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A Randomized Controlled Study Comparing And Evaluating The Peri-Operative Outcomes Of Using Straight Versus Angled Handpieces During The Surgical Extraction Of Impacted Mandibular Third Molars

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Abstract
Introduction: *The straight handpiece is one of the most commonly used instruments in third molar surgeries. However, its use has been suggested to carry a potential risk of soft tissue injury, possibly due to its design limitations leading to direct positioning and excessive heating, which could contribute to soft tissue damage. Direct positioning can sometimes cause excessive heating, leading to potential soft tissue damage. Additionally,*

its design might limit accessibility in the confined surgical area, making it more difficult to maneuver effectively. This study aims to evaluate whether using an angled handpiece enhances accessibility and reduces the risk of soft tissue damage during surgical procedures.

AIM: *Comparison and evaluation of the use of straight and angled handpieces on perioperative outcomes in operative removal of obstructed lower third molars.*

Materials and Methods*: This research included 30 healthy participants aged 18 to 40, all of whom were undergoing extraction of impacted lower third molars at the Department of Oral and Maxillofacial Surgery. Participants were randomly assigned to two groups.: Group A, where the extraction was carried out using an angled handpiece, and Group B, where a straight handpiece was employed.*

Results: *No statistically significant differences were found in postoperative pain, edema, mouth opening, or surgical time between the angled and straight handpiece groups.*

Conclusion: *The findings of our research indicate that there were no notable statistical differences observed between the two groups in relation to post-operative outcomes such as pain, edema, mouth opening, or surgical time. The lack of statistical significance may be attributed to the small sample size, emphasizing the importance of larger cohorts for a more accurate assessment of the clinical impact. However, operator comfort was reported to be better with angled handpieces in certain cases.*

Category: *Dentistry, Pain Management, Patient Care*

Keywords*: angled handpiece, straight handpiece, third molar, edema, ulceration, impacted mandibular third molars*

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I. Introduction

Mandibular third molar extraction is a prevalent surgical procedure performed to address issues such as impactions, infection, or orthodontic concerns related to wisdom teeth. Removal of impacted lower third molars is a commonly performed dental alveolar procedure and is often associated with various postoperative complications. Due to the intricate anatomy of the mandibular region, including the proximity of the inferior alveolar nerve and the variability in tooth positioning, successful management of these complications often hinges on the effectiveness of the surgical tools employed [1, 2].

After the surgical removal of third molars, patients often experience discomfort, including pain, limited jaw movement known as trismus, and swelling or edema during the postoperative period. Surgical handpieces play a critical role in the efficiency and safety of the extraction process. Traditionally, straight handpieces have been the standard choice, providing a direct approach to the surgical site. However, their design may restrict maneuverability and visibility, especially in challenging cases with limited access [3, 4].

This study aims to conduct a comparative clinical evaluation of perioperative outcomes following mandibular third molar surgery using straight and angled surgical handpieces. By studying surgical time, postoperative discomfort, complications rates, and patient satisfaction, this research aims to compare the benefits of each handpiece type. The results are expected to offer valuable insights for enhancing surgical techniques and enhancing patient care during mandibular third molar extractions [5, 6].

II. Materials And Methods

This study involved 30 healthy individuals, aged 18 to 40, who sought treatment at the Department of Oral and Maxillofacial Surgery at SRM Kattankulathur Dental College and Hospital, located in Chennai, Tamil Nadu, India. The research protocol underwent a comprehensive review and received approval from the institutions ethical committee, as per their letter no. SRMIEC-ST0324-1024.And study commenced on 20/05/2024-9/9/2024 in accordance to "in accordance with the Declaration of Helsinki"

Patients were randomly allocated using the software method using an online tool that allocates patients randomly into two groups, comprising 30 patients each. Group A underwent treatment utilizing an angled handpiece, whereas Group B received treatment employing a straight handpiece . The study protocol was clearly explained to all patients, and informed consent was obtained from each participant [7, 8].

Inclusion Criteria

The criteria for patient inclusion are as follows:Individuals aged between 18 and 40,ASA I and ASA II classification,Impacted cases fall within the mild and moderate categories of the Peterson difficulty index [9, 10]

Exclusion Criteria

Patients who have undergone radiation therapy,ASA III and ASA IV,Impactions that fall under Pederson's classification of very difficult cases [9, 10](Figure 2).

Materials

Straight handpiece, Angled handpiece , Orthopantomogram/IOPA (Figure 2), Odontectomy bur,Impaction Kit

Methodology

Sample selection: Eligible patients were assigned to either Group A, which utilized an angled handpiece, or Group B, which used a straight handpiece, through a software-based allocation method using an open-epi random number generator for randomization.

The preoperative evaluation of each patient included a comprehensive case history. Then radiographic evaluation was followed, where the type of impaction was analyzed. Mouth opening was measured using a metal scale, and facial measurements were obtained with thread to establish baseline assessments for edema. (Figure 2), (Figure 3), (Figure 4)

The surgeries were carried out in an operating room under rigorous aseptic protocols. Local anesthesia was administered using 2% lignocaine mixed with 1:80,000 epinephrine, with a total volume ranging from 2 to 4 ml. Nerve blocks were applied to the inferior alveolar, lingual, and long buccal nerves. A standard Ward's or modified Ward's incision was made. In the study group (Group A), after reflecting the flap, a bone osteotomy was completed using an angled handpiece (Fig. 4). Tooth sectioning was done according to the impaction, and the tooth was removed with an appropriate elevator. In the control group (Group B) here, a straight handpiece (Fig. 3) was used, and all the following procedures were similar to those in Group A. [11, 12, 13] .

All patients received postoperative instructions and were prescribed antibiotics and analgesics. Patient assessments were conducted on the 0^{th} day (operation day) and the 7th postoperative day based on the following parameters: Pain assessment was conducted via a visual analog scale (VAS). The Visual Analog Scale (VAS) utilized a scoring system ranging from 0 to 10, where 0 represented no pain, 5 indicated moderate discomfort, and 10 corresponded to the most intense pain imaginable. Facial swelling was assessed through craniometric measurements, specifically by calculating the distance from the outer canthus of the eye to the angle of the mandible (Line BE), from the tragus to the corner of the mouth (Line AC), and from the tragus to the soft tissue pogonion (Line AD). Maximum mouth opening was measured by the distance, in millimeters, between the incisal edges of the upper and lower central incisor (Figure 1) [14, 15].

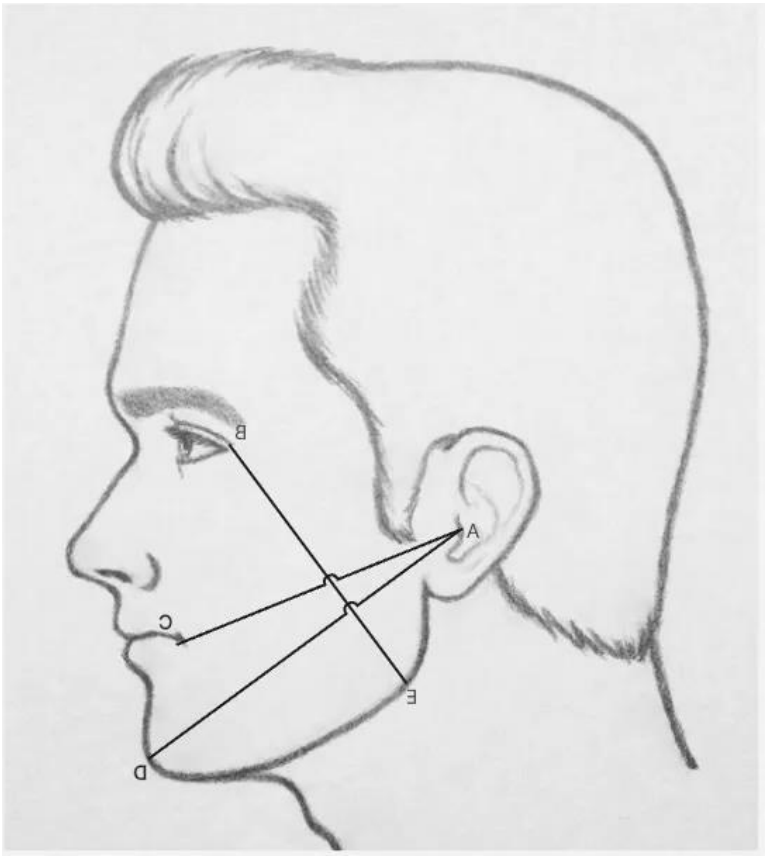


Figure 1: Line Be: The Measurements Included The Distance Between The Outer Corner Of The Eye And The Angle Of The Mandible (Ac), The Distance From The Ear's Tragus To The Corner Of The Mouth (Ad), And The Distance From The Tragus To The Soft Tissue Pogonion.

Figure 2: Iopa Of A Few Cases Done Using Angled Handpiece Under Classified Pedersons Index

Figure 3: Straight Handpiece

Figure 4: Angled Handpiece

ETHICS Committee review

The study began after obtaining ethical approval from the institute's ethical committee, as per their letter no. SRMIEC-ST0324-1024 dated 03/04/2024.

Statistical analysis

Descriptive statistics were used to summarize the variables. An unpaired t-test was used to compare the study and control groups, applying a significance level of 5% and a 95% confidence interval. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 21.0., released in 2012 by IBM Corp. (Armonk, NY).

Table: 1 Descriptive statistics of study population

		Frequency N (%)
Impaction	Distoangular	5 (16.7)
	Horizontal	7 (23.3)
	Mesioangular	7 (23.4)
	Vertical	11 (36.7)
Gender	Female	15 (50)
	Male	15 (50)

Table 2: comparison between angled and straight handpiece on age, Peterson difficulty, surgery duration

		Mean ± SD	t	P value[a]	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
AGE (in yrs)	Angled	26.80 ± 4.96	-1.919	.065	-4.533	-9.372	.305
	Straight	31.33 ± 7.6					
PEDERSON DIFFICULTY	Angled	4.80 ± 1.42	-.886	.383	-.400	-1.325	.529
	Straight	5.20 ± 1.01					
SURGERY DURATION (mins)	Angled	33.40 ± 10.90	-1.419	.167	-5.067	-12.381	2.247
	Straight	38.47 ± 8.5					

a.unpaired student t test, SD – Standard deviation

* Statistically significant if < 0.05

Table: 3 comparison of edema at each point between angled and straight handpiece

a. Unpaired student t test, SD – Standard deviation

		Mean ± SD	t	P value[a]	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Pain 0 day (VAS score)	Angled	3.53 ± 0.74	-.821	.418	-.267	-.932	.398
	straight	3.80 ± 1.01					
Pain 7 days (VAS score)	Angled	1.27 ± 0.79	-.757	.455	-.200	-.741	.341
	straight	1.47 ± 0.64					
MOUTH OPEING 0 day (in mm)	Angled	38.80 ± 1.78	.108	.914	.067	-1.192	1.326
	straight	38.73 ± 1.58					
MOUTH OPEING 7 day (in mm)	Angled	42.40 ± 2.55	.245	.808	.200	-1.473	1.873
	straight	42.20 ± 1.85					

Table: 4 comparison of edema at each point between angled and straight handpiece

		Mean ± SD	t	P value[a]	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
AB 0 day (mm)	Angled	117.80 ± 10.83	.601	.553	2.333	-5.620	10.287
	straight	115.47 ± 10.42					
AB 7 day (mm)	Angled	122.73 ± 10.65	.279	.782	1.000	-6.339	8.339
	straight	121.73 ± 8.89					
BC 0 day (mm)	Angled	129.07 ± 17.52	-.424	.675	-2.533	-14.769	9.702
	straight	131.60 ± 15.10					
BC 07 day (mm)	Angled	135.13 ± 17.07	-.434	.668	-2.600	-14.875	9.675
	straight	137.73 ± 15.72					
CE 0 day (mm)	Angled	124.47 ± 13.08	-.555	.583	-2.867	-13.444	7.710
	straight	127.33 ± 15.13					
CE 7 day (mm)	Angled	130.53 ± 12.79	-.742	.464	-3.667	-13.785	6.452
	straight	134.20 ± 14.23					

a. Unpaired student t test, SD – Standard deviation

* Statistically significant if < 0.05

Table:5 crosstabulation of Handpiece and ulceration

		Ulceration on 7th day		Total
		Nil	Yes	
HANDPIECE NAME	Angled	15	0	15
	straight	12	3	15

Type of handpiece and occurrence of ulceration has been put in the crosstabulation (table 3). The chi-square test was used to compare the two groups on occurrence of ulceration and there is no statistically significant difference (p value - 0.068) between two groups on ulceration. (table 4)

Table:6 Chi-square test for comparisons of angled and straight handpiece on ulceration

	Value	df	P value[b]
Pearson Chi-Square	3.333[a]	1	.068
Continuity Correction[b]	1.481	1	.224
Likelihood Ratio	4.493	1	.034
Fisher's Exact Test			0.224

cells (50.0%) have expected count less than 5

The minimum expected count is 1.50.

b chisquare test
* statistically significant if < 0.05

Table: 7 Operator's comment on applicability of handpiece

Operator's comment	Straight N (%)	Angled N (%)
Hard to use	5 (50)	0 (0)
Accessibility	4 (40)	9 (90)
Ease on First time use	2 (2)	10(100)

Figure: 5 Types of impactions

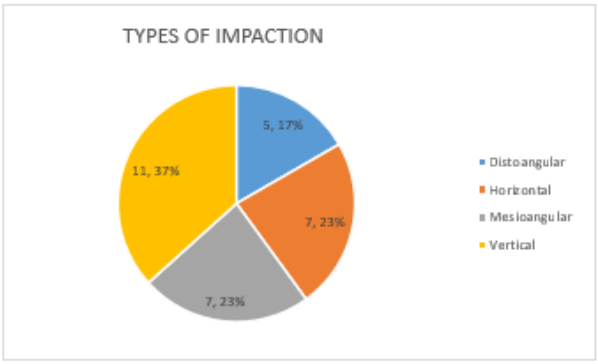


Figure:6 Comparison of two groups on Pederson difficulty, pain on 0 day and pain on 7th day

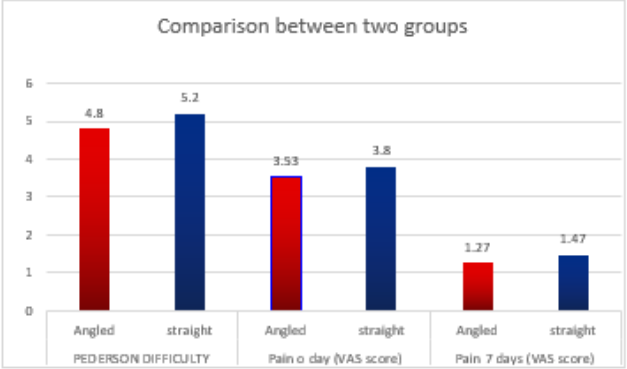


Figure: 7 Comparison of two groups on mouth opening 0 day, 7th day and surgery duration

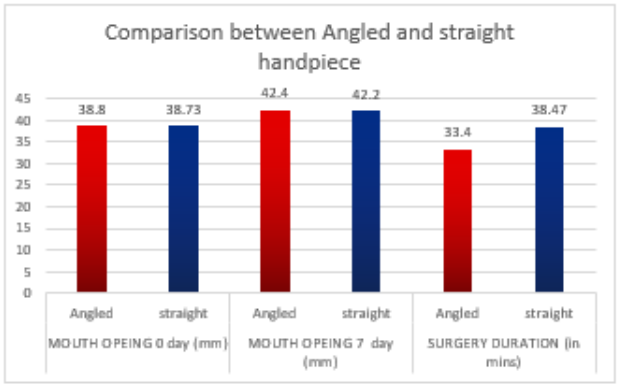


Figure:8 Comparison of two groups on A and B point

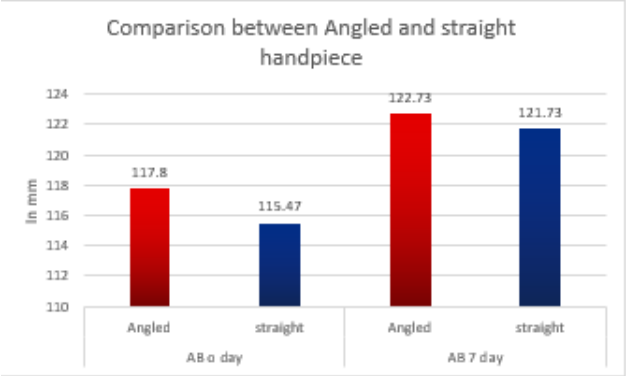


Figure: 9 Comparison of two groups on B and C point

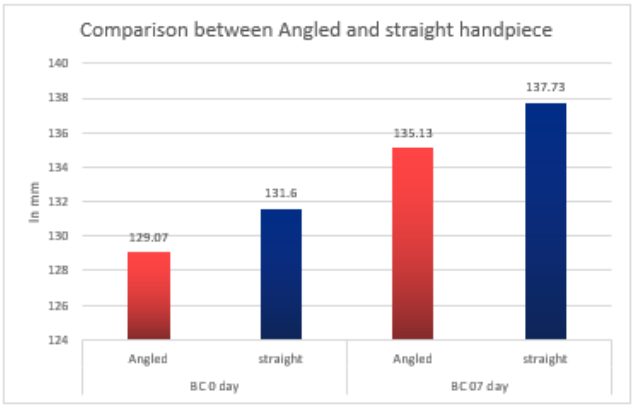
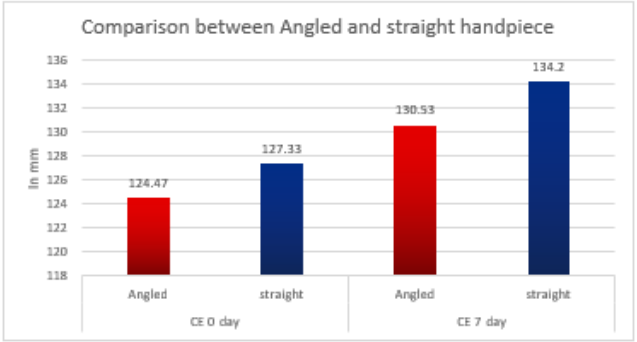


Figure: 10 Comparison of two groups on C and E point



Statistical comparisons of pain levels and mouth opening measurements on the 0th and 7th days between the angled and straight handpiece groups did not reveal any statistically significant differences. As presented in (Table 2), the duration of surgery showed no statistically significant difference between the two groups (P = 0.167). Likewise, the distances measured at points A, B, C, D, and E were also not statistically significant (Figure 5) (Figure 6) (Figure 7)(Table 1)(Table 3)(Table 4).

The type of handpiece and occurrence of ulceration have been put in the crosstabulation. As shown in Table 3, a chi-square test was conducted to compare the incidence of ulceration between the two groups, revealing no statistically significant difference (p = 0.068). between the two groups on ulceration (Figure 9) (Figure 10) (Table 5)(Table 6)(Table 7).

III. Discussion

In the extraction of mandibular third molars, the apparatus often includes either a straight surgical handpiece or a piezoelectric device. Each of these tools has been commonly used, but certain challenges have been observed in clinical practice. The straight handpiece, while effective for bone removal, may present ergonomic challenges due to its linear design, potentially complicating access to deeply impacted molars. Additionally, its high-speed rotation can generate heat, which, if not properly managed with irrigation, might risk bone necrosis and damage to surrounding tissues (Gargallo-Albiol et al., 2012). On the other hand, the piezoelectric device offers more precision and less trauma to soft tissues but tends to be slower, which might extend the duration of the procedure and contribute to operator fatigue (Barone et al., 2010). These considerations highlight potential areas for improvement in surgical instruments, prompting ongoing research into angled handpieces that could offer better accessibility and control [5, 6, 7, 16, 18, 19, 20].

Angled handpieces have not been extensively studied for their effectiveness, which has prompted this investigation. The Waldent surgical handpiece used in this study has a 20-degree angulation, 60mm length, and can reach a maximum speed of 40,000 RPM. This design aims to offer versatility for various surgical scenarios [10, 11, 12, 13, 14, 15].

Our statistical analysis compared angled versus straight handpieces across key metrics, including age, Pederson difficulty score, surgery duration, post-operative pain, mouth opening, and measurements of anatomical points (AB, BC, CE). While none of the differences were statistically significant ($p > 0.05$), trends were observed. Patients treated with the angled handpiece were younger (26.80 years) compared to the straight handpiece group (31.33 years), approaching significance ($p = 0.065$) . Surgical difficulty was similar in both groups, and surgery duration was shorter with the angled handpiece (33.40 minutes vs. 38.47 minutes), though this difference was not statistically significant ($p = 0.167$) . Post-operative pain and mouth opening were comparable between the two groups [21, 22, 23].

Operator feedback provided further insights. The angled handpiece was rated highly for accessibility, with 90% of operators finding it easier to use compared to 40% for the straight handpiece. None of the operators found the angled handpiece difficult to handle, whereas 50% found the straight handpiece challenging. Despite the angled handpiece being new to all operators, they preferred it due to its usability. This is consistent with prior studies showing that ergonomic design can improve surgical outcomes . However, the smaller patient cohort in this study likely limited the detection of significant differences, aligning with prior research suggesting that larger sample sizes are necessary for more conclusive results . The straight handpiece, while more familiar to surgeons, caused more soft tissue injuries due to accessibility issues, underscoring a major drawback compared to the angled design [24, 25, 26].

Modifications to the angled handpiece, such as incorporating fiber optics for better visibility and self-irrigation technology, could enhance its utility. Reducing the handpiece's size or thickness could also minimize operator fatigue, making it more ergonomic for prolonged use [27, 28, 29, 30].

This study had a few limitations. The small sample size may have influenced the lack of statistically significant results, and a larger cohort might reveal more definitive findings. Stratifying patients by surgical difficulty could further highlight the handpieces' effectiveness. Extending the follow-up period could capture long-term outcomes such as chronic pain or nerve injury. Additionally, standardizing the operator to a single experienced surgeon rather than trainees might reduce variability and provide more consistent results. Since the study utilized the simpler Pederson index, employing a more challenging Pederson index could better assess the handpieces' performance in complex cases [8,9,14,30,31].

IV. Conclusion

The objective of this study was to assess the perioperative outcomes associated with mandibular third molar removal using straight versus angled surgical handpieces. The results indicate that there were no statistically significant differences in surgery duration and postoperative pain levels between the angled and straight handpiece groups. Both handpieces performed similarly in terms of mouth opening, soft tissue healing, and overall surgical outcomes. When choosing between an angled or straight handpiece, consider the surgeon's preference, the clinical

scenario, and the potential for enhanced maneuverability in complex cases. Future research could improve by utilizing a larger sample size, stratifying cases based on surgical difficulty, and involving a single experienced surgeon to reduce variability and potential bias.

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