

## Success rate of apicectomy of anterior and premolar teeth

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### ABSTRACT

This study was carried out to assess the success rate of apicectomy of anterior and premolar teeth. Out of 336 patients, who had undergone apicectomy in a private practice between 1997–2001, only 256 patients (76.2%) completed the two years recall visits; which was the minimum time recommended in this study to judge whether the operation was successful or not. The age range of the patients was 12–67 years (mean of 34.7 years), 136 were males and 120 were females.

The overall success rate of apicectomy in this study was 89.1%. Sex of the patient had no bearing on the success rate ( $p > 0.05$ ). Highly significant influence of the patient's age on the success rate was observed ( $p < 0.01$ ); the success rate increased proportionally with increased age. Highly significant influence of the type of the apicetomised tooth on the success rate was noted ( $p < 0.001$ ); upper anterior teeth showed the highest success rate (92.1%), whereas upper premolars showed the lowest success rate (77.4%). Periapical condition of the tooth prior to the operation, preoperative vs postoperative obturation of the root canal, and orthograde obturation vs retrograde obturation were not significant factors affecting the success rate of apicectomy ( $p > 0.05$ ).

**Key Words:** Apicectomy, endodontic surgery.

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### INTRODUCTION

Apicectomy has become an integral part of a comprehensive dental treatment. The primary objective of apicectomy is to eradicate the aetiological agents of periapical pathoses and to restore the periodontium to a state of biologic and functional health.<sup>(1)</sup> The American Association of Endodontists define apicectomy as "the excision of the apical portion of the tooth root and attached soft tissues during periradicular surgery".<sup>(2)</sup>

Historically, this operation was reported 4500 years ago in the form of simple cortical trephination. Around the 11<sup>th</sup> Century AD, Abulcasis, an Arabian physi-

cian, described the first case of apicectomy in his medical encyclopedia, *Altasrif*.<sup>(3)</sup> A root end resection procedure to manage a tooth with necrotic pulp and alveolar abscess was documented in 1871,<sup>(4)</sup> and root end resection with retrograde cavity preparation and filling with amalgam in 1890's.<sup>(5)</sup>

Indications for surgical approach to the root apex include; first, if there is a strong possibility of failure via a nonsurgical approach. Second, if failure has resulted from nonsurgical endodontic treatment, and retreatment is impossible or would not achieve better results. Third, if biopsy is necessary at or near the tooth apex.<sup>(6)</sup>

Contraindications to apicectomy are few and are usually limited to patient factors such as general medical condition and local anatomical factors, like extremely unusual root or bone configuration, close proximity to vital structures and inadequate crown/root ratio.<sup>(7)</sup>

The literature is replete with studies evaluating the success rate of conventional endodontic treatment. Review of English literature from 1952–2002 revealed more than 332 articles on the success and failure of conventional root canal treatment. The success rate of endodontic therapy was reported to vary between 40%–96%.<sup>(8–13)</sup> The first International Conference on Endodontics attempted to establish criteria for success of conventional root canal therapy, but no such attempt has been made to define the success in apicectomy. However, as apicectomy is an extension of root canal therapy by surgical means, the criteria of success of both procedures should be identical.<sup>(14)</sup>

Studies of 2,039 apicectomy cases from the 1930's to the 1960's report a success rate ranging from 34% to 100%, with a mean success rate of 82.5%.<sup>(15–18)</sup> A study of 797 apicectomy by Nordenram and Svardstrom<sup>(19)</sup> reported a success rate of 64% with the best results found when root filling and apicectomy were carried out at the same visit when the periapical lesion was less than 5 mm in diameter. A retrospective study by Oginni and Olusile<sup>(20)</sup> showed the success rate of apicectomy of anterior teeth to be 71.9%.

The purpose of this study was to evaluate the success rate of apicectomy of anterior and premolar teeth. The other aim was to look for the influence of some factors on the success rate of apicectomy, like: Age and sex of the patient, type of the apicected tooth, periapical condition of the tooth prior to the operation, preoperative vs postoperative obturation and retrograde vs orthograde filling.

## MATERIALS AND METHODS

The sample of this study included the records of patients who had undergone apicectomy in a private practice from 1997–2001. The records of 76.2% of the patients (256 out of a total of 336 cases) were con-

sidered for inclusion in this study; since they completed the two years recall visits, which was the minimum time recommended in this study to decide whether the operation was successful or not. The age range of the patients was 12–67 years, with a mean of 34.7 years. There were 136 males and 120 females.

The technique of apicectomy included exposure of the operative field under local anaesthesia (lidocaine 2% with adrenaline 1:80,000, Septodont, France). Three-sided flap was then incised, the horizontal incision began in the gingival sulcus and extended through the fibers of gingival attachment to the crestal bone; the vertical incisions were placed at the line angle of the teeth adjacent to the involved tooth. The designed flap was then gently elevated from the cortical bone and retracted with suitable retractor. Covering bone was removed with surgical round bur in a straight handpiece under normal saline cooling. After removal of the periapical pathoses with surgical curette, the root tip was resected with a surgical bur. Haemostasis was achieved by means of gauze packing. The root canal was then obturated by gutta percha points (United Dental Manufacturers, Inc, USA), with zinc-oxide root canal sealer (DoriDent, Austria). The excess gutta percha was removed with hot instrument.

Retrograde amalgam filling, when needed, was performed by preparing mini-Class I cavity in the apical region of the root stump by using a small inverted cone bur in mini-handpiece. The operative field was isolated and the cavity filled with amalgam (Degussa Dental, Germany).

In each case, the remaining bony cavity was vigorously irrigated with normal saline solution, so as to remove any debris or excess filling material. The flap was then repositioned and sutured with 3/0 black silk suture (Ethicon, England). Within the first week the sutures were removed and a postoperative radiograph was taken. The follow up included instructing every patient to recall at 6, 12 and 24 months. At each recall visit the apicected tooth was radiographed and examined clinically for sinus tract, swelling, tenderness to percussion or palpation of the apical region, and also for mobility. The patient was also asked for any symptoms since the last visit.

The criteria of success of apicectomy in the present study were those recommended by Harty *et al.*<sup>(14)</sup> They included:

1. The tooth remains clinically symptomless and functional for two or more years, at that time there should be an absence of:
  - (a) Break down of the incision;
  - (b) Persistent sinus tract;
  - (c) Tenderness to percussion;
  - (d) Tenderness, discomforts or pain over the operation site;
  - (e) Recurrence of swelling;
  - (f) Excess mobility of the tooth;
  - (g) Drifting of the tooth because of lack of bony support or inadequate root length;
  - (h) Periodontal disease of iatrogenic origin.
2. There is no radiographic evidence of any abnormality. Periapical scar without symptoms was considered successful.

3. The radiographic appearance of the periodontal ligament remains normal or return to normality.

The results were analyzed using Fisher's exact test. A  $p$ -value  $< 0.05$  was accepted to be significant.

### RESULTS

The overall success rate of apicectomy in the present study was 89.1%, 228 out of 256 patients, (Table 1).

Table (1): The overall success rate of apicectomy

	No.	Percentage
<b>Successful</b>	228	89.1%
<b>Unsuccessful</b>	28	10.9%
<b>Total</b>	256	100%

The success rate of apicectomy was greater in females than males, but without reaching a significant level ( $p > 0.05$ ) (Table 2).

Table (2): Success rate of apicectomy according to patients' sex

Sex	Successful* No. (%)	Unsuccessful No. (%)	Total No. (%)
<b>Male</b>	120 (88.2%)	16 (11.8%)	136 (53.1%)
<b>Female</b>	108 (90%)	12 (10%)	120 (46.9%)
<b>Total</b>	228 (89.1%)	28 (10.9%)	256 (100%)

\*Not significant,  $p > 0.05$  (Fisher's exact test).

Highly significant influence of the patient's age on the success rate of apicectomy was noted ( $p < 0.01$ ). The success rate was found to be increased proportionally with increased age (Table 3).

Type of the operated tooth was found

to have a highly significant influence on the success rate of apicectomy ( $p < 0.001$ ). Upper anterior teeth carried the highest success rate followed in a descending order by lower anterior, lower premolars, and upper premolar teeth (Table 4).

Table (3): Success rate of apicectomy according to patients' age

Age (Years)	Successful* No. (%)	Unsuccessful No. (%)	Total No. (%)
<b>&lt;15</b>	11 (78.6%)	3 (21.4%)	14 (5.5%)
<b>15-29</b>	131 (88%)	18 (12%)	149 (58.2%)
<b>30-44</b>	66 (91.1%)	6 (8.3%)	72 (28.1%)
<b>45-60</b>	16 (94%)	1 (6%)	17 (6.6%)
<b>&gt;60</b>	4 (100%)	-----	4 (1.6%)
<b>Total</b>	228 (89.1%)	28 (10.9%)	256 (100%)

\* Highly significant,  $p < 0.01$  (Fisher's exact test).

Table (4): Success rate of apicectomy according to tooth type

<b>Tooth Type</b>	<b>Successful* No. (%)</b>	<b>Unsuccessful No. (%)</b>	<b>Total No. (%)</b>
<b>Upper Anterior</b>	151 (92.1%)	13 (7.9%)	164 (64.1%)
<b>Lower Anterior</b>	43 (87.8%)	6 (12.2%)	49 (19.1%)
<b>Upper Premolar</b>	24 (77.4%)	7 (22.6%)	31 (12.1%)
<b>Lower Premolar</b>	10 (83.3%)	2 (16.7%)	12 (4.7%)
<b>Total</b>	228 (89.1%)	28 (10.9%)	256 (100%)

\* Very highly significant,  $p < 0.001$ (Fisher's exact test).

Periapical condition of the apicected tooth prior to surgery had no significant influence ( $p > 0.05$ ) on the success rate of apicectomy (Table 5).

Preoperative obturation of the tooth had no significant influence ( $p > 0.05$ ) on

the success rate of apicectomy (Table 6).

Retrograde filling with amalgam increased the success rate of apicectomy by about 9%, as compared to orthograde filling alone, the difference failed to reach a significant level ( $p > 0.05$ ), (Table 7).

Table (5): Success rate of apicectomy according to periapical condition of the tooth

<b>Periapical Condition</b>	<b>Successful* No. (%)</b>	<b>Unsuccessful No. (%)</b>	<b>Total No. (%)</b>
<b>Normal Periodontal Ligament</b>	11 (91.7%)	1 (8.3%)	12 (4.7%)
<b>Thickened Periodontal Ligament</b>	28 (90.3%)	3 (9.7%)	31 (12.1%)
<b>Frank Radiolucent Lesion</b>	189 (88.7%)	24 (11.3%)	213 (83.2%)
<b>Total</b>	228 (89.1%)	28 (10.9%)	256 (100%)

\* Not significant,  $p > 0.05$  (Fisher's exact test).

Table (6): Success rate of apicectomy according preoperative vs intraoperative obturation

<b>Obturation Timing</b>	<b>Successful* No. (%)</b>	<b>Unsuccessful No. (%)</b>	<b>Total No. (%)</b>
<b>Preoperative Obturation</b>	35 (87.5%)	5 (12.5%)	40 (15.6%)
<b>Intraoperative Obturation</b>	193 (89.4%)	23 (10.6%)	216 (84.4%)
<b>Total</b>	228 (89.1%)	28 (10.9%)	256 (100%)

\* Not significant,  $p > 0.05$  (Fisher's exact test).

Table (7): Success rate of apicectomy according to orthograde vs retrograde filling

	<b>Successful* No. (%)</b>	<b>Unsuccessful No. (%)</b>	<b>Total No. (%)</b>
<b>Retrograde Filling</b>	30 (96.8%)	1 (3.2%)	31 (12.1%)
<b>Orthograde Filling</b>	198 (88%)	27 (12%)	225 (87.9%)
<b>Total</b>	228 (89.1%)	28 (10.9%)	256 (100%)

\* Not significant,  $p > 0.05$  (Fisher's exact test).

## DISCUSSION

A large number of papers have been published concerning the history, technique, materials and equipments used in apicectomy; but few have been made to assess the success rate of this operation, despite the frequency and ease with which this operation is performed. In addition, the follow up of apicected teeth would be more feasible than conventionally treated teeth, since the patients will take the instructions for recall visits more seriously for operated teeth as compared to conventionally treated teeth, which he/she may consider it just a filling in the tooth. The lack of adequate studies on the success rate of apicectomy is probably due to the fact that it lies between two dental disciplines, namely, conservative dentistry and oral surgery.

In the present study only 76.2% (256/336) of the patients who have had apicectomy attained the two years follow up visits, which was the minimum time recommend to decide whether the operation was successful or not. The remaining 80 patients (23.8%) were failed to complete the two years recall visits. Some of these cases might have been unsuccessful and the patients did not return because the tooth or teeth had been extracted. Also, patients with successful treatment and symptomless teeth were less likely to make efforts to return. It is accepted in the literature that if the proportion of losses of the sample is large (between 30–40%), this would certainly raise serious doubts about the validity of the study results.<sup>(21)</sup>

The overall success rate of apicectomy in the present study was 89.1%. It comes in accordance with many previous studies, which reported that the success rate of apicectomy is about 90%.<sup>(14, 22–24)</sup> However, other studies reported a much lower success rate than the present study. Harty *et al.*<sup>(14)</sup> found that the success rate of 1016 cases of apicectomy was 90%. Oginni and Olusile<sup>(18)</sup> concluded that the success rate of apicectomy of anterior teeth was 71.9%. Peterson and Gutmann<sup>(25)</sup> reported a success rate of 64%. This great variation in the success rate of apicectomy may be attributed to the lack of agreement on a definition of success and failure of surgery, the difference in the expertise of those who perform the operations, and the decision to operate

rate or not to operate on teeth with unfavorable prognosis.

The outcome of apicectomy was not influenced by the sex of the patient, as there was no significant difference between males and females. The results come in accordance with those of many previous studies.<sup>(14, 23, 26)</sup>

Age of the patients showed a highly significant influence on the success rate of apicectomy ( $p < 0.01$ ). The success rate has shown to be increased proportionally with increased age. The lowest success rate (78.6%) was noted in the age group of less than 15 years, whereas the age group of more than 60 years showed the highest success rates. An explanation of this increased rate of success in older patients may be attributed to the fact that root canals of elderly people are usually smaller, due to excessive dentine deposition, and thus easier to seal effectively. The findings of this study come in agreement with those of Harty *et al.*,<sup>(14)</sup> who found that the success rate of apicectomy was improved with age. In contrast to the findings of this study, Lyons *et al.*<sup>(23)</sup> concluded that the success rate of apicectomy was not influenced by the patient's age.

Type of the apicected tooth showed a highly significant influence on the success rate of apicectomy. The upper anterior teeth showed the highest success rate (92.1%), whereas the lowest success rate was noted in upper premolars (77.4%). The high success rate in the anterior teeth may be attributed to the good visual and manipulative access to the anterior region, which is a prerequisite for the success of apicectomy. The high failure rate in the premolar teeth may be due to limited access to the apical region of these teeth, thick overlying bone, and close proximity to vital structures (maxillary sinus for upper premolars and mental neurovascular bundle for lower premolars). All these factors increase the difficulty of the operation and may affect the outcome of surgery. The findings of this study come in agreement with those of Ericson *et al.*,<sup>(27)</sup> who reported a study of 314 maxillary teeth which had undergone apicectomy, the maxillary first premolar showed the lowest success rate. The results of this study disagree with those of Maddalone and Gagliani,<sup>(22)</sup> who

found that no significant difference in the outcome of apicectomy occurred between anterior, premolar, and molar teeth.

Periapical status of the apicected tooth prior to surgery, with respect to the presence of normal or thickened periodontal ligament or presence of frank radiolucent area, had no significant influence on the success rate of apicectomy. This is in contrast to the findings of Harty *et al.*,<sup>(14)</sup> who reported that teeth with radiographically normal periapex and teeth with thickened periodontal ligament showed a significantly higher success rate as compared to teeth with radiolucent areas. The efficiency of apical seal is considered to be the most important single factor for success of apicectomy and if the operator adheres to adequate treatment procedures and techniques the success rate of apicectomy will be high, irrespective of the periapical condition of the apiceted tooth.

Whether the root canal was obturated preoperatively or intraoperatively and whether retrograde amalgam filling was performed or not had no bearing on the success rate of apicectomy. The same conclusion regarding the benefits of retrograde filling with amalgam was also arrived at by Harty *et al.*<sup>(14)</sup> The results of this study come in contrast with those of Molven *et al.*,<sup>(28)</sup> who found that teeth retrofilled with amalgam showed a failure rate of 27% compared with 3.6% in cases filled at the surgical appointment by orthograde method. This variation in the benefits of retrograde filling with amalgam may be attributed to the variation in the operator's decisions in operating on teeth with doubtful prognosis and, off course, the clinicians' skill in preparing and filling the root end cavity.

### CONCLUSIONS

A study on apicected anterior and premolar teeth showed the success rate of this operation to be 89.1%. Factors that had no bearing on the outcome of apicectomy were sex of the patient, preoperative vs intraoperative obturation, retrograde vs. orthograde obturation, and periapical condition of the tooth prior to surgery. Highly significant influence on the success rate of apicectomy was noted for patient's age and type of the apicected tooth.

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