



**Innovative Ultra Conservative Endodontic Access Cavity Designs for Anterior and Posterior Teeth: Clinical Cases**

**Supported By Literature Review**

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**Abstract**

The primary goal of endodontic therapy is the long-term retention of a functional tooth by preventing or treating apical periodontitis. However, there are many other factors that impact endodontic outcomes such as the quality of the restoration and structural integrity of the tooth after root canal preparation. There are various access cavity designs involving the minimal removal of tooth structure that have been described for gaining entry to pulp chambers during root canal treatment. Minimally invasive access cavity preparations have been proposed in Endodontics with the aim of preserving the pericervical dentin (about four mm above and below the alveolar crest). Pericervical dentin functions as a stress distributor, hence preserving it may potentially improve the resistance of the remaining tooth structure to fracture. There is a lack of sufficient scientific evidence to support the introduction of these new designs of access cavities

into routine clinical practice. The present case series presents the preparation of ultraconservative access designs in both anterior and posterior teeth with supporting literature review. It highlights the merits and demerits of such designs.

**Keywords:** Access Cavity Preparations; Conservative Access Cavity; Ninja Access Cavity, Minimally Invasive Access Cavity, Ultraconservative Access Cavity.

**Introduction**

The contemporary practice of Endodontics and restorative dentistry has shifted to preserving tooth structure. Minimally invasive Endodontics refers to a concept that advocates the preservation of as much natural tooth structure as possible by downsizing the preparation of the access cavity, the taper of prepared canals, and the prepared apical size [1]. Minimally invasive endodontic access cavities (MIECs) have been described as openings to gain access to the root canal

system, which aim to preserve sound tooth structure mainly pericervical dentin. It is around 4mm above and 4mm below to the crestalbone. Because the pericervical dentin functions as a stress distributor, preserving it may potentially improve the resistance to fracture after endodontic treatment of tooth [2]. This approach was proposed by Clark and Khademi based on the assumption that the removal of dental hard tissues such as the pericervical dentin, the oblique ridges, and thinning the marginal ridges for clinical convenience can potentially increase the chances of tooth fracture[3]. While the claim of preventing tooth fracture has yet to be clinically validated, there have been concerns regarding the potential drawbacks of MIEC approaches. For instance, a constricted access cavity design poses challenges in the subsequent procedural steps, including an impaired vision of the pulp chamber and canal, reduced effectiveness and efficiency in canal instrumentation and disinfection, and the loss of orientation [4].

Traditional endodontic cavity (TECs) (figure 1)aims at straight line access into the root canals which increases biomechanical preparation efficacy and reduces the procedural errors, Traditional access cavity designs were questioned, regarded as legacy concepts, and modified to fit the current trends of tissue preservation in Endodontics[5].



Figure 1: Traditional endodontic cavity (TECs)

Newer access designs include:

- a) Conservative Endodontic Access Cavity

- b) Ninja Endodontic Access Cavity
- c) Orifice-Directed Dentin Conservation Access Cavity
- d) Incisal Access
- e) Cala Lilly Enamel Preparation

**Classification of Endodontic Access Cavity Designs [2]**

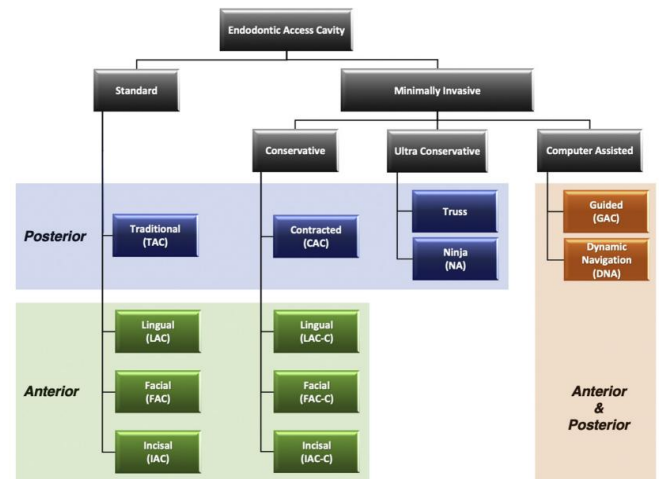


Figure 2: A diagram showing the different types of standard and minimally invasive access cavity preparations in anterior and posterior teeth [6].

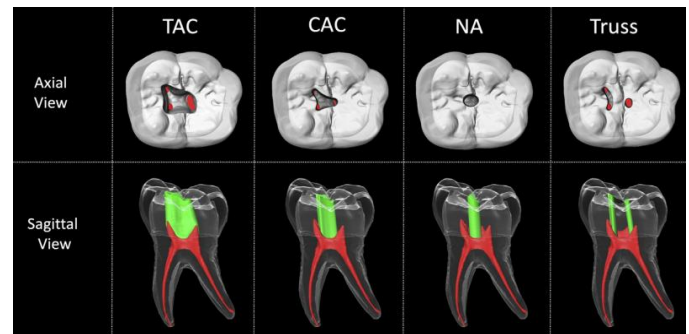


Figure 3: A micro-computed tomographic illustration of a mandibular first molar showing traditional, conservative, and ultraconservative access cavity preparations. The access is presented from the occlusal and buccal views. The green area represents the tooth structure removed during access preparation [5].

**Conservative Endodontic Access Cavity (CAC)**(figure 3) John Khademi and David Clark modified traditional access cavities and developed the constricted or conservative endodontic access cavities to minimize the tooth structure removal while maintaining the mechanical

stability of the tooth for long-term survival and function of the endodontically treated teeth. Here, teeth are accessed at central fossa and extended only as necessary to detect canal orifices, thus preserves the pericervical dentin and part of the chamber floor. Table 1 describes the main differences between traditional access cavity and Conservative Endodontic Access Cavity.

Table 1: Comparison between traditional access cavity and conservative access cavity [7].

Traditional access cavity	Conservative access cavity
It follows the principle of extension for prevention	It follows the concept of prevention of extension
During cavity preparation, the centre of the pulp chamber should be the target of the initial preparation, at a point where the roof and floor of the pulp chamber are at the widest	During the cavity preparation only the tooth structure required to be removed is prepared and the access is made as conservative as possible
Widening of access cavity prevents iatrogenic possibilities during access cavity preparation	During access cavity preparation lack of clinical judgement may lead to iatrogenic complications
No preservation of the pericervical dentin	Preservation of the pericervical dentin
Possibility of soffit is less probable	Soffit is prepared during conservative access preparation
Attempted for all the teeth during Endodontic treatment	Cannot be attempted for all teeth during endodontic treatment

**Ninja Endodontic Access Cavity (NEC) or Ultraconservative Access Cavity (figure 3).**The Ninja access cavity is also called as “PEAC” (point endodontic access cavity) as well as “UEC” (ultraconservative

endodontic cavity). ‘Ninja’ outline starts from central fossa and moves towards the canal orifices following an oblique projection. This access cavity aims to perform an ultra-conservative cavity just locating the orifices, with an extreme unroofing of the pulp chamber and preservation of all the pulp horns, extremely convergent walls and preservation of the occlusal enamel [5]. This case report series presents the root canal treatment of mandibular molars by preparing ninja or ultraconservative access cavity design.

**Orifice-Directed Dentin Conservation Access Cavity / ‘Truss’ Access Cavity (figure 3)** Purpose of this design is to preserve the dentin ie. Leaving a truss of dentin between the two cavities that has been prepared. Separate cavities are made to approach the canals. Mandibular molars, two separate cavities are made to approach the mesial and the distal canals where as in maxillary molars, the mesiobuccal and the distobuccal cavities is approached in one cavity and a separate cavity for the palatal canal is made[2].

**Cala Lilly Enamel Preparation** Traditional parallel-sided access compared with the Cala Lilly enamel preparation. Unfavourable C factor and poor enamel rod engagement are typically present when removing old amalgam or composite restorations or with traditional endodontic access 900 degree to the occlusal table. The enamel is cut back at 45 with the Cala Lilly shape. This modified preparation will now allow engagement of nearly the entire occlusal surface

**The “incisal access cavity” (IAC), or “incisally shifted access cavity,”** has been proposed as an alternative access location for anterior teeth. It starts from the center of the incisal edge toward the lingual/palatal surface and extends buccolingually and mesiodistally to include the entire pulp chamber [8].

In anterior teeth, conservative access cavity through lingual aspect is called as Lingual Access Cavity-Conservative (LAC-C) [8].

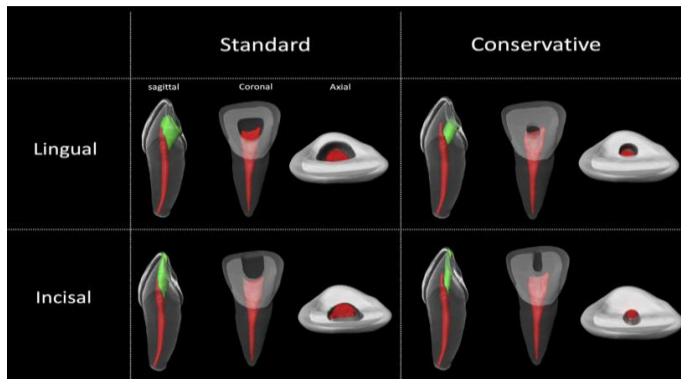


Figure 4: A micro-computed tomographic illustration of a maxillary central incisor showing lingual and incisal access cavity preparations in standard and conservative manner. The access is presented from the sagittal, coronal, and axial views. The green area represents the tooth structure removed during access preparation [5].

#### Armamentarium Used for the Minimal Access Cavity Preparation

Usually, a size #10–12 bur can be used to access smaller teeth, and the size #12 and #14 ones to access bigger teeth, like molars. Rhodium surface mirrors give the best visibility and light transmission, especially through small access cavities and avoid double image and refraction. Specialized endodontic explorers (DG-16 and JW-17) can be useful in locating the root canals.

MC K-files and H-files (VDW, Munich, Germany), in the sizes 0.08, 0.10, and 0.15, taper 0.04, the Micro-Openers K-files, in the sizes 0.10 and 0.15/taper 0.04 and 0.10/taper 0.06 (Maillefer, Baillagues, Switzerland) and the Micro-Debriders H-files (Maillefer, Baillagues, Switzerland), in the sizes 20 and 30, taper 0.02. 4.5× to 5× magnification loupes are very helpful in such cases.

Ultrasonic Devices and Ultrasonic Tips have been very helpful in the conservation of tooth structure during access cavity preparation [5].

The present case series presents the preparation of ultraconservative access designs in both anterior and posterior teeth with supporting literature review. It highlights the merits and demerits of such designs.

#### Case Report 1

A 23 years old male patient reported to our clinic with the chief complaint of pain and sensitivity along with tenderness in the lower left back tooth region since 10 days. On clinical examination the tooth was carious and tender on percussion and on radiographic examination it showed pulpal involvement of tooth (figure 5a). On clinical and radiographic findings, diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made. Root canal therapy was suggested as an appropriate course of action for this tooth. The treatment procedure, including its details, was thoroughly explained to the patient, and an informed consent was taken prior to proceeding with the treatment. To ensure effective anaesthesia, a local anesthetic solution containing 2% lignocaine containing 1:100,000 epinephrine (Neon Laboratories Ltd., Maharashtra, India) was given before the application of a rubber dam (Coltene Whale dent Pvt. Ltd, USA). Ninja access cavity design was planned for the access to pulp chamber. It was prepared by an oblique projection towards the central fossa of the root orifices in an occlusal plane. It is parallel with the enamel cut of 90° or more to the occlusal plane, making it easier to trace the root canal orifices from the varying visual angulations (figure 5b). DG 16 endodontic explorers was used to negotiate the root canal orifices from various angulations and three main root canals were detected as mesiobuccal, mesiolingual and distal canals. A magnification of 2.5x with dental magnifiers (Daray, Derbyshire) was used during the negotiation of canals. Initial instrumentation was carried out using a K #10 file (Mani Inc., Japan). An

apex locator (PropexPixi, Dentsply, Maillefer, Switzerland) was used for the confirmation of working length and after that it was verified radiographically (Figure 5c). Biomechanical preparation utilized the wave one gold file system (Dentsply). Throughout the procedure, irrigation was done with normal saline and 3% NaOCl, final irrigant was 17% EDTA.

Canals were dried with paper points calcium hydroxide was used as an intracanal medicament. After that, IRM (Caulk, Dentsply, USA) was used to seal the access cavity temporarily to provide provisional protection and sealing.

The patient was recalled for the next appointment after one week, during which he was completely free of symptoms. Obturation was done with gutta-percha (Dentsply, Maillefer, Switzerland). Cold lateral compaction technique was used for the obturation. Seal apex (calcium hydroxide based) sealer was used as a sealant. Access cavity was filled with resin composite material (Figure 5d). After a follow up period of six months, the patient was asymptomatic, indicating a successful result of non surgical endodontic therapy.



Figure 5b: Ninja or ultraconservative Access ca Cavity

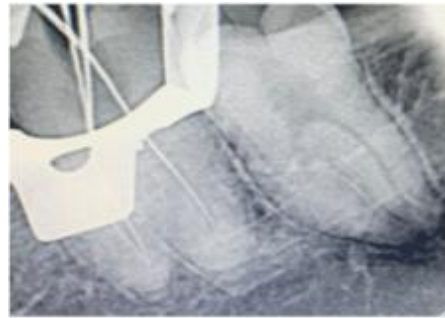


Figure 5c: Working Length Determination

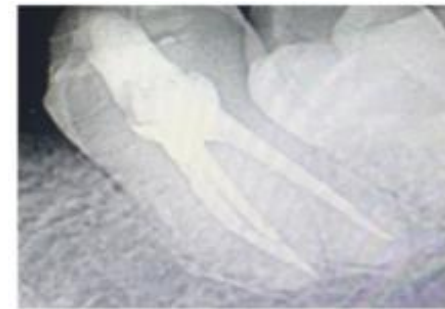


Figure 5d: Post Obturation

### Case Report 2

A 33 years old male patient reported to our clinic with the chief complaint of sensitivity to hot and cold food items in the lower right back tooth region since 14 days. On clinical examination the tooth was carious from the occlusal aspect and on radiographic examination it showed pulpal involvement of tooth (figure 6a). On clinical and radiographic findings, diagnosis of symptomatic irreversible pulpitis was made. Root canal therapy was suggested as an appropriate treatment. The treatment procedure was thoroughly explained to the patient, and an informed consent was taken prior to proceeding with the treatment.



Figure 5a: Preoperative Radiograph

Ultraconservative or ninja access cavity was designed after the administration of local anesthetic solution containing 2% lignocaine containing 1:100,000 epinephrine, after proper isolation with rubber dam (figure 6b). All the canals were located with the help of DG16 endodontic explorer and magnifying loupes. Working length was taken with the help of apex locator and verified radiographically (figure 6c). Biomechanical preparation utilized the Protaper Gold NITI rotary files (Dentsply), with the mesiobuccal and mesiolingual canals enlarged upto F1 (0.20/0.07 in) and the distal canal enlarged to F2 (0.25/0.08 in). Throughout the procedure, irrigation was done with normal saline and 3% NaOCl, final irrigant was 17% EDTA. Calcium hydroxide was used as an intracanal medicament. The patient was recalled for the next appointment after one week, during which he reported completely free of symptoms. Obturation was done using AH plus resin based sealer (figure 6d). After a follow up period of six months, the patient was asymptomatic, indicating a successful result of non surgical endodontic therapy.

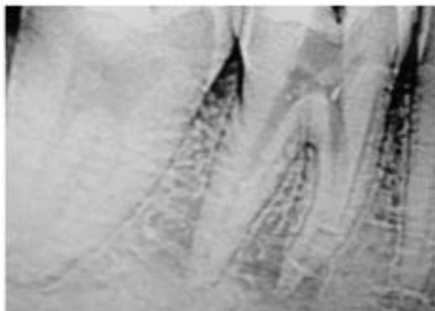


Figure 6a: Preoperative Radiograph



Figure 6b: Ninja or ultraconservative Access cavity

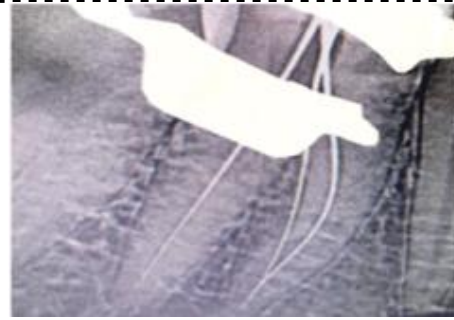


Figure 6c: Working Length Determination



Figure 6d: Post Obturation

### Case Report 3

A 19 years old female patient reported to our clinic with the chief complaint of pain on biting in the anterior front tooth region since 2 weeks. On clinical examination the tooth was restored with composite and radiograph showed that the tooth was deeply restored involving the pulp chamber. Tooth was tender on percussion. Based on clinical and radiographic findings (figure 7a), diagnosis of symptomatic apical periodontitis was made. Root canal therapy was suggested as an appropriate treatment. The treatment procedure was thoroughly explained to the patient, and an informed consent was taken prior to proceeding with the treatment.

A local anesthetic solution containing 2% lignocaine containing 1:100,000 epinephrine was used after proper isolation with rubber dam. Conservative access cavity was prepared through lingual aspect called as Lingual Access Cavity-Conservative (LAC-C) (figure 7b). Canal was located with the help of DG16 endodontic explorer and magnifying loupes. Working length was taken

(figure 7c). BMP was done with the help of Protaper Gold NITI rotary file system (Dentsply). The canal was enlarged to F3 (0.25/0.08). Throughout the procedure, irrigation was done with normal saline and 3% NaOCl, final irrigant was 17% EDTA. Intracanal medicament (calcium hydroxide) was placed inside the canal. After a recall period of one week, the patient reported completely free of symptoms. Obturation was done using AH plus resin based sealer and the gutta-percha was then sheared off at the canal orifice and then bulk-fill nanohybrid composite restoration was used for post-endodontic restoration and radiograph was taken to visualize adequate packing of the restorative material (figure 7d). On follow up, after a period of 6 months the patient was completely asymptomatic.



Figure 7a: Preoperative Radiograph

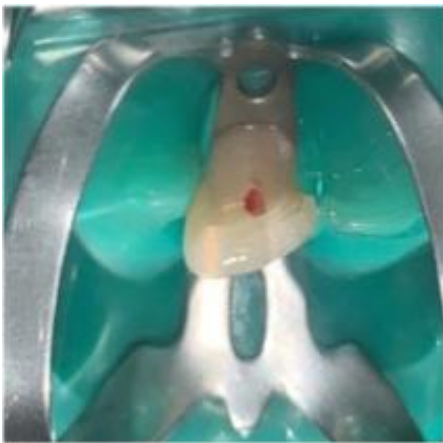


Figure 7b: Conservative Access cavity



Figure 7c: Working Length Determination

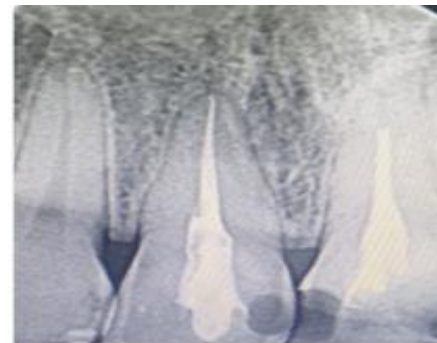


Figure 7d: Post Obturation

### **Discussion**

Minimal invasive Endodontics plays a great role in preservation of what remains. It reinforces and improves the mechanical behavior of a tooth. The endodontic access of the traditional type is based on certain principles which go very well with the instruments as well as the restorative materials available at that point of time. However, with the advent of advancements in the materials and instruments there has been a decrease in the amount of tooth structure loss and therefore sticking on to the traditional principles of preparations of access cavity jeopardize the tooth structure. NEC is actually an even smaller access cavity than the one made for a CEC on the occlusal surface, that should enable the clinician to find and access all the orifices of the canals. CECs, TECs and NECs and found that TECs presented lower fracture strength than CECs and NECs in maxillary and mandibular premolars and molars and no statistical

significance was found in the fracture resistance mean values of CECs and NEC [5]. Cone beam computed tomography aids the clinician in avoiding the removal of excessive hard tissue by allowing assessment of the angulation and orientation of the root canal.

The dentin conservation afforded an increased resistance to fracture in CEC group which is doubled the fracture resistance in TEC group. However, it is essential to critically evaluate the pros and cons of minimally invasive approaches before full embracement.

MB2 detection rate of CEC (53.3%) and TEC (60%) are higher than statistically that of NEC (%31.6). There was no significant difference between CEC and TEC in terms of determining MB2 canals [10]. In a recent study it was seen that the minimally invasive access yielded more bacteria-positive samples and a higher bacteria count compared with the TAC [11]. One study evaluated the amount of remaining pulp tissue in the root canal space and the pulp chamber after TACs and truss access and their results showed that truss access yielded more remaining pulp tissue in the pulp chamber but not in the root canal space or the isthmus area [12]. Two studies [13-14] showed that the CAC increased the chance of canal transportation, and one study showed no difference between the TAC and minimally invasive designs [15]. Minimally invasive approaches take longer time to perform the root canal in initial treatments or retreatments. Few clinical approaches may be adopted in MIEC to overcome the problems in chemomechanical debridement of the root canal system, which include increase the concentration of the disinfectant used as irrigant, the use of irrigant agitation techniques, increase the time spent on chemical disinfection, the use of heat-treated NiTi files with improved flexibility and fatigue resistance, the placement of calcium hydroxide as intracanal medicament, the use of the retrograde surgical

tip to access and debride the areas beneath the pulp horns and the use of an operating microscope[6].

Both traditional and conservative access designs have their own pros and cons, as concentrating on too many conservative designs can lead to inefficient cleaning and shaping and also inability to get the extra canals can in turn lead to failure of the treatment. Therefore, one must know when to use based on the right tooth and situation in order to avoid failures.

### **Conclusions**

Ninja or ultraconservative access cavity aims to preserve the maximum tooth structure during the root canal treatment. Ninja access approach mainly emphasizes on the preservation of the healthy tooth structure with the minimally invasive approach. In ultraconservative cavity maximum of the tooth structure remains intact, so there is decreased need for complex and more expensive prosthodontics restorations. However, more researches and clinical evidences of ninja access should be performed in Endodontics to help conservative access openings to overcome traditional access and changing the paradigm of “Endodontics” to “Conservative Endodontics” This review should in still in the reader that endodontically treated teeth are not weak by itself but it is the various procedures carried out that contributes to it. So as a dentist it is our duty to follow and provide ethical treatment to the patients for the extended survival of the tooth.

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