

# Comparison of New Flap Design with Conventional Flap Designs on Postoperative Pain and Swelling Following Mandibular Third Molar Removal

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## ABSTRACT

**Aim:** To evaluate a new flap design that is a modification of an envelope flap in reducing the postoperative complications and to compare it with the conventional flaps such as a bayonet flap and an envelope flap for the surgical removal of impacted mandibular third molars.

**Materials and methods:** A prospective randomized control clinical study was conducted on 90 medically healthy patients who came with impacted mandibular third molars. The patients were randomly divided into group I, group II, and group III of 30 patients each. All three group patients underwent surgical removal of impacted mandibular third molars wherein for group I patients, a bayonet flap was raised, for group II a modified envelope flap (new flap design), and for group III an envelope flap was raised. Postoperative pain and swelling at day 1, 3, and 7 were assessed and compared. Data were analyzed with ANOVA, using SPSS software version 20.

**Results:** The group II proved more successful in reducing the postsurgical sequelae of impacted third molar removal. Postoperative analysis showed increased amount of pain and swelling in groups I and III as compared to group II.

**Conclusion:** The new design flap that is a modification of an envelope flap is more superior to other two conventional techniques.

**Clinical significance:** The new flap design is useful in reducing postoperative pain and swelling, which is the most common sequel of surgical removal of the impacted third molar and is easy to practice.

**Keywords:** Impaction, Mandibular third molar, Modified envelop flap, Pain, Swelling.

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## INTRODUCTION

An impacted tooth is that which fails to erupt completely in the dental arch within the expected time due to various reasons such as lack of space, development in the abnormal position, a physical barrier in the eruption path, high density of the overlying bone, or size and position of the adjacent tooth. Mandibular third molars are found to be the most commonly impacted teeth. About 90% of the population have mandibular third molars, whereas 33% have impacted mandibular molars.<sup>1</sup> Thus, impaction of third molars is found to be highly prevalent and can be attributed to both genetic and environmental factors.

Surgical extraction of the impacted mandibular third molar is one of the most commonly performed minor oral surgical procedures. Various indications have been suggested for mandibular third molar surgeries, which generally include caries and their outcomes; germination disorders; periodontal problems like pericoronitis; periodontal defects or caries in the distal aspect of second molars; and cysts, tumors, or other pathologies in relation to the impacted third molar or for orthodontic and prosthodontic treatment purposes.

Pain and swelling are the most common postoperative complications associated with surgical extraction of impacted third molars. Apart from this, trismus, dry socket, paresthesia, wound infection, delayed-onset wound infection, which occurs after suture removal, periodontal pocket formation, loss of connective tissue attachment, or bone loss on the distal aspect of the second molar are also seen as postoperative complications of third molar surgery.

To avoid and minimize these complications, various flap designs have been advocated in surgical removal of the third

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molar as incisions and flap designs are crucial factors in producing postoperative complications. Various flap designs are practiced out of which the bayonet flap (triangular flap) and the envelope flap (Szmyd flap) are commonly used.

Each flap has its own advantages and disadvantages. The bayonet flap is more conservative because lesser amount of tissue is reflected to keep the flap tension free during handling. On the other

hand, the envelope flap provides very good exposure of the surgical site and has adequate blood supply because of its broad base.

All flap designs have one or more drawbacks either in the primary healing or in restoring the periodontal health of the adjacent tooth. Hence, it has become imperative to design a flap, which will optimally satisfy all the requisites of an ideal flap like good postoperative healing, minimal pain and swelling, and less postoperative complications.

This study has proposed the removal of impacted mandibular third molars with three different flap designs out of which two were commonly practiced, one flap design was a new flap design (modified envelope flap) and compared the results in terms of pain and swelling with the commonly practiced flaps for surgical removal of the mandibular third molar.

## MATERIALS AND METHODS

The prospective randomized control clinical study included 90 medically healthy patients of both sex, aged between 18 years and 50 years, who visited the Department of Oral and Maxillofacial Surgery with impacted mandibular third molars indicated for surgical removal.

### Inclusion Criteria

- Impacted mandibular third molar completely or partially impacted with the absence of acute inflammatory symptoms
- Teeth posing score between 4 and 7 out of 10 on a scale of surgical difficulty as per the Pederson assessment index
- Both male and female sex, aged between 18 years and 50 years
- A medically healthy patient with no systemic disease and who is not on any medication that could interfere with the healing process

### Exclusion Criteria

- Patients with impacted third molars associated with existing pathology and infection
- Teeth posing score between 1–3 and 7–10 out of 10 on a scale of surgical difficulty as per the Pederson assessment index
- Debilitated patients who were deemed unfit to undergo surgery and immunocompromised
- Pregnant and lactating mothers
- Patient who had taken analgesics 12 hours prior to surgery

Preoperative assessments included examination of the presence of signs of inflammation and infection. Radiographic investigation included intra oral periapical (IOPA) to determine the type and surgical difficulty of impaction.

After preoperative evaluation and obtaining a written informed consent, all the patients included in the study were allocated into three groups as follows:

Group I patients were those who underwent surgical removal of the impacted mandibular third molar using the bayonet flap.

Group II patients were those who underwent surgical removal of the impacted mandibular third molar using the new design of the modified envelope flap.

Group III patients were those who underwent surgical removal of the impacted mandibular third molar using the envelope flap.

The study was conducted after obtaining ethical clearance from the institution and an informed consent from patients.

### Surgical Procedure

Group I, group II, and group III patients were operated for surgical removal of the lower third molar.

Mouth disinfection was done using chlorhexidine solution. Local anesthesia was achieved through administration of 2% lignocaine hydrochloride with adrenaline (1:80,000) using the inferior alveolar nerve block, the lingual nerve block, and the long buccal nerve block. The duration of each operation and the interval between the initial flap incision and the final suturing was noted. The flap design for bayonet and envelope was followed from the textbook *Impacted Teeth* by CC Alling, HF Helfrick, and DA Alling.

### Bayonet Flap

#### Incision

It has three parts: anterior, intermediate or gingival, and distal. Anteriorly, the incision extended into the buccal vestibule forming a triangle with the interdental papillae. Intermediately, it extended around the gingival margin of the second molar turning into the impacted tooth area including the distal papillae of the second molar in the flap. Distally, the incision must slope outward as well as backward, as the ascending ramus lies on the lateral side of the body of the mandible (Fig. 1).

### Modified Envelope Flap (New Flap Design)

#### Incision

It began medial to the external oblique ridge and extended to distal lower angle of the second molar followed by sulcular incision that was made from distofacial angle of the second molar to the middle of the second molar allowing minimal flap retraction (Fig. 2).

### Envelope Flap

#### Incision

It began medial to the external oblique ridge and extended to distal lower angle of the second molar followed by sulcular incision that was made from distofacial angle of the second molar to mesiofacial angle of the first molar (Fig. 3).

For all the three groups, incision was placed using a no. 15 BP blade. Bone osteotomy under copious saline irrigation was done using a no. 703 stainless steel straight fissure bur using a micro motor handpiece with the speed of 24,000 rpm and the bone covering the buccal and distal side was removed. Tooth



Fig. 1: Bayonet flap



Fig. 2: Modified envelope flap



Fig. 3: Envelope flap

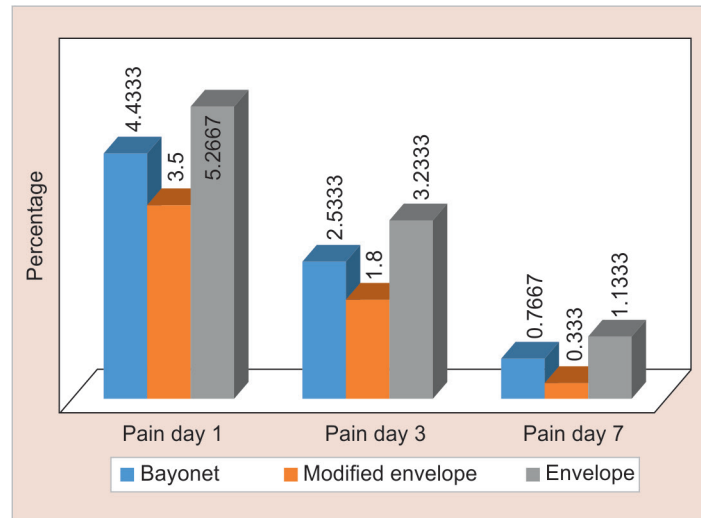


Fig. 4: Pain assessment at days 1, 3, and 7

sectioning was carried out if necessary. The tooth was elevated and removed using a Coupland elevator/other suitable elevators. The socket was rinsed with saline and betadine solution and hemostasis was achieved. The flap was being repositioned and wound closure was done using 3-0 black braided silk.

### Intraoperative Assessment

Intraoperative assessment included the following:

- Flap design
- Operative time
- Complications, if any

After the surgical procedure, all the patients were prescribed amoxicillin 500 mg TID, metronidazole 400 mg TID, and ibuprofen 400 mg TID all to be taken orally for 5 days. Postoperative instructions were given to the patient.

### Postoperative Follow-up

Postoperative follow-up was done on 1st, 3rd, and 7th day to measure pain and swelling as these are the most common postoperative sequela of impacted tooth removal.

### Assessment of Postoperative Pain

The pain was evaluated subjectively according to the 10 cm visual analogue scale with 0 as no pain and 10 as maximum.

### Assessment of Postoperative Swelling

The postoperative swelling was assessed using following grades:

Grade 0 = No swelling

Grade 1 = Edema that involves the alveolar mucosa buccally and/or lingually (intraorally)

Grade 2 = Edema that involves the alveolar mucosa buccally and/or lingually and involves the cheek (extraorally) to the lower border of the mandible

Grade 3 = Edema that involves the alveolar mucosa buccally and/or lingually and involves the cheek (extraorally) below the lower border of the mandible

### Statistical Analysis

Data were analyzed with ANOVA using SPSS software version 20.

### RESULT

Visual analog scale (VAS) pain measurements were done at day 1, 3, and 7 postoperatively. There was difference in VAS score from time to time in each treatment group. ANOVA tests results were obtained. The pain in all groups increased on day 1 postoperatively and decreased on day 3 and day 7. The average values of the highest pain were in the conventional groups, whereas the modified envelope flap group showed less pain as compared to other conventional groups (Fig. 4).

The mean pain on day 1 (Table 1) of subjects in group I was  $4.4333 \pm 1.04000$ , in group II was  $3.5000 \pm 1.52564$ , and in group III was  $5.2667 \pm 1.38796$ , and there was a statistically significant difference in mean pain on day 1 in subjects between groups (i.e.,  $p = 0.963$ ).

The mean pain on day 3 (Table 2) in group I was  $2.5333 \pm 1.52527$ , in group II was  $1.8000 \pm 1.03057$ , and in group III was  $3.2333 \pm 1.25075$ , and there was a statistically significant difference in pain on day 3 in subjects between groups (i.e.,  $p < 0.001$ ).

The mean pain on day 7 (Table 3) of subjects in group I was  $0.7667 \pm 1.07265$ , in group II was  $0.3333 \pm 0.47946$ , and in group III was  $1.1333 \pm 1.07425$ , and there was a statistically significant difference in mean pain on day 7 in subjects between groups (i.e.,  $p = 0.005$ ).

Swelling scale measurements were done at day 1, 3, and 7 postoperatively. There was difference in swelling from time to time with each treatment group. ANOVA test results were obtained. The swelling in all groups increased on day 1 postoperatively and decreased on day 3 and day 7. The average values of the highest

swelling were in the conventional groups, whereas the modified envelope flap group showed less swelling as compared to other conventional groups (Fig. 5).

The mean swelling on day 1 (Table 4) in group I was  $1.6333 \pm 0.49013$ , in group II was  $1.2000 \pm 0.40684$ , and in group III was  $1.6667 \pm 0.47946$ . There was a statistically significant difference in mean swelling on day 1 in subjects between the groups (i.e.,  $p < 0.001$ ).

The mean swelling on day 3 (Table 5) in subjects in group I was  $0.7333 \pm 0.44978$ , in group II was  $0.4667 \pm 0.50742$ , and in group III was  $1.1000 \pm 0.66176$ . There was a statistically significant difference in mean swelling on day 3 in subjects between the groups (i.e.,  $p < 0.001$ ).

The mean swelling on day 7 (Table 6) in subjects in group I was  $0.2667 \pm 0.44978$ , in group II was  $0.0333 \pm 0.18257$ , and in group III was  $0.3333 \pm 0.47946$ . There was a statistically significant difference in mean swelling on day 7 in subjects between the groups (i.e.,  $p = 0.011$ ).

## DISCUSSION

Third molar surgery is the most common minor oral surgical procedure and has always been a nightmare due to the complications arising postoperatively. The most commonly occurring postoperative complications being pain, swelling, trismus, and wound dehiscence. Flap designs play an important role in the occurrence of these postoperative sequelae. Many researchers have developed and tried different designs in search of a surgical flap method that will lead to least postoperative pain and swelling.<sup>2</sup> This study mainly focused to evaluate the new flap design (a modification of the envelope flap) in reducing the most common postoperative complications like pain and swelling and compared it with the conventional flaps such as the bayonet flap and the envelope flap for the surgical removal of impacted mandibular third molars. The results showed that the new flap reduces the postoperative complications like pain and swelling as compared to the conventional groups like the bayonet flap and the envelope flap. Similarly, a study conducted by Krisna Arindra had concluded that the reverse triangular flap designs reduced the occurrence of postoperative third molar complications as it prevented the trauma of the buccal tissue of the second molars.<sup>3</sup> In this study, the flap

**Table 1:** Pain assessment at day 1 (One-way ANOVA)

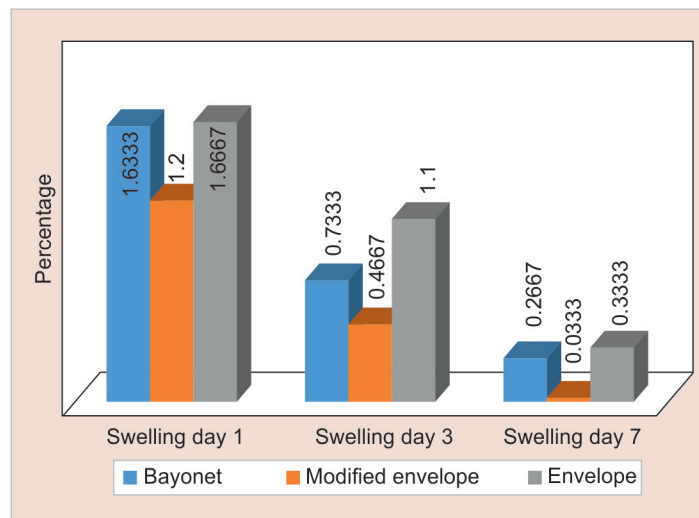
	<i>n</i>	Mean	Std. deviation	<i>p</i>
Bayonet	30	4.4333	1.04000	<0.001
Modified envelope	30	3.5000	1.52564	
Envelope	30	5.2667	1.38796	

**Table 2:** Pain assessment at day 3 (One-way ANOVA)

	<i>n</i>	Mean	Std. deviation	<i>p</i>
Bayonet	30	2.5333	1.52527	<0.001
Modified envelope	30	1.8000	1.03057	
Envelope	30	3.2333	1.25075	

**Table 3:** Pain assessment at day 7 (One-way ANOVA)

	<i>n</i>	Mean	Std. deviation	<i>p</i>
Bayonet	30	0.7667	1.07265	0.005
Modified envelope	30	0.3333	0.47946	
Envelope	30	1.1333	1.07425	



**Fig. 5:** Swelling assessment at days 1, 3, and 7

**Table 4:** Swelling assessment at day 1 (One-way ANOVA)

	<i>n</i>	<i>Mean</i>	<i>Std. deviation</i>	<i>p</i>
Bayonet	30	1.6333	0.49013	<0.001
Modified envelope	30	1.2000	0.40684	
Envelope	30	1.6667	0.47946	

**Table 5:** Swelling assessment at day 3 (One-way ANOVA)

	<i>n</i>	<i>Mean</i>	<i>Std. deviation</i>	<i>p</i>
Bayonet	30	0.7333	0.44978	<0.001
Modified envelope	30	0.4667	0.50742	
Envelope	30	1.1000	0.66176	

**Table 6:** Swelling assessment at day 7 (One-way ANOVA)

	<i>n</i>	<i>Mean</i>	<i>Std. deviation</i>	<i>p</i>
Bayonet	30	0.2667	0.44978	0.011
Modified envelope	30	0.0333	0.18257	
Envelope	30	0.3333	0.47946	

design played a role in reducing pain and swelling as there is no buccal vestibular incision.

The measures of pain and swelling were recorded by means of VAS and rating scale, respectively, which according to Berge are effective measurement options.<sup>4</sup> Pain is physiologically attributed to the local tissue damage and inflammation that causes the release of endogenous mediators such as bradykinin and serotonin.<sup>5</sup> Postoperative swelling is caused by the response of the tissues to manipulation and trauma caused during surgery.<sup>6</sup> The new flap design that is used in this study had less tissue manipulation and trauma, which could be the reason for less postoperative swelling. In a study conducted by Dolanmaz et al.,<sup>7</sup> flap designs had no significant differences in pain scores. But in our study there were significant differences in pain scores postoperatively. Sandhu et al. reported that the envelope flap design had higher pain and swelling compared to the bayonet flap.<sup>8</sup> In our study, the new flap had better reduction in pain and swelling compared to both bayonet and envelope flaps. Kirk et al. and Baqain et al. demonstrated a significant association between flap designs and swelling after the surgery.<sup>2,9</sup> In this study, the flap design played a role in reduction of pain and swelling similar to what was experienced by the present study.

Each flap design has its own advantages and disadvantages. Erdogan et al. had reported reduced VAS scores in the envelope flap group.<sup>10</sup> In our study, the new flap design had reduced pain scores than the envelope flap as the reason being not extending the flap till the mesial aspect of the first molar, which made the surgical site less exposed. McCagie insisted that when an incision is extended to the sulcus, as in the standard triangular flap or the modified triangular flap, it will result in more swelling.<sup>11</sup> Since there is no extension into the sulcus of the new flap design, the swelling was comparatively less than the bayonet flap. According to this opinion, an envelope incision will avoid this complication, since its anterior extension is confined to the gingival trough. This is contrary to Koyuncu, who showed that severity of pain and swelling with the envelope group was greater than the modified triangular group after the first 4 days.<sup>12</sup> The new flap design is found to be better when compared on 1st, 3rd, and 7th postoperative days.

van Gool et al. deduced that the oblique vertical incision was more beneficial to better access and was not easily torn when

compared to horizontal incisions,<sup>13</sup> whereas the desired access was achieved without the vertical or horizontal release incision, which is the advantage in avoiding most postoperative complications. In another study,<sup>14</sup> the authors revealed that the modified triangular flap had slightly higher pain scores than the envelope flap, which is similar in our study. In a study conducted to compare routine triangular flaps and an alternate flap, which is lingual based in third molar extractions, the alternate flap showed greater pain reduction but did not show difference in swelling.<sup>15</sup> It was concluded that the alternate flap was superior to the conventional triangular flap in relation to postoperative pain whereas this new flap design achieved reduction in both pain and swelling. Ustad et al. showed that pain and swelling were significantly greater in the triangular flap than the envelope flap,<sup>16</sup> whereas in our study there was more pain in the envelope than the bayonet and least in the new flap design. The potential problems of the envelope flap and the bayonet flap have been discussed in various literatures,<sup>17,18</sup> which have been overcome in our new flap design.

In our study, the envelope flap was modified in a way to reduce maximum postoperative complications. The modification was done by extending the anterior limb only to the middle of the cervical second molar gingiva and creating a vertical releasing flap on the distal side that led from the lingual to the buccal side through the external oblique line in the retro molar area of the mandibular third molar. The design of the proposed incision could bring a major role in the success of third molar surgery. The results of the study proved the efficacy of the newly designed flap.

## CONCLUSION

The modified envelope flap (new flap design) is found to be the most appropriate flap for the third molar impaction. It has proven to be best in reducing the common postoperative complications like pain and swelling. It is really beneficial to oral surgeons to make their patients satisfied. However, the selection of the flap design is based on the surgeon's preference and skill and they must personalize each case depending on the characteristics of each patient. If the new flap design can address other postoperative complications like trismus, periodontal pocket depth distal to the second molar, and wound dehiscence, this will become the preferred flap design considering the benefits to patients on the postoperative outcome after surgical removal of the impacted third molar.

The ethical clearance of the study was obtained on February 22, 2017.

## REFERENCES

- Rosa AL, Carneiro MG, Lavrador MA, et al. Influence of flap design on periodontal healing of second molars after extraction of impacted mandibular third molars. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002;93(4):404–407. DOI: 10.1067/moe.2002.122823.
- Kirk DG, Liston PN, Tong DC, et al. Influence of two different flap designs on incidence of pain, swelling trismus, and alveolar osteitis in the week following third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;104:1–7. DOI: 10.1016/j.tripleo.2007.01.032.
- Arinda PK, Indrapradana A. Comparison of three flap designs on postoperative complication after third molar surgery. *Intisari Sains Medis* 2018;9(2):89–94.
- Berge TI. The use of a visual analogue scale in observer assessment of postoperative swelling subsequent to third-molar surgery. *Acta Odontol Scand* 1989;47(3):167–174. DOI: 10.3109/00016358909007697.

5. Yamaguchi A, Sano K. Effectiveness of preemptive analgesia on postoperative pain following third molar surgery, review of literatures. *Jpn Dent Sci Rev* 2013;49(4):131–138. DOI: 10.1016/j.jdsr.2013.07.002.
6. Santosh BS, Shivamurthy DM, Shilpa IG, et al. Comparison of pain, swelling, and trismus in the surgical removal of impacted mandibular third molars by following two different flap techniques. *J Adv Med Dent Sci Res* 2016;4(1):139–142.
7. Dolanmaz D, Esen A, Isik K, et al. Effect of two flap designs on postoperative pain and swelling after impacted third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013;116(4):244–246. DOI: 10.1016/j.oooo.2011.11.030.
8. Sandhu A, Sandhu S, Kaur T. Comparison of two different flap designs in the surgical removal of bilateral impacted mandibular third molars. *Int J Oral Maxillofac Surg* 2010;39(11):1091–1096. DOI: 10.1016/j.ijom.2010.07.003.
9. Baqain ZH, Al-Shafiq A, Hamdan AA, et al. Flap design and mandibular third molar surgery: a split mouth randomized clinical study. *Int J Oral Maxillofac Surg* 2012;41(8):1020–1024. DOI: 10.1016/j.ijom.2012.02.011.
10. Erdogan O, Tatli U, Ustun Y, et al. Influence of two different flap designs on the sequelae of mandibular third molar surgery. *Oral Maxillofac Surg* 2011;15(3):147–152. DOI: 10.1007/s10006-011-0268-7.
11. McCagie J. A standard procedure for the removal of unerupted wisdom teeth. *Dent Prac* 1957;7:150–154.
12. Koyuncu B, Cetingul E. Short-term clinical outcomes of two different flap techniques in impacted mandibular third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2013;116(3):179–184. DOI: 10.1016/j.oooo.2011.12.023.
13. van Gool AV, Ten Bosch JJ, Boering G. Clinical consequences of complaints and complications after removal of the mandibular third molar. *Int J Oral Surg* 1977;6(1):29–37. DOI: 10.1016/S0300-9785(77)80069-0.
14. Alqahtani NA, Khaleelahmed S, Desai F. Evaluation of two flap designs on the mandibular second molar after third molar extractions. *J Oral Maxillofac Pathol* 2017;21(2):317–318. DOI: 10.4103/jomfp.JOMFP\_75\_17.
15. Yolcu U, Acar AH. Comparison of a new flap design with the routinely used triangular flap design in third molar surgery. *Int J Oral Maxillofac Surg* 2015;44(11):1390–1397. DOI: 10.1016/j.ijom.2015.07.007.
16. Ustad F, et al. Comparative evaluation of envelop and triangular flaps in inferior third molar surgery. *Indian J Stomatol* 2013;4(3):66–70.
17. Bhargava D, Thomas S, Moghe S, et al. Review of Mucoperiosteal Flap Designs for Mandibular Third Molar Surgery. *Acta Sci Med Sci* 2018;2(1):7–10.
18. Blanco G, Lora D, Marzola C. The Different Types of Flaps in the Surgical Relations of the Third Impacted Molars—Literature Review. *Dentistry* 2016;7:425. DOI: 10.4172/2161-1122.1000425.