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.

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.

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.

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One point that is perhaps worth noting is the upper first molar, the tooth with the most anatomy.
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 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).

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.

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 pull of sealant 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 external of the root. Among accessory canals are the furcal canals (on behalf of which interradicular radiolucency 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.
Back to school

Ali Baloch tells *Dental Tribune* how the MSc in Endodontics at Warwick University has been one of the most positive steps in his career to date

I t was a cold November morning in Falkirk, one of those depressing days when things weren’t likely to go my way. I had been doing long hours for a week so I was feeling drained, and to make things even worse, I was suffering with a fever too.

Just as I was anticipating things getting worse, the phone rang. This turned out to be one of the best moments of my week. It was Dr John Hall from Warwick Dentistry, part of the University of Warwick, who wanted to discuss the application that I had submitted to apply for a place on Warwick Dentistry’s new MSc in Endodontics programme.

After a telephone interview with Dr Hall where we discussed my background, current skills and knowledge in more detail, Dr Hall then advised me that I had been selected for the course!

I was on cloud nine and could not believe that I was going to be part of one of the most prestigious institutions in the UK. This didn’t just mean another degree; it meant that I would experience a huge learning and knowledge opportunity from the experienced and well-qualified faculty at Warwick.

Although driving 600 miles every month just to get to the University was slightly inconvenient, my passion for this field helped me to shrug off such problems. It was made easier that the course is part-time, giving me the flexibility to fit the 10 taught days around my normal working practice schedule.

I was really excited on my first day at Warwick Dentistry. There were rigorous classes throughout the induction pro-

## About the author

Dr Shahzad Ali Baloch, BDS (Hons) graduated with a distinction in Orthodontics from the Muntazah University College of Dentistry Lahore, Pakistan in 2004. He worked at a multidisciplinary group practice in Islamabad for a couple of years and developed a special interest in Endodontics and Oral surgery. He moved to the UK in 2007 and started his Overseas Registration Exams. Dr Baloch then worked as a SHO in Oral and Maxillofacial surgery at Aberdeen Royal Infirmary and Southern University Hospitals where he underwent training. He is now practicing in Falkirk, Scotland as a Dentist with special interest in Endodontics. He is also a part time student in MSc Endodontics at Warwick University.
A useful tool
Dr Paul Jones explains how CBCT can play an important part in endodontics

When our associate took a class on Cone Beam CT, I said to myself, why would an endodontist need a CBCT? A few months later, I had what I called my “aha moment”. I saw a CBCT taken by an oral surgeon on a patient I had seen twice, but had been unable to locate which upper posterior tooth was causing her pain. It was clear from the CBCT (Fig 2) that the upper second molar had a large periapical lesion that was obscured by the zygoma and the sinus on my periapical images (Fig 1). I was hooked. Now it was clear why CBCT would be useful in my endodontic practice. The more I use CBCT, the more valuable it has become. Here are some indications for using it in an endodontic office.

**Diagnosis and treatment planning**
Inconclusive diagnosis like my first case, most of us occasionally struggle with locating the tooth causing the patient’s symptoms. No tooth is any more tender to percussion, palpation or mastication than any other. Nothing shows on the X-ray. The patient often can’t even tell if the problem is upper or lower. If the pathology has progressed enough to cause apical periodontitis, it should show on the CBCT. In the past, I sent that patient away and had them wait for the problem to localise. Using CBCT, I can usually find and treat the problem earlier.

Low et al. showed that 34 per cent of lesions detected with cone beam tomography were missed with periapical radiography in maxillary premolars and molars.

**Suspected fractures**
The second most frustrating diagnosis endodontists face is the

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