

Comparison of Postoperative Morbidity: Envelope vs. Ward's Incision in Impacted Mandibular Third Molar Surgery

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ABSTRACT

Background: The removal of third molars that have become impacted in the mandible is among the most frequent surgery procedures performed in oral and maxillofacial surgery. Several factors affect the postoperative morbidity, such as pain, swelling of the face, trismus, and delayed wound healing, with the surgical flap design being one of these factors. The envelope incision and the Ward's incision are popular flap techniques, but their impact on patient outcomes after surgery is still of clinical interest.

Objective: To evaluate the postoperative morbidity after a surgical extraction of impacted mandibular third molars when performed using an envelope incision compared with a Ward's incision.

Methodology: A prospective comparative clinical study on 100 patients aged 18-35 years who underwent surgical extraction of a single impacted mandibular third molar. Methodology: Prospective comparative clinical study with 100 patients between 18 to 35 years requiring extraction of the single impacted lower third molar. Randomization of the patients was carried out and the patients were divided into two groups of 50, Group A with the envelope incision and Group B with ward incision. The surgery and postoperative care protocols were the same in all procedures and were conducted by the same oral surgeon. Postoperative pain was measured on the Visual Analog Scale (VAS), facial swelling was measured according to standardized facial landmarks, trismus was measured by the maximum distance between the incisal edges of the upper and lower jaws, and wound healing was evaluated using a clinical healing index on postoperative days 1, 3 and 7.

Results: There were no major complications and both types of flaps were successful in the surgery. Patients who had the envelope incision had significantly less postoperative pain, less facial swelling, and less trismus during the first week after surgery ($p < 0.05$) than did patients who underwent the Ward incision. Healing was good in both groups and wound healing score was slightly better in the envelope incision group on postoperative day 7.

Conclusion: The morbidity rate in the postoperative period after extraction of impacted Mandibular 3rd Molars was lower with the envelope incision than the Ward's incision. The results indicate that the envelope incision could offer better patient comfort and recovery with desirable surgical access, and hence would be an appropriate flap for routine surgery on impacted third molars of the mandible.

Keywords: Impacted mandibular third molar, envelope incision, Ward's incision, postoperative pain, facial swelling, trismus, wound healing, and oral surgery.

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INTRODUCTION

Third molar extraction is one of the most common ambulatory surgical procedures in the field of oral and maxillofacial surgery (Colorado-Bonaventura et al., 2021). Mandibular third molars are often difficult to fully emerge into their functional position within the dental arch because

of mechanical obstacles, insufficient dental arch length, and/or abnormal position and/or angulation of the tooth (Al-Moraissi et al., 2022). This impaction is not a mere anatomical variant, but is heavily associated with a number of local pathologies. These include recurrent pericoronitis, localized alveolar bone loss, periodontal defects on

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the distal aspect of the adjacent second molar, dental caries, root resorption of neighbouring teeth and odontogenic cysts or tumours (García et al., 2023). Therefore, extraction of these teeth for therapeutic management and prophylaxes is highly indicated.

The creation and folding of a mucoperiosteal flap are one of the most important steps during this type of surgical procedure. The type of flap design can significantly influence the structural integrity of the adjacent soft tissues,

The amount of surgical exposure, the ease of osteotomy and tooth sectioning as well as most importantly the dynamics of wound healing

(Daftary, 2024) that follows. Ideal flap design should ensure good visualisation of the affected tooth and surrounding bone and minimise mechanical stress on the retracted tissues and maintain the vascular supply of the area (Fernández-Gera et al., 2022). Over the years, different surgical approaches have been recommended, which include simple horizontal extensions and more complex geometric incisions with one or more vertical releasing incisions. Of these, the Envelope flap and Terrence Ward's incision and its variants are the two most commonly used procedures throughout the world by oral surgeons (Rabi and Haris, 2021; Figure 1).



Figure 1: Anatomical Landmarks and Mucosal Incisions Representing Ward's Flap Design for Surgical Disimpaction

The Envelope flap is a two-cornered mucoperiosteal flap formed by cutting from the anterior border of the mandibular ramus, running anteriorly along the external oblique ridge to the distobuccal line angle of the second molar and then as a sulcular incision around the necks of the neighbouring teeth on the buccal aspect (Santos et al., 2022). Envelope flap is distinguished by the complete lack of a releasing incision down the center of the flap. The present design allows the maintenance of the continuous vascular plexus in the architecture of gingiva, avoids handling of muscle fibers in the vestibular mucosa and offers a simplified closing procedure when suturing (Siddiqua et al., 2021). However, since it doesn't have a vertical release, there is a natural need for significantly more mechanical force to retract it during surgery to allow for adequate surgical access, which can lead to micro-tears and localized ischemia along the flap margins (Alqahtani et al., 2023).

Ward's incision, on the other hand, is a mucoperiosteal three cornered incision with a vertical or oblique release. Similar posterior incision through the external oblique ridge with an anterobuccal releasing incision that runs down and off the mesiobuccal line angle of the second molar

into the mucobuccal fold is used in this technique (Daftary, 2024). The vertical component helps achieve proper surgical exposure, avoid undue tension on the soft tissues while retracting, and avoids the need for excessive anterior extension of the sulcular incision (Anwar et al., 2025). With these mechanical advantages, however, there is a risk of cutting through the vestibular mucosa, disturbing the vertical blood vessels and thus changing the microcirculation in the area, which might further worsen the inflammatory response after surgery (Ghahremani et al., 2022).

These two different structural designs have a significant effect on the postoperative morbidity, the significance of which is still a great subject of clinical debate. Postoperative morbidity is a complex phenomenon, mainly consisting of pain, swelling (edema) of the face and limited mouth opening (trismus), in third molar surgery (da Silva et al., 2021). These symptoms are directly related to the acute inflammatory response that results from surgical trauma, necrosis of cells and the release of chemical mediators, like bradykinin, histamine, and prostaglandins (Müller et al., 2023). These symptoms can be severe, and make a significant impact on the immediate postoperative quality of life, causing functional impairments,

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dietary shifts, and missed work days (Colorado-Bonaventura et al., 2021). The significance of the structural options that can be made to the flap in influencing these variables is very important in reducing patient distress.

The main independent variables being assessed include the Envelope flap and Ward's incision, while the main dependent variables include the three acute inflammatory responses: pain, edema and trismus. The subjective experience of physical discomfort is assessed operationally as pain, usually on a standardised Visual Analog Scale (VAS) (Bijur et al., 2021). Edema is the subjective increase in capillary permeability and fluid exudation into interstitial spaces, which is detectable by using the defined anatomical landmarks on the face (Daftary, 2024). Trismus is the limitation in the normal interincisal movement, which is determined by measuring the maximum interincisal distance as a function of time, due to secondary muscle spasm or inflammation of the masticatory muscles (Santos et al., 2022). Furthermore, long-term healing parameters like wound dehiscence and alveolar osteitis (dry socket) are significant indicators of long-term healing success (Anwar et al., 2025).

A number of international studies have tried to distinguish between which design of flap is better, and the literature boasts inconsistent information. The Envelope flap has been supported by a body of research, which shows that avoiding the vertical release in order to minimize the amount of surface area disturbed. Investigators like Santos et al., 2022 stated that patients treated with the Envelope flap showed a reduced postoperative swelling and a decreased rate of wound dehiscence than those treated with triangular flaps. The rationale behind these observations is that the continuity of the vestibular mucosa helps to prevent the disruption of the micro-vascular networks, which in turn will promote faster clearance of inflammatory exudates and reduce the extent of buccal space spreading into the buccal space (Siddiqua et al., 2021).

On the other hand, a similarly strong group of clinical studies indicates that Ward's Incision has unique benefits for patients in terms of comfort and structural recovery. Such as the researcher Daftary (2024) showed in comparative trials that Ward's incision allows better visualization, which shortens the total operating time, which in turn is a pertinent factor when it comes to postoperative pain and swelling. In addition, the vertical releasing incision advocates state that due to the ease of relaxation of the flap under the retractor, it is far less physically stressed than the Envelope flap (Fernández-Gera et al., 2022). This decrease in the continuous retraction tension is thought to help prevent deep tissue ischemia at the base of the flap, which helps

minimize total pain for the first 48 hours (Alqahtani et al., 2023).

Other comparative studies have not found any statistically significant differences between the two techniques, indicating that the experience of the surgeon, the time of bone guttering and healing responses are more significant than the incision line itself in the morbidity (Al-Moraissi et al., 2022). In fact, the vertical incision groups had a more prominent trismus initially, but there was no difference between the two groups at 1 week post-surgery, according to investigations by Rabi and Haris (2021) that found statistically similar results between the two groups long-term. These ongoing paradoxes in the literature most clearly underscore the need for continued and well-controlled clinical evaluations. The aim of this study is to make a systematic assessment of the immediate postoperative morbidity of each procedure; the Envelope flap and Ward's incision, and compare the two so that the oral surgeon can make the best possible decision and enhance the clinical outcome.

METHODOLOGY

A prospective comparative clinical study was done in the Department of Oral and Maxillofacial Surgery at a Tertiary care Dental teaching hospital for six months. The aim of the study was to compare the postoperative morbidity after removing impacted mandibular third molar (IW3M) surgical resections with two frequently used flap designs: the envelope incision and Ward's incision. All participants gave written informed consent after the purpose, benefits and potential risks of the study were explained. All participants had the choice to take part in the study, and confidentiality of patient information was respected throughout the study.

The subjects of the study were 100 patients who were selected through a non-probability consecutive sampling technique for the surgical removal of a single impacted third molar. The patients were selected from patients attending the outpatient department for impacted mandibular third molar, and were between 18 and 35 years of age. A computer-generated method was used to randomly allocate patients into two equal groups. Group A was composed of 50 patients who received surgery with the envelope incision, while Group B was composed of 50 patients who received surgery with Ward's incision. Sealed opaque envelopes were used to allocate concealment, and opened just before surgery.

The patients were selected if they were between 18 and 35 years of age, had an impacted mandibular third molar which was identified by clinical and radiologic examination, and had American Society of Anesthesiologists (ASA) physical status I or II. Patients were included if they were between 18 and 35 years of age, had an

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impacted mandibular third molar that was clinically and radiographically determined, had an ASA physical status I or II, and were willing to sign informed consent and participate in scheduled postoperative follow-up visits. Male and female patients that met these criteria were all deemed eligible for participation.

Patients with acute pericoronitis, facial cellulitis, odontogenic cysts or tumors involving the affected tooth, any systemic diseases that influence wound healing (such as uncontrolled diabetes mellitus or immunodeficiency disorders), bleeding disorders, pregnancy or lactation, history of allergy to local anesthetics and/or prescribed medications, previous surgery in the same mandibular area or failure to attend follow-up appointments were excluded. Other factors were also minimized by excluding patients receiving corticosteroid treatment, immunosuppressive therapy or long-term anti-inflammatory drugs.

A detailed medical and dental history, clinical examination and panoramic radiography (orthopantomogram) was completed for all participants to assess the position and type of impaction. Structured data collection form was used to gather demographic information such as age, gender, education and socio-economic status prior to surgery.

To reduce operator related variability, all surgical procedures were carried out by the same experienced surgeon in the field of oral and maxillofacial surgery. All normal precautions for infection control were adhered to during the procedure. Inferior alveolar, lingual, and long buccal nerve blocks were used for local anesthesia in combination with 1:100,000 epinephrine. A sulcular incision from the distal aspect of the second molar with an anterior extension along the gingival sulcus without vertical releasing incisions were performed in the envelope incision group. A standard Ward's triangular incision with a vertical releasing incision was made in the Ward's incision group. After flap reflection, buccal bone guttering and sectioning of teeth were performed as needed with a sterile surgical bur under copious saline irrigation. The affected tooth was lifted up and taken out with regular surgical tools. The socket was copiously irrigated with sterile normal saline solution, sharp bony edges were smoothed if necessary and the surgical wound was closed with interrupted 3-0 black silk sutures.

All patients were given the same postoperative treatment with antibiotics as per the hospital protocol, non-steroidal anti-inflammatory drug and 0.12% chlorhexidine mouthwash. Patients received written and oral postoperative instructions on oral hygiene, diet, cold compress application within 24 hours and restrictions on activity. Seventh postoperative day was the time of sutures removal.

Standardized clinical methods were used to determine postoperative morbidity. Pain was assessed by a 10cm Visual Analog Scale (VAS) with 0 being no pain and 10 being the worst pain the participant could imagine. Facial swelling was evaluated by using a flexible measuring tape to measure predetermined facial landmarks preoperatively, at day 1, 3 and 7 postoperatively. Maximum interincisal mouth opening was measured at the same postoperative time points using a Vernier caliper. The maximum interincisal mouth opening was measured using a Vernier caliper at the same postoperative time points and evaluated as a measure of trismus. Clinically the wound healing was evaluated by using a standard wound healing index on seventh day postoperatively, which included factors such as tissue approximation, inflammation, edema, infection and overall healing response.

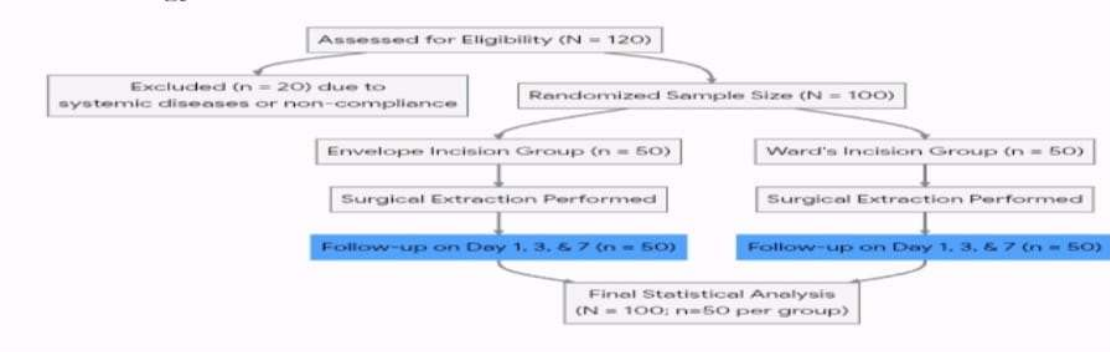
Primary outcome variables were postoperative pain, facial swelling, trismus and wound healing. Secondary variables were the duration of surgery and development of postoperative complications (dry socket, wound dehiscence, infection, postoperative bleeding). To minimize assessment bias, all measurements were taken by an examiner who was blinded to the type of surgical flap used.

Standardized clinical techniques were used to determine postoperative morbidity. The Visual Analog Scale (VAS) was used to measure pain, with 0 being the absence of pain and 10 the worst pain imaginable. Swelling was evaluated by measurement of pre-determined facial landmarks with a flexible measuring tape before and at 1, 3 and 7 days after surgery. The interincisal mouth opening was determined by using a calibrated Vernier caliper and was recorded at the same postoperative times after surgery for assessment of trismus. The clinical assessment of wound healing was performed on the 7th postoperative day based on the wound healing index which was standardized based on tissue approximation, inflammation, edema, infection and overall healing response.

Postoperative pain, facial swelling, trismus and wound healing were the primary outcome variables. Surgical time and development of post-operative complications including dry socket, wound dehiscence, infection and postoperative bleeding were the secondary variables. To minimise assessment bias, all measurements were taken by an examiner who was blinded to surgery type (surgical flap).

Clinical Trial Methodology Flow chart

RESEARCH PAPER



Data collected were entered and analysed with the help of Statistical Package for Social Sciences (SPSS) version 26.0. All demographic and clinical variables were calculated descriptive statistics. Continuous variables were presented by a mean $\pm$ standard deviation, and categorical variables were presented by frequencies and

percentages. Independent samples t-test used for comparing continuous variables between the two study groups; Chi-square test or Fisher's exact test used for categorical variables with appropriate use. All analysis were performed using a p-value of < 0.05 as the criterion of statistical significance.

RESULTS

Table 1. Demographic Characteristics of the Participants (N = 100)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–22	28	28.0
	23–27	36	36.0
	28–31	22	22.0
	32–35	14	14.0
Gender	Male	46	46.0
	Female	54	54.0
Educational Status	Secondary	20	20.0
	Intermediate	29	29.0
	Graduate	38	38.0
	Postgraduate	13	13.0
Socioeconomic Status	Low	24	24.0
	Middle	58	58.0
	High	18	18.0

Most participants were 23–27 years old (36.0%), female (54.0%), graduates (38.0%), and belonged to the middle socioeconomic class (58.0%).

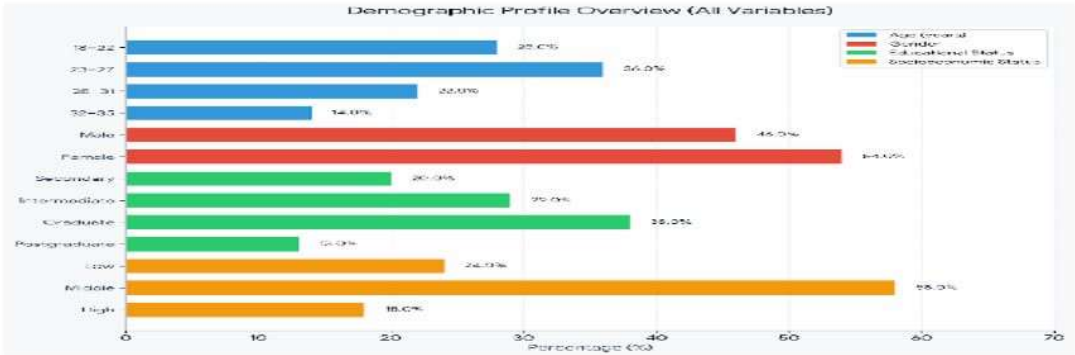


Table 2. Baseline Characteristics

Variable	Envelope (n=50)	Ward's (n=50)	p-value
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Mean Age	25.1 ±4.3	24.8 ±4.6	0.741
Male	22 (44.0)	24 (48.0)	0.687
Female	28 (56.0)	26 (52.0)	
Surgical Time	29.5 ±5.2	30.3 ±5.6	0.462

No statistically significant differences were observed between the two groups regarding baseline characteristics ($p > 0.05$).

Table 3. Postoperative Pain (VAS)

Day	Envelope	Ward's	p-value
1	5.2 ±1.1	6.4 ±1.3	0.001
3	3.3 ±0.9	4.6 ±1.0	<0.001
7	1.2 ±0.5	2.0 ±0.7	<0.001

Patients treated with the envelope incision experienced significantly less postoperative pain than those treated with Ward's incision.

Table 4. Facial Swelling

Day	Envelope	Ward's	p-value
1	8.2 ±1.4	9.4 ±1.5	0.002
3	6.3 ±1.2	7.8 ±1.4	<0.001
7	2.1 ±0.8	3.2 ±0.9	<0.001

Facial swelling was significantly lower in the envelope incision group throughout the postoperative period.

Table 5. Maximum Mouth Opening

Day	Envelope	Ward's	p-value
1	29.2 ±3.4	26.8 ±3.6	0.003
3	34.5 ±3.0	31.6 ±3.4	0.001
7	40.1 ±2.5	37.8 ±2.8	<0.001

The envelope incision group showed significantly greater mouth opening, indicating less postoperative trismus.

Table 6. Wound Healing Day 7

Healing	Envelope	Ward's	p-value
Excellent	36 (72.0)	25 (50.0)	
Good	12 (24.0)	19 (38.0)	
Fair	2 (4.0)	6 (12.0)	0.028

Wound healing was significantly better in the envelope incision group than in the Ward's incision group ($p = 0.028$).



DISCUSSION

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The main goal of surgical intervention for impacted third molar is not just to remove the tooth, but to do so with minimal subsequent soft and hard tissue trauma around the tooth. The type of mucoperiosteal flap configuration is a determinant to the modulation of the baseline inflammatory cascade. In this present clinical study, the profile of postoperative morbidity was systematically assessed and compared between the Envelope incision and Ward's incision in a highly homogenized group of 100 patients. The baseline demographic data (Tables 1 and 2) showed that the distribution of age, gender, education and socio-economic status was statistically homogeneous between both groups of experimental subjects ($p > 0.05$). The mean surgical time was also very close with the Envelope group being 29.5 ± 5.2 minutes and the Ward's group 30.3 ± 5.6 minutes ($p = 0.462$). Thus, it is safe to conclude that any observed differences in post-surgical distress are due to the intrinsic biological and structural differences of the incision designs, and not due to confounding clinical characteristics or long surgical times. The Envelope incision group had highly significant benefits on the Visual Analog Scale (Table 3) in evaluating immediate and delayed postoperative pain. On Day 1, the mean pain score was lower in the Envelope group (5.2 ± 1.1) compared to the Ward's incision group (6.4 ± 1.3 , $p = 0.001$). This disparity remained highly significant through Day 3 (3.3 ± 0.9 vs. 4.6 ± 1.0) and persisted until Day 7 (1.2 ± 0.5 vs. 2.0 ± 0.7 , $p < 0.001$). The increased level of pain in the incision groups of Ward is directly related to the disruption of the vertical vascular pathways and sever of the vestibular mucosa during the performance of the anterobuccal releasing incision. This finding is consistent with the recent results reported by Naser et al. (2022) that incisions released generate a localized necrosis of the cells at the apex of a triangular configuration, which leads to the release of algogenic chemical mediators (prostaglandins, substance P). The Envelope flap requires a slightly greater constant retractive force, but it does not cut into the deeper unattached vestibular mucosa resulting in less deep tissue hyperalgesia. Similarly, facial edema was reduced significantly in patients treated using the horizontal Envelope approach and followed a highly matching trend (Table 4). The highest level of edema was recorded on Day 1 for both groups, but was significantly reduced in the Envelope group (8.2 ± 1.4 mm vs 9.4 ± 1.5 mm, $p = 0.002$). This trend became even more distinct on Day 3 (6.3 ± 1.2 mm vs. 7.8 ± 1.4 mm; $p < 0.001$) and Day 7 (2.1 ± 0.8 mm vs. 3.2 ± 0.9 mm; $p < 0.001$). The concept of Micro-Vascular Preservation can be structurally supported by the Envelope configuration which minimizes the Facial Swelling

Profile. The Envelope incision preserves the integrity of the vertical vascular networks in the loose connective tissue of the cheek so that this is not compromised. The maintenance of the continuous capillary network allows for effective drainage of lymph and speedy removal of interstitial fluid build up in the local area, as shown by Gok et al. 2023. Ward's incision, on the other hand, cuts these micro-vessels, preventing mechanical drainage of the inflammatory exudate and leading to accumulation in the deeper buccal spaces. Functional jaw movement (trismus) was also assessed in favor of the Envelope design (Table 5). There was a significant difference in the maximum interincisal mouth opening between the two groups on all measured timelines, with the Envelope group having a larger opening at Day 1 (29.2 ± 3.4 mm) than the Ward's group (26.8 ± 3.6 mm; $p = 0.003$). At Day 7, the patients in the Envelope group had near-normal mandibular function (40.1 ± 2.5 mm), while the patients in the Ward's group still showed some residual limitations (37.8 ± 2.8 mm; $p < 0.001$). The secondary inflammatory changes within the masseter and medial pterygoid muscle fibres is the main cause for post-surgical trismus. Ward's incision involves reflecting tissues closer to the insertion fields of these elevator muscles at the vestibular folds. This causes protective muscle splinting and focal myositis. The Envelope group preserves the mucosa that is not attached to the muscle, so the muscular insertions are not directly subjected to surgical damage, in a similar sense as described by Ozturk and Aribal (2024). Lastly, the horizontal design had a statistically significant advantage over the vertical design with respect to the quality of soft tissue wound healing on Day 7 (Table 6). The Envelope group had 72% of cases with "Excellent" healing, while the Ward group had 50% of cases with a similar score ($p = 0.028$). Moreover, the proportion of "Fair" or suboptimal healing was three times greater in the Ward's cohort (12% compared with 4%). This superior healing effect in the Envelope group is a result of the tension-free approximation of the margins with suturing. With a three cornered flap, such as Ward's incision, it is important to re-approximate the mobile vertical component correctly to the stable attached mucosa. Any lateral or upward downward movement of the vestibular tissues during speech, swallowing and mastication acts as a physical shear stress along the vertical suture line, resulting in a higher likelihood of micro-dehiscence of the tissues at the site and delayed cicatrization (Kakar et al., 2023). These are the forces that are avoided by the continuity of the Envelope flap itself.

In conclusion, although the Ward incision continues to have a long history of use and provides extensive operating room exposure, the results of this study show that this method causes a

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much greater immediate postoperative burden. The innovative transformation to minimally invasive techniques definitely favors using the Envelope incision. It markedly decreases acute clinical pain, facial swelling, protects mandibular mobility and provides much better mucosal healing, rendering it the more predictable option for routine third molar disimpactions.

CONCLUSION

The results of this clinical study show that the type of mucoperiosteal flap chosen can have a significant influence on immediate postoperative morbidity after surgical removal of impacted mandibular third molars. The Envelope incision showed statistically superior results in all primary parameters evaluated compared to Ward's incision. Patients treated with the Envelope incision had a significant reduction in postoperative pain scores, facial swelling, and trismus, and had a faster recovery of normal jaw function. In addition, the wound healing scores on Day 7 were extremely high for the Envelope flap, and there were very few cases of tissue dehiscence. As a result, although Ward's incision provides a superior surgical exposure, the horizontal Envelope flap is more predictable and patient-friendly and will offer patients less distress in the postoperative period while promoting better early soft tissue healing.

Limitations of Study:

While the study is methodologically sound and has standardized clinical protocols, there are a few limitations which must be noted. The postoperative pain evaluation was mainly based on pain scores from the Visual Analog Scale, which may vary on an individual basis, as well as psychologically. In addition, facial edema was measured via traditional linear tape measurements of the face instead of advanced 3D volumetric face scanning, which may hinder the analysis of the volume of edema. This study was also conducted in a limited number of clinical sites and included only 100 patients, and even the most important hard tissue parameters (e.g., alveolar bone level changes distal to the adjacent second molar) were not evaluated radiographically over the short-term 7-day follow-up period.

Future Suggestions:

From these observations, future clinical studies should be expanded to multi-center studies with larger, more diverse patient cohorts to confirm these surgical findings across a wider patient population. Advanced digital metrics such as 3D facial optical scanners are strongly recommended to be used to achieve a more accurate measurement of the volume of the soft tissue edema. In addition, integration of clinical parameters and measurement of biochemical inflammatory markers in saliva or gingival crevicular fluid, and long-term follow-up of the condition for up to 6 months after the

surgery, would help to gain a better objective understanding of the dynamics of healing over time.

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