International Journal Dental and Medical Sciences Research
Volume 3, Issue 1, Jan-Feb 2021 pp 311-320 www.ijdmsrjournal.com ISSN: 2582-6018

Evaluation of five different flap designs used in the surgical extraction of the impacted mandibular third molar. Oral and Maxillofacial Surgery.

Dr. Jasbinder Kumar, Dr. Satish Kumaran P.
Post Graduate, Dept. of Oral and Maxillofacial Surgery, M.R. Ambedkar Dental College and Hospital, Bangalore.
Professor, Dept. of Oral and Maxillofacial Surgery. M.R. Ambedkar Dental College and Hospital, Bangalore.

Date of Submission: 25-12-2020 Date of Acceptance: 12-01-2021

ABSTRACT-Purpose: The purpose of this study was to compare different flap designs in extraction of impacted mandibular third molar by assessing their post-operative complications.
Patients and Methods: 100 medically fit patients of an age group of 20-40 years irrespective of gender were included in the study. 100 patients were randomly divided into five groups with 20 patients in each group. In Group 1 Ward's incision was used, in Group 2 Modified Ward's incision was used, in Group 3 Envelope incision was used, in Group 4 Comma incision was used and in Group 5 Bayonet incision was used.
Result: No statistical differences were noted between the groups in terms of visibility, accessibility, excessive bleeding during surgery, healing of the flap, sensitivity of the adjacent teeth and dry socket. A statistical significant difference was observed in post-operative swelling and distal pocket in adjacent teeth which was significant higher in Ward's and Modified Ward's incision in comparison to other incision.
Conclusion: The selection of the flap design is dependent on needs of the case and preference of the operating surgeon and does not seem to have a significant influence on the long term health of tissue.
Keywords: Flap design, impaction

I. INTRODUCTION-

One of the daily occurring minor surgical procedures in the Department of Oral Surgery is the removal of the impacted third molar. Third molars are present in 90% of the population with 33% having at least one embedded wisdom tooth.[1]The greatest incidence of impaction is found in third molars.[2]The first surgical step to access the impacted wisdom tooth is the incision. The incision planned should grant sufficient access and enhanced visibility to allow ease of surgical procedure and allow fast completion of surgery to maximize the comfort level to the patient.[3] Some of the common complications that occur during the surgical extraction of the impacted mandibular third molar are trismus, pain, swelling, inferior alveolar nerve damage, lingual nerve damage and compromised periodontal status of the second molar.[4] Other potential complications include injury to the adjacent teeth and fracture of mandible.[5] Therefore reducing the incidence of these complications becomes important. Phenolated antiseptics and chlorhexidine have been recommended post-operatively for mouth rinsing to reduce the complications.[6]The incidence of pathological fracture during surgical removal of lower third molar is relatively and approximately 0.005% as reported in literature.[7] Another regimen for limiting the duration and severity of surgery related edema is application of local cold.[8] The number of mucoperiosteal flap designs that have been described to decrease the incidence of these complications shows that a concensus on one single universal incision design for the ideal flap has not been reached. Incisions and flap designs in any surgical procedure are based on sound basic principles. Incisions should be as close as possible to the surgical field. Incisions should not lie over bony defect. Incisions should not cut major muscles or tendon insertions. The extension of the incision should be minimum.The various techniques used for placing incisions in the mucosa and reflection of the mucoperiosteal flap are directly related to the intensity and the frequency of post-operative complications in third molar surgery.[9]

The incision design is important for allowing optimal visibility, for proper access to the impacted tooth and also for subsequent healing of the surgically created defect. The actual design of the flap is many times a compromise between the peri and the post-operative considerations because of so many objectives.[1]One of the complications that is associated following surgical removal of an impacted mandibular third molar is compromised periodontal status.[10]The attachment loss after the

International Journal Dental and Medical Sciences Research
Volume 3, Issue 1, Jan-Feb 2021 pp 311-320 www.ijdmsrjournal.com ISSN: 2582-6018

extraction of third molar is greater at the distal site as compared to mesial site. Change in alveolar bone height is also a matter of controversy. Bone loss on the distal aspect of the second molar is common with many of the flap designs. The flap design has considerable influence on wound healing. Wound dehiscence at distofacial edge is more frequently seen in primary closure.[11]

Surgeons many times end up adopting one basic incision technique and many arise to the conclusion that choice of flap design does not affect the healing to the surgical wound.[12]This is not correct and thorough planning of incision is essential of unhampered healing and different incisions should be adopted for different scenarios.

One more complication that is more frequent and that has significant impact on the patient's post-operative quality of life is pain. The sensation of pain is subjective and depends on the individual's pain threshold and may be influenced by diverse factors including age, gender, anxiety and surgical difficulty. It is found that pain after extraction of mandibular third molar increases with increased surgical difficulty and duration of the intervention.[13]Another method of reducing post-operative pain is the careful reflection of the flap and by using irrigation for cooling during the cutting of the alveolar bone and the tooth.[14]

One of the factors most commonly linked to the intensity of the post-operative pain and swelling is the type of healing of the surgical wound. In primary healing, the socket is covered and sealed hermetically by mucosa. In secondary healing, the socket remains in communication with oral cavity.[15] Therefore suturing the fresh socket is conducive to good healing.

Another complication that is associated following surgical removal of third molar is facial swelling. Factors that influence the incidence of facial swelling after third molar removal include patient age, gender, physique and oral hygiene. Facial swelling depends a lot on the type and extent of soft tissue manipulation, the type of third molar, and the degree of impaction and ease of the extraction.[16]

One more complication that is related to mandibular third molar surgery is trismus. Trismus is the most common and most frequent post-operative sequelae of wisdom tooth removal. Trismus is the spasm of masticatory muscles of jaw. Like edema, trismus also reaches its peaks in two days and resolves on its own by the end of the first week. One of the factors that contributes to trismus is the elevation of flap beyond the external oblique ridge, therefore emphasizing proper incision and flap design.[17]

Aim:

The aim of this study is to evaluate the five different flap designs in the extraction of impacted mandibular third molars by assessing their post operative complications.

Objective:

1 To evaluate the mean pain score
2 To evaluate the swelling
3 To evaluate the trismus
4 To evaluate distal pocket formation
5 To evaluate gingival recession postoperative.

II. MATERIALS AND METHODS-

SOURCE OF DATA

The study includes 100 medically fit patients from December 2017-June 2019 of an age group of 20-40 years irrespective of gender having mesioangular[18] impacted mandibular third molars visiting the department of Oral and Maxillofacial Surgery in M.R Ambedkar Dental College and Hospital, Bangalore. Patients were included in the study after ethical clearance from the institution and informed consent from the patient.

METHOD OF COLLECTION OF DATA:

INCLUSION CRITERIA

1) Patients aged between 20-40 years who require mandibular third molar extraction
2) Patients with the presence of a healthy second molar adjacent to the mandibular third molar
3) Patients with good general health and good oral hygiene
4) Medically fit patients.

EXCLUSION CRITERIA

1) Patients with pericoronitis, periapical infection or lesions with respect to impacted mandibular third molars
2) Root canal treated / periodontally weak mandibular second molars
3) Smokers, alcoholics and patient with uncontrolled/ severe systemic diseases.
4) Female patients on oral contraceptives, pregnant and lactating mothers.

PRE SURGICAL PREPARATION

The first step was evaluation of patient for the procedure.

Pre surgical evaluation of all patients include IOPA/OPG.

Parameters:

100 patients were divided into group 1,2,3,4 and 5 with 20 patients in each group. The study was open labelled, prospective and randomized. All subjects

International Journal Dental and Medical Sciences Research
Volume 3, Issue 1, Jan-Feb 2021 pp 311-320 www.ijdmsrjournal.com ISSN: 2582-6018

were present with completely submerged and mesioangular impacted third molars.
In this study, following parameters were taken.
1) Age and gender distribution
2) Mean pain score
Visual Analogue Scale[9] (VAS) was used (0 to 10) [Table 1, Figure 1]

Group	Day 1	Day 3	Day 7	Day 14
Group 1 Group 2 Group 3 Group 4 Group 5				

Table 1

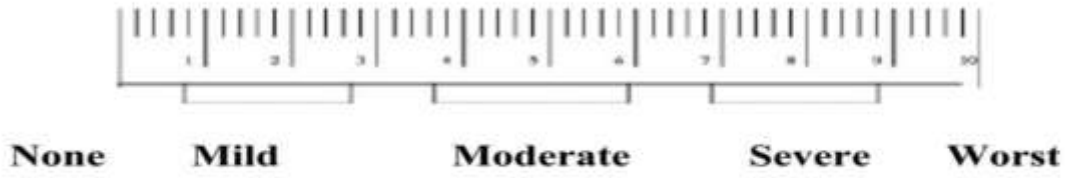

Figure 1

3. Swelling-
The facial swelling was recorded by a thread, which was transferred to a standardized scale. The horizontal facial measurement was taken as distance from the corner of the mouth to the tragus of ear. The vertical measurement was taken as the distance from the outer canthus of the eye to the angle of the mandible by palpating the inferior border[9]. [Table 2]
Facial measurement= Horizontal measurement+ Vertical measurement

Group	Preoperative	Day 1	Day 3	Day 7	Day 14
Group 1 Group 2 Group 3 Group 4 Group 5					

Table 2

4.Trismus
The maximum interincisal mouth opening was recorded using calibrated scale as the distance between the upper and lower central incisors[9].[Table 3]

Group	Preoperative (in mm)	Day 1 (in mm)	Day 3 (in mm)	Day 7 (in mm)	Day 14 (in mm)
Group 1 Group 2 Group 3 Group 4 Group 5					

Table 3

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5. Distal pocket formation

It was measured as position of epithelial attachment below the cement-enamel junction or the periodontal pocket depth on distal aspect of the second molar[4]. Probing measurements were obtained from the free gingival margin to the bottom of the periodontal pocket using William probe. The markings on probe are 1,2,3,5,7,8,9,10 mm.[Figure 2, Table 4]

Figure 2

Group	Total patients	Pocket depth at 7 days (mm)	Pocket depth at 14 days (mm)
Group 1 Group 2 Group 3 Group 4 Group 5			

Table 4

6. Gingival recession-

Gingival recession is measured clinically as the distance from the cement-enamel junction to the depth of the free gingival margin using the markings, on the periodontal probe and reflects the exposure of the root cementum[9]. [Table 5]

Group	Total patients	Below CEJ at 7 days (mm)	Below CEJ at 14 days (mm)
Group 1 Group 2 Group 3 Group 4 Group 5			

Table 5

Surgical procedure-

Standard sterile operating technique was followed for the surgical extraction of the third molar.

100 patients were randomly divided into Group 1, 2, 3, 4 and 5 with 20 patients in each group.

In Group 1 Ward's incision was used.[1]

In Group 2 Modified Ward's incision was used.[1]

In Group 3 Envelope incision was used.[9]

In Group 4 Comma incision was used.[1]

In Group 5 Bayonet incision was used.[9]

Post operative management includes prescribing Amoxyclav 625 mg TID for 5 days, Metronidazole 400 mg TID for 5 days, Diclofenac sodium 50mg TID for 5 days and Chlorohexidine gargles. All medication were per-oral, started half hour prior to the procedure.

Injection Dexamethasone 8mg IV given stat, half hour prior to procedure.

Armamentarium:

1. Local anaesthetic solution (1:20000 Lignocaine + Adrenaline), a disposable syringe with 27 gauge needle
2. Scalpel handles with no. 15 disposable Bard Parker blade
3. Austin flap retractor
4. Straight or Coupland tooth elevator
5. Dental extraction forceps

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6. Surgical hand-pieces
7. Bone cutting or surgical burs- round bur, straight fissure bur(702 and 703)
8. Mosquito artery forceps
9. Surgical spoon curette
10. Bone file
11. Needle holder
12. Tissue holding forceps
13. 3-0 black braided silk suture
14. Surgical scissors
15. Suction tips
16. Irrigation device (10 ml syringe)
17. Tongue depressor
18. Cheek retractor
19. Mouth mirror and dental probe
20. Sterile patient drapes

Operative technique:
100 patients were randomly divided into 5 groups, 20 in each group. Surgical extraction of impacted third molar was performed under local anaesthesia in all groups using following five incisions.
Group 1- Ward's incision.[1]
Group 2- Modified Ward's incision.[2]
Group 3- Envelope incision.[9]
Group 4- Comma incision.[1]
Group 5- Bayonet incision.[9]
The block required was regular inferior alveolar nerve block, lingual nerve block and long buccal nerve block. Only after confirming that all three blocks are functioning effectively and the patient has numbness in that region was the procedure started.

III. RESULT-

Age and Gender distribution among study group.

Age and gender distribution among study groups

Variable	Group 1	Group 2	Group 3	Group 4	Group 5	
Age	M SD	M SD	M SD	M SD	M SD	P value
M &SD	28.9 6.7	29.1 6.9	29.4 6.1	31.8 8.4	27.4 6.0	0.30
Range	21-42	20-49	22-44	20-45	20-44	
Gender	N %	N %	N %	N %	N %	
Male	6 30	12 60	11 55	12 60	8 40	P value
Females	14 70	8 40	9 45	8 40	12 60	0.22

Comparison of mean VAS scores between 5 study groups at different time intervals.

Comparison of mean VAS score between 05 study groups at different time intervals using Kruskal Wallis test.

Time	Groups	N	Mean	SD	Min.	Max.	P value
Day 1	Group 1	20	2.50	0.89	2	4	
	Group 2	20	2.60	0.94	2	4	0.007*
	Group 3	20	3.10	1.02	2	4	
	Group 4	20	2.20	0.62	2	4	
	Group 5	20	3.10	1.02	2	4	
Day 3	Group 1	20	2.10	0.45	2	4	
	Group 2	20	2.00	0.00	2	4	0.009*
	Group3	20	2.50	0.89	2	4	
	Group 4	20	2.10	0.45	2	4	
	Group 5	20	2.00	0.00	2	2	
Day 7	Group 1	20	2.00	0.00	2	2	
	Group 2	20	2.00	0.00	2	2	0.41
	Group 3	20	2.00	0.00	2	2	
	Group 4	20	1.90	0.45	0	2	

	Group 5	20	2.00	0.00	2	2	
Day 14	Group 1	20	0.20	0.62	0	2	
	Group 2	20	0.10	0.45	0	2	0.01*
	Group 3	20	0.60	0.94	0	2	
	Group 4	20	0.00	0.00	0	0	
	Group 5	20	0.10	0.45	0	2	

Table 7

Comparison of mean swelling size (in cm) between 05 study groups at different time intervals.

Comparison of mean swelling size (in cm) between 05 study groups at different time intervals using one way ANOVA Test.

Time	Groups	N	Mean	SD	Min.	Max.	P value
Baseline	Group 1	20	10.27	0.53	9.5	9.5	
	Group 2	20	10.66	0.82	9.3	9.3	0.19
	Group 3	20	10.30	0.57	9.4	9.4	
	Group 4	20	10.18	0.50	9.5	9.5	
	Group 5	20	10.39	0.75	9.0	9.0	
Day 1	Group 1	20	11.25	0.47	0.47	10.5	
	Group 2	20	11.65	0.81	0.81	10.4	0.005*
	Group 3	20	10.99	0.58	10.2	12.4	
	Group 4	20	10.97	0.46	10.4	12.0	
	Group 5	20	11.23	0.71	10.0	12.6	
Day 3	Group 1	20	10.96	0.56	9.8	12.0	
	Group 2	20	11.53	0.86	10.0	13.0	0.001*
	Group 3	20	10.78	0.59	10.0	12.0	
	Group 4	20	10.67	0.52	10.0	11.8	
	Group 5	20	10.92	0.71	9.8	12.2	
Day 7	Group 1	20	10.63	0.56	9.6	12.0	
	Group 2	20	11.07	0.83	9.8	12.8	0.03*
	Group 3	20	10.54	0.60	9.6	11.8	
	Group 4	20	10.41	0.49	9.8	11.4	
	Group 5	20	10.62	0.77	9.4	12.0	
Day 14	Group 1	20	10.40	0.50	9.6	11.6	
	Group 2	20	10.77	0.82	9.4	12.4	0.14
	Group 3	20	10.42	0.58	9.4	11.8	
	Group 4	20	10.26	0.46	9.6	11.2	
	Group 5	20	10.45	0.72	9.4	11.8	

Table 8

Comparison of mean mouth opening (in mm) between 05 study groups at different time intervals using one way ANOVA Test.

Comparison of mean mouth opening (in mm) between 05 study groups at different time interval using one way ANOVA test

Time	Groups	N	Mean	SD	Min	Max	P value
Baseline	Group 1	20	38.95	5.71	30	50	
	Group 2	20	39.60	7.13	24	52	0.78
	Group 3	20	37.65	6.06	20	45	
	Group 4	20	38.50	4.92	30	50	
	Group 5	20	39.85	5.96	30	50	
Day 1	Group 1	20	24.35	6.73	15	40	
	Group 2	20	24.75	7.38	15	40	0.91
	Group 3	20	23.05	4.71	15.0	30	
	Group 4	20	24.55	4.42	18.0	32	
	Group 5	20	23.50	8.91	10.0	40	

Day 3	Group 1	20	29.05	6.50	19.0	42	
	Group 2	20	30.30	7.32	20.0	42.0	0.74
	Group 3	20	27.90	4.80	20.0	36.0	
	Group 4	20	29.30	3.21	24.0	36	
	Group 5	20	28.30	6.81	18.0	42	
Day 7	Group 1	20	33.55	6.10	24.0	44	
	Group 2	20	35.30	6.50	24.0	44	0.65
	Group 3	20	32.80	4.37	25	40	
	Group 4	20	34.45	4.03	28	44	
	Group 5	20	33.85	5.32	25	45	
Day 14	Group 1	20	37.65	5.58	28	48	
	Group 2	20	38.95	6.86	24.0	50	0.76
	Group 3	20	37.10	4.92	30	45	
	Group 4	20	37.75	4.83	30.0	50	
	Group 5	20	39.05	5.82	30.0	50	

Table 9

Comparison of mean pocket depth (in mm) between 05 study groups at different time intervals.

Comparison of mean pocket depth (in mm) between 05 study groups at different time intervalsusing one way ANOVA test.

Time	Groups	N	Mean	SD	Min	Max	P value
Baseline	Group 1	20	3.55	0.51	3	4.5	
	Group 2	20	3.57	0.44	3	4.5	0.48
	Group 3	20	3.35	0.49	2	4.0	
	Group 4	20	3.41	0.44	3	4.0	
	Group 5	20	3.40	0.45	3	4.0	
Day 7	Group 1	20	4.50	0.52	3.6	5.5	
	Group 2	20	4.53	0.43	3.6	5.0	<0.001*
	Group 3	20	3.87	0.49	2.6	4.8	
	Group 4	20	3.92	0.43	3.4	4.6	
	Group 5	20	4.04	0.48	3.4	4.8	
Day 14	Group 1	20	4.50	0.52	3.6	5.5	
	Group 2	20	4.53	0.43	3.6	5.0	<0.001*
	Group 3	20	3.87	0.49	2.6	4.8	
	Group 4	20	3.92	0.43	3.4	4.6	
	Group 5	20	4.04	0.48	3.4	4.8	

Table 10

Comparison of mean gingival recession (in mm) between 05 study groups at different time interval.

Comparison of mean gingival recession (in mm) between 05 study groups at different time intervals using one way ANOVA test.

Time	Groups	N	Mean	SD	Min.	Max.	P value
Day 7	Group 1	20	0.52	0.11	0.4	0.8	
	Group 2	20	0.58	0.19	0.4	1.0	<0.001*
	Group 3	20	0.90	0.16	0.5	1.0	
	Group 4	20	0.50	0.13	0.2	0.8	
	Group 5	20	0.62	0.17	0.4	1.0	
Day 14	Group 1	20	0.53	0.11	0.4	0.8	
	Group 2	20	0.58	0.19	0.4	1.0	<0.001*
	Group 3	20	0.91	0.16	0.5	1.0	
	Group 4	20	0.50	0.13	0.2	0.8	
	Group 5	20	0.62	0.17	0.4	1.0	

Table 11

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Volume 3, Issue 1, Jan-Feb 2021 pp 311-320 www.ijdmsrjournal.com ISSN: 2582-6018

IV. DISCUSSION-

In our study, all the mesioangular impaction cases were operated under local anaesthesia. Out of 100 patients that were divided into 5 study groups, the mean age of patients was between 20-40 years of age and there is no statistical difference in age and gender between the study groups. [Table 6,]. This is similar to another study.[6]

Mean value of VAS score was highest for Group 3 (Envelope incision) and lowest for Group 4(Comma incision). Similar results were reported by other authors.[1, 9,11,19]

Comparison of VAS score between study groups showed a statistical difference of 0.007 after day 1, 0.009 after day 3 and 0.01 after day 14. Our VAS scores indicate that Comma incision is the least painful and the Envelope incision has highest pain potential. This finding has also mentioned by few other authors.[1,9,11,19]

The introduction of NSAIDS have significantly reduce the intensity or severity of pain.[20] Difficulty and duration of the operation increased the intensity of pain. Average pain is associated with depth and preoperative index of difficulty.[21,22]

In our study, mean value of swelling was highest for Group 2 (Modified Ward's incision) and lowest for Group 4 (Comma incision) which is supported by another studies.[1,3,4,19,23]

Comparison of mean swelling between 5 groups showed a statistical difference of 0.005 after day 1, 0.001 after day 3, and 0.03 after day 7.

Similarly comparison of mean swelling size between different time intervals showed a statistical difference of 0.001 in each study group.[Table 18, Graph 8].

In our study, the value of mean swelling size from day 1 to day 14 decreases in each group and is supported by another study.[8]

Multiple comparison of mean difference in swelling size between study groups at different time intervals showed a statistical difference between Group 2 (Modified Ward's incision)Vs Group 3 (Envelope incision) and between Group 2(Modified Ward's incision)Vs Group 4 (Comma incision) after day 1 and day 3. [Table 10]

Our mean value of swelling indicate that Modified Ward's incision leads to highest swelling and Comma incision leads to least swelling.[1,3,4,19,21,23,24]

To control postoperative inflammation, it is necessary to provide an adequate anti inflammatory therapy. Use of corticosteroids to limit the post- operative edema has been advocated due to their inhibitory action.[25,26]

In our study, there was no statistical difference in the mean mouth opening between 5 study groups at different time intervals.[Table 11,].

This is supported by the study which found that there is no advantage in choosing either flap design over the other to reduce the severity of trismus because distal incision path of all commonly used flap designs being the same.[19]

The reduction of mouth opening resolves within 7-10 days after surgical procedure with administration of antibiotics and analgesics.[17]

Mean value of pocket depth was highest for Group 2 (Modified Ward's incision) and least for Group 3 (Envelope incision). Similar result were reported by others authors.[3]

Comparison of pocket depth between study groups at different time intervals shows a statistical difference of 0.001.[Table 12,]

Our mean value of pocket depth indicate that Modified Ward's incision leads to maximum pocket depth and Envelope incision leads to minimum pocket depth. This finding has also mentioned by few other author.[3,10]

Gingival recession (in mm) between 5 study groups after day 7 showed a mean value of 0.52 with S.D 0.11 for Group 1 (Ward's incision), .58 with S.D 0.19 for Group 2 (Modified Ward's incision), 0.90 with S.D 0.16 for Group 3 (Envelope incision), 0.50 with S.D 0.13 for Group 4 (Comma incision), 0.62 with S.D 0.17 for Group 5 (Bayonet incision).[Table 14,]

Gingival recession between 5 study groups after day 14 showed same mean value as after day 7. Mean value of gingival recession was highest for Group 3 (Envelope incision) and lowest for Group 4 (Comma incision). Many article report the same finding.[1, 4,28]

Comparison of mean gingival recession between 05 study groups at different time intervals showed a statistical difference of 0.001.

V. CONCLUSION-

Five techniques of flap design have been described in our study for the surgical removal of the impacted mandibular third molar. We found advantages and disadvantages associated with each flap. The Envelope flap has advantage of good adaptation of gingival margin, but seems to be associated with more post-operative pain.

The Ward's incision and the Modified Ward incision have the advantage of better accessibility and visibility but seem to be associated with increased pocket depth distal to second molar. The Comma incision was found to be encountered with less degree of post-operative

healing issues compared to other flap designs, the only disadvantage seen is decreased accessibility.

The Bayonet incision also has advantage of good accessibility but over extension of the another incision into the sulcus puts the underlying vascularity at risk of rupture.

In our study all five flap designs performed adequately with no major significant changes in the parameters evaluated.

Therefore we conclude that the selection of the flap design is dependent on needs of the case and preference of the operating surgeon and does not seems to have a significant influence on the health of the tissue.

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