DOI: 10.7860/JCDR/2022/52600.16144

Original Article

Dentistry Section

Needle Probe- A Novel Instrument for Atraumatic Extraction of Broken Maxillary Root Apices

TRIPTHI SHETTY[1], RANGANATH JHAWAR[2], PRAKYATH MALLI[3]

ABSTRACT

Introduction: Atraumatic extraction is the need of the hour to best preserve both hard and soft tissues. A novel instrument was designed, needle probe, in an effort to achieve the same efficacy with respect to extraction of maxillary teeth broken root fragments.

Aim: The aim of the study was to assess the efficacy of using needle probe in removing fractured maxillary tooth apical sections in terms of application, use and its handling.

Materials and Methods: In the present clinical, cross-sectional study, fifty patients requiring removal of fractured maxillary tooth root fragment as a complication of routine extraction were enrolled. The study was conducted between June 2020 to June 2021. Patients were assigned irrespective of gender, age or tooth, to group A (n=25) where extraction of root pieces was done using endodontic H files and group B (n=25) in whom extraction was done using the novel needle probe. Data was tabulated accordingly and analysed using Statistical Package for the Social Sciences (SPSS) version 22 and categorical data between groups were analysed using Student's t-test with significance level set at 0.05.

Results: The average time taken for successful removal of the root fragment in Group A was 3 minutes 3 seconds±23 seconds and 2 minutes 12 seconds±46 seconds in Group B. All inclusive, the needle probe proved to have excellent ease of operation, access and visibility in 24%, 24% and 36% cases as opposed to the conventional use of H files with minimal complications and tissue trauma.

Conclusion: Failure to retrieve the broken root is mostly associated with ankylosed and hypercementosis roots. The needle probe can be promising in its use for atraumatic root fragment extraction. The novel needle probe is easy to use, quick in application and hence results in better patient compliance.

Keywords: Ankylosed teeth, Hypercementosis, Root fragment extraction, Tissue trauma

INTRODUCTION

The extraction of the decayed, diseased and misaligned tooth although a mainstay of oral surgery, is actually a technique sensitive procedure. Be it therapeutic extraction of maxillary premolars for orthodontic purposes or routine extraction of unsalvageable teeth, the mantra today is atraumatic extraction aiming to preserve the alveolus and the cortical plates while maintaining the investing tissues [1]. Advent of technology in terms of techniques and instrumentations have aided in achieving this feat to a large extent. However, fracture of tooth at the apex is a commonly encountered complication even today. This harrowing outcome is unpleasant equally to both the patient and clinician. This delicate situation causes the need for additional surgical procedure or sometimes a referral to the specialist [2]. Inadvertent attempt to retrieve a broken maxillary tooth apex may lead tearing of Schneiderian membrane, formation of oro-antral fistula, slippage of the tooth into the maxillary sinus to name a few complications [3].

To avoid the same, many varying concepts have been employed for the removal of the apical portion of the fractured maxillary teeth [4]. An open technique involving elevation of a well-designed buccal flap to subsequently gain access through a bony window to the broken fragment is less preferred than the close technique due to the drawback of possible bone resorption [5]. Also, with the advent of the worrisome Coronavirus Disease-2019 pandemic use of such an imminent aerosol producing procedures have to be restricted to emergency protocol only [6].

The close technique however rallies on the concept of bone preservation being minimally invasive procedure where root extraction is performed through the alveolar cavity with different instruments. Many methods over the years have been adapted for retrieving the root fragment from the socket namely removal with apex elevators periotome, luxators, syringe needle or by engaging endodontic H file within the root canal [1]. Each of these mentioned instruments have their limitations to be used in broken maxillary tooth retrieval such as being difficult to handling in terms of access and visibility these instruments provide and technique sensitive thereby requiring special training in adaptation of instrument, breakage of the instrument itself, dislodging the root apex further and socket perforation [3,4]. Hence, the need to design an instrument that is simple to use, and successful in atraumatically removing the broken tooth apex and has no or minimal associated complication. A simple hand held instrument "the needle probe" that can aid in atraumatic removal of these broken root apices was designed. The instrument can be used in removal of not only broken root apices but also for tooth roots and or any root fragments that occur as a consequence of routine extraction. The present cross-sectional clinical study was aimed at evaluating the technical applicability, ease of operation and shortcomings of the novel needle probe in easy and quick retrieval of broken maxillary tooth root apices.

MATERIALS AND METHODS

The present cross-sectional clinical study involved 50 patients indicated for extraction of the broken root fragment as a complication of routine extraction of maxillary tooth who presented to the Oral and Maxillofacial Surgery Department at AB Shetty Memorial Institute of Dental Sciences Mangalore, Karnataka, India between June 2020 to June 2021. Ethical clearance for the study was obtained by the Institutional Ethics Committee (ABSM/EC/22/2020).

Inclusion criteria: Patients requiring removal of broken root apices as a complication of routine extraction of maxillary tooth aged between 18-65 years were included in the study.

Exclusion criteria: Patients with previous history of attempted and failed extraction of root apex, fractured root fragment beyond four

days of breaking and those not willing to provide informed consent were excluded. Patients with neurological diseases, psychiatric problems, history of drug allergy, moderate to severe uncontrolled systemic conditions which required close observation and follow-up were also excluded from the study.

Sample size calculation: Sample size was calculated using the following formula:

$n=\{4s^2 (Z_{cv}+Z_{power})^2\}/D^2$

where, 'n'-sample size; 's'- standard deviation; 'Z_{cv}'- critical value for a; Z_{power}, Z value for 1 beta; 'D'- the expected difference between the two means; a value, 0.05.

Substituting values in the equation n=16.2. So, the final sample of 25 subjects in each group was considered.

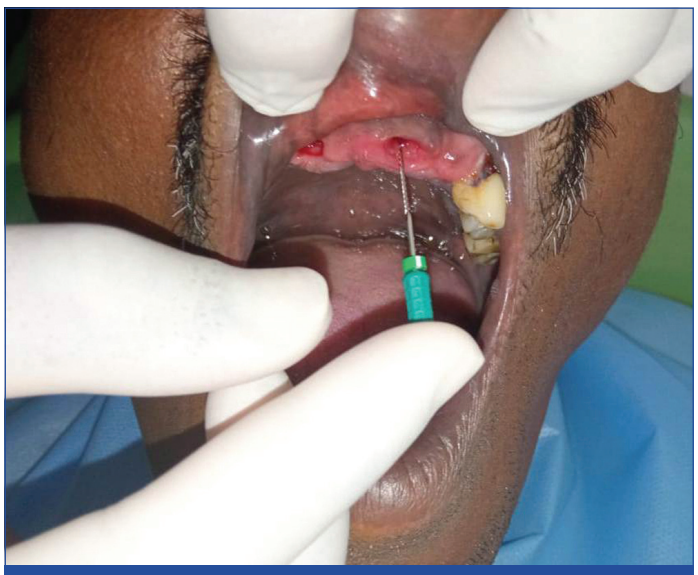
Study Procedure

From the pool of patients reporting to the Department of Oral and Maxillofacial Surgery from June 2020 to June 2021, 50 patients in whom the maxillary teeth apices were fractured as a consequence of routine extraction were enrolled in this prospective observational clinical study and a simple random sample of 25 each was allotted to each group. Patients were assigned, irrespective of gender, age or tooth, to group A (n=25) where extraction of root pieces was done using endodontic H files and group B (n=25) in whom extraction was done using the novel needle probe. Informed consent was obtained by all patients enrolled in the study irrespective of the group assigned.

All procedures were done by 1 of 3 clinicians with atleast four years of clinical experience who were up skilled regarding the needle probe by audio-visual presentations and hands on demonstration of use and application. Data was collected by a single person. The variables measured were time taken for removal of the broken apex (in min, staring from application of the needle probe/H file to retrieval of the apex), accessibility and visibility and ease of operation. Complications if any, during the procedure were also noted.

All patients underwent extraction of broken maxillary tooth apex under strict aseptic precautions.

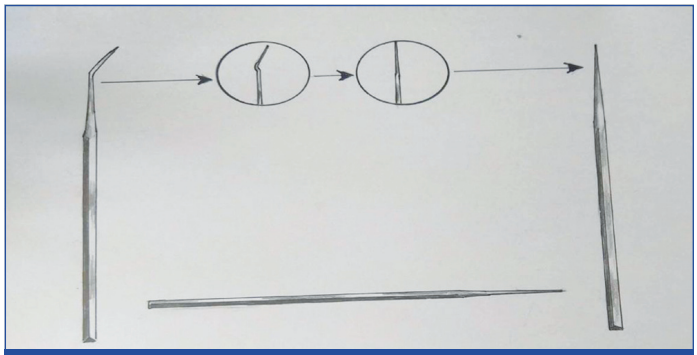
Group A: Based on the tooth and the apparent canal diameter, the fragment position, visibility and access, a suitable H file ranging between No. 25 to No. 40 was used to engage the broken root apex. After insertion, the file was engaged into the canal with a quarter of a rotation in a clockwise fashion and the same was confirmed by tugging of the file to ensure ample locking of the fragment [Table/Fig-1]. Next clockwise and anticlockwise alternate rotations with strong apical pressure are done to ensure release of the periodontal fibres. After a couple of rotations the file is pulled out to retrieve the fragment [7].



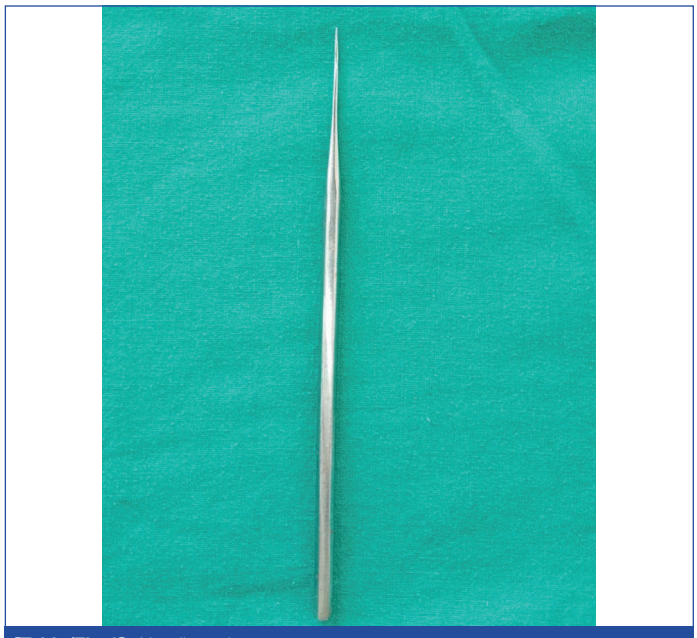
[Table/Fig-1]: Tugging of the H-file in canal of the fractured root segment.

Group B: The novel needle probe was conceptualised as a modification of the straight dental probe and works on the wedge principle enabling expansion of the bony socket to extract the tooth remnant [Table/Fig-2]. The instrument is designed such that the blade, shank and handle all lie in a single straight line with a tip that is slender and sharp pointed like that of a straight needle [Table/Fig-3]. It is to be held in a pen grasp, inserted into the socket between the broken tooth fragment and root, wedging it in between them causing alveolar socket expansion and fragment dislodgement [Table/Fig-4].

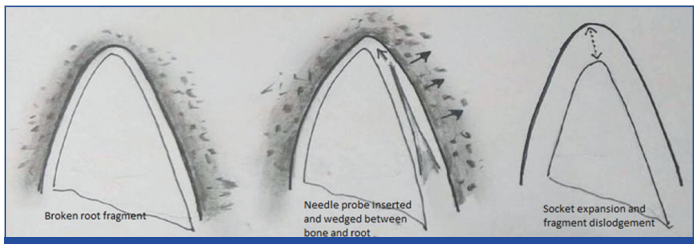
After assessment of the broken tooth apex the needle probe was inserted such that sharp tip is inserted between the alveolus and the root fragment. Gentle apical pressure is applied and held for a few seconds. The fragment dislodged is subsequently removed [Table/Fig-5].



[Table/Fig-2]: Design of the Novel needle probe.

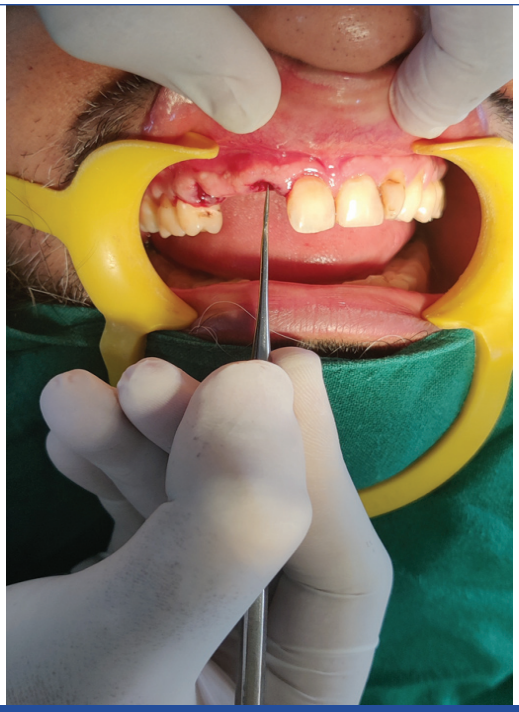


[Table/Fig-3]: Needle probe.



[Table/Fig-4]: Mechanism of action of the Novel needle probe.

Demographic data was recorded using case history proforma and then transferred to statistical analysis software for analysis (SPSS version 22). The end point was successful extraction of the broken root apex in both groups. Summary statistics for age, sex, type of tooth (anteriors, premolars, molars), and reason for extraction (carious teeth, orthodontic extractions, fractured teeth and others such as extractions for prosthetic rehabilitations, periodontally compromised teeth and



[Table/Fig-5]: Dislodgement and removal of the root fragment using the Novel needle probe.

supernumerary teeth) was calculated for the entire population and for individual groups in terms of for continuous and categoric variables. In each group, data pertaining to time of procedure i.e., from insertion of instrument to retrieval of tooth fragment, ease of using the instrument, access and visibility during instrumentation was collected using the 5 point Likert scale of quality [8]. The scale corresponds to 0: very poor; 1: poor; 2: acceptable; 3: good; 4: excellent. Time taken to perform the procedure was measured by a single person in minutes. The operating clinician was asked to rate their experience in terms of ease, accessibility and visibility of the instrument used after each case on the mentioned scale and data was collected by a single person. Any complication that arose in either group as a consequence of the respective procedure was also noted.

STATISTICAL ANALYSIS

Data was tabulated and analysed using SPSS for windows version 22 (IBM Corp, Armonk, NY) and categorical data between groups were analysed using Student's t-test. The significance level was set at 0.05.

RESULTS

A total of 22 females and 28 males with mean ages of 45 years (range 17-61 years) and 50 years (range 18-64 years) in group A and group B, respectively were enrolled in the study. Twenty five (50%) of the total extractions were of the premolars, 19 (38%) molars and 6 (12%) were anterior teeth. Majority of the teeth for extraction were due to caries: 24 (48%), followed by 18 (36%) orthodontic extractions, 4 (8%) fractured teeth and 4 (8%) extraction due to other indications such as prosthetic rehabilitations, periodontally compromised teeth and supernumerary teeth. Data of variables within the Group A and Group B is as described in [Table/Fig-6].

The average time taken for successful removal of the root fragment in Group A was 3 minutes 3 seconds±23 seconds and 2 minutes 12 seconds±46 seconds in Group B. The ease of operation with H files was found to be excellent in 12% cases and access and visibility found to be good in 16% each respectively in comparison to 24% of excellent ease of operation and 24% of excellent access and 36% of excellent visibility while using the novel needle probe [Table/Fig-7]. The difference was found to be statistically insignificant. One patient in group A reported of repeated deflection of the H file causing difficulty in access and anchorage to the apex thereby delaying the extraction. One patient in group B reported perforation of socket due to inadvertent rupture and breach of the thin alveolar bone of the tooth socket which could potentially cause future infection. Both instances were managed aptly.

Parameter	Group A	Group B	Total
Age, mean (range)	45 (17-61)	50 (18-64)	49 (17-64)
Gender, n (%)			
Male	12 (48%)	16 (64%)	28 (56%)
Female	13 (52%)	9 (36%)	22 (44%)
Type of teeth, n (%)			
Anterior teeth	3 (12%)	3 (12%)	6 (12%)
Premolars	11 (44%)	14 (56%)	25 (50%)
Molars	11 (44%)	8 (32%)	19 (38%)
Reason for extraction, n (%)			
Non restorable teeth	11 (44%)	13 (52%)	24 (48%)
Orthodontic extractions	9 (36%)	9 (36%)	18 (36%)
Fractured teeth	2 (8%)	2 (8%)	4 (8%)
Others (extractions for prosthetic rehabilitations, periodontally compromised teeth and supernumerary teeth)	3 (12%)	1 (4%)	4 (8%)
Average time taken, (minutes)	3 minutes 3 seconds±23 seconds	2 minutes 12 seconds±46 seconds	*p=0.108

[Table/Fig-6]: Demographic data of H file (Group A) and needle probe (Group B).
*using student's t-test
p-value <0.05 considered significant

Variables	Very poor	Poor	Acceptable	Good	Excellent	p-value*
Ease of operation, n (%)						
Group A	3 (12%)	6 (24%)	4 (16%)	9 (36%)	3 (12%)	0.5
Group B	0	4 (16%)	2 (8%)	13 (52%)	6 (24%)	
Access, n (%)						
Group A	5 (20%)	9 (36%)	7 (28%)	4 (16%)	0	0.5
Group B	0	4 (16%)	4 (16%)	11 (44%)	6 (24%)	
Visibility, n (%)						
Group A	11 (44%)	6 (24%)	4 (16%)	4 (16%)	0	0.4347
Group B	0	3 (12%)	4 (16%)	9 (36%)	9 (36%)	

[Table/Fig-7]: Comparison of technical application between H file (Group A) and novel needle probe (Group B).
*using student's t-test
p-value <0.05 considered significant

DISCUSSION

The present study demonstrated successful atraumatic extraction of fractured root apices in a much simpler fashion. Though vast number of different techniques with or without specialised instruments has been described in the past, many have their own limitations [9]. Though statistically insignificant, the clinicians were of the opinion that the needle probe offered better ease in operation with lesser complication than the H file.

Many different methods for the retrieval of broken root fragments are found in literature. Pippi R et al, in a case report attempted removal of the broken root tips with the help of endodontic H files [5]. The files engage effectively in the dentin than those by the K files or reamers however, it was not recommended to invisible and/or calcified canals, bony interferences, root hypercementosis and serious curvatures or lacerations. File breakage is also a commonly reported untoward outcome. Tip of the instrument fractured and retained in the socket causes infection and delays wound healing [7]. The needle probe can be applied in all scenarios contraindicated for application of the files above mentioned except in cases of root hypercemntosis. Reyazulla MA et al., revived an easy non invasive protocol for extraction of root fragment of maxillary teeth which had already been advocated by Dlorr and Howarthin 1985 [10]. He

advocated removal of broken tooth apices with local anaesthetic syringe needle tip which was slowly engaged in the canal and slowly prying out the needle with the fragment attached. This however is a highly technique sensitive procedure with reports of needle breakage and deflection [10]. The technique mentioned in this study of employing the needle probe overcomes these disadvantages as it engages into the socket space and is a sturdy instrument. Singh C et al., designed a buccal envelope flap corresponding to the broken root and introducing sharp probe to push the fragment out. This technique breaches the buccal cortical bone and defeats the purpose of bone preservation [1]. Elevators, though indispensible in extricating broken teeth and fragments, their use in the maxillary region, especially non judicious can lead to traumatic complications [11]. The needle probe is simple hand held instrument which could be used along the same lines as elevator and much safer in application because of its fine delicate tip generating just the ample amount of force thereby not causing any damaging impact.

Limitation(s)

Though the needle probe is applicable in many clinical scenarios presenting with complicated removal of broken tooth apices. But its use is limited in situations of tooth akylosis and hypercementosis.

CONCLUSION(S)

To summarise, this study utilising the novel needle probe helps to establish its use and application in extraction of fractured maxillary tooth apices removal. This instrument causes minimum trauma, has the property of easy handling and provides ease in application and working. Hence, we introduce it as a novel instrument into a plethora of other armamentarium available for removal of broken teeth apices with the added advantage of being applicable in those cases where others cannot be used. The result highlights the needle probe as an aid in accurate and quick retrieval of root remnant in the maxilla. However, the instrument is nascent in inception and continued modification in its design and application needs to be a continuous process to address these limitations and improve its functioning. Future research should entail establishing the versatility and advantages of the needle probe over other surgical armamentarium used in quick and atraumatic removal of broken tooth apices.

REFERENCES

[1] Singh C, Sharma D, Newaskar V, Agrawal D. A simple technique for removal of broken root tip of maxillary premolars: A technical note. Journal of Maxillofacial and Oral Surgery. 2015;14(3):866-67.
[2] Edward J, Aziz MA, Usha AM, Narayanan JK. Comparing the Efficiency of two different extraction techniques in removal of maxillary third molars: A randomized controlled trial. Journal of maxillofacial and oral surgery. 2017;16(4):424-29.
[3] Heidbrink JA. Necessity for removal of all broken-off root tips. Journal of Dental Research. 1921;3(4):389-90.
[4] Ramesh N, Thangavel K, Aravind RJ, Kumar I, Priydharshini G, Ashmi A. Various techniques employed in the removal of apical root tips following dental extraction. Annals of SBV. 2020;9(2):37.
[5] Pippi R, Colaci R, Pietrantoni A. The window approach for extraction of tooth root fragments: A different soft tissue management. Journal of Clinical & Diagnostic Research. 2018;12(7):ZD04-05.
[6] Deogade SC, Naitam D. COVID-19 and dental aerosols: The infection connection. Avicenna Journal of Medicine. 2021;11(2):107.
[7] Talathi A, Umale V, Chandurkar K, Kulshrestha R, Rehani A. Atraumatic technique for removal of broken root tips of maxillary posterior teeth with endodontic K file-A technical consideration. J Dent Oral Disord Ther. 2018;6(2):01-04.
[8] Brown S. Likert scale examples for surveys. ANR Program evaluation, Iowa State University, USA. 2010 Dec.
[9] Muska E, Walter C, Knight A, Taneja P, Bulsara Y, Hahn M, et al. Atraumatic vertical tooth extraction: A proof of principle clinical study of a novel system. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 2013;116(5):e303-10.
[10] Reyazulla MA, Gopinath AL, Dutta A. Atraumatic removal of broken root piece-revival of a forgotten technique. Int J Oral Health Med Res. 2015;2(2):130-32.
[11] Nayyar J, Clarke M, O'sullivan M, Stassen LF. Fractured root tips during dental extractions and retained root fragments. A clinical dilemma? British Dental Journal. 2015;218(5):285-90.

PARTICULARS OF CONTRIBUTORS:
1. Reader, Department of Oral and Maxillofacial Surgery, AB Shetty Memorial Institute of Dental Sciences, NITTE (Deemed to be University), Mangalore, Karnataka, India.
2. Consultant, Department of Oral and Maxillofacial Surgery, HBT Medical College and Trauma Centre, Mumbai, Maharashtra, India.
3. Senior Lecturer, Department of Prosthodontics, Yenepoya Dental College, Yenepoya University, Mangalore, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Tripthi Shetty,
Reader, Department of Oral and Maxillofacial Surgery, 6th Floor ABSMIDS, Derlakatte, Mangalore-575018, Karnataka, India.
E-mail: drtripthips@nitte.edu.in

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Sep 28, 2021
- Manual Googling: Jan 07, 2022
- iThenticate Software: Jan 18, 2022 (7%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Sep 27, 2021**
Date of Peer Review: **Dec 18, 2021**
Date of Acceptance: **Jan 08, 2022**
Date of Publishing: **Mar 01, 2022**