Use of operating microscopy, ultrasound and MTA in periapical microsurgery

Trends & Applications

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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 by 6 per cent. Endodontic failure is usually associated with technical limitations that prevent adequate micro-surgical control in the complex internal micro- anatomy 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 peritubular microsurgery is performed traditionally, without the use of microsurgery. 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) — that is, in the macro-surgical form — its success rate does not exceed 60 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 semi-technical examination, a negative response to pain was observed in the palpation, 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. 1–5) and the preoperative CBCT scan showed fracture of the vestibular cortical bone (Fig. 4). The proposed treatment was endodontic microsurgery aimed at endodontic retrograde treatment. In this therapeutic situation, the prosthetic crown and the intra-radicular retainer would be kept; there was no need for new prosthesis 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 perioperative 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 65 l/min.

Fig. 1: Initial radiograph. — Fig. 2: Initial radiograph. — Fig. 3: Pre-op clinical photograph. — Fig. 4: Pre-op CBCT scan. — Fig. 5: Flap design. — Fig. 6: Piezo-osteotomy. — Fig. 7: Retrograde preparation. — Fig. 8: Isthmus. — Fig. 9: Isthmus. — Fig. 10: Initial radiograph. — Fig. 11: Initial radiograph.

As 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 anaesthesia was established, the papillae-based incision was made, followed by a vertical relaxing incision. Using a micro-syndemotome, the syndemotome was performed smoothly to prevent damage to the soft-tissue structures (Fig. 5).

The fracture of the vestibular cortical bone was treated using piezo-osteotomy with an ultrasonic tip (ST1 Bone Surgery Tip, Vista Dental) at full power. The osteotomy exposed the entire periapical lesion (Fig. 6). Subsequently, apical curettage was performed (Fig. 7).

The apicectomy was also performed using a piezo-electric ultrasonic system with a W7 ultrasonic tip (VDentus) 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 was infected by the conventional endodontic preparation owing to the limitations inherent in the kinetics 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 JT1 ultrasonic tips (B&L Biotech), the retrograde preparation was performed, adjusting the ultrasonic power to 30 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
LONDON'S TOP 10 ATTRACTIONS

1. BRITISH MUSEUM
The world-famous British Museum exhibits the works of man from prehistoric to modern times, from around the world. Highlights include the Rosetta Stone, the Parthenon sculptures and the mummies in the Ancient Egypt collection. Entry is free but special exhibitions require tickets.

2. NATIONAL GALLERY
The crowning glory of Trafalgar Square, London's National Gallery is a vast space filled with Western European paintings from the 13th to the 19th centuries. In this iconic art gallery you can find works by masters such as Van Gogh, da Vinci, Botticelli, Constable, Renoir, Titian and Stubbs. Entry is free but special exhibitions require tickets.

3. NATURAL HISTORY MUSEUM
As well as the permanent (and permanently fascinating!) dinosaur exhibition, the Natural History Museum boasts a collection of the biggest, tallest and rarest animals in the world. See a life-sized blue whale, a 40-million-year-old spider, and the beautiful Central Hall. Entry is free but special exhibitions require tickets.

4. TATE MODERN
Sitting grandly on the banks of the Thames is Tate Modern, Britain's national museum of modern and contemporary art. Its unique shape is due to it previously being a power station. The gallery's restaurants offer fabulous views across the city. Entry is free but special exhibitions require tickets.

5. THE LONDON EYE
The London Eye is a major feature of London's skyline. It boasts some of London's best views from its 32 capsules, each weighing 10 tonnes and holding up to 25 people. Climb aboard for a breathtaking experience, with an unforgettable perspective of more than 55 of London's most famous landmarks – all in just 30 minutes!

6. SCIENCE MUSEUM
From the future of space travel to asking that difficult question: “who am I?” the Science Museum makes your brain perform Olympic-standard mental gymnastics. See, touch and experience the major scientific advances of the last 300 years; and don't forget the awesome Imax cinema. Entry is free but some exhibitions require tickets.

7. VICTORIA & ALBERT MUSEUM
The V&A celebrates art and design with 3,000 years' worth of amazing artefacts from around the world. A real treasure trove of goodies, you never know what you’ll discover next: furniture, paintings, sculpture, metal work and textiles; the list goes on and on... Entry is free but special exhibitions require you to purchase tickets.

8. TOWER OF LONDON
Take a tour with one of the Yeoman Warders around the Tower of London, one of the world’s most famous buildings. Discover its 900-year history as a royal palace, prison and place of execution, arsenal, jewel house and zoo! Gaze up at the White Tower, tiptoe through a medieval king’s bedchamber and marvel at the Crown Jewels.

9. ROYAL MUSEUMS GREENWICH
Visit the National Maritime Museum - the world’s largest maritime museum, see the historic Queen’s House, stand astride the Prime Meridian at Royal Observatory Greenwich and explore the famous Cutty Sark: all part of the Royal Museums Greenwich. Some are free to enter; some charges apply.

10. MADAME TUSSAUDS
At Madame Tussauds, you’ll come face-to-face with some of the world’s most famous faces. From Shakespeare to Lady Gaga you’ll meet influential figures from showbiz, sport, politics and even royalty. Strike a pose with Usain Bolt, get close to One Direction or receive a once-in-a-lifetime audience with Her Majesty the Queen.

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The retro-prepared canal was retro-obturated with white MTA (Angelus). The occlusal cavity was filled with surgical calcium sulphate (Glbitsu).

Discussion
The use of operating microsurgery in combination with ultrasonic tips and MTA-based bioceramic 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 periapical tissue can be minimised, leading to better aesthetic results.

The apicectomy 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 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 dislodges 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 intracanal 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 3 mm or more into the root canal. This is possible owing to the long neck of the ultrasonic tips in addition to a sequence of three to four bends along its length. These bends allow the active tip to gain full accessibility to the root canal.

The ultrasonic tips also allow for non-circular movements for better mechanical cleaning 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 medial root.
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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 predominantly 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 course 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 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 when our CPD is due 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.

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 bioce- ramics, 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 biomimatisation. 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 scars or periodontal recession.

Conclusion

The combination of operating microscopy, ultrasonic aid 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.

A list of references is available from the publisher.

Sarah Weston has been working for mydentist, a member of the Association of the Dental Groups (www.dental groups.co.uk), in Woodbridge, Suffolk, since 2019.