The significance of radiographs in endodontic therapy

The success of any endodontic therapy depends on adequate chemical and mechanical debride ment of the infected root canal. This requires basic knowledge of the canal anatomy and the ability to identify any aberration in it. Studies have shown that micro-organisms in the root canal system reside in the main canal, the canal’s ramification, the accessory or lateral root canal, and even the dentinal tubules. Therefore, optimal debridement can only be achieved if the clinician is able to identify the presence of additional canals prior to or during treatment (Table 1).

Currently, the only method available to assess the root, the root canal anatomy and its peri-radicular area preoperatively is through dental radiographs. Whether radiographs are performed intra- or extra- orally (dental panoramic tomogram or cone beam computed tomography, CBCT), fractures, resorptive defects or procedural errors can also be identified this way. Thorough examination of radiographs is important, as it can provide an indication of the complexity of the treatment, including anticipated difficulties (Table 2).

The use of CBCT has been widely explored and its advantages are well documented.3, 4 While its benefits for diagnosis in endodontic treatment cannot be

Table 1: Factors and rationales when using a 2-D radiograph for diagnostic purposes

<table>
<thead>
<tr>
<th>Factors</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angulation of the central beam</td>
<td>Affects the position and size of the object</td>
</tr>
<tr>
<td>Exposure time</td>
<td>Affects the diagnostic quality of the radiograph</td>
</tr>
<tr>
<td>Receptor sensitivity</td>
<td>Affects the diagnostic quality of the radiograph</td>
</tr>
<tr>
<td>Processing procedure</td>
<td>Affects the diagnostic quality of the radiograph</td>
</tr>
<tr>
<td>Viewing conditions</td>
<td>Important for identifying normal anatomical structures and presence of pathology</td>
</tr>
<tr>
<td>Clinical experience of the observer</td>
<td>An observer with more experience analysing radiographs may be able to detect the presence of pathology better.</td>
</tr>
<tr>
<td>Superimposition of anatomic structures</td>
<td>Affects the diagnostic quality of the radiograph</td>
</tr>
<tr>
<td>Position of the tooth in the jaw</td>
<td>Superimposition of anatomical structures, density of surrounding bone, single- vs. multiple-rooted teeth</td>
</tr>
<tr>
<td>Location of the lesion</td>
<td>May be superimposed with anatomical structures, such as the mental foramen, maxillary sinus or nasal sinus</td>
</tr>
</tbody>
</table>

Table 2: Types of radiographs and their advantages and disadvantages

<table>
<thead>
<tr>
<th>Types</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra- oral</td>
<td>Conventional periapical</td>
<td>• Cheaper</td>
</tr>
<tr>
<td></td>
<td>Digital periapical</td>
<td>• Allows image enhancement/modification (contrast, brightness, texture, size)</td>
</tr>
<tr>
<td></td>
<td>Extra-oral</td>
<td>Dental panoramic tomogram</td>
</tr>
<tr>
<td></td>
<td>CBCT</td>
<td>• 3-D image</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Image can be modified</td>
</tr>
</tbody>
</table>

Table 3: Factors and rationales when using a 2-D radiograph for diagnostic purposes.
Factors assessed

Intra-oral radiographs, such as conventional and digital periapical radiographs, are still routinely used as one of the important investigative tools during endodontic examination and the diagnosis stage. Even though it has a few limitations, an appropriately taken and processed periapical radiograph can still provide enough information and evidence to aid in diagnosis. An acceptable periapical radiograph must have adequate contrast and no or minimal processing error and include at least 3 mm of the surrounding periapical area to allow accurate assessment of the tooth of interest and its surrounding area. Additional periapical radiographs at different angles (10–30 degrees horizontally or vertically) could be taken to determine the location of a periapical lesion or any resorptive defect present on the root and its surface (internal or external). An earlier study has shown that accuracy in detecting the presence of twin canals increased using a periapical radiograph with a horizontal shift. Another conclusion was that the detection of periapical lesions was more accurate with an angulated radiograph. However, the degree of angulation should not be excessive, as it would result in overlapping of the image or changes in the image size, thus reducing the diagnostic quality of such a radiograph.

Periapical radiographs taken at different angulations may be necessary in order to determine the number of root and root canals of a tooth, especially in premolars and molars. Several studies have shown that radiographs taken at a horizontal angle of 30 degrees improved the ability to determine the canal type in premolar teeth. Periapical radiographs can be taken either by using the parallelizing or bisecting angle technique.

Dental radiographs are needed for the assessment of the crown, pulp chamber, root(s) and periapical area of a particular tooth (Table 1). Clinicians should make it a routine to assess the entire radiograph thoroughly (i.e. the adjacent teeth and its surrounding tissue) before focusing on the tooth of interest. It is essential to ensure that the radiograph is mounted correctly prior to assessment. This is to prevent misdiagnosis or misinterpretation of the radiograph. Use of magnification, such as a magnifying glass, could aid in detailed assessment of the radiograph. Restoration status and the presence of a carious lesion or periapical pathology on any tooth should be identified, documented and included in the treatment plan. When assessing the radiograph of the tooth of interest, the clinician should start from the crown then move towards the root and its periapical area. Any findings must be included in the documentation and considered when deciding on the treatment option.

The periapical radiograph must have minimal distortion and magnification, as any elongation or foreshortening would result in incorrect measurement of the root canal length. Careful assessment of the root is essential to identify any root aberration that may be present (Fig. 1). It is quite common to find a Chinese patient with a C-shaped canal or other Mongoloid trait with an aberrant root or root canal anatomy. Thus, thorough assessment of the radiograph is necessary to ascertain the presence of additional roots or root canals and thereby establish treatment difficulty.

Since endodontic therapy involves the treatment of the root canal, which is not visible to the naked eye, radiographs aid in determining whether treatment was carried out satisfactorily and adequately.

Proper assessment Dental radiographs are important in endodontic therapy to determine tooth morphology, ascertain the cause of the dental problem and provide an early assessment of the tooth of interest. Based on a radiograph, the restorability of a tooth and the complexity of the treatment can be assessed.

It also helps clinicians decide whether he or she has the skills to perform the treatment or should refer the patient to a specialist. The presence of a pulp stone in the pulp chamber or another obstruction within the tooth or root canal (e.g. a post, a pin, a separated instrument or root filling material) can be determined prior to treatment (Fig. 2).

<table>
<thead>
<tr>
<th>Area</th>
<th>Factors assessed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown</td>
<td>• Guts (depth, location, extension)</td>
<td>Assessment of the restorability of the tooth and treatment complexity.</td>
</tr>
<tr>
<td></td>
<td>• Restoration status (secondary roots, margins, depth, extension)</td>
<td></td>
</tr>
<tr>
<td>Pulp chamber</td>
<td>• Size, shape, location of the pulp horn</td>
<td>Measures the depth and direction of the bur during access.</td>
</tr>
<tr>
<td></td>
<td>• Distance to the occlusal surface of the crown</td>
<td>Prevents iatrogenic perforation of the tooth during access.</td>
</tr>
<tr>
<td>Root</td>
<td>• Number of roots</td>
<td>Determination of the number of roots and root canals is important to avoid missed and untreated canals, which would result in endodontic treatment failure.</td>
</tr>
<tr>
<td></td>
<td>• Size of roots</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Curvature (degree, direction)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Presence of accessory roots</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Crown–root ratio</td>
<td></td>
</tr>
<tr>
<td>Root canal</td>
<td>• Number of root canals</td>
<td>The clinician must pay extra attention when treating arched or obliterated canals.</td>
</tr>
<tr>
<td></td>
<td>• Size of canals</td>
<td>Use of magnification, such as dental loupes or a microscope, is recommended in this situation.</td>
</tr>
<tr>
<td></td>
<td>• Presence of accessory lateral root canals</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Factors to consider during radiograph assessment
errors, such as perforation of the pulp chamber are for preventing procedural complications and even during access to the lesion. A periapical radiograph must be taken to minimise the extent of superimposition on adjacent teeth. The SLOB rule (same lingual, opposite buccal) can be used to determine the location of an additional root or root canal.

The size of the root canal can also be assessed from the radiograph. This information will provide some indication of the complexity of the treatment and the choice of the obturation material and technique. A tooth with an open apex may require placement of a calcific barrier, such as mineral trioxide aggregate, apically prior to obturation.

The status and quality of the existing coronal restoration must be assessed radiographically and clinically. All defective restorations must be removed and replaced with either permanent or temporary restorations. Any carious lesion must be noted, and the depth of the lesion must be determined clinically. This is important in order to ensure that the tooth is deemed restorable prior to treatment. The clinician must decide on how to restore the tooth after completion of endodontic therapy prior to initiation of treatment.

Posts, separated instruments or root filling material within the root canal may complicate the endodontic treatment (Fig. 3). The size and type of post will determine the feasibility of removing such a post. A separated instrument in the apical third of the root and below the curved root may be more difficult to remove than a more coronally located fragment.

Operative assessment (treatment phase)
Working length is confirmed and quality of obturation is assessed during treatment to ensure the treatment is carried out satisfactorily. A periapical radiograph may also be taken to ascertain the correct angulation of the bur or endodontic file when negotiating a blocked or calcified canal, during post space preparation and even during access preparation through a calcified pulpal chamber (Fig. 4). This is essential for preventing procedural errors, such as perforation of the pulpal floor or canal wall.

During obturation, it is important that the root canal be obturated to the predetermined working length and have no voids. This can be confirmed by taking a periapical radiograph during treatment. Obturation that is shorter or longer than the working length may affect the treatment outcome.

Post-operative assessment
After therapy has been completed, a periapical radiograph should be taken to ensure that the treatment was carried out adequately. This will function as a baseline when reviewing the patient six to 12 months later. From this immediate post-operative radiograph, the quality of the final coronal restoration can be ascertained and the size of the periapical lesion, if present, can be assessed. At the recall appointment, a new periapical radiograph of the endodontically treated tooth is taken to monitor the healing of the periapical lesion and to confirm the success of treatment. The presence of a new periapical lesion or the enlargement of an existing one should be noted, and necessary measures should be taken to identify the cause of treatment failure.

Conclusion
Using intra-oral radiographs is the only method in endodontic therapy that allows the clinician to make an assessment of the root and its supporting tissue. In order to gain the full benefit of this radiograph, clinicians have to ensure that it is appropriately exposed, shows no processing errors and has no or minimal image distortion. It also has to be correctly mounted, labelled and dated. Clinicians must be able to select which radiograph is necessary to aid in their endodontic diagnosis based on the patient’s history and clinical examination.

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“Our aim is to be a leading provider of evidence-based endodontic CE”

An interview with APEC President Dr Ibrahim Abu Tahun, Jordan

Dr Ibrahim Abu Tahun in the Jordanian capital of Amman for the 18th time to attend the scientific congress of the Asian Pacific Endodontic Confederation (APEC), which will be held under the theme “Next generation endodonties”. Dental Tribune Asia Pacific had the opportunity to speak with Dr Ibrahim Abu Tahun, President of APEC and Assistant Professor of Endodontics at the University of Jordan's Faculty of Dentistry, about the congress and the current state of the specialty in his home country.

In early April, specialists and other dental professionals from the Middle East and Asia Pacific regions will be gathering in the Jordanian capital of Queen of Jordan led world leaders in the march against terrorism in Paris. Decades of political stability, moderation and tolerance under His Majesty's wise leadership have made Jordan an oasis of peace and one of the top ten countries worldwide in terms of security. Could you give us an accurate view of the current status of endodontics in Jordan?

There is a general surplus of dentists, both general practitioners and specialists, entering the Jordanian market each year. The total number of registered dentists in the Jordanian Dental Association at the end of 2011 was slightly over 7,000, and 10 per cent of these were specialists. The kingdom currently prides itself on having the highest number of highly qualified dental professionals with postgraduate qualifications compared with any other country in the Middle East. Many of them have been trained in Western Europe, North America and Australia.

Is endodontics therefore a recognised specialty in your country?

In the past, Jordanian endodontists were members of the Jordanian Society of Conservative Dentistry and had to practise under the umbrella and regulations of the Jordanian Dental Association. In 2007 the establishment of the Jordanian Endodontic Society. Endodontics is of the eight dental specialties recognised by the Jordan Medical Council, which is the highest medical authority responsible for the organisation of the medical profession and specialisation in the country. Since then, endodontics has experienced significant progress in Jordan.

Ranked number one in scientific research in the Arab world and 50th overall worldwide, the Jordanian educational system attracts a large number of foreign students. It is also home to many foreign universities’ campuses.

The country is the region’s top medical tourism destination, as rated by the World Bank, and fifth in the world overall, having everything from highly skilled doctors to state-of-the-art facilities. Clinics here cater for all dentistry needs. Plans are currently underway to make it a regional hub for the training of medical staff in the Middle East and North Africa.

How many visitors do you expect for the APEC congress?

Around 1,000 participants are expected to attend this large international event. Organised for the first time in our part of the world, the 18th APEC conference is going to attract dentists from all over the Arab world and the entire Asia Pacific region.

What are the main topics, and who is the conference aimed at?

The theme of the conference is “Next generation endodontics”. The scientific programme, with emphasis placed on Asian Pacific experience, provided by speakers from the respective countries, will have two parallel sessions with world-leading experts in the field, original clinical and scientific research posters, as well as pre- and post-congress hands-on sessions, covering the recent advancements and issues in the field.

Our aim is to be a leading provider of evidence-based continuing endodontic education for the entire dental team and anyone with a general interest in endodontics.

How do you think the congress is going to affect endodontic treatment and diagnostics in the future?

Such international meetings always constitute a platform for scientists and practitioners to update their knowledge and interact with the latest endodontic innovations worldwide to improve their knowledge and answer the ultimate question: where do we stand?

In addition to the scientific programmes, what can participants look forward to in Amman?

This pioneer endodontic event in the Asia Pacific region is intended to connect colleagues from around the world to generate and update knowledge and foster friendship. A wide range of dental products, including instruments and other equipment, will be on display by our industry partners.

It is a great pleasure and honour to welcome participants to the country where some of the earliest chapters of human civilisation were written. Travelling to Jordan, with its rich heritage of biblical and historical sites, will provide visitors with a unique opportunity to enjoy the warmth and hospitality of our country and its people.

Thank you very much for the interview.
Endodontic imaging mode available from Planmeca

Planmeca has introduced a new imaging mode that was developed especially for use in endodontics and in cases dealing with small anatomical details, such as imaging of the ear. The new mode, which produces extremely high-resolution images with a very small voxel size of only 75 μm, is available for all Planmeca ProMax 3D imaging units.

According to Planmeca, the new mode provides clinicians with perfect visualisation of even the smallest anatomical details. Owing to new intelligent noise and artefact removal algorithms, noise-free and crystal-clear images can be produced, the Finnish dental equipment manufacturer said. With Planmeca ARA, for example, artefacts resulting from metal restorations and root fillings in the patient’s mouth that cause shadows and streaks in CBCT images can be removed effectively. In addition, the new Planmeca AINO Adaptive Image Noise Optimiser is intended to reduce noise in CBCT images resulting from a particularly low radiation dose or small voxel size without losing valuable details. The company said that the filter particularly improves image quality in the endodontic mode, where noise is inherent due to the extremely small voxel size. It has also proven useful when used in accordance with the Planmeca Ultra Low Dose protocol, where noise is induced by the particularly low dose.

Planmeca AINO also allows the reduction of exposure values and consequently the radiation dose in all other imaging modes, according to Planmeca.

Irrigatys

With endodontic treatment, there is the risk of superinfection. The French laboratory ITENA Clinical claims to have solved this problem with its revolutionary Irrigatys handpiece. This two-in-one device is used for both irrigation and agitation of the cleaning solution inside the root canal. To achieve this, the laboratory put a perforated metal tip at the top of the handpiece to deliver the cleaning solution in an oscillating movement. A removable tank allows the root canal to be treated successively using sodium hypochlorite and EDTA. The irrigation line directs the cleaning solution through the metal tip.

The patented technology, achieved after six years of research, optimises the results of a very complex procedure, according to the company. Ambidextrous, light and flexible, the device has excellent ergonomics, providing intuitive handling. Irrigatys recharges on a charging station that can be fixed to the chair.

Irrigatys is available with all of its accessories in a starter kit. The metal tips are available in two sizes, 17 mm and 21 mm, to cover all clinical cases.

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Endodontic treatment in the future will be simpler and standardised

An exclusive interview with Drs Laurent Bataillard and Didier Lakomsky, MICRO-MEGA

Since 1905, MICRO-MEGA has been at the heart of great technological revolutions in the field of dentistry. Today, the French pioneering company is still delivering turnkey endodontic solutions to practitioners around the world. At the start of a series of innovations, Dental Tribune International recently travelled to Besançon in France to meet Managing Director Dr Laurent Bataillard and Endodontics Business Unit Director Dr Didier Lakomsky to discuss how their company intends to reassert its global reputation of French expertise, which it established in 1997 when it introduced its first nerve broach.

“From March 2007, we are no longer manufacturing in France and in Besançon and we are even considering partial or complete outsource of jobs abroad. MICRO-MEGA has been designing, manufacturing and marketing dental surgical instruments in the heart of the French watchmaking and microtechnology capital for over a century now.”

Moreover, all production stages, from the product design to the delivery of the final product, take place under one roof. This results in great flexibility and quick response, an important synergy between the various entities, perfect control of the entire production process, as well as optimised traceability and follow-up.

Despite our international orientation, we need to remember where we come from. We have strengthened our presence in Besançon and in France through partnerships with university hospitals and local practitioners, and we are even considering patenting of a local modern concept.

Dr Didier Lakomsky: What is your role in the company?

Dr Laurent Bataillard: How do you intend to implement your international development strategy?

Our aim is to continue our strong development in Asia while consolidating our position in Europe and the US.

Furthermore, all production stages, from the product design to the delivery of the final product, take place under one roof. This results in great flexibility and quick response, an important synergy between the various entities, perfect control of the entire production process, as well as optimised traceability and follow-up.

Despite our international orientation, we need to remember where we come from. We have strengthened our presence in Besançon and in France through partnerships with university hospitals and local practitioners, and we are even considering patenting of a local modern concept.

By responding to everyone’s needs closely, The Garniers, the company’s founding family, have always collaborated with the great names in the history of dentistry. These successful partnerships have brought about revolutionary products, like the nerve broach, the Gromatic (first contra-angle with reciprocating movement), the HERO 642 sequence (first MICRO-MEGA NiTi sequence, developed by Prods. F. Calas and J.-M. Vulcain), Revo-S (NiTi sequence with three instruments, designed by Drs J.-P. Mallet and F. Diemer) and One Shape (first single instrument in continuous rotation, developed by Prods. F. Pérez and M. Guigand).

We are currently strengthening our presence all over the world through conferences and training for dentists. Our aim is to continue our strong development in Asia while consolidating our position in Europe and the US. We work with the opinion leaders of the main European markets and conduct precisely targeted studies in order to offer complete and specific endodontic solutions corresponding to practitioners’ habits. Our strength lies in our products’ quality, simplicity, security and efficiency; these are the key-words that define our day-to-day work.

Is ecology a matter of concern for you?

Naturally, we try to recycle as much as possible and to avoid waste. We also seek ongoing improvement of our manufacturing processes.

Dr Lakomsky, what is your role in the company?

The Sanavis Group is one of the ten most important dental equipment suppliers in the world. The grouping of the company’s former MICRO-MEGA, SeiCan and SycoTec is now able to offer practitioners worldwide a comprehensive range of innovative solutions: endodontic files, micro-motors, and complete retreatment and hygiene systems.

There is a strong product synergy today between the various group entities. MICRO-MEGA’s core business is endodontics. Our historical expertise started with the nerve broach and is constantly evolving with the latest technologies. Do things differently and/or create something new based on our knowledge—that is our challenge for the years to come.

French consumers seem to be very sensitive when it comes to the country of origin of the products they buy. What does “made in France” mean to you?

It reflects the intent, among others, to maintain our industry in France and in Besançon and to avoid outsourcing of jobs abroad. MICRO-MEGA has been designing, manufacturing and marketing dental surgical instruments in the heart of the French watchmaking and microtechnology capital for over a century now.

What were the benefits of the company’s takeover by the Sanavis Group in 2009?

The Sanavis Group is one of the ten most important dental equipment suppliers in the world. The grouping of the company’s former MICRO-MEGA, SeiCan and SycoTec is now able to offer practitioners worldwide a comprehensive range of innovative solutions: endodontic files, micro-motors, and complete retreatment and hygiene systems.
Dr Didier Lakomsky: MICRO-MEGA’s reputation is based on technical expertise combined with comprehensive networking with dental professionals. My role is to define and implement high-performing products in close co-operation with endodontic specialists, general practitioners and distribution partners worldwide. Ensuring benefit from these exchanges with practitioners, anticipating future market needs and transforming them into relevant technical solutions are also part of my function at MICRO-MEGA. A structural consequence of my work is the grouping of the marketing and the research and development departments concerning product planning in the short, medium and long term. In this regard, I encourage and support synergies.

What do you think endodontic treatment will look like in the future?

Above all, it will be simpler and more standardised. Continuous rotation and reciprocating motion are currently enjoying irrefutable success. This evolution—one could even call it a revolution—has enabled general practitioners to increase the number of endodontic treatments performed in their practice. Increasing endodontic treatment is a trend that is likely to continue in the coming years.

In the future, endodontic treatment will be quicker, but will still respect bacterial prevention standards. Sodium hypochlorite may be replaced by a new irrigation solution that offers the same efficiency while reducing the irrigation time.

We can expect solutions that are more sophisticated and that have scientifically proven effectiveness. The technological evolutions will extend gradually over the next three to five years. Practitioners will work with increasingly flexible and resistant materials, allowing the treatment of even complex root canals, and with imaging techniques like CBCT, offering an extremely precise 3-D visualisation of the root canal structure and enabling practitioners to choose the appropriate treatment method according to the anatomical and clinical complexity. This is often referred to as stratification. In the longer term, the introduction of pulp regeneration techniques according to the clinical case is expected, with diagnostic methods allowing the evaluation of the reversibility of a case of pulpitis.

What are MICRO-MEGA’s objectives today?

Our goals are to provide general practitioners with solutions that make endodontic treatment reproducible and as simple as possible, to enable them to increase their number of cases and to improve their success rate significantly. The last is a fundamental condition for our company’s success.

Thank you very much for the interview.
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