Endodontic explorer in integration with calibrated probe: A design concept.

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Abstract

Operative dentistry, a field of dentistry concerned with the diagnosis, prevention, and treatment of dental problems, is critical in maintaining oral health and restoring damaged teeth. This paper examines the instruments used in operative dentistry, specifically probes and explorers, emphasising their importance as well as their limitations. Probes are slender tools that are used to measure gum pockets and evaluate periodontal health. Explorers, on the other hand, like the DG16 endodontic explorer, aid in the detection of tooth decay, dental caries, and irregularities on tooth surfaces. We proudly present a design concept for an endodontic explorer coupled with a calibrations, with the goal of improving efficiency and accuracy in endodontic procedures. A bi-angled working length, optimised shank and working tip proportions, and ergonomic elements for comfortable use are all part of the design.

Keywords: endodontics, endodontic explorer, calibrated probe, root canal, diagnosis, treatment planning, instrument design.

Introduction

The diagnosis, treatment, and prevention of disorders of the tooth pulp and periapical tissues are the main goals of the specialised discipline of dentistry known as endodontics. The ability of the healthcare provider to precisely diagnose and navigate the intricate root canal system is crucial to the success of endodontic operations. To help in the diagnosis and treatment of root canal diseases, a variety of dental devices and tools have been created.

The endodontic explorer is one of the tools frequently used in endodontic treatment. An endodontic explorer is traditionally a long, thin, pointed device with a sharp tip that is used to detect the canal opening and examine the tooth's root surface for abnormalities or calcified regions.[(1)] It gives the doctor tactile input, assisting in the identification of fractures, cracks, or hidden canals.

When it comes regarding precise measurements and examination of root canal architecture, the standard endodontic explorer has certain drawbacks. Traditional probing methods also frequently lack standardised calibration, which can result in inconsistent readings and perhaps may result in an inaccurate treatment planning[(2)].

Through advancements in dental materials and techniques, operative dentistry has become more precise, efficient, and patient-friendly. Dentists now have access to a wide range of tooth-coloured restorative materials that closely mimic the natural appearance of teeth, resulting in aesthetically pleasing and long-lasting dental restorations. By providing comprehensive care for dental diseases and damage, operative dentistry plays a vital role in preserving oral health and improving the quality of life for individuals of all ages. Regular dental visits and early intervention through operative dentistry can help prevent the progression of dental problems, ensuring healthy and functional smiles for years to come.[3]

Periodontal probe

An essential dental tool for gauging periodontal pocket depth and gum health is the periodontal probe. It assists in determining and maintaining records of gum disease. The probe's thin handle features calibrated markings at the tip that allow you to measure the depth of a pocket in millimetres[(4)] . In order to take measurements at the gumline, dental experts carefully place the probe into the pocket next to the tooth. To document these parameters and follow the development of the condition and determine the best course of action.

The measurements obtained with a periodontal probe are subjective and dependent on the clinician's technique and force applied during probing[5]. Variations in probing force among different clinicians can lead to inconsistent measurements, which may affect the accuracy of the diagnosis and treatment planning. Inability to detect early stages of periodontal disease: Periodontal probes primarily assess the pocket depth, which is the space between the gum tissue and the tooth surface. While pocket depth measurements are important for assessing the severity of periodontal disease, they may not detect early stages of disease, such as gingivitis, which is characterized by inflammation of the gum tissue without significant pocket formation[(6)]. Although periodontal probes provide

information about pocket depth, they do not provide comprehensive data on other important periodontal parameters, such as clinical attachment level, bleeding on probing, furcation involvement, or mobility[7]. To obtain a more complete assessment, additional diagnostic tools, such as radiographs and periodontal charts, may be necessary. probing may be challenging in areas with limited accessibility, such as furcation, deep narrow pockets, or areas with crowding or mispositioned teeth. In such cases, alternative techniques or instruments, such as dental endoscopy or diagnostic imaging, may be required to accurately evaluate the periodontal condition. Probing can cause discomfort or pain for some patients, especially if they have sensitive gums or areas of active inflammation. This discomfort may lead to patient resistance or incomplete probing, which can affect the accuracy of the measuremnts.

Fig.1: William's probe

Fig.2: straight probe

Explorer

Dentists utilise a dental explorer, also known as a probe, which is a pointed instrument with a sharp tip. It aids in the detection of tartar, calculus, and irregularities on tooth surfaces. Professionals can explore and analyse the oral cavity using the explorer's hook-like tip to spot weaker or damaged regions of the tooth enamel. The explorer gives tactile input during dental examinations to evaluate tooth surfaces for caries and other dental issues[8]. It is made of sturdy stainless steel and has a non-slip grip.

An endodontics explorer, also known as an endodontic explorer or a DG16 explorer, is a specialized dental instrument used in the field of endodontics. It is designed specifically for diagnosing and locating root canal or pulp chamber openings, exploring canals, and detecting abnormalities in the root canal system. The primary purpose of an endodontics explorer is to aid endodontists (dentists specializing in root canal treatment) in identifying and examining the anatomy of the root canal system[9]. It helps in locating canal orifices, detecting calcified canals, and assessing the presence of any obstructions or irregularities. The endodontics explorer has a long, thin, and tapered tip that facilitates access to narrow or hard-to-reach areas within the root canal. The tip is often sharp and may have a slight curve to it, allowing for enhanced tactile sensitivity and manoeuvrability during the exploration process. While the DG16 explorer is a commonly used instrument in endodontics, there are variations and alternative designs available. Some endodontics explorers may have a double-ended tip, with one end being more pointed and the other end being more rounded or flattened. These variations provide different options for exploring and assessing various aspects of the root canal system. When performing root canal treatment, the endodontist carefully inserts the explorer's tip into the pulp chamber or along the root canal, feeling for irregularities or changes in the canal's anatomy. The explorer is used to locate and explore canal openings, remove pulp remnants, detect calcified canals or blockages, and assess the length of the root canal[10].

Fig.3: Explorer

DG16 endodontic explorer

Dentists utilise the DG16 endodontic explorer during root canal execution. It features a narrow, curved working end with a sharp or hook-like point and a thin, thin grip[11]. Its stainless steel construction enables accurate investigation of root canal apertures to find abnormalities and flaws. When doing root canal therapy, dentists utilise it to evaluate the health of the pulp chamber and root canals and spot any blockages or anomalies.

The endodontic explorer can provide some tactile feedback to the dentist, but its sensitivity is limited compared to more advanced instruments such as electronic apex locators[12]. This can make it challenging to accurately detect minor cracks, fractures, or calcified canals. If not used carefully, the sharp tip of the explorer can potentially damage the delicate tissues within the root canal system, such as the dentin walls or the pulp chamber. Vigorous or improper use may lead to unnecessary perforations or transportation of the canal. The explorer relies solely on tactile feedback to assess the condition of the root canal. It does not provide any visual information about the internal anatomy, such as the presence of additional canals or the extent of root curvature[13]. This limitation may result in incomplete or inaccurate treatment planning. The endodontic explorer is not suitable for every clinical situation. For example, in cases where there is a significant amount of calcification or obstructions within the canal, the explorer may be ineffective in negotiating the canal space[14]. In such instances, additional diagnostic aids or alternative instruments may be required. Like any dental instrument, the endodontic explorer has the potential to carry infectious agents from one patient to another if not properly sterilized between uses. Strict adherence to infection control protocols is necessary to minimize the risk of cross-contamination[15].

FIG.4: DG16 Explorer

Endodontic explorer in integration with probe: a concept design

Endodontic instruments play a crucial role in diagnosing and treating dental pulp and periapical diseases. The combination of a periodontal probe and DG16 explorer into a single instrument aims to improve efficiency and accuracy during endodontic procedures.

Design:

This concept design has been registered and granted a design patent by the Indian Patent Office (Design number: 37202:March 2024).

Instrument Design:

2.1 Working Length:

The instrument incorporates a bi-angled working length, allowing for enhanced access and manoeuvrability within the coronal pulp chamber floor aiding in locating the orifices. The first angle is set at 45 degrees, enabling better visualization and exploration of the canal walls. The second angle, positioned at 90 degrees, facilitates tactile feedback and detection of irregularities.

2.2 Shank:

The shank, measuring 8mm in length and 1mm in diameter, provides the necessary strength and flexibility for precise instrumentation. Its dimensions have been optimized to ensure proper control during use.

2.3 Working Tip:

The working tip of the instrument is 11mm in length and tapers to a diameter of 0.15mm. This fine tip allows for delicate probing and exploration within the root canal, minimizing the risk of iatrogenic damage. Graduations at 0.5, 1, 1.5, 2, 2.5, 3, 3.5, and 4mm provide reference points for accurate depth measurement.

2.4 Body Features:

A handle measuring 16cm in length and 5.5mm in diameter. The diameter has been chosen to ensure a comfortable grip for clinicians of various hand sizes. Additionally, the handle incorporates an indentation to enhance grip stability during instrument manipulation, reducing the risk of slippage.

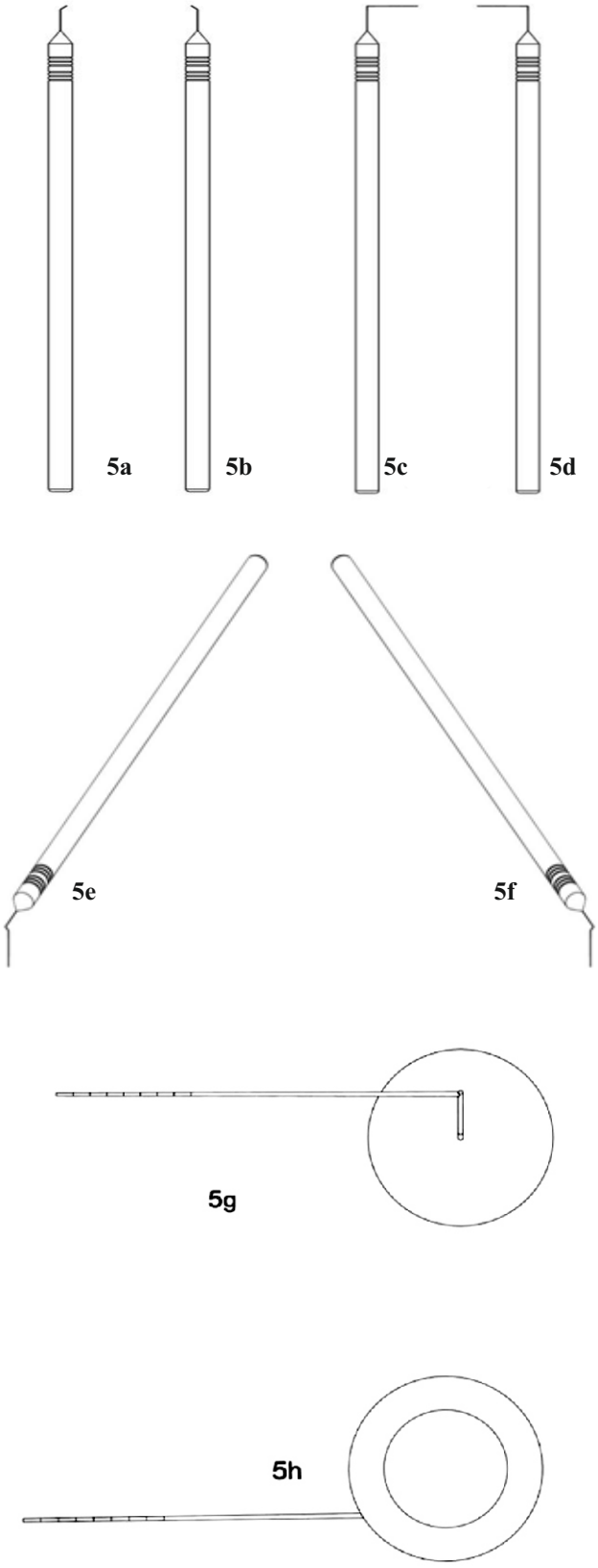

Fig.5 (a) Top View; (b)Bottom View; (c) Right View; (d) Left View; (e) Isometric left View; (f) Isometric right View; (g) Front View; (h) Bottom View

Benefits and Clinical Applications:

Bi-angled working length for a comprehensive assessment.

Tapered working tip and graduations for accurate depth measurement.

Facilitates identification of canal irregularities, including calcifications and hidden canals.

Ergonomic handle design with indentation for enhanced grip, promoting operator comfort and control.

Conclusion

Dentistry has a long history that dates back to ancient times, and it is a field of art and science that is always developing. Over time, many instruments have been designed, some of which have become accepted norms while others have fallen by the wayside. The goal continues to ease the burden on practitioners and improve the standard of patient care through continual developments and innovative ideas. This concept design is our gift to this age-old, loving science that constantly puts the health of our smiles first.

Conflict of Interest: Nil

Source of Support: Nil

Reference:

1. STROPKO JJ, DOYON GE, GUTMANN JL. Root-end management: resection, cavity preparation, and material placement. Endod Topics 2005;11:131–51. https://doi.org/10.1111/j.1601-1546.2005.00158.x.
2. Ko T-J, Byrd KM, Kim SA. The Chairside Periodontal Diagnostic Toolkit: Past, Present, and Future. Diagnostics 2021;11:932. https://doi.org/10.3390/diagnostics11060932.
3. Berg JH, Stapleton FB. Physician and Dentist. Clin Pediatr (Phila) 2012;51:531–7. https://doi.org/10.1177/0009922811435167.
4. Serino G, Rosling B, Ramberg P, Socransky SS, Lindhe J. Initial outcome and long-term effect of surgical and non-surgical treatment of advanced periodontal disease. J Clin Periodontol 2001;28:910–6. https://doi.org/10.1034/j.1600-051x.2001.028010910.x.
5. Pihlstrom BL. Measurement of Attachment Level in Clinical Trials: Probing Methods. J Periodontol 1992;63:1072–7. https://doi.org/10.1902/jop.1992.63.12s.1072.
6. Beltrán-Aguilar ED, Eke PI, Thornton-Evans G, Petersen PE. Recording and surveillance systems for periodontal diseases. Periodontol 2000 2012;60:40–53. https://doi.org/10.1111/j.1600-0757.2012.00446.x.
7. Renvert S, Persson GR. A systematic review on the use of residual probing depth, bleeding on probing and furcation status following initial periodontal therapy to predict further attachment and tooth loss. J Clin Periodontol 2002;29:82–9. https://doi.org/10.1034/j.1600-051X.29.s-3.2.x.
8. Macey R, Walsh T, Riley P, Glenny A-M, Worthington H V, O'Malley L, et al. Visual or visual-tactile examination to detect and inform the diagnosis of enamel caries. Cochrane Database of Systematic Reviews 2021;2021. https://doi.org/10.1002/14651858.CD014546.
9. Adams N, Tomson PL. Access cavity preparation. Br Dent J 2014;216:333–9. https://doi.org/10.1038/sj.bdj.2014.206.
10. Selden HS. The role of a dental operating microscope in improved nonsurgical treatment of "calcified" canals. Oral Surgery, Oral Medicine, Oral Pathology 1989;68:93–8. https://doi.org/10.1016/0030-4220(89)90121-7.
11. Mandel E, Friedman S. Endodontic retreatment: A rational approach to root canal reinstrumentation. J Endod 1992;18:565–9. https://doi.org/10.1016/S0099-2399(06)81216-1.
12. Ali R, Okechukwu NC, Brunton P, Nattress B. An overview of electronic apex locators: part 1. Br Dent J 2013;214:155–8. https://doi.org/10.1038/sj.bdj.2013.161.
13. Allen PF, Whitworth JM. Endodontic considerations in the elderly. Gerodontology 2004;21:185–94. https://doi.org/10.1111/j.1741-2358.2004.00039.x.
14. Chaniotis A, Ordinola-Zapata R. Present status and future directions: Management of curved and calcified root canals. Int Endod J 2022;55:656–84. https://doi.org/10.1111/iej.13685.
15. Bonsor SJ, Nichol R, Reid TMS, Pearson GJ. An alternative regimen for root canal disinfection. Br Dent J 2006;201:101–5. https://doi.org/10.1038/sj.bdj.4813819.