What's inside a tooth

A tooth, you would think, is a pretty simple structure. But take a look inside and you will be amazed at what you find, says Diana Dumitriu

Looking inside a tooth and you will see that pulpal space is not a simple hollow space and root canals are not straight tubules, but rather complicated anatomical structures with intricate communications and ramifications.

The thing I love the most about endodontics is that it is a great game of imagination. Most often, the only images we have are radiographs – CBCT images are still not widely available – so we have two-dimensional images of complex three-dimensional objects. It is advised to take at least two radiographs from different angles before any root canal treatment is carried out, but you will still be only getting mere hints of the configuration of pulpal space. The rest is your imagination based on knowledge and experience.

Lower lateral incisor, mesial view 1

Having mentioned my love of endodontics, I enrolled in a master's degree at Warwick University – after all, what is life without a master degree? This is a new programme only in its first year, with strong European roots. Along with the first assignment, we have been taught how to clear teeth according to professor Castellucci's protocol. That is, how to make natural extracted teeth transparent after staining the pulpal space with India ink or methylene blue. Not only have we been taught to clear the teeth, we have also benefited from a photography lessons from a professional photographer, which really boosted my photography skills. The results are the photos with this article.

Upper first molar , mesial view 1

Endodontic failures

Missed anatomy is the main cause of endodontic failure. Often, the entire root canal or a significant part of it is not instrumented, disinfected and filled, thus enabling microbes to thrive in the endodontic space and consequently form an abscess of the periapical area leading to endodontic failure. A canal may be left untreated because the dentist fails to recognise its presence. Understanding that the root-canal system is complex is essential.

One point that is perhaps worth noting is the upper first molar, the tooth with the most an-

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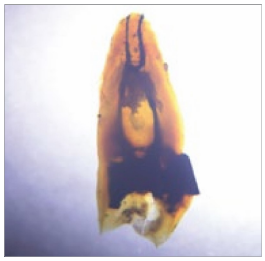
atomical variations. It has three roots and can have up to seven canals. Most often it has four root canals, two root canals on the mesial-buccal root (up to 95.2 per cent according to research), but sometimes it has three mesio-buccal root canals (see upper first molar, mesial view 1).

Endodontists agree that only magnification and illumination (loupes and a microscope) enable the location of the MB2. Without them and this root canal could be located only in 18.2 per cent of the cases. Fortunately, the two mesial-buccal root canals most often merge to open in a single apical foramen, but still not in all of the cases. When a root contains two root canals that merge, it is worth noticing that most often, the lingual or palatal root has straighter access to the apex.

All oval roots should be suspected of containing two root canals with communications (isthmuses) between them, sometimes fully formed other times incomplete. Also, a canal can split (see the lateral lower incisor), sometimes canals can split and rejoin again (see the upper second premolar). There are root canals that merge inapproaching apex to open in a single apical foramen (see mesial root on the lower molar).



Upper second premolar mesial , older pt 1

If we deal with an oval canal located on an oval root, it is wise to treat it as two separate canals with a communication, to achieve the best shaping and cleaning. Most often the apical foramen has an oval shape, hence the need to enlarge the root canal to a size superior to the file used for apical gauging.

Lower first molar , lingual view 1

Lower first molar, mesial view 1

Calcification of the canal

Often with age we notice significant calcification of the root canals that makes root canal therapy more time demanding. This is a real problem as we see an ageing population retaining their natural teeth and for sure they have great expectations from their dentist.

Notice the wide canals on an upper premolar extracted from a young patient for orthodontic reasons compared with an upper premolar from an older patient with a rather intricate anatomy. Endodontic treatment on a tooth of a young patient if such a situation arises may seem easier but in fact it is not, as special care must be taken because apical constriction is absent and over instrumentation and overfilling may occur frequently.

Of great interest is the fact that the apical foramen, the orifice where the pulp ends and the periodontal space begins, is very rarely located at the radiologic apex. Often it is located on a side and is up to three mm from the anatomical tip of the root (see the lower molar both mesial and distal root). Hence some root fillings may appear short on radiographs with a puff of sealer somewhere on the side of the root.

To complicate the situation even more, we have to be aware of the presence of accessory canals, which are branches of the main pulp canal or chamber that communicates with the exterior of the root. Among accessory canals are the furcal canals (on behalf of which interradicular radioluscency on necrotic teeth can be accounted).

Lateral canals are located on the coronal third or middle part of the root. They cannot be accessed or instrumented as most often are horizontal from the main root canal. With a thorough irrigation protocol they can still be debrided and due to the hydrodynamics of the root filling material, appear filled on post-operational radiographs.

From the start, anatomy of the tooth has perhaps the greatest importance in predicting the success of Endodontic therapy. Of course, we all want good, predictable results for our patients, so carefully evaluating pulpal space anatomy is of paramount importance. This factor dictates the choices of therapeutic method for mechanical preparation, irrigation to filling.

I have to admit that before starting the master's degree course at Warwick, I thought success in endodontics was found in rotary files. And like many others, I was hoping to find a file that would miraculously carry out all the treatment Unfortunately, there is no such thing. Perhaps the greatest miracle of all is realising there are no miracles, at least not in the medical world. It is all about understanding biological and evidence-based concepts, in order to take the best decisions for your cases.

Understanding endodontic anatomy has helped me tremendously. From the start, the access cavity has to be extended so that it can provide straight-line access to the root canal. I think about all the curvatures and figure how much and where I need to extend, bearing in mind that every canal has a degree of curvature. I now understand ribbon-shaped canals, oval canals and the need to adjust shaping and filling techniques.

A challenging area

Root canal therapy is maybe one of the most challenging areas of dentistry. It is important to understand all the factors that lead to success, to be able to give our patients all the options and help them make the best choice.

After all, our patients want us to help them keep their natural dentition their entire life. And this is certain to make them happy and bring a smile to their faces. DT

About the author

Diana Dumitriu graduated in 2000 from Bucharest Dental School and has worked in private practice, also in Bucharest, from 2001 to 2008. In January 2008, she started practising in UK. She has a special interest in Endodontics and is currently enrolled in the MSc course in Endodontics at Warwick University and working at Chard NHS Dental Practice in Somerset.