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INWARD FRAGMENTATION TECHNIQUE VERSUS CONVENTIONAL TECHNIQUE IN THE SURGICAL REMOVAL OF IMPACTED MANDIBULAR THIRD MOLARS: A SYSTEMATIC REVIEW

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ABSTRACT

Conventional surgical extraction of impacted mandibular third molar conjointly requires a lateral flap reflection and lateral rotary osteotomy for the extrusion of the tooth. The aim of this systematic review is to evaluate the efficacy of a novel inward fragmentation technique (IFT) in conjunction with an occlusal mini flap approach to reduce the amount of bone removal to a minimum and thereby performing the procedure more conservatively. The Databases of PubMed, Cochrane and Google scholar were searched for the related topics along with a complimentary manual search of all oral surgery journals till December 2019. Articles were selected based on the inclusion criteria, which included all randomized controlled clinical trials (RCTs). All in-vivo RCT's that used inward fragmentation technique for the surgical extraction of third molars were selected. Data from studies were extracted and analyzed for their quality. The outcome measure was to evaluate the reduction of pain level and duration, swelling, injury to the lingual nerve and loss of alveolar bone. Based on the study findings, the inward fragmentation technique was superior to the conventional surgical technique in terms of reduction in pain, swelling, loss of alveolar bone height, injury to the lingual nerve. The inward fragmentation technique appears more advantageous than the

conventional technique in terms of reduction of pain, swelling, loss of alveolar bone height, injury to the lingual nerve following surgical removal of impacted third molar and may have a better impact on quality of life (QOL) post extraction. This also indicates the clinical validity in terms of its ability to differentiate between the two technique groups and the excellent compatibility exhibited with radiographically determined alveolar bone patterns.

INTRODUCTION

Third molars are present in 90% of the population, with 33% having at least one impacted third molar, thus extraction is a relatively common procedure¹. Extraction involves the manipulation of both soft and hard tissues, so the patient usually experiences pain, oedema, and trismus in the immediate postoperative period. Conventional surgical extraction of impacted mandibular third molars (M3M) requires lateral bone removal to allow an outwardly directed mobilization of the tooth 2 . In cases of deep impaction this technique may be associated with the risk of mandibular angle fracture³. A mucoperiosteal flap exposing the buccal bone of the M3M and of the adjacent second molar is most commonly used. Research has shown that such exposure, even without bone removal or extraction, leads to bone resorption⁴. Morbidity following third molar surgery is currently being discussed with the aim of reducing intra as well as postoperative complications to a minimum. Recently a shift in paradigms can be observed towards atraumatic techniques in third molar surgery, such as odonto-section, ⁵ partial removal of M3M crowns ⁶ and use of piezoelectric devices⁷. Flapless third molar surgery has been shown in horizontally dislocated teeth⁸ which are partially erupted. Despite this there is not much discussion in the literature on the performance of atraumatic procedures in particular for complex situations and fully impacted M3M in close relationship with the IAN. In implant surgery, "flapless" techniques have become increasingly important. There are significant advantages, which make flapless surgery attractive for both surgeon and patient ⁹. Minimal trauma to the soft tissue reduces scar formation, preservation of osseous vascularization via the periosteum and reduced patient discomfort. As an alternative to punch techniques, occlusal mini-incisions have been used in implant surgery ¹⁰

For exodontia surgery, in contrast occlusal mini flaps have not been recommended previously due to inadequate visualization of the surgical site. In inward fragmentation technique, surgery is performed under local anaesthesia. The surgeon works in a 12 o'clock position observing the site on a video screen via a Storz Hopkins support endoscope (30 view angle, 2.7 mm or 4 mm diameter, Karl Storz, Tuttlingen, Germany). The support endoscope is placed posterior to the surgical site. A sulcus is performed near the mesiobuccal edge of the second molar to its distal surface¹¹. The incision line is continued sagittally towards the mandibular ramus along the extension of the M3M. Soft tissue reflection is carried out over the crest only to allow the insertion of the periosteum is performed on the lateral and lingual aspects of the M3M region.

Crestal exposure of the M3M is performed using a round bur with a low speed handpiece and sterile saline irrigation. Exposure is restricted to the occlusal aspect only, independently of the angulation and degree of impaction of the

tooth. Trepanation of the M3M is performed using Lindemann straight burs in order to provide access to the $pulp^{12}$. The trepanation is oriented in a transverse direction intending to create an internal space-making cavity, which may vary depending on the individual situation. The transverse cut is performed in the buccal and central parts of the crown with the exception of the lingual aspect. Thus, using a round bur with a low speed handpiece and sterile saline irrigation, the pulp is opened widely towards the level of the furcation in order to obtain a space for inward fragmentation of the crown and at the same time an overview of the internal tooth anatomy and the furcation area is obtained ¹³. Crown removal is performed by inward fragmentation. The use of large diamond round burs in the furcation area is essential to ensure complete separation of the roots before inward fragmentation while avoiding lingual nerve damage. Following removal of the distal crown by inward fracturing with an elevator, the mesial part is luxated, also inwardly, and subsequently removed. In the majority of cases the adjacent root can be removed together with the mesial crown fragment. The space created by removal of the crown fragments opens the sight towards the furcation area and remaining roots. After removal of the crown, the remaining roots are identified. The majority of roots could be removed with elevators. In case of ankylosis the roots are removed with round burs under direct vision. In critical zones at the lingual aspect of the mandible and adjacent to the alveolar nerve, diamond burs mounted on a low speed handpiece are used.

Final examination of the alveolus is performed under endoscopic vision for root remnants and determination of the bone level using a periodontal probe¹⁴. Probing is performed along the axis of the tooth to the buccal side with reference to the most apical extension of the alveolus. Wound closure is performed depending on the preoperative situation. The socket is rinsed with physiological saline, and the incision is closed with 2 interrupted sutures (silk 4-0). All patients receive paracetamol 500 mg 4 times daily, additionally an antibiotic treatment (amoxicillin 650 mg 3 times daily) is administered for 4 days.

Thus, the inward fragmentation technique (IFT) with an occlusal mini flap approach allows low traumatic access to M3M, exact visualization of critical structures and results in vertical buccal bone loss below 1 mm. Anatomical integrity in highly complex cases can be maintained with a low complication rate. Few studies have adopted the same technique without the use of endoscope where the inclusion criteria is primarily mesioangular impaction of M3M and have suggested less pain and swelling outcomes in addition to no neurosensory disturbances of lingual nerve. From the existing literature, it is obvious that the type of incision and the method of sectioning is an important consideration in the surgical removal of the impacted teeth. Further it is vital to note that the design of the flap is a critical parameter in the surgery of third molars. The design of the flap influences the visibility and accessibility to the impacted tooth and also has an impact on the subsequent healing process of the surgical defect created following surgery.

Thus inward fragmentation technique is strongly recommended due to the ease of tooth sectioning, less pain and swelling, less alveolar bone resorption and no neurosensory defects of lingual nerve in the patients who have undergone mandibular third molar surgery. With a rich case bank established over 3 decades we have been able to publish extensively in our domain ^{15–25}. Based

on this inspiration we aim to do a systematic review to analyse the existing literature for quality of life following mandibular third molar surgery by comparison and evaluation of inward fragmentation technique (IFT) and conventional surgical extraction technique by performing ostectomy.

2.MATERIALS AND METHODS 2.1 Structured question

Is Inward Fragmentation Technique (IFT) effective in lowering postoperative incidence of Neurosensory disturbances, swelling, pain (level and duration) compared to Conventional Surgical Extraction (with ostectomy) following mandibular third molar surgery.

2.2 Hypothesis

Null hypothesis: There is significant reduction in pain, swelling, lingual nerve paresthesia using inward fragmentation technique.

Alternate hypothesis: There is no significant reduction in pain, swelling, lingual nerve paresthesia using inward fragmentation technique.

2.3 Population, intervention, comparison, and outcome (PICO) analysis

Our population, intervention, comparison, and outcome (PICO) analysis was as follows:

Population: Patients undergoing mandibular third molar surgery

Intervention: Inward Fragmentation Technique (IFT)

Comparison: Conventional Surgical Extraction (with ostectomy)

Outcome: Quality of Life

2.3.1 Inclusion criteria

Types of studies included in this systematic review were Randomised controlled trials. No publication **date**, and language restriction were imposed. **2.3.2 Types of participants/samples**

Patients with third molar extraction were eligible for inclusion in this study.

2.3.3 Types of intervention

Inward **fragmentation** Technique

2.3.4 Types of comparison

conventional **rotary** instruments

2.3.5 Outcome measures

The primary outcome was pain score after surgery. Secondary outcomes included operation time, swelling after, mouths open, analgesic dosage after surgery, and nerve paresthesias.

2.4 Literature search and search methodology

For identification of studies included or considered for this review, detailed search strategies were carried out on the following databases: PUBMED Advanced Search (until December 2019), Cochrane Search, Google Search. Electronic search was carried out using the keywords in the Search engines-

PubMed, Cochrane and Google Scholar which yielded a total of 5 articles. No limits and language restrictions were applied during the electronic search to include the search phase of the systematic review. No time restriction was applied. Reference list of reviews and of the identified in vivo studies were also checked for possible additional studies. Risk of bias assessment was performed independently by two investigators, with disagreements resolved by discussion. Risk of bias was assessed as described in the Cochrane handbook.

2.5 Screening and Selection of studies

Based on pre-set inclusion and exclusion criteria, the titles of the studies identified from the search were assessed independently by two review authors. Conflicts concerning inclusion of the studies were resolved by discussion. One article was excluded after reading titles. Two titles were identified from the search after excluding one duplication. Abstracts of selected articles were reviewed independently. No articles were excluded after reading the abstract. Full text articles were retrieved for 3 relevant studies.

The reference list of the full text articles were reviewed for identifying additional studies. Titles of articles relevant to the review were selected by discussion. Quality Assessment criteria to evaluate the studies were decided by two review authors in accordance with CONSORT guidelines. The risk of bias for each study was independently assessed by the review authors and conflicts concerning risk of bias were sorted by discussion.

2.6 Data extraction and quality evaluation

Data extraction for general characteristics of studies and outcome variables of interest was done. For each trial the following data were recorded: Author and Journal, Study Design, Sample Size, Participants and Group, Methodology, Outcome measures, Results and Conclusion. Variables of interest were pain level and duration, swelling, bone height, nerve paresthesia.

Finally, three articles were included for review in the present study, and their characteristics are described in Table 1 and Table 2.

2.7Levels of evidence in included studies

The levels of evidence for the reviewed studies are based on Higgins and Green. Cochrane reviewer's handbook 2009. (Table 3).

The quality assessment of included trials was undertaken independently as a part of the data extraction process. Four main quality criteria were examined.

1. Method of Randomization, recorded as

- a) YES- Adequate as described in the text
- b) NO- Inadequate as described in the text
- c) Unclear in the text
- 2. Allocation Concealment, recorded as
 - a) YES- Adequate as described in the text
 - b) NO- Inadequate as described in the text
 - c) Unclear in the text

3. Outcome assessors Blinded to intervention, recorded as

a) YES- Adequate as described in the text

b) NO- Inadequate as described in the text

c) Unclear in the text

4. Completeness of Follow up (was there a clear explanation for withdrawals and dropouts in each treatment group) assessed as

a)YES- Dropouts were explained

b) NO- Dropouts were not explained

c) None- No Dropouts or withdrawals.

Other methodological criteria examined included:

- 1. Presence or Absence of sample size calculation.
- 2. Comparability of Groups at the start.
- 3. Clear Inclusion or Exclusion criteria.
- 4. Presence or Absence of estimate of measurement error.

2.8 Risk of bias in included studies

The study was assessed to have a "High risk" of bias if it did not record a "Yes" in three or more of the four main categories, "Moderate Risk "if two out of four categories did not record a "Yes", and "Low Risk" if all the four categories including randomization, allocation concealment, Blinding and Completeness of follow up were considered adequate. In case of non-randomized and clinical trials without a control group, it is recorded as not applicable. The three main methodological studies were assessed for quality, and the included studies showed low to high risk of bias (Table 4).

RESULTS AND DISCUSSION	
Table 1: Characteristics of included studies: I	Methodologies

S N 0	Aut hor	Ye ar	Stud y desig n	Sa mpl e size	A g of p at ie nt s	Techni que Used	Method of Evaluati on
1.	Wilf ried Eng elke et al	20 13	Clinica 1 Trial	21	18 - 36 ye ar (m ea n ag e 24 .4)	Inward Fragmen tation Techniq ue	Preoperat ive and post- operative bone height using CBCT

2	Nith in Mat hew Che rian et al	20 15	Rando mised Control led Trial	24	In de pe nd en t	Inward Fragmenta tion Technique versus Conventio nal rotary technique	Duration of surgery and post- operative neurosens ory deficits
3.	Raju Chand rasekh ar et al 2017	20 17	Rando mised Split Mouth Study	15	18 - 35 ye ar s	Inward Fragmenta tion Technique versus Conventio nal rotary technique	Pain, swelling, trismus, alveolar osteitis, post operative pain score, no. of additional painkillers used, wound dehiscence, neurosensor y deficit

Table 2: Characteristics of included studies: Findings

S.N	Author and vear	Technique used	Parameters evaluated	Results	Inferen ce
-					

1.	Wilfried Engelke et al, 2013	Inward Fragmentatio n Technique	 Preoperative and post-operative bone height using CBCT Duration of Surgery Infection Neurosens ory deficits 	 1.Maximu m vertical bone-loss of 2 mm 2.27.3 (14-44) min 3.one late infection was seen 4.Two temporary incomplet e neurosens ory disturbanc es, which recovered 	1.Less with IFT 2.More with IFT 3.Less with IFT 4.Less with IFT
				recovered within 6 and 10 weeks after surgery	
2.	Nithin Mathew Cherian et al, 2015	Inward Fragmentatio n Technique versus Conventional rotary technique	 Duration of surgery Post- operative neurosensor y deficits 	 1.16.75 min in conventio nal technique 15.43 min in IFT 2.No incidences reported in both the groups 	1.Less with IFT 2.No significa nt differen ces between both the groups.
3.	Raju Chandrasekhar et al 2017	Inward Fragmentatio n Technique versus Conventional rotary	1.Pain	1.Mean pain (VAS) Group A - 5.20 Group B -	1.Less with IFT

technique Group A - conventional rotary technique Group B - Inward Fragmentatio n Technique	 2.Swelling 3.Trismus 4.Alveolar bone height loss both pre and post operatively 5.Duration of surgery 6.Wound dehiscence 7. Infection 	1.47 2.Swellin g Group A - 1.19 Group B - 1.17 3.Trismus Group A - 33.07 Group B - 41.40 4.Group A - pre op - post op bone height - 2mm Group B - pre op - post op bone height - 2mm Group B - pre op - post op bone height - 2mm Group B - pre op bone height - 0mm	 2.Less with IFT 3.Less with IFT 4.Less with IFT 5.Less with IFT 5.Less with IFT 5.Nil with IFT 8.Nil with IFT
	dehiscence 7. Infection	cases Group B - Nil 7.Nil infections in both groups	with IFT
	8. Neurosensor y deficit	8.Group A - 2 cases Group B - Nil	

SI No	Author and year	Study design	Level of Evidence
1.	Wilfried Engelke et al, 2013	Clinical Trial	Ι
2.	Nithin Mathew Cherian et al, 2015	Randomised Controlled Trial	Ι
3.	Raju Chandrashekar et al, 2017	Randomised Split Mouth Study	Ι

Table 3: Levels of evidence in included studies

Table 4: Risk of bias in included studies

S. No	Study	Randomiza tion	Allocatio n conceal ment	Asses sor Blind ed	Drop outs descri bed	Ri sk of Bi as
1.	Wilfried Engelke et al, 2013	No	No	No	No	Hi gh
2.	Nithin Mathew Cherian et al, 2015	Yes	Yes	Yes	No	Lo w
3.	Raju Chandrashekar et al, 2017	Yes	Yes	Yes	No	Lo w

The surgical removal of impacted mandibular third molar involves the manipulation of both soft and hard tissues leading to immediate postoperative sequelae ^{26,27} Most of the surgical procedures demand proper **preoperative**

planning and the blending of surgical technique with surgical principles for decreasing the incidence of complications which may occur intraoperatively or develop in the postoperative period.

Conventional surgical extraction of impacted mandibular third molar requires lateral and distal bone removal using rotary instruments to allow mobilization of the tooth, and this technique is associated with increased postoperative pain, swelling, increased incidences of dry socket and damage to the inferior alveolar nerve. Morbidity following third molar surgery is currently being discussed with the aim of reducing intraoperative as well as postoperative complications. To achieve reduction in the post-operative morbidity numerous attempts have been made such as- use of analgesics, local or systemic corticosteroids, modification in flap designs, use of drain, secondary wound closure and coronectomy ^{28–31}. Recently a shift in paradigms can be observed towards atraumatic techniques in third molar surgery to reduce the postoperative complications. In this regard, a new technique called Inward Fragmentation Technique (IFT) has evolved in the management of selective cases of third molar impactions, which does not involve rising of flap or bone removal.³² Evidence regarding the efficacy of IFT is sparse, ^{33,34} therefore this systematic review aimed to compare the outcomes of conventional technique versus IFT in the surgical removal of impacted mandibular third molars.

The aim of this systematic review is to assess the efficacy of Inward Fragmentation Technique with Conventional rotary Instrument on outcome parameters like Pain, Swelling, Trismus, alveolar height both pre and post operatively, neurosensory deficit in impacted mandibular third molar surgery. There were one clinical trial and two randomised controlled trials included in this systematic review. All of the studies have used Inward Fragmentation Technique to compare the incidence of postoperative Pain, Swelling, Trismus, Alveolar height both pre and post operatively and neurosensory deficit. The inward fragmentation technique appears more advantageous than the conventional technique in terms of reduction of pain, swelling, loss of alveolar bone height, injury to the lingual nerve following surgical removal of impacted third molar and may have a better impact on quality of life (QOL) post extraction. From this systematic review it was observed that Inward Fragmentation Technique had lesser postoperative complication and better quality of life when compared to Conventional rotary Instrument in mandibular third molar surgery.

In the reviewed studies very less number of patients were evaluated, hence more studies have to be done in **future** on a multicentric basis with a larger sample size for evaluating multiple parameters that determine the quality of life in patients following lower third molar surgery.

CONCLUSION

From this **systematic** review it can be concluded that Inward Fragmentation Technique leads to better quality of life of patients when compared to Conventional rotary Instrument in mandibular third molar surgery. More randomized controlled trials have to be done to evaluate the efficacy of the Inward Fragmentation Technique for the removal of impacted mandibular third molars.

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CONFLICT OF INTEREST Authors in this study did not have any conflict

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