Use of operating microscopy, ultrasound and MTA in periapical microsurgery

Treatment of a persistent endodontic infection

By Prof. Leandro A.P. Pereira, Brazil

In most cases, pulpal and periapical pathologies are caused by intra-canal infections and their initial treatment is by conventional endodontic treatment. In cases of teeth without apical periodontitis, the success rate is approximately 98 per cent. If apical periodontitis and primary infections (which may be of bacterial or non-bacterial origin) occur, this rate is reduced to 86 per cent. Endodontic failure is usually associated with technical limitations that prevent adequate intra-canal microbial control in the complex internal microanatomy of the root canal system.

The treatment recommended for cases of primary endodontic infections is endodontic retreatment, which has a success rate of approximately 83 per cent. Thus, even after the endodontic retreatment, owing to the factors of complex internal microanatomy, the failure may persist. In these clinical situations, apical microsurgery has been proven to be an alternative for the clinical treatment of these infections.

Various technological advances in the area of apical microsurgery have occurred in recent years. A very important triad has been established for achieving high success rates, consisting of the use of operating microscopy, ultrasound and mineral trioxide aggregate (MTA). When periapical surgery is performed traditionally, without the use of microsurgery, the success rate is approximately 86 per cent.

However, when performed with the contemporary technique of microsurgery, its success rate is over 90 per cent. This evolution has made microsurgical endodontic treatment a more viable clinical procedure with greater predictability.

Clinical case

A 42-year-old female patient presented at our clinic with spontaneous pain resulting from apical periodontitis around tooth #36. The last endodontic retreatment had been performed 19 months before. During the semiotechnical examination, a negative response to pain was observed in the palpatory and vertical and horizontal percussion tests. Thermal and electric pulp tests of tooth #36 obtained no response. Responses of the neighboring teeth were normal. On the radiograph, we detected a metal-ceramic prosthetic crown functioning within acceptable standards, as well as a cast metal intra-radicular retainer. Overall, this was a satisfactory endodontic treatment with good shaping and good obturation.

However, tooth #36 showed apical periodontitis (Figs. 1-3) and the preoperative CBCT scan showed fracture of the vestibular cortical bone (Fig. 4). The proposed treatment was endodontic microsurgery aimed at endodontic retrograde retreatment. In this therapeutic situation, the prosthetic crown and the intra-radicular retainer would be kept; there was no need for new prosthetic rehabilitation. After the evaluation of all the advantages, disadvantages and risks, the endodontic microsurgical treatment was performed.

One hour before the microsurgical procedure, 4 mg of dexamethasone was administered orally for the purpose of preemptive analgesia. The control of peroperative anxiety was accomplished through conscious inhalation sedation with a nitrous oxide and oxygen mixture at a ratio of 65 per cent to 35 per cent and a minute volume of 6.5 l/min. For anaesthetic solution, 1.4 ml of 2 per cent lidocaine with 1:100,000 epinephrine was used, with 1.8 ml each of the solution administered through the traditional technique to block the inferior alveolar nerve and the buccal nerve. Another 1.8 ml of the same solution was infiltrated between the gingivae and mucosa.

After anesthesia was established, the papillae-based incision was made, followed by a vertical relaxing incision. Using a micro-scalpel, the syndesmotome, the syndesmotome was performed smoothly to achieve the purpose of treatment with good shaping and good obturation.

The fracture of the vestibular cortical bone was treated using piezo-osteotomy with an ultrasonic tip (ST3 Bone Surgery Tip, Vista Dental) at full power. The osteotomy exposed the entire periapical lesion (Fig. 5). Subsequently, apical curettage was performed (Fig. 7).

The apicectomy was also performed using a piezo-ultrasonic system with a WY ultrasonic tip (Denturo) at a power of 80 per cent and under copious irrigation with a sterile saline solution (Fig. 8). The apex was cut at an angle perpendicular to the long axis of the root to allow for removal of possible ramifications of canals located to both the vestibular and lingual directions. After the apicectomy of the medial root, it was possible to observe an infected apical region of the mesial canal, which had not been cleaned and shaped (Fig. 9). With a retro-mirror, an isthmus was found connecting the vestibular mesial canal to the lingual mesial (Fig. 10). This isthmus had not been shaped and disinfected by the conventional endodontic preparation owing to the limitations inherent in the kinematics and design of the endodontic instruments and the auxiliary irrigant chemicals. These poorly cleaned and shaped areas of the canals were identified as the possible cause of the apical periodontitis.

Using NiTi/ITAT ultrasonic tips (B&L Biotech), the retrograde preparation was performed, adjusting the ultrasonic power to 50 per cent and under irrigation with a sterile saline solution. The quality of the retrograde preparation was evaluated with a surgical micro-mirror (Fig. 11). The isthmus of the medial root was cleaned using these ultrasonic tips with movements in the vestibular-lingual
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...direction. The retro-prepared canal was irrigated with 2 per cent chlorhexidine, followed by sterile saline with irrigation micro-cannulas (Angelus). The canal was dried using aspiration micro-cannulas on a vacuum pump, leaving it ready to receive the retrograde obturation material.

The canal was retro-obturated with white MTA (Angelus). The placement of the MTA in the retrograde cavity was done with the MAP System (Rhoux) and retro-condensed until the canal was completely filled (Fig. 12). In order to prevent the growth of the connective tissue inside the apical bone cavity, it was filled with surgical calcium sulphate (GidMibi).

The postoperative control radiographs were taken after 72 hours (Figs. 13–15) six months (Fig. 16) and 12 months (Fig. 17). On the last radiograph, it was possible to see the advanced repair of the bone in the apical region.

Discussion

The use of operating microsurgery in combination with ultrasonic tips and MTA-based bioactive retrograde-obturation materials has increased the success rates of endodontic microsurgery from 60 per cent to levels above 90 per cent. The enhanced visibility provided by the microscope allows for evaluation of microstructures and details that are not visible to the naked eye. It allows the microsurgeon to refine his or her motor precision. Trauma to the delicate periodontal and periradicular tissue can be minimised, leading to better aesthetic results.

The osteotomy needed for access to the apical third had traditionally been performed with chisels or drills and high rotation.

In the 1980s, piezo-osteotomy was finally introduced. In this surgical method, the osteotomy is done with ultrasound, which has technical and biological advantages over the use of drills at high or low rotation. Ultrasound is as safe, as it only works on mineralised tissue. It preserves soft tissue, such as nerves, blood vessels and mucosa. The amplitude of its micro-movements varies between 60 and 210 µm, allowing for precise cuts into hard tissue, such as bone and tooth.

With the use of ultrasound, acoustic micro-currents in the operating field are formed that clear the surgical area by improving haemostasis. The ultrasonic energy acts on cellular viability in the region operated on, accelerating the first postoperative phases of the bone repair process. The faster increase of bone morphogenetic protein, modulation of the inflammatory reaction and the stimulation of the formation of osteoblasts are physiological benefits that contribute to this improved and faster healing process. The apicectomy must be performed at 3 mm from the root apex, thus maintaining the length of the dental root, as well as eliminating the majority of the apical ramifications and lateral canals. The rotational movement of drills or vibrational movement of ultrasound during the apicectomy dislocates the remaining gutta-percha and this often leads to misalignment of gutta-percha with the walls of the canal. This is one of the reasons for the combination of the retrograde preparation and later retrograde obturation. In addition, during the retrograde preparation, removal of the infected dentine and the obturation material and cleaning of the isthmus is done, optimising the intra-canal bacterial control and shaping of the canal and leaving it prepared for the sealing material.

A retrograde cavity must be at least 3 mm in depth inside the root canal along its long axis. If this cannot be achieved, the outcome of the proposed cleaning and disinfection, as well as the prognosis of the treatment, will be uncertain. In the microsurgical technique, the retrograde preparation is always done with ultrasonic tips because it is the only way to achieve preparations of flat areas of the root canals, known as isthmuses. It is possible to observe the elliptical preparation with greater vestibular lingual extension of the original anatomy of the microanatomy of the mental root.
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www.DTStudyClub.com
Career development opportunities and support in a corporate practice

By Sarah Weston, UK

Having worked for most of my career in the independent sector, I was aware of the negative press surrounding corporate dentistry before I joined the mydentist group, but I have to say that those rumours were all unfounded. In fact, I feel quite passionately that new graduates are still being given that negative message. As a company we should try to give the next generation the facts and talk to them directly.

20 years ago I qualified from Guy’s Hospital. Since then I have worked in Australia, New Zealand and the UK across most sectors of the profession, be it as a house officer in New Zealand, in NHS and private practices, as a partner or associate. At my current practice in Woodbridge in Suffolk we are predominately NHS in a small market town, but do offer a range of private services.

With an interesting demographic of patients we get the chance to utilise all our skills. We routinely see 25-30 patients a day and I am lucky that I work with a really great team and most of us have worked together for a while now. It’s good to be with other people who understand the stress and strains of the job and can have a good laugh together at times.

I work full time so my days tend to be fairly similar. I start with a coffee then move on to checking day-lists, patient records and lab work etc. I hate surprises so I like to know what’s coming.

Most of my days are spent performing a mix of examinations and treatments with the odd interesting case thrown in. I also offer facial aesthetic procedures and have recently been on the denture excellence course. It is great to be able to offer such a wide choice of treatment options to patients and the denture excellence has really taken off. It is an area I really enjoy as a good denture can make so much difference to someone’s quality of life.

I am hoping to undertake an implant restoration course soon as well, so I will be able to restore the implants placed by colleagues at local practices in the group.

Since working for the corporate I have also become a mentor, which has definitely been a high-light for me. It is a role I really enjoy, as after 20 years in the job it is nice to pass on some of my experience to the younger generation.

I had a great VT instructor when I started and I hope I can be as good to new associates as he was to me. It’s a job that is mutually beneficial—it is extremely rewarding to see a mentee improve and gain in confidence and it does the same for the mentor.

Within the corporate we are so lucky to have a high level of support from practice and area managers through to clinical support managers (CSM) and clinical directors. They are there to help prevent small problems becoming larger ones. I know that the ‘red flags’ and KPIs can feel intrusive at times, but I do feel they are there to help clinicians above everything else. A visit from the CSM should be seen as a positive thing and I am lucky to have a great CSM in my area. One thing I have learned is that it can be lonely in the independent sector and there is no-one looking out for you in the same way. I think the support network available is the real strength of corporate dentistry.

We are also incredibly lucky to have the online academy and the reminder to complete CPD when it is required. This can be a burden for dentists and if there is any way to make it easier then we should be grateful. My practice manager keeps us in check with our CPD and the opportunity to complete it online is a great help, especially when I am busy in practice five days a week. Overall, I feel that my move to mydentist was the best thing I could have done for my career. The opportunities are there to further my career in ways that I didn’t feel existed in the independent sector.

While I enjoy my job enormously, I would relish the chance to move out of the surgery environment a little in the coming years and expand on my mentoring role and continue with more training and support of new dentists. I hope I can achieve this within the company.

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The filling of the elliptical retrograde cavity with MTA was also evident on the postoperative CBCT scan.

Selecting the appropriate retrograde obturation material is fundamental for achieving a high level of success. The ideal material should promote the filling of the region, protect the surgical wound and be radiopaque, biocompatible, impermeable, antimicrobial and osteoconductive. It should also have excellent properties in a moist environment. Various materials, including Cavit (3M ESPE), zinc oxide, eugenol, calcium hydroxide, amalgam, gutta-percha, tricalcium phosphate and hydroxyapatite, have been used in the attempt to seal retrograde preparations. However, none of these materials have been found to be capable of re-establishing the original architecture of the areas affected.

The introduction of bioactive sealant materials such as MTA, the precursor of the group of bio ceramics, made a great leap in terms of sealing and biocompatibility. It offers the most desirable characteristics of a repair material, such as tissue biocompatibility, stimulation of neo-formation of cement and biomineralisation. It also promotes superior sealing compared with other materials. Owing to the qualities described, MTA is now the material that best meets the requirements for material suitable for retrograde obturation. It is also the material with the best scientific track record in terms of effectiveness and clinical safety. For this reason, it was the material of choice for the apical sealing in this case.

In the apical repair process, bone repair is expected to occur through neo-formation of bone tissue in the region of the apical periodontitis and the repair is expected to be without scarring or periodontal recession.

Conclusion

The combination of operating microscopy, ultrasonics and MTA allows for extremely precise and predictable treatment. Endodontic microsurgery, when performed in accordance with these modern concepts, can be considered to be a therapeutic alternative for the aesthetic and functional maintenance of teeth with secondary or persistent apical periodontitis.

Editorial note

A list of references is available from the publisher.

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Image: Fig. 12: Cervical filling with white MTA Angelus. — Fig. 13: Post-op radiograph after 72 hours. — Fig. 14: Post-op radiograph. — Fig. 15: Post-op CBCT scan showing the filled isthmus. — Fig. 16: Post-op radiograph at six months. — Fig. 17: Post-op radiograph at 12 months.