Minimally invasive endodontics - Part 2: 3D disinfection and obturation of root canals

Dr. Dimitar Kosturkov, DMD, PhD

Shaping of root canals is very important in order to provide good disinfection and obturation of root canals. This has to be achieved by creating a continuous tapered shape of the canal, while preserving the natural anatomy and maintaining the size and position of the apical foramen [1]. With the new materials and techniques, this task seems to be easier than in the past. Despite all efforts after shaping and disinfection of root canals, there are still some bacteria left in the dentin tubules. That is why it is important to provide three dimensional obturation of the root canals, which will stop the recolonization of the endodontic space from bacteria. After good root canal obturation, the metabolic activity of microorganisms will stop as they will be deprived of sources to thrive and be literally buried in the tubules of dentine wall [2].

Disinfection

The instrumentation of root canals **does not result** in bacteria-free environment [3, 4, 5]. Many irrigants are used for disinfection, but one of the most commonly used in endodontics is sodium hypochlorite (NaOCl). The activation of this solution by passive ultrasonic irrigation makes it possible to penetrate and disinfect deep in the dentin walls and also to reach the apical preparation even when it has a very small diameter and taper. The activation of sodium hypochlorite has good effect not only by increasing the depth of penetration, but also by reduction of the exposure time. The most common used concentration of sodium hypochlorite is 5,25%, which disinfection activity towards bacteria can be increased by activation with sonic/ultrasonic devices or by heating.

The negative effects of sodium hypochlorite on dentin when increase proportionally to the concentration and time of exposure, lead to significant decrease in elastic modulus of dentin. This makes the tooth more brittle and prone to fractures [6, 7]. This has to be taken into consideration especially for teeth with bone loss due to

About Dr. Dimitar Kosturkov

Dr. Dimitar Kosturkov graduated with honors from the Faculty of Dental Medicine in Sofia, Bulgaria, in 2014. Since then, he has been an endodontist and restorative dentist at Uzunov Dental Clinic in Sofia. From 2016 to 2019, he was a full-time PhD student in the Department of Conservative Dentistry at FDM-Sofia. In 2017, he began teaching students at FDM-Sofia. In 2019, he successfully defended his dissertation on the topic: “Pulse Oximetry in Dental Medicine” and obtained his PhD degree. In 2020, he obtained a specialty in operative dentistry and endodontics from FDM-Sofia. Since 2021, he has been a chief assistant professor in the Department of Conservative Dentistry at FDM-Sofia. He is author of numerous publications in Bulgarian and international journals and scientific projects.

Dr. Kosturkov’s main interests are in the fields of endodontics, treatment of dental caries, dental photography and digital dental medicine. He is a member of the Bulgarian Dental Association (BDA), the Control Commission of the Sofia Region Body of BDA and the Bulgarian Scientific Society of Dental Medicine. He is a speaker at Inspire Dental Academy and Dentstore Bulgaria and an international endodontics speaker for Kerr Endodontics and Carl Zeiss.

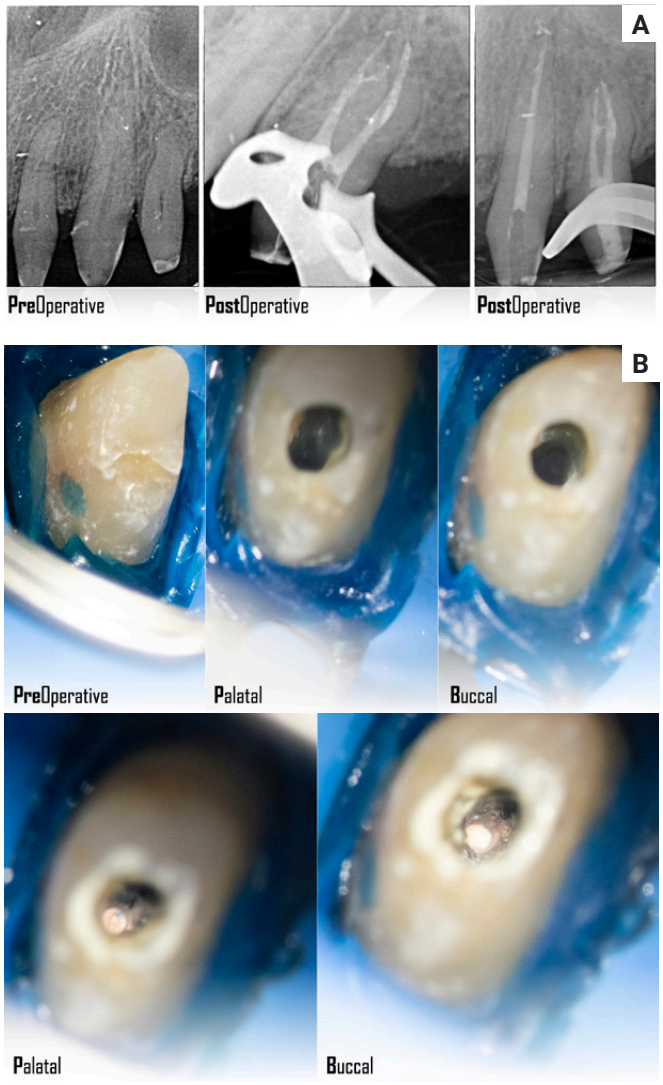


Fig.1 3D obturation on premolar (Continuous wave of condensation, elements™ IC, gutta-percha and Sealapex™ Kerr) - A) X-rays before and after obturation of root canals; B) clinical images – before, during and after root canal obturation.

periodontal disease and teeth of elderly (over 55 years), where 50% reduction in the tensile and fatigue strength of coronal dentin is observed and the incremental rate of crack extension is up to 100 times greater [8, 9].

Obturation

The purpose of root canal obturation is to fill and seal the cleaned endodontic space. Some experts say that inadequate sealing of the radicular system causes up to 65% of endodontic failures [10, 11]. No method for disinfection is able to leave the canal bacteria free. A good 3D obturation will prevent the multiplication of bacteria by isolating them from resources for their metabolic activity and thus provide long term success. After root canal preparation the shape of the root canal is not always completely the same as the shape of the master apical file, but only in the last 3-5 mm of the root. Therefore, often **when obturated with single cone technique, there is space between the gutta percha (GP) cone and root canal wall. This space is obturated usually with sealer, which is considered to be the "weak" side of the obturation.** In such cases often lateral condensation technique is used instead of single cone. It is well known that when lateral condensation is performed there is still space left between the gutta percha points, which is filled with sealer (ideally, but also voids are observed often). Also the forces used for condensation sometimes lead to root fractures, which is a huge drawback. MIE requires safe, predictable 3D obturation of the complex anatomy of the endodontic space (fig. 1).

Predictable 3D obturation of root canals can be achieved by using elements™IC and Continuous wave of condensation technique, which is safe and reproduceable. It has 3 stages: cone fit, down pack and back fill (fig. 2).

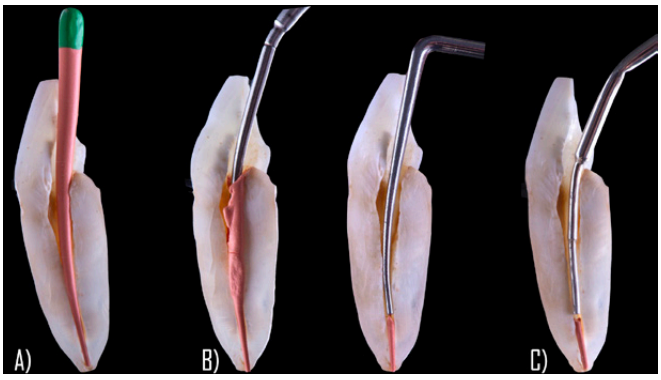


Fig.2 Continuous wave of condensation – steps: A) Cone fit; B) Down pack; C) Back fill.

1. **Cone fit:** during this stage the calibrated master gutta percha cone is calibrated to working length and when pulled back from the root canal there must be a feeling of "tug back" (slight resistance), otherwise the obturation might not be successful. After that the tip of the gutta-percha cone is shortened with 0.5 mm
2. **Down pack:** sealer is inserted in the root canal, the master gutta percha cone is inserted as well with some sealer on the tip. Then it is cut with the heat plugger of elements™ IC unit – first at the level of orifice (fig. 3 – A). Then until 2/3 of root canal, or approximately 4-6 mm away from the apical preparation - with continuous heating of the plugger and apical progression for 4 seconds (fig. 3 – B). At that point the heat plugger is switched off and the operator waits for 10 seconds with slight apical pressure (fig. 3 – C). After 10 seconds, the heat plugger is switched on for 1 second, turned off and pulled coronally so it cuts the gutta percha, leaving 4-6 mm of the cone in the apical zone (fig. 3 – D). This gutta percha is condensed with cold Buchanan hand plugger (fig. 3 – E).

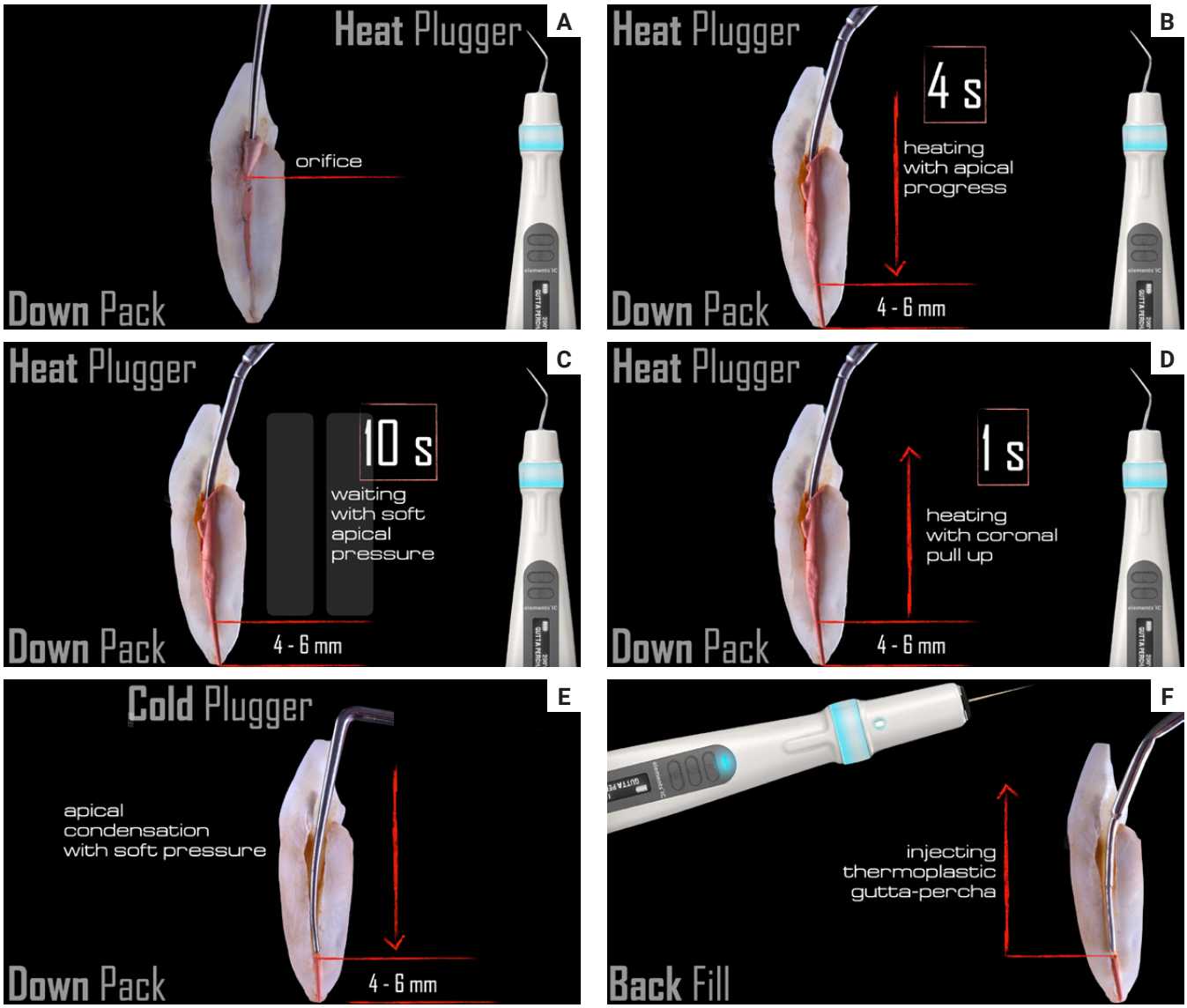


Fig.3 Down pack and backfill: A) GP is cut at the level of the orifice; B), C), D) 2/3 of GP is cut so that only 4-6 mm is left in the apical third of the root canal; E) apical portion of GP is condensed with cold Buchanan Hand Plugger; F) obturation of the middle and coronal part of root canal with thermoplastic GP.

3. **Back fill:** using the obturation unit part of elements™ IC, the gutta percha is heated in special cartridge and injected in thermoplastic state inside of the root canal (fig. 3 – F). Then it is condensed with cold Buchanan hand plugger.

Case report

Anamnesis and chief complaint: 34-year-old patient complains from spontaneous sharp pain in the region of tooth #36. The pain appears at night for two days. Painkillers are partially releasing the pain. The same tooth #36 had caries treatment done few months ago and at present is with disto-occlusal (DO) composite restoration.

Clinical examinations: Extensive DO composite restoration on tooth #36. No pain on percussion, no tooth mobility, no redness or swelling of the oral mucosa in the region of the tooth.

Paraclinical examinations: From X-rays (fig.4) it is visible that there is deep composite restoration which is nearby/ in contact with the distal pulp horn. Pulp chamber is constricted. There are no morphological changes in the periapical region of the tooth. Electric pulp test shows higher values than normal, which correspond to pulp inflammation.

Fig.4 PreOperative X-ray of tooth #36.

Pulp diagnosis: Symptomatic irreversible pulpitis on tooth #36

Apical diagnosis: Normal apical tissues on tooth #36

Treatment plan: Non-surgical endodontic treatment of tooth #36 (fig. 5). Removal of old restoration, caries removal, endodontic access, pulpectomy, orifice localization, 3D shaping, 3D disinfection and 3D obturation of root canals. Obturation of the cavity.

Shaping of the root canals: Two **mesial canals** were found and shaped up to ZenFlex™ 25/06 master apical file (MAF). Shaping protocol: Traverse™ 25/08 for orifice opening and coronal enlargement > Traverse™ Glide Path size 13/06 to full working length > Zenflex™ 20/04 > Zenflex™ 25/06 (fig.6.a).

Two **distal canals** were found and shaped up to ZenFlex™ 30/04 MAF. Shaping protocol: Traverse™25/08 for orifice opening and coronal enlargement > Traverse™ Glide Path size 13/06 to full working length > Zenflex™ 20/04 > Zenflex™ 25/06 > Zenflex™ 35/04 (fig. 6. b).

Disinfection: Standard protocol. Passive ultrasonic irrigation with three cycles of 20 seconds alternating solutions of 5,25% sodium hypochlorite and 17% EDTA. Final irrigation with 95º alcohol.

Obturation: Continuous wave of condensation technique with elements™IC unit. Sealapex™ Xpress sealer was used, applied manually with paper points (fig. 7).

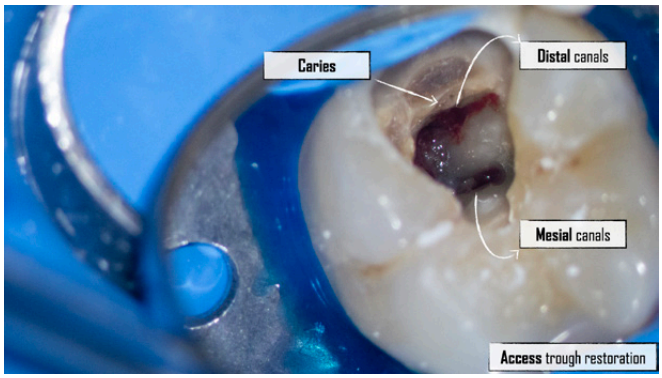


Fig.5 View of tooth #36 after removal of composite restoration.

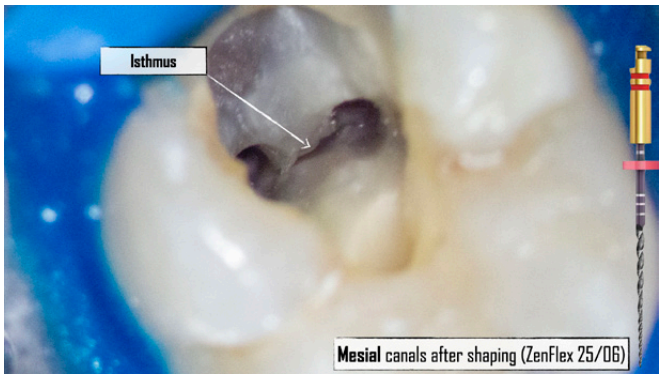


Fig.6a View of mesial canals of tooth #36 after shaping.

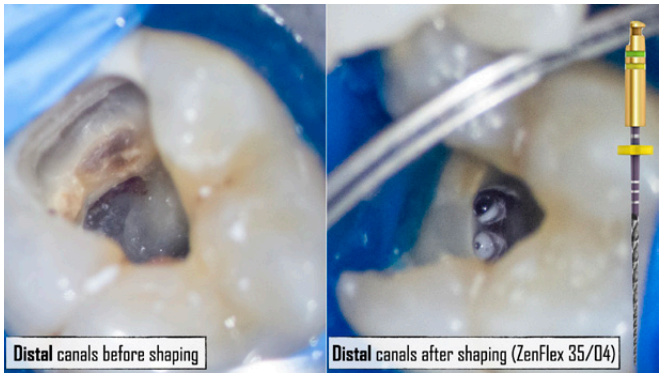
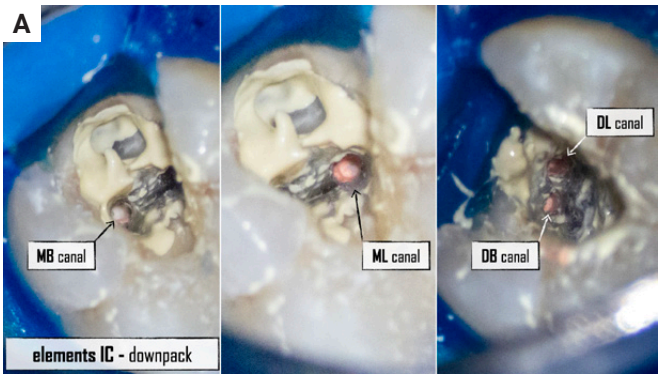
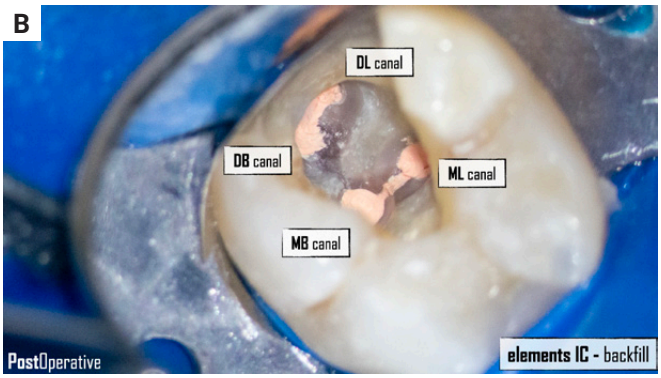


Fig.6b View of distal canals of tooth #36 before and after shaping.





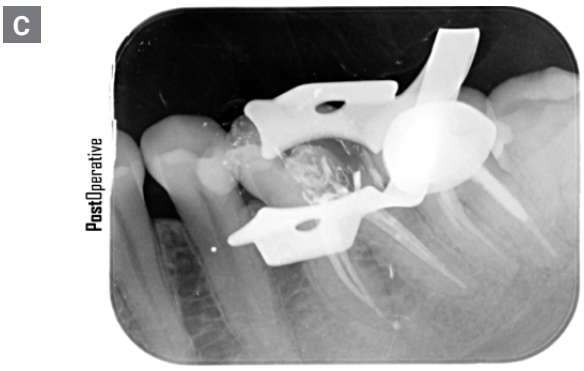


Fig.7 Obturation of root canals using elements™IC and continuous wave of condensation technique – A) downpack stage; B) backfill stage; C) postoperative X-ray.

Fig.8 Preoperative, postoperative X-rays and 18 months follow up X-ray of tooth #36.

The cavity was restored with composite resin and the case was followed up for 18 months now (fig. 8).

Conclusion

The success rate of endodontics depends on not only on conservative access and shaping of the root canals, but also sufficient disinfection and efficient obturation. Without a doubt implementing high-end technology and modern approaches will improve the long-term success and preservation of endodontically treated teeth.

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Disclosure: Dr. Dimitar Kosturkov is a consultant for Kerr. The opinions and technique expressed in this article are based on the experience of Dr. Dimitar Kosturkov. Kerr is a medical device manufacturer and does not dispense medical advice. Clinicians should use their own professional judgment in treating their patients.