ISSN: 0975-3583,0976-2833 VOL15, ISSUE 12, 2024

A Review of the Comparison Between Primary and Secondary Wound Closure Following the Removal of Impacted Mandibular Third Molars

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Abstract

Aims and Objectives This comparative study compares the primary and secondary healing after surgical removal of impacted mandibular third molars, evaluating and monitoring the extent of swelling and severity of pain and trismus.

Materials and Methods:
A total of 60 patients (37 females and 23 males), aged between 18 and 40 years, were included in the study. They were randomly divided into two equal groups of 30 patients each. All surgeries were performed by the same operator under identical clinical conditions. In Group 1, 30 patients underwent primary closure, while in Group 2, 30 patients underwent secondary closure. Pain, swelling, and

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trismus were assessed on the 1st, 3rd, and 7th days post-surgery using a Visual Analog Scale (VAS).

Results

An analysis of the initial findings revealed that patients who underwent primary closure experienced significantly higher levels of pain, swelling, and trismus compared to those who had secondary closure. Further analysis of the subsequent findings showed a statistically significant difference in pain, swelling, and trismus between the two groups.

Conclusion

The results of this study indicate that secondary closure and healing by secondary intention are the preferred approaches following the removal of impacted mandibular third molars. This method appears to reduce postoperative swelling, pain, and trismus, leading to greater patient comfort.

Introduction

The extraction of lower third molars is among the most commonly performed procedures in oral and maxillofacial surgery. This procedure frequently leads to significant postoperative discomfort.. Various methods and medications have been explored to alleviate postoperative discomfort, aiming to prevent loss of work hours and minimize the impact on the patient's quality of life. Different anti-inflammatory and antibacterial drugs have been tested in the context of mandibular third molar surgery to evaluate their effectiveness in relieving postoperative complications.[1-7]

Researchers have also compared the use of cones or drains saturated with antimicrobial agents in third molar sockets with primary closure and found that, in most studies, the medicated group experienced a significant reduction in postoperative discomfort[9-10]. Research indicates that the level of postoperative discomfort is also influenced by the type of wound closure.[10-12] From a cost-effectiveness perspective, it has been estimated that the expenses associated with recovery and temporary inability to work raise the overall cost of third molar removal by 25%.[13-14] In addition to the economic impact, third molar surgery leads to considerable morbidity, including pain, trismus, and swelling, which can be severe enough to disrupt normal activities. Minimizing or reducing post-operative complications after third molar surgery is a worthy objective, especially if it does not interfere with the healing process.[5] The type of healing of the surgical wound is one of the key factors most closely associated with the severity of post-operative pain and swelling. [10-12] In secondary healing, the socket continues to be open to the oral cavity, while in primary healing, the socket is completely sealed off and covered by a mucosal flap.[12] Primary closure is favored by Howe, Archer, Giralnick, Kruger, Thoma,

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Killey, and Kay. On the other hand, authors such as Bourgoyne, Blair, Ivy, Padgett, and Mead prefer the wounds to heal through secondary closure.[11] Conversely, Clark and Winter suggest that wounds can be treated using either method. The use of a surgical drain has also been recommended. Woodward supports the idea of creating a small opening behind the second molar to aid in post-operative wound irrigation.[11]. Our study compares primary and secondary healing following the surgical removal of impacted mandibular third molars, assessing the rate of post-operative infection and tracking the degree of swelling, pain, and trismus.

Materials and Methods

A total of 60 patients (37 females, 23 males; aged 18–40 years) participated in the study. They were randomly divided into two groups of 30 each. Group 1 consisted of 30 patients who underwent primary closure, while Group 2 had 30 patients who underwent secondary closure. Before the surgery, patients were informed that two equally acceptable surgical closure techniques would be used, and written consent was obtained.

Selection criteria included healthy patients aged 18–40 years, without harmful habits, and with mesioangularly impacted asymptomatic mandibular third molars. Both groups required osteotomy and tooth sectioning. Patients were not allergic to the local anesthetic used. All surgeries were performed by the same surgeon, and patients received the same post-operative instructions and medications.

The patients were evaluated on the 1st, 3rd, and 7th post-operative days for pain, swelling, and trismus, using a VAS scale.

Surgical Protocol

All 60 mandibular third molars were surgically removed under local anesthesia using Ward’s incision (Fig. 1). Ostectomy was performed, the tooth was

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extracted, and after ensuring hemostasis, either primary or secondary closure was randomly applied.

In group 1 (primary healing), the flap was securely repositioned using 3-0 black silk sutures (Fig. 2).

• In group 2 (secondary healing), a 5–6 mm wide wedge of mucosa was excised from the buccal flap, which was then repositioned and sutured with 3-0 black silk (Fig. 3). No dressing was applied to the open socket.

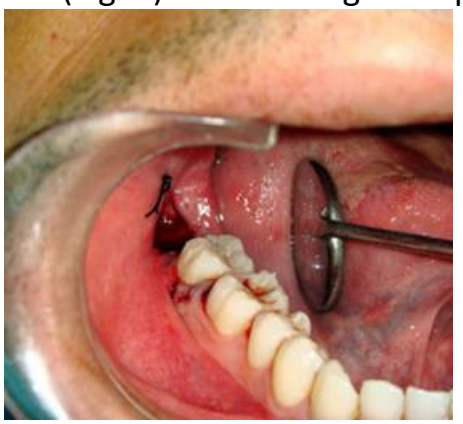

Table 1 VAS scale to evaluate pain: reference values given to patients[12, 15]

Score		
0	No pain	The patient feels well
1	Slight pain	If the patient is distracted he or she does not feel the pain
2	Mild pain	The patient feels the pain even if concentrating on some activity
3	Severe pain	The patient is very disturbed but nevertheless can continue with normal activities
4	Very severe pain	The patient is forced to abandon normal activities
5	Extremely severe pain	The patient must abandon every type of activity and feels the need to lie down

Table 2 VAS scale to evaluate swelling: reference values given to patients[12, 15]

Score		
0	No swelling	

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1	Slight swelling	The patient detects a slight swelling but it is not very noticeable
2	Mild swelling	The swelling is noticeable but does not interfere with normal mastication and swallowing
3	Severe swelling	The swelling is evident and hinders normal mastication
4	Very severe swelling	The swelling is marked. Mastication is hindered but there is no reduction in mouth opening (no trismus)
5	Extremely severe swelling	The swelling is very evident and mouth opening is reduced (trismus)

Evaluation Criteria

Patients were assessed for pain, swelling, and trismus on the 1st, 3rd, and 7th post-operative days. Pain was measured by the patient using a Visual Analogue Scale (VAS) ranging from 0 to 5 (Table 1). Swelling was also evaluated by the patient using a VAS of 0 to 5 (Table 2). Trismus was measured using a simple graduated metallic scale.

Statistical Methods

The VAS scale values at each visit for the two groups are presented as mean, standard error, minimum, and maximum. The mean differences between the two groups are provided with a 95% confidence interval. A suitable repeated measures analysis of variance (ANOVA) model was applied to compare the variation in VAS scale values recorded on each of the 7 days across the two groups. The F value for the repeated measures ANOVA is shown in the Results section as Fn,d (where n represents the numerator degree of freedom and d represents the denominator degree of freedom). Differences with $P<0.05$ were considered statistically significant. To minimize the risk of a Type II error, no correction for multiple comparisons was made in the significance levels reported.

Result

A significant difference in pain severity was observed between the two groups at all recorded time points. Pain intensity was higher in Group 1 (primary healing) on the 1st, 3rd, and 7th post-operative days. There was also a statistically significant difference in swelling between the two groups on the 1st, 3rd, and 7th post-operative days. Swelling was more pronounced in Group 1, with the peak occurring on day 3. In Group 2, the swelling had a smaller peak, also on day 3. A significant difference was found in the degree of mouth opening between the groups, with Group 1 experiencing more trismus associated with primary closure.

Pain:-

Highly significant differences were noted between the days, with an F value of 61.0 and a probability of 0.000, as well as between the closure methods, with an

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F value of 68.53 and a probability of 0.000. For primary closure, on the 1st day, the mean VAS pain score was 2.9, with a minimum of 1.0 and a maximum of 5.0, and a standard deviation of 0.92. On the 3rd day, the mean VAS pain score remained 2.9, with minimum and maximum values of 1.0 and 4.0, respectively. On the 7th day, the mean pain score dropped to 1.0, with a minimum of 0.0 and a maximum of 2.0, and a standard deviation of 0.61.

For secondary closure, on the 1st day, the mean VAS pain score was 1.7, with a minimum of 1.0 and a maximum of 4.0, and a standard deviation of 0.92. On the 3rd day, the mean score was 1.5, with minimum and maximum values of 1.0 and 3.0, respectively. On the 7th day, the mean pain score decreased to 0.9, with a minimum of 0.0 and a maximum of 2.0, and a standard deviation of 0.61.

Table 3 Pain statistical analysis of data

Class		VAS 1 day	VAS 3 day	VAS 7 day	Classes	F'	d.f.	P value
Primary closure (Group 1)	N	30	30	30	Between closures	68.53	1, 174	0.000
	Mean	2.9	2.9	1.0	Between days	61.00	2, 174	0.000
	SE	0.92	0.71	0.61	Closure X days	11.97	2, 174	0.000
	Minimum	1.0	1.0	0.0				
	Maximum	5.0	4.0	2.0				
Secondary closure (Group 2)	N	30	30	30				
	Mean	1.7	1.5	0.9				
	SE	0.91	0.57	0.68				
	Minimu	1.0	1.0	0.0				
	Maxim	4.0	3.0	2.0				
Diffference between means		1.2	1.4	0.1				
CI 95%	Lower	2.10	1.96	0.73				
	Upper	2.54	2.40	1.17				

Graph 1 Comparison of pain between primary and secondary Closure

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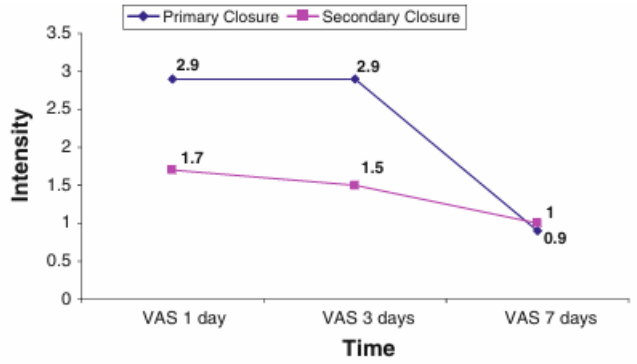

Graph 1 Comparison of pain between primary and secondary closure

The 95% confidence interval observed for VAS on the 1st day ranged from 2.10 to 2.54, while on the 3rd day, it ranged from 1.96 to 2.40, and on the 7th day, it was between 0.73 and 1.17 (Table 3 and Graph 1).

Swelling

Highly significant differences were found between days, with an F0 value of 159.2 and a probability of 0.000, as well as between closure types, with an F value of 318.60 and a probability of 0.000. For primary closure, on the 1st day, the mean VAS for swelling was 3.6, ranging from 2.0 to 5.0, with a standard deviation of 0.67. On the 3rd day, the mean increased to 4.2, with a range from 3.0 to 5.0. By the 7th day, the mean dropped to 1.5, with a minimum of 0.0 and a maximum of 3.0, and a standard deviation of 0.63. For secondary closure, on the 1st day, the mean VAS for swelling was 1.4, with a range from 1.0 to 2.0, and a standard deviation of 0.50. On the 3rd day, the mean increased to 2.2, with a range from 1.0 to 3.0. By the 7th day, the mean was 0.9, with a range from 0.0 to 2.0, and a standard deviation of 0.55. The 95% confidence intervals observed were 2.35 to 2.67 on the 1st day, 1.05 to 3.32 on the 3rd day, and 1.05 to 1.37 on the 7th day (Table 4; Graph 2).

Trismus

Highly significant differences were observed between days, with an F0 value of 73.3 and a probability of 0.000, as well as between closure types, with an F value of 507.8 and a probability of 0.000. For primary closure, on the 1st day, the mean VAS for trismus was 27.6, with a range from 20 to 32 and a standard deviation of 2.79. On the 3rd day, the mean remained at 28, with a range of 20 to 32. By the 7th day, the mean increased to 30.4, with a range from 27 to 33 and a standard deviation of 1.25. For secondary closure, on the 1st day, the mean VAS for trismus was 15.5, with a range from 9.0 to 20.0 and a standard deviation of 3.77. On the 3rd day, the mean slightly increased to 15.6, with a range from 9.0 to 22. By the 7th day, the mean value rose to 24.5, with a range from 20.0 to 29.0 and a standard deviation of 2.91. The 95% confidence

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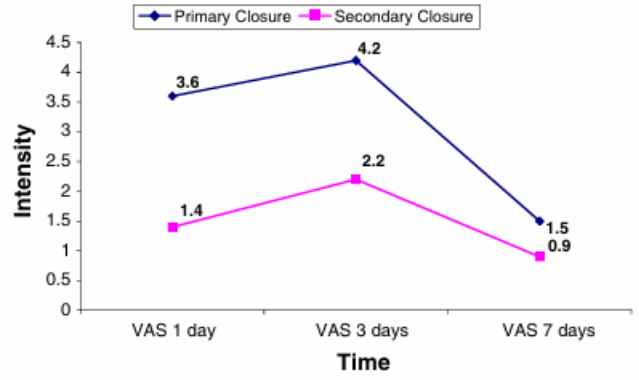
intervals were 20.62 to 22.40 on the 1st day, 20.91 to 22.69 on the 3rd day, and 26.54 to 28.32 on the 7th day (Table 5; Graph 3). An analysis of the immediate findings showed that patients with primary closure experienced significantly greater pain compared to those with secondary closure. Upon analyzing subsequent findings, a statistically significant difference in pain was observed.

Table 4 Swelling statistical analysis of data

Class		VAS 1 day	VAS 3 day	VAS 7 day	Classes	F'	d.f.	P value
Primary closure (Group 1)	N	30	30	30	Between closures	318.6	1, 174	0.000
	Mean	3.6	4.2	1.5	Between days	159.2	2, 174	0.000
	SE	0.67	0.70	0.63	Closure X days	30.2	2, 174	0.000
	Minimum	2.0	3.0	0.0				
	Maximum	5.0	5.0	3.0				
Secondary closure (Group 2)	N	30	30	30				
	Mean	1.4	2.2	0.9				
	SE	0.50	0.59	0.55				
	Minimu	1.0	1.0	0.0				
	Maxim	2.0	3.0	2.0				
Difference between means		2.2	2.0	0.6				
CI 95%	Lower	2.35	3.00	1.05				
	Upper	2.67	3.32	1.37				



Graph 2 Comparison of swelling between primary and secondary closure

Graph 2 Comparison of swelling between primary and secondary Closure

experienced between both the groups[24]. An analysis of initial results indicated that patients with primary closure experienced significantly more swelling than

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those with secondary closure. Further examination of later findings also revealed that swelling was notably higher in patients with primary closure compared to those with secondary closure

An analysis of initial findings revealed that trismus was significantly more pronounced in patients with primary closure. Further analysis of subsequent results also indicated that trismus was considerably greater in patients with primary closure compared to those with secondary closure.

Discussion

Acute inflammation is the body's initial and early reaction to injury. A key aspect of this response is to transport leucocytes to the injury site, where they assist in eliminating invading bacteria and breaking down the necrotic tissue caused by the damage.

Healing of the Wounds can be Accomplished in One of the Following 2 Ways[24]

1. Healing by primary intention
2. Healing by secondary intention

Healing by Primary Intention

Immediately following injury, the gap between the edges of the wound fills with blood, which then forms a clot to protect the wound from dehydration and infection. The acute inflammatory response begins within 24 hours with the arrival of neutrophils at the wound's edges. By the third day, these neutrophils are replaced by macrophages. Basal cells from both sides of the epidermis begin to proliferate and migrate into the wound, forming epithelial spurs. A well-approximated wound is covered by a layer of epithelium within 48 hours. By the fifth day, a multilayered new epithelium forms, differentiating into superficial and deeper layers. By the third day, fibroblasts also infiltrate the wound area, and by the fifth day, new collagen fibrils begin to form, continuing to dominate until the healing process is complete.

Healing by Secondary Intention

After removal of the tooth, the blood which fills the socket coagulates, within first 24–48 h after extraction, there is vasodilatation and engorgement of blood vessels in the remnants of the periodontal ligament and mobilization of

Table 5 Trismus statistical analysis of data

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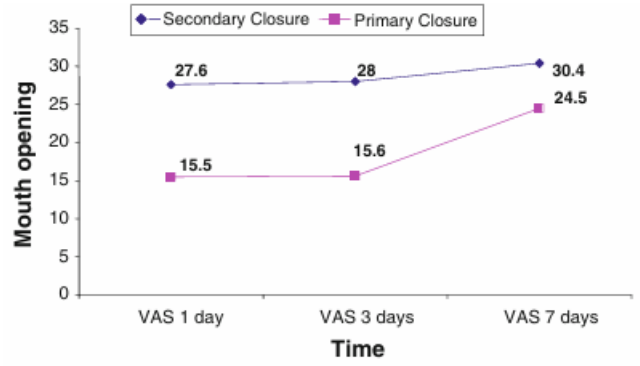
Class		VAS 1 day	VAS 3 day	VAS 7 day	Classes	F'	d.f.	P value
Primary closure (Group 1)	N	30	30	30	Between closures	507.8	1, 174	0.000
	Mean	15.5	15.6	24.5	Between days	73.3	2, 174	0.000
	SE	3.77	4.00	2.91	Closure X days	21.9	2, 174	0.000
	Minimum	9.0	9.0	20.0				
	Maximum	2.0	22.0	29.0				
Secondary closure (Group 2)	N	30	30	30				
	Mean	27.6	28.0	30.4				
	SE	2.79	2.60	1.25				
	Minimu	20.0	20.0	27.0				
	Maxim	32.0	32.0	33.0				
Difference between means		12.1	12.4	5.9				
CI 95%	Lower	20.62	20.91	26.54				
	Upper	22.40	22.69	28.32				



Graph 3 Comparison of trismus between primary and secondary closure

Graph 3 Comparison of trismus between primary and secondary Closure

leucocytes to the immediate area around the clot[24]Within the first week following tooth extraction, fibroblasts proliferate from the connective tissue cells in the remaining periodontal ligament, and these fibroblasts start to grow into the clot at the edges. This clot acts as a scaffold, allowing cells involved in the healing process to migrate and facilitate recovery. However, this scaffold is only temporary and is gradually replaced by granulation tissue. The epithelium around the wound's edge shows signs of proliferation, with mild mitotic activity even at this stage. The crest of the alveolar bone, which forms the socket's margin, shows the onset of osteoclastic activity. Additionally, endothelial cell proliferation marks the start of capillary growth into the area.

During this phase, the blood clot starts to organize as fibroblasts and occasional small capillaries from the remaining periodontal ligament grow into the

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periphery. A dense layer of leucocytes forms over the clot's surface, while the wound edges continue to show epithelial proliferation.[17]

The primary indicators of patient discomfort during the postoperative period following third molar extraction are the level of swelling, pain, and trismus. This study aimed to compare primary intention closure with window closure followed by healing by secondary intention. The effectiveness of these techniques was assessed based on patient comfort and the postoperative condition of the surgical site. The study found that secondary healing was more comfortable for patients in terms of these three factors. Swelling and pain were assessed using the VAS scale, an effective tool for evaluating clinical parameters that affect an individual's subjective experience, such as pain. Trismus was measured by assessing the interincisal mouth opening.[12,18] It has also been suggested that photographic techniques and computerized tomography scanning could be used to assess anatomical changes in the profiles of patients undergoing third molar surgery.[19]

Stereophotographic techniques, proposed by Pedersen and Mearsk-Moller[12, 20] are probably the most sophisticated method described to date, but are too complex for clinical use.[24]

Henrikson et al.21 suggested using the VAS scale to assess swelling and compared the effects of two drugs on the postoperative recovery after third molar surgery. A review of the results indicates that the sample size was sufficient to detect statistically significant differences in patients' responses to the closure technique. Edema, pain severity, and trismus are key indicators of patient discomfort. Our findings suggest that patients with secondary closure experienced more comfort on the 1st, 3rd, and 7th postoperative days. During the immediate postoperative period, patients with primary closure had greater hematoma and edema formation. The results of this study show that secondary closure of the socket leads to less discomfort for the patient by reducing post-extraction swelling, pain, and trismus, which aligns with several findings reported in the literature [10-12,22] .In a split-mouth study on 56 patients, Dubois et al.[11] extracted both mandibular third molars simultaneously. Closure was primary on the left; on the right, the mucosa distal to the second molar was incised so as to create a window of approximately 6 mm circumference and leave the socket open for secondary healing. Secondary closure was found to minimise swelling and pain in the immediate post operative period, helping to reduce patient discomfort[24].

Holland and Hindle[22] found that postoperative pain and swelling were more pronounced with closed healing compared to open healing, and recommended open healing as the preferred technique. However, they also noted that, one month after surgery, the wound seemed to have healed better with closed healing.

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Brabander and Cattaneo[10] assessed two different wound closure methods following the removal of mandibular third molars impacted in the mucosa. In the experimental group, a section of mucosa distal to the second molar was excised, and a drain made of vaselined gauze was placed in the socket to facilitate secondary closure of the surgical site. In the control group they utilised the same surgical procedure but without drainage. Secondary closure was found to be preferable as it reduces pain and swelling post-surgery, but insertion of a vaselined gauze drain did not influence these parameters.[24]

Rakprasitkul and Pairuchvej[18]compared primary healing with the insertion of a small drainage tube, removed on day 3, to primary healing without the drainage. They found no significant difference in pain severity between the two groups, but swelling was notably less in the drainage group. Additionally, the drainage group experienced less reduction in mouth opening and less bleeding.

In a similar splitmouth study, Saglam[12] compared test side (surgical extraction, primary closure and drainage for 72 h) with control side (surgical extraction and primary closure alone).[24]

The results obtained by Rakprasitkul and Pairuchvej[18] were confirmed, and swelling, pain and trismus were significantly less severe on the test side. The use of drainage is recommended when the primary closure technique is employed. The results obtained in the present study enable us to conclude that, open healing of the surgical wound after removal of impacted third molars produces less post operative swelling, pain and trismus than occurs with closed healing, by hermetically suturing the socket.

Perhaps the English dentist, Mr Hunter, was correct in his text, ‘‘it is also a common practice, to close the gum as it is termed; this is more for show than use; for the gum cannot be made to close as to unite by the first intention.’’[23,24].

Summary and Conclusion

The results of this study indicate that secondary closure and healing by secondary intention are the preferred approaches after the removal of impacted mandibular third molars. Secondary closure seems to reduce postoperative swelling, pain, and trismus, leading to greater patient comfort. Additionally, it is easier for patients to manage postoperative care and hygiene at a secondary closure site compared to a primary closure site that has dehisced. If infection and wound opening after primary closure could be controlled, healing would likely be more efficient, occur faster, and result in fewer mucosal deformities. Furthermore, this would reduce the need for postoperative care by the patient.

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