow sufficient removal of infected tissue without risking unwanted excessive removal of dentine.

In vital cases, the size of the preparation may be more moderate than in cases of pulp necroses or revisions, as less removal of dentine will be required here. Ultimately, of course, the treatment size should be determined by apical guaging (apical measurement). As this is only practicable to a limited extent in the case of very extreme, even opposing curvatures, even more attention should be paid to tactile feedback during instrumental canal preparation. Sufficient preparation is always required for root canal irrigation and subsequent obturation so that a shape of at least size 30, 40 or better of size 30.06 or 35.06 (usually larger in the case of strong curvatures), which is usually required in extreme cases, must be prepared manually using the step-back technique. Otherwise, it will not be possible to achieve sufficient disinfection and filling of the root canal.

Notes on preparation

The preparation of an optimal primary and secondary access cavity is extremely important, particularly in the case of strong curvatures. Therefore, a most straightline access to the canal system is an indispensable prerequisite for a successful preparation. The marking of the instrument tip in the gutta-percha point determines the length up to which the second canal must now be prepared. This avoids risky streaming of the instruments, as well as the unnecessary removal of dentine. Furthermore, the chemical preparation of the canal system is an indispensable part of the preparation, since only part of the canal wall surface is addressed during mechanical prepa-

Case 1: Pulp necrosis in an S-shaped canal

In November 2013, a 46-year-old emergency patient with acute symptoms of tooth #25 presented. The tooth had been restored with a ceramic inlay, the sensitivity test for cold was negative, and the tooth was sensitive to percussion and pressure. The preoperative radiograph revealed periapical periodontitis (Fig. 1). The diagnosis was pulp necrosis after a previous preparation close to the pulp. The inlay was removed and an adhesive pre-endodontic build-up was fabricated from composite. During trepanation, pus drained from the canal entrances. Working length was then determined, followed by initial preparation with Kerr files up to only ISO size 8, for time reasons, together with intermittent irrigation with heated 6% sodium hypochlorite (NaOCl). Subsequently, a drug deposit was inserted by rotating in Lucermit. Owing to the small preparation size, the use of calcium hydroxide would only have been possible to a limited extent.

Root canal therapy was continued approximately six weeks later: after anaesthesia and placement of a rubber dam, tooth #25 was trepanned under the microscope (Fig. 4). The glide path was first prepared manually with C+ Files of ISO sizes 6 and 8 (Dentsply Maillefer), then mechanically with PathFiles of size 13, 16 and 19 (Dentsply Maillefer). The more flexible HyFlex Glidepath files (COLTENE) were not yet available at the time of treatment. A detailed image of the broad new PathFile illustrated how extremely the S-shaped canal configuration had stressed the rotary NiTi instruments after a single use (Fig. 3). It depicted the plastic deformation of the instrument, a clear indication that this instrument could only withstand the requirements with good fortune. A fractured instrument would certainly have been within the realms of possibility.

After radiographic confirmation of the working length, the canals were prepared with the Hyflex CM (controlled memory) NiTi files (COLTENE), Figs. 4 & 5. The following sequence was used: 15.04, 20.04, 20.06, 25.04, 25.06, 30.04 and 30.06. Intermittent irrigation was again performed with heated 6% NaOCl.
After apical gauging, the final preparation was performed in steps of 0.2 mm from ISO size 35 to ISO size 60 using manual NIT Kerr files in the step-back technique for safety reasons. Thus, a cone of ten was created in the apical region. Although possible in principle, the use of a 35.06 HyFlex CM was deliberately abstained from, as while these instruments offer high flexibility in general, the stiffness might still have been too great for the S-shaped course of the canals. Finally, irrigation was performed with a 17% EDTA solution and 6% NaOCl, activating the irrigation liquids by ultrasound.

After the master point try-in with configured gutta-percha points, warm vertical root canal filling was performed using the modified Schilder technique (Figs. 6–8). The tooth was sealed adhesively with a glass-fibre pin and composite. After local anaesthesia, the restoration and the cement build-up was created under rubber dam isolation. At the same time, the coronal pulp was removed during trepanation of the pulp chamber (Fig. 14). As pain treatment, Lidex was applied as a drug owing to the time limitation, and the tooth was closed adhesively with composite.

Further treatment was performed in one visit in December 2013. After local anaesthesia, the drug was removed and the course of the canal was probed with C+ Files of ISO sizes 6, 8 and 10 under control of an endodontic motor. The radiographic confirmation of the working length showed a pronounced, abrupt curvature of the canals in the apical third of the mesial root (Fig. 15). The glide path was prepared with PathFiles of sizes 13, 16 and 19, then expanded with ProTaper hand files S1 and S2 (Dentsply Maillefer), which were prebent with the Endo-Bender (Kerr). Rotary preparation was performed with the HyFlex CM.

In this case, the following sequence was used with ascending sizes and tapers: 15.04, 20.04, 20.06, 25.06, 30.04, 30.06 and 35.06. The path of the canal was manually expanded intermittently with prebent ProTaper hand instruments F1 to F3 and then perfectly shaped with the corresponding rotary HyFlex files, as the instruments were stopped in the mesial root by the speed limiter of the endodontic motor owing to the extreme curvature. The entire preparation was performed under intensive irrigation with heated 6% NaOCl. In addition, an ultrasound-activated final irrigation with 17% EDTA and NaOCl was performed three times for 20 seconds. After the master point try-in, the root canal was obturated vertically with warm gutta-percha using the modified Schilder technique (Figs. 16–18). Tooth #37 was sealed adhesively with a glass-fibre pin and composite (Fig. 19). Postoperative radiographic checks after one year and approximately 4.5 years showed continued uneventful apical conditions (Figs. 20 & 21).

Discussion
These cases demonstrate that the safe preparation of even extreme curvatures is predictable owing to the use of highly flexible instruments such as the HyFlex CM.

Meanwhile, additional instruments have become available in sizes 15.01, 15.02 and 20.02, as has HyFlex EDM size 10.05, which are superior to the files used at the time in terms of material properties and thus offer greater safety in difficult cases (Figs. 22 & 23). Furthermore, it can be seen that hybridisation with manual instruments can be helpful or even necessary to minimise the risk of fracture and to control abrupt curvatures. The file sequences used are of course material-intensive, especially since the files were discarded after use in each patient case. This procedure is costly, but offers the best possible safety to avoid cross-contamination and instrument fracture.

Conclusion
The postoperative radiographic checks after several years proved that even very complex anatomies can nowadays be treated safely, predictably and sustainably with suitable instruments. For the patient, this implies the long-term preservation of the natural dentition, even in challenging cases.

Editorial note: A full list of references is available from the author.

About the Author
Dr Bernard Bengs is a specialist in endodontics certified by the German Society of Endodontology and Traumatology. vonstraße 1, 10785 Berlin, Germany
He can be contacted on dr.bengs@gmx.de

Figs. 15 & 16: Radiographic measurement and master point image

Figs. 17 & 18: Root canal filing and check of tooth #37

Figs. 19–23: Pin check and post-op check after one year and 4.5 years, respectively

Figs. 9–12: Pin check and post-op check after one year and 4.5 years, respectively
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