

## Success Rate of Apical Surgery: Evaluating EBA and MTA as Retrograde Filling Materials

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**Abstract:** **BACKGROUND:** Apical surgery is a viable choice for treating a tooth that has undergone endodontic treatment but still has persisting periapical lesions or symptoms. **AIM OF STUDY:** The current objective was to describe the role of apical surgery in the reduction of endodontic complications and its influence on the incidence of tooth fractures following surgical intervention. **PATIENTS AND METHODS:** A total of 73 patients who had undergone apical surgery with Super EBA and MTA as root canal filling materials were recruited for the study. The patients were aged between 20 and 60 years. Data were collected from clinics located in Baghdad, Iraq, during the period between July 2022 and September 2023. This data included both clinical and surgical data collected prior to surgery and again after surgery. In order to achieve the study objective, a number of different variables were recorded and distributed to all patients. These included complication rates, pain rates, and a fracture resistance scale. **RESULTS:** In terms of current findings, our study found that most class of patients who in ages (31 - 40) were 36.99% of total patients, males had 27.4% and females had 72.6%, rate of smokers were 24.66% of the total cases, the most symptoms were pain with 70 cases, swelling with 64 cases, maxillary anterior tooth was 61.64%, which those were the most types of tooth, lesion size included  $\leq 5$  mm with 26 cases and  $>5$  mm with 47 cases. In terms of apical surgery outcomes, all patients were conducted apical surgery repaired with super-EBA, which included 73.97% of patients, and MTA included 26.03% of patients, where all patients were conducted apical surgery under local anesthesia. Also, the success rate of treatment was 91.78%, severe fracture resistance had 91.78% of total patients, where the rate of complications was 10.96%. **CONCLUSION:** The apical surgery had a satisfactory success rate, which has the potential to improve further with extended clinical and radiological monitoring. Apical surgery with EPA and MTA enrolled positive rates of satisfaction to the patient's teeth treatment, which a satisfaction rate get 91.78%, where success rates of Super-EBA material had 92.59% and success rates of MTA had 89.47%..

**Keywords:** Endodontics; Complications; Tooth Fractures; Lesion Size; and Apical Surgery.

### INTRODUCTION

Endodontics is a conservative treatment whose primary objective is the long-term preservation of a functional tooth through the prevention or treatment of pulp and periapical lesions. This is done in order to avoid the necessity for exodontics of the same tooth and to keep it in the mouth. The treatment consists of three equally important phases: preparation of ducts, microbiological control, and obturation. The preparation of the access cavity is the first clinical step and is a crucial step towards the elimination of pulp and periapical infection [Shahi, S. *et al.*, 2007– Pecora, C. N. *et al.*, 2015] .

The initial surgical procedure in endodontic treatment is the creation of an access or chamber opening. The ultimate outcome of this treatment is contingent upon the success of this initial step. The procedure primarily involves creating an access in the crown, which is of paramount importance as it facilitates the subsequent stages of the treatment [Siqueira, J, 2001 – Setzer, F. C. *et al.*, 2012]. The subsequent entry of instruments through the pulp chamber necessitates a correct washing and disinfection of the pulp chamber and ducts, the elimination of organic remains in the ducts, and

the preservation of the healthy dental structure. Additionally, the infected coronal structure must be eliminated in the slightest amount possible, and the correct localisation of ducts must be achieved [Abu-Melha, A. S. *et al.*, 2012 – Liu, Z. *et al.*, 2013] .

Incorrect preparation of the access canal may result in the manifestation of errors in subsequent treatment. One of the errors that may occur during the preparation of the access canal is the elimination of both decayed and healthy dental structures, as well as defective restorations, which may result in the weakening of the coronal structure [Song, M. *et al.*, 2012 – Lui, J.-N. *et al.*, 2013].

In light of the aforementioned considerations, a study was conducted to compare two endodontic access techniques with the objective of determining which of them can be more conservative with the dental structure following the performance of endodontic access, thereby ensuring a favourable prognosis and maintaining durability. Additionally, the study aimed to address the primary failure observed in endodontic

practice, namely coronal fracture [Çalışkan, M. et al., 2016 - Song, M. et al., 2013].

Minimally invasive endodontics relies on the philosophy of reducing the extraction and preservation of tooth hard tissue. When treating endodontic diseases, the dentist has to develop the necessary expertise in order to operate effectively within the limited space in the pulp chamber [Kreisler, M. et al., 2013 – Atsumi, M. et al., 2007].

## PATIENTS AND METHODS

### Inclusion/Exclusion Criteria of Study

Cross-sectional research collected demographic and clinical information from clinics in Baghdad, Iraq, throughout the period from July 2022 till September 2023. The study included specific criteria of participant selection and grounds for excluding people. The inclusion criteria for this study have as follows: patients with no significant medical history, patients over the age of 18, teeth with no any apical lesions, normal pocket depth, and not mobility, nevertheless experiencing symptoms following trying all nonsurgical treatments, teeth with small periapical lesions in relation to clinical signs, normal periodontal probing depth, and no mobility, and teeth with a large periapical lesion that extends towards the crown but without any periodontal pocket and mobility. The study utilized the following exclusion criteria: persons under the age of 20; participants who were lactating or expecting a child; teeth with pathologies associated with either vertical or horizontal root fractures; and teeth with perforations in the cervical or lateral canal walls.

### Examination Considerations

Data from a total of 73 individuals who had apical surgery were collected at clinics in Baghdad, Iraq, for all of the study period. The study involved patients ages 20 to 60 who had apical surgery using Super EBA as well as MTA for root canal filling materials. The study's criteria were classified as demographic, prior to surgery, and postoperative elements. The demographic criteria included patients' gender, smoking habits, existence of other medical conditions, ASA score, and age. The preoperative surgical considerations included the tooth's kind and location, symptoms, and histological evaluation.

### Surgical Procedures

The surgical procedure was conducted utilizing an operation loupe that had a magnification of 3.5X. This provided the best possible level of

magnification and lighting. The surgery utilized the loupe technique for several procedures, such as osteotomies, root-end resections, root examinations, root-end preparations, root-end fillings, as well as suturings. The procedure did not involve making cuts or lifting sections of tissue by a magnifying surgical instrument.

Prior to the operation, the mouth area was enclosed with a sterile barrier. The procedure utilized the mucogingival flap technique. A mucoperiosteal flap, including the whole thickness, was raised using a local anesthetic consisting of 2% lidocaine with 1:80,000 adrenaline. Following the elevation of the mucoperiosteal flap, an osteotomy was conducted to extract the bone covering the root apices. Following the osteotomy, the periradicular tissues around the root apex were delicately curetted and then submitted for biopsy. To improve the analysis, methylene blue was injected to the surgical site. Following the examination of the surgical area, a 3-mm part of the root tip was surgically removed. The root was excised using bevels at a 0-degree angle or close to it. Subsequently, the excised surface and outer surfaces of the root were inspected for the existence of fractures and isthmuses. When the crack was unable to be fully eliminated without jeopardizing the tooth's ability to stay in place, the surgical procedure was terminated as well as an extraction was recommended instead. If an isthmus was observed among the canals, the root-end preparation encompassed the isthmus. Hemostasis was performed by exerting pressure using tiny gauzes saturated with adrenaline. Surgical microretro tips were used in a surgical sonic unit to make root-end preparations at a depth of 3 mm. Sterile water was used to rinse the cavity. Following the completion of the root-end cavity preparation, the root-end filling procedure was carried out. MTA and Super-EBA are used to be root-end filling substances. MTA was inserted into a root-end cavity using a microplugger when utilized for root-end filling material. When Super-EBA is used as a root-end filling material, it is inserted into the root-end cavity using a microplugger, similar to MTA.

### Determinations of Medication

Every patient received a nonsteroidal analgesic, and they were directed to rinse their mouth twice a day with a 0.1% solution of chlorhexidine digluconate for a duration of 10 days. Antibiotics were administered, beginning one day before to the surgery and continuing for four days after the operation. The suggested dose is 1 gram of

amoxicillin every 12 hours or, alternatively, 150 milligrams of clindamycin every 6 hours.

### Clinical and Radiographic Evaluation

The postoperative clinical examination of complications was enrolled and distributed after apical surgery, as well as determine clinical examination of pain was diagnosed by VAS score, where it ranged between 0 – 10, which 0 shown that there is no pain in teeth, while 10 shown that there was severe pain in teeth.

In terms of the Mohs scale [Gerberich, W. W. *et al.*, 2015], clinical findings were defined as Tooth Fracture level after apical surgery, which categorize into mild, which represents a lower level of resistance within the range (0 – 4); moderate, which represents moderate fracture resistance within the range (5 - 7), and severe represents severe fracture resistance within range

(8 - 10). Typically, the patients were seen again after one year, during which clinical and radiological tests were conducted at each appointment. The postoperative outcome evaluation was conducted. The radiographic healing pattern was classified based on the Molven and Rud classification. The healing outcomes of patients who underwent apical surgery were determined after a 1-year follow-up. The outcomes were categorized as either complete healing or incomplete healing. Complete healing was defined as the complete reformation with an intact lamina dura surrounding the root. Teeth are considered "not healed" when they show ambiguous or inadequate healing or when they exhibit clinical failure, notwithstanding the results of radiographic assessment.

## RESULTS

**Table 1:** Distribution of demographic and clinical preoperative data

Characteristics	Case number, [73]	Percentage [%]
Age		
20 – 30	10	13.70%
31 – 40	27	36.99%
41 – 50	25	34.25%
51 – 60	11	15.07%
Gender		
Male	20	27.4%
Female	53	72.6%
Comorbidity, %		
Yes	48	65.75%
No	25	34.25%
Hypertension	33	45.21%
Diabetes	20	27.40%
Obesity	29	39.73%
Others	15	20.55%
Smoking		
Yes	18	24.66%
No	55	75.34%
Malnutrition		
Yes	63	86.30%
No	10	13.70%
ASA Classification		
I	8	10.96%
II	25	34.25%
III	40	54.79%
Education status		
Primary	5	6.85%
Secondary	11	15.07%
College/university	57	78.08%
Income status, \$		
< 700	45	61.64%
700 - 1000	18	24.66%
> 1000	10	13.70%

**Table 2:** Enrol examination and radiographic data

Variables	Number of patients [73]	Percentage [%]
Symptoms		
Pain	70	95.89%
Redness	30	41.10%
Tenderness	40	54.79%
Swelling	64	87.67%
Difficulty chewing or biting	50	68.49%
Tooth type		
Maxillary anterior tooth	45	61.64%
Maxillary premolar tooth	10	13.70%
Maxillary molar tooth	4	5.48%
Mandibular anterior tooth	7	9.59%
Mandibular premolar tooth	2	2.74%
Mandibular molar tooth	5	6.85%
Apical extent of root canal filling		
0–2 mm short of apex	41	56.16%
>2 mm short of apex	26	35.62%
Beyond apex	6	8.22%
Lesion size		
≤5 mm	26	35.62%
>5 mm	47	64.38%
Bony destruction pattern		
Apical	70	95.89%
Apicomarginal	3	4.11%
Root-end filling materials		
Super-EBA	54	73.97%
MTA	19	26.03%
Histopathological examination		
Cyst	40	54.79%
Granuloma	23	31.51%
Others	10	13.70%
Local anesthesia		
Yes	73	100%
No	0	0%
Radiographic images		
X-rays technique	73	100%
Patient's medical history		
Previous surgeries		
Yes	19	26.03%
No	54	73.97%
Allergies		
Yes	4	5.48%
No	69	94.52%
Medications being taken		
Yes	32	43.84%
No	41	56.16%
Previous restorations		
Yes	11	15.07%
No	62	84.93%

**Table 3:** Determine healed outcomes related to patients after apical surgery for one-year follow-up

Tooth type	N, Healed	% healed
Maxillary anterior	40	54.79%
Maxillary premolar	30	41.10%
Maxillary molar	44	60.27%
Mandibular anterior	28	38.36%
Mandibular premolar	12	16.44%
Mandibular molar	52	71.23%

**Table 4:** Distribution of pain scores on patients after apical surgery

Scores	Number of patients [73]	Percentage [%]
0, No pain	66	90.41%
1 – 4, Mild pain	4	5.48%
5 – 7, Moderate pain	2	2.74%
8 – 10, Severe pain	1	1.37%

**Table 5:** Post-operative complications

Items	Number of patients [73]	Percentage [%]
Pain	2	2.74%
Swelling and bruising	1	1.37%
Infection	3	4.11%
Nerve damage	0	0.0%
Failure of the surgery	2	2.74%
<b>Total</b>	<b>8</b>	<b>10.96%</b>

**Table 6:** Assessment of Tooth Fracture level after apical surgery by Mohs scale

Items	Case number [73]	Percentage [%]
Mild (lower level of resistance), [0 – 4]	1	1.37%
Moderate (moderate fracture resistance), [5-7]	5	6.85%
Severe (severe fracture resistance), [8-10]	67	91.78%

**Table 7:** Determine treatment outcomes of patients' satisfaction after apical surgery

Items	Case number [73]	Percentage [%]
Favourable	67	91.78%
Uncertain	4	5.48%
Unfavourable	2	2.74%

**Table 8:** Success and failure rates of Root-filling materials regarding to Super-EBA and MTA

Items	Super-EBA, 54	MTA, 19
Success rate	50 [92.59%]	17 [89.47%]
Failure rate	4 [5.48]	2 [10.53%]
Total	54 [100%]	19 [100%]

## DISCUSSION

Apical surgery is an option that is typically used as a last resort before tooth extraction, even though its consequences were uncertain. Currently, apical surgery has evolved into a contemporary technique which yields favorable outcomes in the treatment of endodontic lesions, demonstrating consistent healing patterns [von Arx, T. et al., 2007].

The average clinical success rates for conventional root-end surgery were shown to be 60% (with rates varying from 44 to 80%) [Peñarrocha, M. et al., 2007]. Recent studies on apical surgery have

shown success rates varying from 89 to 100%, which is in direct contradiction to previous results. All teeth involved in this study underwent apical surgery with current equipment. In this brief clinical investigation, the proportion of teeth evaluated as healed and unhealed, respectively. The postoperative success rate during the 12-month follow-up was determined to be 91.78%. This is analogous to the findings of other research conducted utilizing magnification, ultrasonic surgical tips, as well as filling materials like Super-EBA or MTA [Testori, T. et al., 1999].

In addition, the study shows that Super-EBA has been noticed to have a clinical success rate of above 90%. Therefore, in this investigation, Super-EBA along with MTA were used for a retrograde filling substance. Super-EBA and MTA have demonstrated comparable therapeutic results in several clinical studies. The trial yielded where success rate of 85.7% for MTA as well as 91.1% for Super-EBA. The statistical study of the success rates found no significant difference between the two techniques in repairing with apical surgery [Gagliani, M. et al., 2005].

Upon reviewing other studies on apical surgery, various factors were identified as potential prognostic indicators that could impact the clinical outcomes. These factors include gender, age, tooth location, presence or absence for a post-coronal restoration of the tooth, previous surgical or nonsurgical treatment, size of periapical lesions, the histopathology of periapical lesions, smoking habits, and preoperative signs as well as symptoms [Song, M. et al., 2011].

The precise success rate of several long-term follow-up studies revealed contradictory findings. The author conducted a study on 477 teeth that had periapical surgery, collecting data from 1 to 8 years post-surgery. The findings showed that the total success rate is 87.2%, surpassing the 80.9% seen during the 1-year follow-up visit. Cases exhibiting partial or unclear recovery or year post-surgery may ultimately experience either complete or poor healing as time progresses [Wälivaara, D.-Å. et al., 2011]. [Maddalone, M. et al., 2003; Kramer, I. R. et al., 1992] Nevertheless, several other studies have seen a decrease in the success rate for apical surgery with time. The authors expressed worry with the limited duration of the follow-up period, that prohibited the observation of any potential degeneration in the treated teeth within 1-2 years following the operation. In four years after surgical treatment, the condition may reoccur in 5% to 25% of the patients that have been treated. Therefore, it was inferred by some that the long-term efficacy rate might be reduced in comparison with short-term studies. Molven et al. indicated that instances categorized as unclear after a 1-year follow-up may be unpredictable and require a longer period of time for a definitive assessment of the outcome [Rubinstein, R. A. et al., 1999].

## CONCLUSION

The results of our study demonstrate that the apical surgery technique is an extremely effective

procedure. The investigation yielded a satisfaction rate of 91.78%. In accordance with the findings of this study, the maxillary teeth exhibited more favourable outcomes in comparison to the mandibular teeth. The findings indicated that the anterior tooth exhibited more favourable outcomes in comparison to the posterior teeth. The use of apical surgery with EPA and MTA has been demonstrated to be a safe and effective approach for the treatment of these areas, with success rates of Super-EBA material at 92.59% and success rates of MTA at 89.47%.

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