What's new for the clinician – summaries of recently published papers (August 2025)

SADJ AUGUST 2025, Vol. 80 No.7 P389-P392

Edited and Compiled by Prof V Yengopal, Faculty of Dentistry, University of the Western Cape

1. DIGITAL VERSUS TRADITIONAL APICAL BARRIER TECHNIQUES IN ENDODONTIC PROCEDURES

Endodontic procedures often require precise management of the root apex, particularly in cases involving open apices or periapical lesions. Apical barrier techniques are essential to achieve an effective seal and promote periapical healing. Traditionally, materials such as mineral trioxide aggregate (MTA) and calcium hydroxide have been used to create an artificial apical barrier. However, advancements in digital dentistry, including 3D imaging, guided endodontics, and bioceramic materials, are transforming the approach to apical barrier formation.

It is well recognised that apexification, apical barrier procedures, and regenerative endodontic procedures (REPs) can eliminate the symptoms and signs of pulp necrosis in immature teeth, with or without apical periodontitis, and promote healing of bone lesions[1]. Although the clinical application of REPs has increased, recent evidence confirms that their long observation periods, variability in outcomes, and dependency on multiple clinical factors currently limit their ability to replace apexification or apical barrier procedures entirely[1]. It should be noted that for immature teeth or adult teeth with an open apex, proper placement of barrier materials in the apical area remains a challenge for most dentists.

It is hypothesised that a novel apical barrier technique (N-ABT) using 3D printing technology to obtain filling instruments matching large root canals, using Cone Beam Computed Tomography (CBCT) data to calculate the volume of required barrier material, and using an apical barrier material that is easy to shape and transport, would achieve more ideal filling results. Moreover, this digital method would be beneficial for future automated obturation procedures. Wang and colleagues from China (2025)[1] reported on a trial that sought to improve the accuracy of filling in apical barrier procedures by comparing N-ABT with the traditional apical barrier technique (T-ABT).

Materials and methods

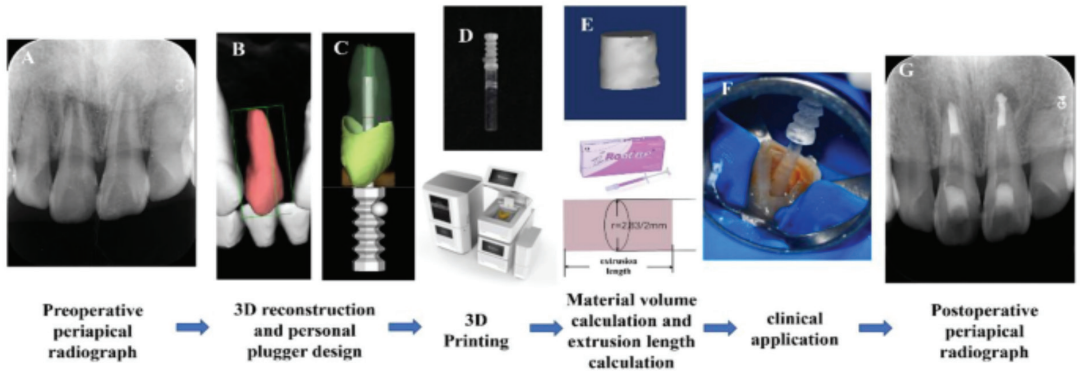
This randomised controlled clinical trial was reported according to CONSORT 2010 guidelines.

A total of 50 teeth from 47 patients were included. The first author enrolled participants and generated the random allocation sequence using a computer-generated method and sealed envelope allocation concealment. The study was conducted in a single-blind manner. Teeth were randomly assigned to either the N-ABT group ($n=25$) or the T-ABT group ($n=25$) using a 1:1 allocation ratio.

The inclusion criteria ensured that the teeth were anterior or premolar teeth with necrotic pulp and open apex, from cooperative and compliant patients who not allergic to agents necessary to complete the procedure, the degree of root canal curvature is less than 10 degrees. Patients were excluded if they had medical contraindications, systemic diseases or conditions known to affect periapical healing (e.g., diabetes, immunosuppression, smoking), teeth with vertical root fractures, teeth with apical cyst, or nonrestorable teeth, periodontally involved teeth.

The Novel apical barrier technique(N-ABT) is graphically illustrated in fig 1 below:

Fig. 1



The procedure of novel apical barrier technique. A. Preoperative imaging data were collected, and DICOM data were obtained from CBCT scans. B. A 3D tooth model was extracted using Mimics software. C. A personalized plugger matching the internal diameter of the root canal was designed in 3ds Max software. D. The personalized plugger was printed using a 3D printer. (E) The material volume was calculated and adjusted, and the material length from the material tube was determined. (F) The personalized plugger was used to place the calculated volume of material into the apical area. (G) Postoperative imaging data were collected

Clinical procedures before apical barrier obturation

The tooth was anesthetised and a rubber dam was placed. After access opening, the pulp tissue was removed by hand-use 40# H file before irrigation. The canal was initially irrigated with 1.5% sodium hypochlorite (NaOCl) and sonically agitated for 15 s, followed by irrigation with saline. Next, the canal was irrigated with 17% EDTA, sonically agitated for 15 s, and irrigated again with 2% chlorhexidine for 2 min, followed by final irrigation with NS. A side-vented needle was placed 1 mm short of the working length for irrigation.

After drying the canals with sterile paper points, calcium hydroxide dressing was placed into the root canal, positioned within 1 mm of the working length. After placing a sterile cotton pellet, the access cavity was sealed with temporary restorative material (Caviton).

At the next visit, typically 14 days later, all teeth were required to be asymptomatic, with no signs of infection in the root canals. The calcium hydroxide dressing was removed using alternating irrigation with 1.5% NaOCl, 17% EDTA, and saline (20 mL each) under ultrasonic activation, monitored under a dental operating microscope. Complete removal of calcium hydroxide was confirmed under direct visualisation, and the canals were dried with sterile paper points.

Apical barrier obturation

In the N-ABT group, the volume-calculated iRoot BP Plus was placed into the middle third of the root canal using a traditional plugger and then condensed to the apex with the personalised plugger A minimum thickness of 4 mm at the apex was obtained and confirmed radiographically (see Fig. 1).

In the T-ABT group (control group), the operator used a traditional plugger to condense an uncontrolled volume of material into the apical area. If the periapical radiograph showed poor compaction or underfilling, a second obturation attempt was performed.

During this process, the number of obturation attempts and the total time spent (from initial material placement to completion of obturation, including any repeated material placements) were recorded.

Clinical procedures after apical barrier obturation

After apical barrier obturation, the remaining iRoot BP Plus material on the root canal wall was removed as much as possible with disposable micro applicator, and then a wet cotton pellet was placed inside the pulp chamber and root canal to facilitate the complete curing of BP in a humid environment, avoiding contact with the apical barrier material. The access cavity was sealed with temporary restorative material (Caviton). One week later, the temporary restorative material and cotton pellet was removed. Finally, the canal space was subsequently restored with dual-cure resin cement (Relyx™ U200), accompanied by a fiber post to provide mechanical support, and the tooth cavity was restored with a nano hybrid universal restorative (Filtek™ Z250).

Patients were followed up at 1, 3, 6, 12, and 24 months. The presence of pain during percussion, palpation, or biting was evaluated and recorded. Any tooth-related pain or soft tissue damage was considered treatment failure. Periapical radiographs were obtained at each follow-up point, and CBCT scans were taken at 12 and 24 months to evaluate the condition of the periradicular tissues. If acute symptoms developed, the patient was withdrawn from the trial.

Radiographic evaluation

CBCT data were calibrated and evaluated by two independent endodontist observers using the CBCT Periapical Index (CBCT-PAI) scores. CBCT-PAI scores range from 0 to 5. The difference between CBCT-PAI scores before treatment and at 12- or 24-months post-treatment was calculated as CBCT-PAI change (ΔCBCT-PAI).

Results:A total of 47 patients with 50 teeth requiring an apical barrier procedure were recruited. Of these, 45 teeth completed the 12- and 24-month follow-up. Chi-square test showed no significant differences between the N-ABT and T-ABT groups in terms of patient age, gender, tooth type, aetiology, apical foramen size, tooth length, and CBCT-PAI score.

Outcome of healed or healing between two groups

At the 12- and 24-month follow-ups, no differences in clinical outcomes were observed between the N-ABT and T-ABT groups, as none of the cases exhibited tooth-related pain or soft tissue damage.

All cases were considered successful, as they remained asymptomatic and radiographic results showed a reduction in the size of the apical radiolucency. Adjusted analysis revealed comparable healing probabilities between the N-ABT group (22.7%) and the T-ABT group (17.4%) at 12 months (RR = 1.30, 95% CI 0.65–2.61), persisting through 24 months (N-ABT 68.2% vs. T-ABT 47.8%; RR = 1.43, 95% CI 0.94–2.16). No statistically significant differences in healed rates were observed between the two groups.

Changes in CBCT-PAI between two groups

All intergroup comparisons remained nonsignificant ($P > 0.05$) suggesting that both procedures achieved comparable clinical efficacy and radiographic outcomes during the observation period.

Filling quality and efficiency between two groups

Filling status was categorised based on the extent of overfilling into no overfilling (0 mm), mild overfilling (< 1 mm), moderate overfilling (1–2 mm), and severe overfilling (> 2 mm), by CBCT scan and calculation. The N-ABT group showed a significantly higher rate of no overfilling (9/22, 40.9%) and mild overfilling (13/22, 59.1%) compared to the T-ABT group (2/23, 8.7%; 10/23, 43.5%). In contrast, the T-ABT group had higher rates of moderate overfilling (7/23, 30.4%) and severe overfilling (4/23, 17.4%), while no cases of moderate or severe overfilling were observed in the N-ABT group, with all differences being statistically significant ($P < 0.05$), except for the overfilling < 1 mm category. These results suggest that N-ABT can effectively reduce overfilling, particularly excessive overfilling, which may be attributed to the precise control of material volume and accurate positioning during obturation. Interestingly, overfilling appeared to have little effect on periapical healing.

N-The ABT group required only one obturation session, while the T-ABT group required an average of 1.41 ± 0.50 sessions ($P < 0.01$). This finding indicates that N-ABT facilitates one-time filling, which is advantageous for future automated filling and saves working time. Because only one session

was required in the N-ABT group, the total filling time was significantly shorter (38.78 ± 15.56 s) compared with the T-ABT group (99.31 ± 25.08 s), with a statistically significant difference ($P < 0.01$).

These results suggest that the N-ABT group improved both filling efficiency and quality, reduced technical sensitivity, and provided a foundation for future automated filling.

Conclusion

In this study population, the clinical effectiveness of N-ABT was found to be superior to that of T-ABT, with the difference (20.4%) at the 24-month follow-up exceeding the estimated minimum clinically important difference of 10%.

Implications for practice

These findings indicate that the novel apical barrier technique is a highly predictable and effective clinical procedure that reduces technical sensitivity and supports further automation in treatment, facilitating its broader therapeutic application.

REFERENCE

1. Wang, C., Chen, S., Wang, L. *et al.* A randomised controlled trial comparing novel and traditional apical barrier techniques in endodontic procedures. *Clin Oral Invest 29, 372 (2025).* https://0-doi-org.innopac.wits.ac.za/10.1007/s00784-025-06450-x

2. EFFECT OF DIFFERENT PACIFIER DESIGNS ON OROFACIAL TISSUES: A COMPUTATIONAL SIMULATION COMPARATIVE STUDY

Pacifiers, also known as soothers or dummies are a common tool used to comfort infants and promote self-soothing. They offer several benefits, including helping babies to settle, reducing the risk of sudden infant death syndrome (SIDS), and preventing thumb-sucking, which can be even harder to break as a habit. However, the prolonged use of pacifiers – especially beyond the recommended infant stage – has been linked to a higher risk of dental malocclusion. The risk of developing malocclusion increases with the duration and frequency of pacifier use. Effects are most pronounced when pacifier use extends beyond 12 months and becomes particularly significant after 4 years. These habits can alter the natural positioning of the tongue and affect muscle function and the development of the jaws, sometimes causing persistent dental and skeletal changes if not discontinued in time. Fortunately, early cessation of pacifier use often allows for self-correction of many mild malocclusions.

The design of the pacifier is crucial in minimising these risks. Pacifiers vary in shape, size, and stiffness, and the so-called "physiological" or "orthodontic" pacifiers are specifically engineered to adapt to the palate and better support natural oral development. Research suggests that these designs distribute tongue and sucking forces more evenly across the palate and reduce the risk of dental changes compared to conventional models. The correct size and shape also promote comfort, proper jaw development, and facilitate smooth transitions between breastfeeding and bottle feeding. Ultimately, while pacifier use can be beneficial in early infancy, thoughtful selection of a well-designed pacifier and restricting its use to the recommended age range are essential to safeguard healthy oral and facial development.

Computational modelling has been employed to investigate the mechanical effects of pacifiers on oral structures; however, many studies still rely on simplified representations. More recent models [1] have aimed to represent the suction cycle and pacifier-palate interaction with greater fidelity, incorporating hyperplastic materials and additional tissue layers. These studies demonstrated that pacifier design and size directly influence the stress and deformation distributions on the palate. Despite these advancements, limitations persist regarding the full anatomical representation of the oral cavity and the replication of real physiological conditions

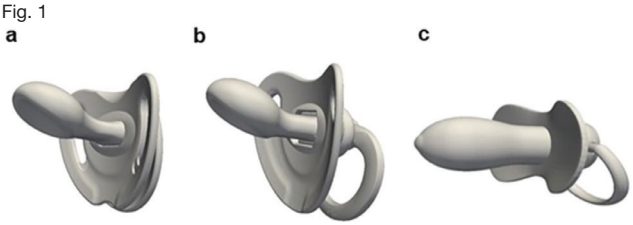
In this study, Pereira et al (2025)[1] developed and validated their own computational model to compare the effects of different pacifier designs.

Methodology

For this study, the researchers used a validated and innovative computational model developed by their own team. The implemented approach consists of a computational methodology capable of providing quantified data on the effects of pacifiers on the oral cavity, thus inferring the relationship between the pacifier and the prevalence of malocclusions. The results obtained clearly complement the empirical tests presented in the literature regarding the effects of different pacifiers on orofacial structures. The computational model comprises a palate, a pacifier, and a tongue. The palate model, obtained by scanning a physical plaster cast of a six-month-old infant's palate, includes six tissues: mucosa, cortical bone, cancellous bone, alveolar bone, periodontal ligament, and teeth.

Three different pacifiers, representative of the wide range of products available on the market, were analysed: an orthodontic pacifier, a standard pacifier and a conventional pacifier, all illustrated in Fig. 1. The geometries of the orthodontic pacifier and the standard pacifier were provided by the manufacturer, while the conventional pacifier was modelled based on measurements taken from actual models using the 3D modelling software Blender™. These specific pacifier models were selected based on prior studies available in literature, which also compare the orthodontic and conventional designs. Furthermore, the inclusion of both the orthodontic and standard models in the present study aimed to assess whether minor design optimisations in pacifiers could contribute to reducing the adverse effects typically associated with their use.

Fig. 1



3D complete models of the tested pacifiers: a. Orthodontic Pacifier; b. Standard Pacifier; c. Conventional Pacifier.

One computational model was created for each pacifier using the OpenFOAM® open-source computational library. The model was implemented in the OpenFOAM® library to calculate tooth displacement, exerted force, and stress distribution on the palate tissues.

www.sada.co.za / SADJ Vol. 80 No.7

Results

In this work the model identified as the most realistic in was used to obtain concrete results regarding the effects of different pacifiers: the orthodontic pacifier (OP), the standard pacifier (SP), and the conventional pacifier (CP).

The simulation studies comprise two suction cycles, during which different results were analysed, namely: stress distribution on the palate surface, the evolution of the force exerted by the pacifier on the palate, the maximum displacement of the teeth, and the force exerted on the teeth. Regarding stress distribution, OP and SP significantly reduced the volume of palatal mucosa exposed to von Mises Stress in the range of 0.01 to 0.05 MPa. Specifically, OP achieved a 95.70% reduction, while SP resulted in a 93.95% reduction, when compared to CP. Furthermore, they led to a maximum reduction in mean tooth displacement of 79% (OP) and 75% (SP). These findings indicate that the pacifier design can significantly impact mechanical loading on the palate and teeth, reducing the risk of developmental oral malocclusions.

Conclusions

This study underscores the importance of pacifier design in mitigating potential adverse effects on orofacial development. The orthodontic pacifier (OP),and the standard pacifier (SP), performed significantly better than the conventional pacifier (CP)for al outcomes measured.

Implications for practice

There is a growing need for pacifiers designed based on scientific evidence to reduce the risks of orofacial deformation resulting from non-nutritive sucking. The computational approach introduced provides valuable insights that can inform the design of improved pacifiers aimed at minimising risks associated with non-nutritive sucking habits.

REFERENCE

1. Pereira, R., Romero, J., Santos, C.P. *et al.* Effect of different pacifier designs on orofacial tissues: a computational simulation comparative study. *Clin Oral Invest 29*, 356 (2025). https://0-doi-org.innopac.wits.ac.za/10.1007/s00784-025-06428-9