Comparison of 2 different flap techniques in the surgical removal of bilateral impacted mandibular third molars

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Aim: To estimate the effects of flap design on wound dehiscence and the postoperative side effects after the extraction of bilateral impacted mandibular third molars.

Materials and methods: This study was designed as a randomized, clinical trial composed of a sample of subjects ≥18 years of age who required surgical extraction of the mandibular third molars. The predictor variable was flap type. A 3-cornered flap was used on one side and a modified triangular flap was used on the other. The primary outcome variable was wound dehiscence. The secondary outcome variables were pain, swelling, and trismus. Other variables were demographic and operative. Descriptive, bivariate statistics were computed. Significance was set at P < 0.05.

Results: Forty patients who required removal of bilateral impacted third molars were included. There were no significant differences regarding wound dehiscence and postoperative side effects between the 2 flap techniques.

Conclusion: Both flap designs obtained similar short-term outcomes in mandibular third molar surgery.

Key words: Third molar surgery, impacted, flap design, wound dehiscence, postoperative sequelae

1. Introduction
Operative extraction of impacted third molars is one of the most frequently performed procedures in oral surgical practice and is associated with various postoperative sequelae. The most common postoperative complaints include pain, trismus, swelling, and wound dehiscence that influence the patients’ quality of life in the week following surgery (1,2). Intraoral, extraoral suture, and flap techniques affect these postoperative complications (3–7).

The overall purpose of this study was to answer the following clinical question: Among patients having mandibular third molars removed, were the complications and side effects noted by using the 3-cornered flap technique higher when compared with the complications and side effects found with the modified triangular flap? The investigators hypothesized that there was no difference in the rate of complications and postoperative side effects between the 2 study groups. The specific aims of this study were: 1) to estimate the wound dehiscence, 2) to identify the postoperative pain by using a visual analog scale (VAS), 3) to have postoperative swelling measured by one of the investigators, and 4) to measure the mouth opening, taken the maximum distance between maxillary and mandibular central incisors by a ruler following third molar surgery in both flap groups.

2. Materials and methods
2.1. Study design and sample
The investigators designed and implemented a randomized, prospective, single-blind clinical trial. The study population was composed of subjects presenting to the Department of Oral and Maxillofacial Surgery for evaluation and management of impacted mandibular third molars between January 2011 and July 2011. The inclusion criteria consisted of the presence of bilateral, symmetrical, vertically bony impacted third molars on panoramic radiographs. The patients selected had no history of medical illness or medication that could influence the course of postoperative wound healing or alter their wound healing after surgery. Patients were excluded from randomization if they had a preexisting abscess or cellulitis, acute pericoronitis, or preexisting conditions associated with their third molars. Those who required antibiotics for some other reason (such as prophylaxis for endocarditis) were also excluded, as were those who...
had been given radiotherapy, immunocompromised patients, those who were pregnant, those who are already taking antimicrobials, and those with systemic diseases such as diabetes, cancer, or renal failure. Forty patients (29 female and 11 male, aged 18–40, mean age: 23.47 years old) who required the removal of bilateral impacted third molars were included in this study. Four patients were excluded due to failure to attend for follow-up. The remaining 36 patients (7 males and 29 females; age range 18–40 years, mean age: 23.30 years) were included in the study. Participants gave consent for the study, which was approved by the local ethics committee.

2.2. Study variables

The primary predictor variable was flap type. There were 2 different flap designs used, the 3-cornered flap and the modified triangular flap. The 3-cornered flap technique was named as Group I: the incision was done from the mandibular ramus horizontally and was continued by a vertical incision line from the distofacial line angle of the second molar apically to the mucogingival line approximately 8 to 10 mm (Figure 1).

The modified triangular flap type was named as Group II: the first part of the incision was similar to that in Group I. It was continued by a sulcular incision starting near the distobuccal edge of the second molar and then extended up to the midpoint of the buccal sulcus of the second molar, followed by a relieving incision in the mesial region without cutting the interdental papilla (Figure 2).

The primary outcome variable was postoperative complications classified as present or absent and included wound dehiscence. The secondary outcome variables were postoperative side effects (including pain, swelling, and trismus assessed during the postoperative time periods), demographic, and operative. The flap design and side of the mouth were randomly assigned for each patient. Orthopantomographic radiograms were obtained to ensure the symmetry and the type of impaction. The teeth were surgically removed in 2 sessions at 4-week intervals by the same oral surgeon.

Postoperative pain was scored by means of a 10-cm VAS from 0 (no pain) to 10 (worst pain imaginable) daily for 7 days. Preoperatively, the facial measurements were measured by one of the investigators. To define the amount of postoperative swelling, we used the criteria from a previously published article (8). Three distances were measured. These facial measurements were taken at the distances from the tragus to the pogonion, from the tragus to the corner of the mouth, and from the lateral corner of the eye to the angle of the mandible. The mouth opening, taken as the maximum distance between maxillary and mandibular central incisors, was measured by a ruler (to the nearest mm) preoperatively. The following details were recorded preoperatively: age, sex, the tooth to be removed, type of flap design, and interincisal mouth opening (mm) before surgery.

All operations were done under local anesthesia. For the inferior alveolar block, 2 mL of 2% lidocaine with 1:80 epinephrine (lidocaine/adrenaline; Adeka, Turkey) was used. Operations were done by the same oral surgeon in the same operating room and under similar conditions.
After mobilizing the mucoperiosteal flap and uncovering the surgical site, the proceedings were identical, regardless of the flap design. The crown, which was completely osseously covered, was uncovered from the occlusal down to the equator with rotating instruments of diminishing size (Figure 3). After extraction, potential rests of the

Figure 3a. Intraoral view of the three-cornered flap design. Group I.

Figure 3b. The crown of the third molar, which was completely osseously covered. Group I.

Figure 3c. Postoperative day 10 after surgery. Group I.

Figure 3d. Intraoral view of the modified triangular flap design on the contralateral side of the same patient. Group II.

Figure 3e. Removal of bone from the occlusal down to the equator of the third molar. Group II.

Figure 3f. Postoperative day 10 after surgery. Group II.
dental follicle were removed. The wound was irrigated with cool sterile physiologic saline solution. In all cases a primary wound closure was carried out with atraumatic sutures (Medico, Co., Ltd., China). All patients were given amoxicillin (500 mg every 8 h for 6 days) continuing for 7 days, and diclofenac potassium (50 mg every 12 h) for pain after surgery. Postoperative instructions for the patients included a soft diet and oral hygiene with 0.2% chlorhexidine mouth rinse. Sutures were removed 7 days after surgery.

Each patient returned for evaluation 2 days and 7 days postoperatively. On day 2, clinical measurements of maximum interincisal distance were performed. Three distances were measured by a tape measuring method to evaluate swelling. On day 7, the patients were reviewed, the maximal interincisal opening and swelling were again evaluated, and the VAS forms were collected. Wound dehiscence was noted on the seventh postoperative day. The wound was considered to be dehisced if there was gaping along the entire incision line (9). If found to be present, the wound was not resutured, but with daily control and care was left to heal secondarily and the time taken for complete wound healing was noted. The surgeon that had operated on the patients was never involved in the preoperative or postoperative assessment.

2.3. Data collection methods
Data sources were the subjects’ clinical records. Data were collected related with the age and sex of each subject for each third molar extracted. We recorded age in years at the time of the interview (continuous variable) and we coded sex as a binary variable (male/female). Operative variables were also collected. Immediately after the operation, details of the procedure were recorded, including the duration of surgery in minutes from the first incision to insertion of the last suture (continuous variable) and the type of flap design.

2.4 Data analysis
Recorded data were analyzed using SPSS 15.0 (SPSS Inc., USA). Data were subjected to different types of statistical analyses such as Wilcoxon test, repeated measures ANOVA, Pearson correlation, paired-t test, and McNemar test for the swelling, duration of the intervention, VAS scores, and wound healing variables. Nonparametric tests for changes in time were used in statistical analyses because the maximal interincisal opening data were not normally distributed (controlled with the Shapiro-Wilk test). Group differences for subjective data were controlled with the chi-square test. Descriptive statistics and bivariate analyses were computed. Significance level was set as 0.05.

3. Results
This prospective, randomized clinical study was conducted at the Department of Oral and Maxillofacial Surgery between January 2011 and July 2011 and consisted of 36 healthy patients with bilateral vertically bony impacted third molars. Patients were between 18 and 40 years old, with the average age being 23.30 years. There were 29 female and 7 male patients. In this randomized study, there were no significant differences with respect to the demographic data among the subjects who were enrolled.

According to the Wilcoxon test, for the swelling, the differences between the recording times (0–2 and 2–7 days) were significant in both groups (P = 0.000). There was a higher incidence of swelling in Group I than in Group II. However, the difference between the 2 groups was not statistically significant (P > 0.05). On the seventh postoperative day, minimal swelling was detected for both operations and the difference between the groups was also statistically insignificant (P > 0.05) (Figure 4; Table 1).

![Figure 4. Swelling variable regarding flap designs.](image-url)

### Table 1. Difference in the cheek area measurements for swelling.

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<tr>
<th></th>
<th>n</th>
<th>Cheek area measurements, sum of 3 distances (cm)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Before</td>
</tr>
<tr>
<td>Three-cornered flap</td>
<td>36</td>
<td>36.72 ± 1.87</td>
</tr>
<tr>
<td>Modified triangular flap</td>
<td>36</td>
<td>36.53 ± 1.90</td>
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Statistical analysis using the Wilcoxon test revealed insignificant difference between the VAS pain scores in Group I and Group II (P > 0.05) (Figure 5; Table 2).

The Wilcoxon test was applied for comparing the maximum mouth opening in the 2 groups, and the differences between the recording times (0–2 and 2–7 days) were significant in both groups (P = 0.000). The differences between the 2 groups are in accordance with preoperative difference. There was no significant difference (P > 0.05) observed in mouth opening between the groups before surgery or between the 2 flap designs at 2 or 7 days after surgery (Figure 6; Table 3). Nearly all of the patients regained their preoperative interincisal mouth openings on the seventh postoperative day after both operations.

With the 3-cornered flap (first incision), the average surgery duration was 14 min (minimum 6, maximum

<table>
<thead>
<tr>
<th>VAS scores (mean ± SD)</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
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<tbody>
<tr>
<td>Three-cornered flap</td>
<td>6.64 ± 3.07</td>
<td>4.29 ± 3.10</td>
<td>3.64 ± 2.79</td>
<td>2.87 ± 2.56</td>
<td>2.67 ± 2.36</td>
<td>1.63 ± 1.84</td>
<td>1.39 ± 2.40</td>
</tr>
<tr>
<td>Modified triangular flap</td>
<td>6.70 ± 3.07</td>
<td>4.24 ± 2.82</td>
<td>3.47 ± 2.56</td>
<td>2.78 ± 2.03</td>
<td>2.05 ± 1.71</td>
<td>1.36 ± 1.44</td>
<td>0.85 ± 1.15</td>
</tr>
</tbody>
</table>

Figure 5. The Wilcoxon test results regarding VAS scores.

Table 2. VAS scores, days 1 to 7 after surgery.

Figure 6. Maximum mouth opening variable regarding flap designs.
with the modified-triangular (second incision), it was 13.5 min (minimum 7, maximum 25). According to paired-t test, there was no statistical difference for the duration variable between both incision techniques ($P > 0.05$). Wound dehiscence was found in 11.1% of patients in Group I and 8.3% of patients in Group II, but this was not found to be statistically significant according to the McNemar test ($P > 0.05$).

### 4. Discussion

The purpose of this study was to answer the question of whether complications and side effects would be observed more with the 3-cornered flap or with the triangular flap technique on mandibular bilateral bony impacted third molar surgical extraction. Our null hypothesis was that there was no difference in the rate of postoperative complications and side effects between the 2 study groups. The results revealed similar incidence of wound dehiscence, levels of pain, trismus, and swelling for both techniques during the study. Therefore, the null hypothesis was accepted. The specific aims of this study were to estimate wound dehiscence, to identify the postoperative pain, and to measure the postoperative swelling and mouth opening in both flap groups.

Jakse et al. (9) evaluated the primary wound healing of 2 different flap designs, which were the modified triangular and envelope, in lower third molar surgery and found that the modified triangular flap was significantly less responsible for the development of wound dehiscence. They stated that because the envelope flap is fixed anteriorly with intersulcular sutures, soft tissue tension resulting in postoperative hematoma and masticatory movements causes a higher incidence of wound dehiscence. Sandhu et al. (10) compared the effects of flap design on wound dehiscence after surgical removal of bilateral impacted mandibular third molars and found that the modified triangular flap was superior to the envelope flap for wound dehiscence. Suarez-Cunqueiro et al. (11) also found that the type of incision affected primary wound healing. The findings of our study differ from those of these authors with respect to the effect of surgical technique on wound dehiscence. Results of the present study suggested that there was no significant difference regarding wound dehiscence between the study groups.

For years, the assessment of the edema after an operation has been carried out by different methods, including photometry, cephalostat, ultrasonography, physical measurements of given points on the face, and various imaging methods (12,13). In this study, physical measurements of given points on the face were used. Postoperative swelling after removal of the third molar has been attributed to the reflection of the mucoperiosteum (3,10). Van Gool et al. (3) reported that swelling following third molar surgery was a function of time and maximum swelling occurred between 24 and 48 h postoperatively.

Kirk et al. (14) found a greater degree of swelling with the use of a modified triangular flap compared with an envelope flap. Briguglio et al. (15) reported that there was no correlation between postoperative edema and flap designs for the envelope flap modified by Thibauld and Parant, the Laskin triangular flap, and the envelope flap modified by Laskin. The investigators concluded that the decision to use a certain type of flap should be based on the surgeon's preference. In another clinical study, Suarez-Cunqueiro et al. (11) reported that there were no significant differences between the marginal and paramarginal flaps in terms of swelling values in both study groups. Erdogan et al. (16) compared the influence of triangular and envelope flaps on facial swelling after mandibular third molar surgery and found that the envelope flap yielded to less facial swelling in comparison to the triangular flap. Although there was a higher incidence of swelling in the first flap group than in the second flap group, the difference between the 2 groups was not statistically significant. Comparison of swelling between the 2 groups revealed no significant difference on all postoperative days.

Van Gool et al. (3) and Suarez-Cunqueiro et al. (11) attributed pain following third molar surgery to the incision and reflection of the mucoperiosteum rather than the flap design. In this study, pain was significantly greater in the envelope flap group than the modified triangular flap group. Contrary to this, Kirk et al. (14) investigated the influence of flap designs, which were buccal envelope flap and a modified triangular flap, on postoperative pain, and they found that pain was not directly influenced by the flap design. Both groups showed a reduction in the severity of pain from postoperative days 1 to 7. Garcia et al. (17) reported that the severity of pain following third molar
surgery declined between days 1 and 5. Erdogan et al. (16) compared the influence of triangular and envelope flaps pain after mandibular third molar surgery and found that envelope flaps yield reduced VAS scores in comparison to triangular flaps. The findings of our study differ from those of these authors with respect to the effect of surgical technique on pain. We did not find any influence of flap design on postoperative pain according to the VAS scale. Both groups showed a reduction in the severity of pain from postoperative days 1 to 7. Results of the present study suggested that postoperative pain was not associated with the use of 3-cornered flap or modified triangular flap techniques.

In a clinical study, Conard et al. (18) found severe trismus following third molar surgery on the first postoperative day. In another clinical study, Azaz et al. (19) found 13% of cases of mild–moderate trismus 10 days postoperatively to have slow regression of trismus. Cerqueira et al. (20) found that trismus was greatest at 24 h and was still present 15 days postoperatively following third molar surgery. Van Gool et al. (3) and Suarez-Cunqueiro et al. (11) concluded that trismus was not affected by the type of incision. Sandhu et al. (10) evaluated the effect of modified triangular and envelope flap designs on trismus postoperatively and they found no significant difference in postoperative trismus in either group. Similarly, Kirk et al. (14) investigated the influence of envelope and modified triangular flap designs on postoperative trismus and they reported that the flap designs used in their study did not adversely affect patients in terms of postoperative trismus. Our results on postoperative trismus are in agreement with many of these results reported in the literature. In this study, there was a decrease in trismus over time, with the highest value being seen on the first postoperative day in both groups. There was no significant difference observed in mouth opening between the groups before surgery or between the 2 flap designs at 2 or 7 days after surgery. Thus, it was found that there was no advantage in choosing either of these flap techniques over the other to reduce the severity of trismus.

There were shortcomings of this study, which could affect the ability to generalize the findings, were as follows. The study involved a small sample size and a quality-of-life questionnaire assessing the quality of life after surgery was not given to the patients. Facial measurements are not representative of the total swelling because postoperative swelling has 3 planes of measurements. Transferring the contour is subject to errors in accuracy and reproducibility. Although third molar removal often has a profoundly negative effect on the patient in the first week after the surgery, further randomized studies will be required to identify the incidence of wound dehiscence and control of periodontal pocket depth of the second molar with a longer follow-up.

Although there were no differences regarding clinical outcomes of both flap designs, it seemed that the modified triangular flap design provided a better view for the operation site.

Results of the present study suggest that there were no significant differences in wound dehiscence, postoperative pain, swelling, and maximum mouth opening between the study groups. Therefore, the decision to use a 3-cornered flap or a modified triangular flap may be based on surgeon's preference.

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References
7. Öçgüder DA, Doğan M, Bekaşer SB, Akgün E, Tolunay T, Uğurlu M. Comparison of the open primary repair with augmentation and without augmentation in acute Achilles


