Efficacy of Inward Fragmentation Technique (IFT) Versus Conventional Technique in the Surgical Removal of Impacted Mandibular Third Molar- A Randomized Control Study

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Abstract

The aim of this randomized split mouth study was to compare the outcomes of Inward Fragmentation Technique (IFT) versus Conventional technique in the surgical removal of partially impacted mandibular third molars. Fifteen patients with similar bilateral impactions were included and divided randomly into two groups, Group A patients underwent conventional technique and Group B patients underwent inward fragmentation technique. All the patients in both the groups were critically evaluated for pain, swelling, trismus, Alveolar bone height both pre and post operatively, additional parameters like duration of surgery, wound dehiscence, infection and neurosensory deficit were also assessed. In conclusion, IFT can be a novel treatment option in selective cases of vertical, distoangular, mesioangular and soft tissue impactions. The modern thinking of conservative principles in the surgical practice demands the use of a surgical method with minimum postoperative complications and inward fragmentation technique can be one of them.

Keywords: Impaction, Inward Fragmentation Technique, Postoperative Pain, Swelling, Trismus, Alveolar Bone Height

Introduction

The surgical removal of impacted mandibular third molar involves the manipulation of both soft and hard tissues leading to immediate post-operative sequelae[1,2.] Most of the surgical procedures demand proper preoperative planning and the blending of surgical technique with surgical principles for decreasing the incidence of complications which may occur intraoperatively or develop in the postoperative period. Conventional surgical extraction of impacted mandibular third molar requires lateral and distal bone removal using rotary instruments to allow mobilization of the tooth, this technique is associated with increased postoperative pain, swelling, increased incidences of dry socket and damage to the inferior alveolar nerve. Morbidity following third molar surgery is currently being discussed with the aim of reducing intraoperative as well as postoperative complications. To achieve reduction in the post operative morbidity numerous attempts have been made such as- use of analgesics, local or systemic corticosteroids, modification in flap designs, use of drain, secondary wound closure and coronectomy[3-6] Recently a shift in paradigms can be observed towards atraumatic techniques in third molar surgery to reduce the postoperative complications. In this regard, a new technique called Inward Fragmentation Technique (IFT) has evolved in the management of selective cases of third molar impactions, which does not involve rising of flap or bone removal. Evidence regarding the efficacy of IFT is sparse; therefore this study aims to compare the outcomes of conventional technique versus IFT in the surgical

removal of impacted mandibular third molars.

Aim and Objectives

The aim of this randomized split mouth study was to compare the outcomes of Inward Fragmentation Technique (IFT) versus Conventional technique in the surgical removal of partially impacted mandibular third molars. The objective of this study was to evaluate the efficacy of two different techniques in terms of duration of surgery, bone height at operative site, post-operative sequelae and limitations of inward fragmentation technique if any.

Patients and Methods

A randomized split mouth clinical trial was designed in which the subjects served as their own controls. The study sample was derived from the patients who visited Department of Oral and Maxillofacial Surgery, Faculty of Dental Sciences, Ramaiah University of Applied Sciences, Bangalore, India, for the management of bilateral partially impacted mandibular third molar. Ethical clearance was obtained from the Institution for conducting the study and written informed consent was taken from all the patients included in the study. Fifteen healthy individuals in the age group of 18-35 years with bilateral partially impacted mandibular third molars that were fairly similar in terms of angulation, degree of impaction, estimated difficulty of removal and with absence of acute inflammatory symptoms were included in the study and individuals with horizontally impacted mandibular third molars, missing second molar, underlying systemic disease, compromised immunity, pregnant women and lactating mothers were excluded from the study.

All patients included in the study were randomly allocated into two groups: Group A- undergoing surgical removal by conventional technique on one side and Group B- undergoing surgical removal by IFT on opposite side. All the patients in both the groups were critically evaluated for pain, swelling and trismus, alveolar bone height was measured both pre operatively and post operatively. Further, additional parameters like duration of surgery, wound dehiscence, infection and neurosensory deficit were also assessed. All the parameters were evaluated and assessed preoperatively, intraoperatively and postoperatively as of Table 1.

Patient Evaluation

Pain intensity was assessed using a 10-level visual analog scale (VAS) with the patient placing a mark on the scale to indicate an intensity range from no pain '0' to severe/unbearable pain '10'. The mouth opening was assessed by measuring maximum inter-incisal distance using a divider and scale.

The evaluation of facial swelling was performed measuring distance from Line A: - Tragus to soft tissue pogonion, Line B: - Tragus to corner of mouth, Line C: - Lateral corner of the eye to angle of mandible, using 2-0 silk thread and then transferred on scale, facial swelling was calculated by the sum of three measurements divided by three (A+B+C/3). Pre and post operative alveolar bone height was assessed using Panoramic radiographic (OPG) images- by drawing a tangent (CT) along the occlusal crown surface of adjacent second molar to the longitudinal axis (LA) of the mandibular third molar with reference to the most apical root tip (A). Bone height (BH) was assessed along the longitudinal axis as the distance of the apical point (A) to the intersection with the upper alveolar bone contour (BC)[7]. (Fig 1) Duration of surgery was measured by recording the operating time as follows: Group A- from the start of incision to completion of suturing and Group B- from the start of soft tissue detachment using the periosteal elevator to completion of wound toileting. Assessment of delayed healing or infection was done by clinical assessment of persistent pain, swelling and pus discharge from the extraction socket. Visual control was used to evaluate a possible wound dehiscence.

A standardized operative procedure was carried out by a single operator for all the patients after appropriate pre-operative evaluation. Under strict aseptic precautions, 2% lignocaine with 1:2,00,000 adrenaline was used to procure local anesthesia.

In Group A- a modified ward's incision was given and full thickness mucoperiosteal flap was raised, bone guttering was done using a straight fissure bur under constant irrigation with sterile

normal saline the tooth was delivered followed by wound toileting and primary closure using 3-0 mersilk sutures.

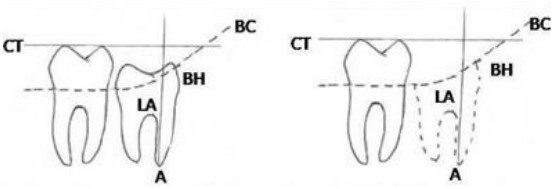

Fig. 1 Radiographic assessment of alveolar bone height

In Group B- soft tissue surrounding the mandibular third molar was detached using the periosteal elevator and crown was exposed, trephination of tooth was performed using straight fissure bur under constant irrigation with sterile normal saline in order to provide access to the pulp chamber, the trephination was oriented in a transverse direction from buccal to lingual parts of crown to create internal space, using a round bur the pulp was opened widely towards the level of furcation, the fragmented mesial and distal parts were removed by giving inward movement into the space created, wound toileting was performed and no sutures were placed in any of the cases. (**Fig. 2**)

All the patients were advised, Amoxicillin 500mg -thrice daily for five days, Metronidazole 400mg -thrice daily for three days, combination of Aceclofenac + Paracetamol twice daily for 3 days, Chlorhexidine mouthwash- thrice daily and soft diet for 3 days.

Statistical Tests:

For statistical analysis Student's t-test and ANOVA were used and was performed using the statistical software SPSS version 8.0 for Windows, the differences with a $P < 0.05$ were found to be statistically significant.

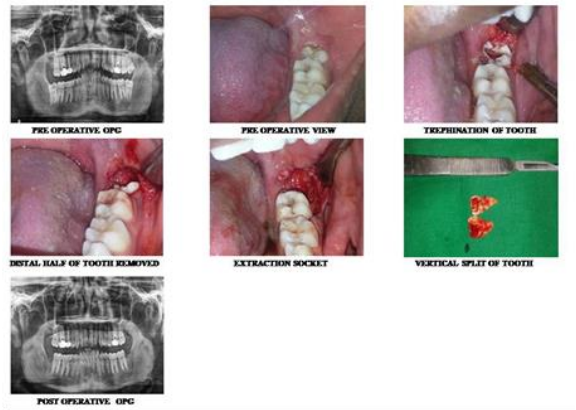

Fig. 2 Stepwise procedure of inward fragmentation technique

Results:

The patient's collected data for different variables at different time intervals were analyzed and the following results and observations were recorded.

The clinical data which includes patient's gender, age and type of impaction is illustrated in **Table 2, 3** and **4** respectively.

The mean value of pain among group A was (5.2 on day 1),(3.66 on day 3), (1.2 on day 7) and among group B, 1.46 on day 1, 0.66 on day 3 and 0.06 on day 7 respectively.(p value .000) **Table 5, Fig. 3**

The mean value of mouth opening among group A was 33.06mm on day 1, 36.13mm on day 3, 40.33mm on day 7 and among group B, 41.40mm on day 1, 42.13mm on day 3 and 42.26mm on day 7 respectively with p value 0 .000 for day 1 and day 3. **Table 6, Fig. 4**

The mean of swelling variable recorded in group A was 2.13mm on day 1, 2.33mm on day 3, 1.16mm on day 7 and patients in the group B had a mean average of 1.17mm on day 1, day 3 and day 7 respectively. There was statistically significant difference between the two groups on day 1 with p value .000. **Table 7, Fig. 5**

The preoperative mean alveolar bone height in group A and group B was 16.46 mm and 16.60 mm respectively with statistical significance. (P value 0.61).

Mean height of alveolar bone recorded post

operatively in both groups was 14.46 mm and 16.60 mm respectively and it was statistically significant. (P value 0.000) **Table 8, Fig. 6**

Duration of surgery among the study population was in the range of 25-35min with a mean average of 28±3 min in group A and was about 30-40min with a mean average of 33±3 min in group B. (p value 0.001) **Table 9, Fig. 7**

The incidence of infection in both the techniques was not statistically significant as none of the patients showed signs of infection. About 8 (53.3%) patients in group A showed wound dehiscence and 2 (13.3%) patients in the same group presented with paraesthesia. None of the patients in the group B showed post operative complications. **Table 10, Fig. 8**

Discussion:

The surgical removal of mandibular third molar is a widely practiced procedure in Oral and Maxillofacial Surgery. The postoperative sequelae to third molar surgery involve some degree of pain, swelling and trismus, their frequency and intensity depends on the nature of surgery[3,8-10]. The problems associated with the removal of impacted mandibular third molar have led us to compare and assess clinically, the level of effectiveness of two different techniques / approaches. The best and easiest way to manage a complication is to prevent its occurrence and it begins with thorough pre-operative assessment of all the patients, which includes history, clinical examination and imaging[11].

In our study digital panoramic radiographs were used for all the patients to assess the type of impaction, preoperative bone height and predict surgical difficulties. The parameters like age, gender, type of impaction were standardized in the study. The incidence of the type of third molar impaction in the present study in the decreasing order of magnitude was Vertical (60%), Mesioangular (26.6%) and Distoangular (13.3%) respectively. (**Table 4**)

The rate of complications associated with the procedure is directly proportional to the duration of the procedure. Surgical time depends on various parameters like patients co-operation, instruments used, experience of the surgeon, accessibility and visibility from patient to patient[12].

The time taken to perform IFT (Group B) was significantly less than conventional third molar removal with (Group A) p value 0.001. The reason for prolonged surgical time in group A was because of placement of incision, raising of mucoperiosteal flap and suturing which were avoided in group B.

Pain is the most common sequelae to the impacted lower third molar surgery[13, 14]. In our study, statistically significant difference (p value 0.000) was found in the pain scores between the two groups. The intensity of pain was more in group A than group B on day 1, the results of day 3 showed persistence of pain in group A whereas the pain level was drastically reduced in group B. However pain had subsided in group A on the 7th post-operative day. **(Table 5, Fig. 3)**. We also observed that patients in group B consumed less dose of analgesics prescribed as a protocol than group A, giving an inference that the patients in group B experienced less pain.

Swelling is the reaction of a living tissue to trauma and is due to synthesis of prostaglandins and release of inflammatory mediators. In a study the authors reported that the amount of facial swelling varied depending on age and sex of the patient, the relation of third molar to the ramus of the mandible and amount of bone to be removed[15]. The swelling scores compared and reported in the previous studies showed that there was peak increase in the swelling during first 24 hrs to 72 hrs that gradually came to pre operative levels on 5th post operative day[4,16]. The results of our study showed statistically significant difference between the two groups with respect to post operative swelling **(Table 7, Fig. 5)** on 1st and 3rd post operative day (p value 0.000). Group A showed marked swelling on day 1 and day 3 postoperatively, whereas group B patients did not show any change in the baseline measurement values. This could be attributed to avoidance of mucoperiosteal flap reflection and ostectomy. However the swelling subsided in group A by 7th post operative day.

Surgery of impacted lower third molar frequently results in restriction of mouth opening. Trismus

after mandibular third molar surgery is usually caused by inflammation of the masticatory muscles, leading to spasm secondary to the raising of a mucoperiosteal flap. In the literature, it is reported that regardless of the surgical trauma the mouth opening reaches its preoperative values approximately on 5th post operative day following traditional third molar surgery [10]

The results of our study showed statistically significant difference (p value 0.001) among the two groups with respect to mouth opening on day 1 and day 3 respectively. The subjects in group A showed significant reduction in the mouth opening on day 1 and day 3 compared to group B which was attributed to the mucoperiosteal flap reflection, tissue handling and increased duration of surgery. **(Table 6, Fig. 4)** Even though group B patients did not show much difference in the baseline value, few patients showed reduction of mouth opening which involved majority of female patients and the time taken and pain intensity in these patients was also more on day 1.

The flap design used to remove impacted lower third molar also has an influence on the incidence of post-operative pain, swelling and trismus. The modified triangular flap is less conducive to cause development of wound dehiscence but it causes greater extra oral swelling, according to some authors[17]. In our study, modified wards incision was used in group A which showed significant rate of increase in pain, swelling and trismus as compared to group B.

One of the factors most closely linked to the intensity of post operative pain and swelling is the type of healing of the surgical wound. Conflicting opinions have been expressed in literature regarding primary and secondary healing. A comparative study on primary and secondary healing following surgical removal of third molar concluded that, open healing of the surgical wound after third molar surgery produces less post operative pain and swelling than the closed healing by suturing[18]. In our study the patients in group B underwent healing by secondary intention as compared to group A where the wound was closed by suturing. The patients in group B showed less pain and swelling compared to group A and is correlating to the results revealed in the literature.

Many a times, the third molar surgery involves the removal of surrounding bone and trauma caused adds to the postoperative morbidity. The bone will be usually removed by using rotary instruments and the heat generated due to this acts as a contributing factor for post-operative sequelae[19].

In our study the bone level analysis was done both pre and post operatively. There was no statistical difference seen between the two groups in pre operative alveolar bone height (p value 0.61). Comparison of bone levels before and following removal revealed a significant mean bone loss of 2.03mm in the conventional technique which was statistically significant with p value 0.000. **(Table 8, Fig. 6)**. However, IFT showed no reduction of the lateral or lingual bone walls as no bone guttering was performed and entire perialveolar bone architecture was maintained.

Although uncommon, few cases of inferior alveolar nerve and lingual nerve injury are reported after third molar surgery. Incidence varies between1.3%and 5.3%. Studies have reported that when the crown of mesioangular impacted tooth is elevated, the root apices compress over the inferior alveolar canal resulting in neuropraxia (Seddon type I). They concluded that unerupted mandibular third molar teeth are closer to inferior alveolar nerve canal than erupted teeth. Mesioangular impactions are most closely positioned to the inferior alveolar canal and can be considered as risk factor for post operative paresthesia[7,20,21]. The resulting neurosensory deficits usually resolve within 4-6 wks without any intervention. In our study, two cases of transient inferior alveolar nerve injury occurred in conventional group which resolved after 2 wks and the cause may be attributed to the position, angulation, approximation of tooth to the inferior alveolar canal and technique employed to remove the tooth. The tooth was mesioangular and was in close approximation to the inferior alveolar canal. The similarly positioned teeth removed using inward fragmentation technique on the opposite side in the same patients did not show any signs and symptoms of neurosensory changes.

Inward fragmentation technique can be considered as a surgical treatment option for third molar surgery in cases which are of mesioangular, vertical, distoangular with class I ramus relationship and position A and B depth. In conditions where, impacted tooth delivery requires tooth division especially in cases where roots show unfavorable curvature or if there are conflicting lines of withdrawal the IFT can be advantageous over the conventional removal technique. IFT cannot be considered in cases of complete bony impactions and horizontal impactions. The mandibular third molars removed in our study included the teeth with bifurcated roots and use of IFT in teeth with fused roots could not be explored.

The best possible intraoperative visualization is necessary to maintain a high level of success as IFT requires the surgical field to be viewed at various angles and distances without losing depth of the field and focus[7]. A precise odontosection and removal of tooth is necessary in this technique without the need for lateral access and hence the procedure is technique sensitive.

Summary & Conclusions

The results of our study showed that IFT produced lesser incidence of pain, swelling, trismus and was performed in shorter time compared to conventional technique. IFT showed no reduction in height of the lateral or lingual bone walls and entire perialveolar bone architecture was maintained compared to conventional technique.

In conclusion, IFT can be a novel treatment option in selective cases of vertical, mesioangular and soft tissue impactions, which fall into level-A and class-1 category. A precise odontosection and removal of tooth without the need for lateral access makes the procedure technique sensitive and demands expertise. The modern thinking of conservative principles in the surgical practice demands the use of a surgical method with minimum postoperative complications and inward fragmentation technique can be one of them.

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Conflict of interest: None declared

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Table 1. Evaluation of parameters at different time intervals

Parameters	Preoperative	Intraoperative	Postoperative			
			Day 1	Day 3	Day 7	1 Month
Pain			✓	✓	✓	
Swelling	✓		✓	✓	✓	
Trismus (Inter-incisal distance)	✓		✓	✓	✓	✓
Radiographic assessment of alveolar bone height	✓					✓
Duration of surgery		✓				
Additional findings (wound dehiscence, infection and neurosensory deficit)			✓	✓	✓	

Table 2. Distribution of gender among study population in percentage

Gender	Group A		Group B	
	Number	Percentage	Number	Percentage
Males	05	33.3 %	05	33.3 %
Females	10	66.6 %	10	66.6 %

Table 3. Distribution of age among study population

Mean age	26.70
Maximum age	35.00
Minimum age	18.00

Table 4. Incidence of type of impactions among study population in number and percentage

Type of Impaction	Group A	Group B	Percentage
Vertical	9	9	60
Mesioangular	4	4	26.6
Distoangular	2	2	13.3

Table 5. Mean and standard deviation of pain among study population using VAS

Pain	Groups	N	Mean	Std. Deviation	Std. Error Mean	Mean difference	p - value	95% Confidence Interval	
								Upper	Lower
Day one	A	15	5.20	1.20	0.31	3.00	0.00	3.03	4.42
	B	15	1.47	0.51	0.13				
Day three	A	15	3.67	0.72	0.18	3.00	0.00	2.53	3.46
	B	15	0.67	0.49	0.12				
Day seven	A	15	1.20	0.86	0.22	1.13	0.00	0.64	1.62
	B	15	0.067	0.26	0.067				

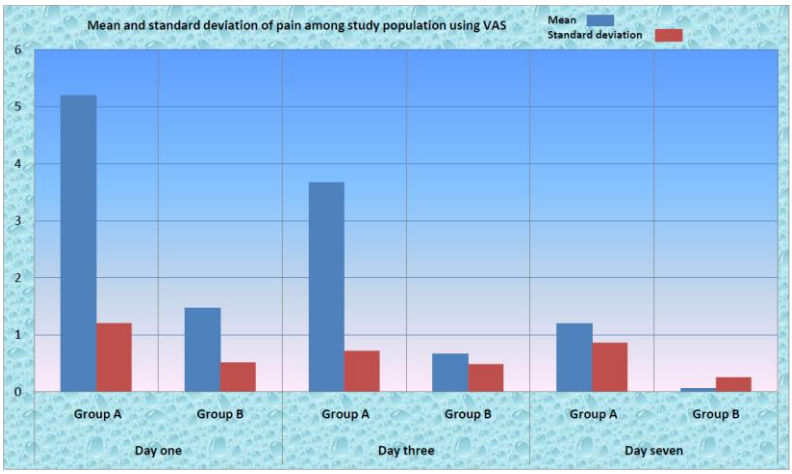

Fig.3 Mean and standard deviation of pain scores among study population using VAS

Table 6. Mean and standard deviation of mouth opening among study population in mm

Mouth Opening	g Groups	N	Mean	Std. Deviation	Std. Error Mean	Mean difference	p - value	95% Confidence Interval	
								Upper	Lower
Day one	A	15	33.07	4.83	1.25	-8.30	0.00	-11.61	-5.04
	B	15	41.40	3.90	1.00				
Day three	A	15	36.13	3.90	1.00	-6.00	0.00	-8.83	-3.16
	B	15	42.13	3.66	0.94				
Day seven	A	15	40.33	3.63	0.94	-1.90	0.15	-4.61	0.74
	B	15	42.26	3.53	0.91				
1 month	A	15	42.26	3.53	0.91	0.00	1.00	-2.61	2.60
	B	15	0.267	3.53	0.91				

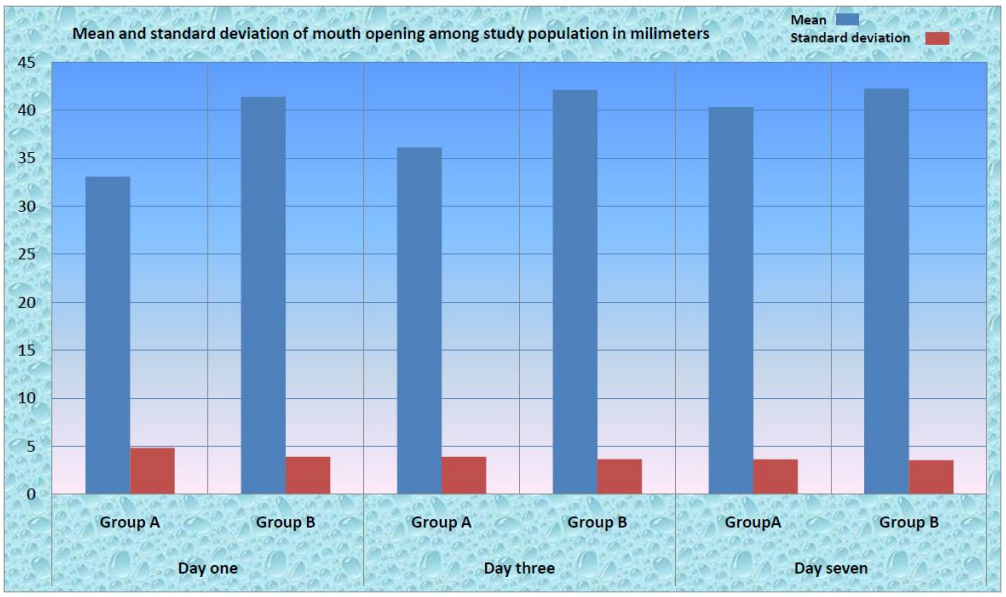

Fig.4 Mean and standard deviation of mouth opening among study population in mm

Table 7. Mean and standard deviation of facial swelling among study population in mm

Swelling	Groups	N	Mean	Std. Deviation	Std. Error Mean	Mean difference	p - value	95% Confidence interval	
								Upper	Lower
Day one	A	15	1.19	4.42	1.14	2.0	0.00	-1.36	5.36
	B	15	1.17	4.56	1.17				
Day three	A	15	1.17	4.52	1.16	0.86	0.60	-2.53	4.26
	B	15	1.17	4.56	1.17				
Day seven	A	15	1.17	4.59	1.18	0.00	1.00	-3.42	3.4
	B	15	1.17	4.56	1.18				

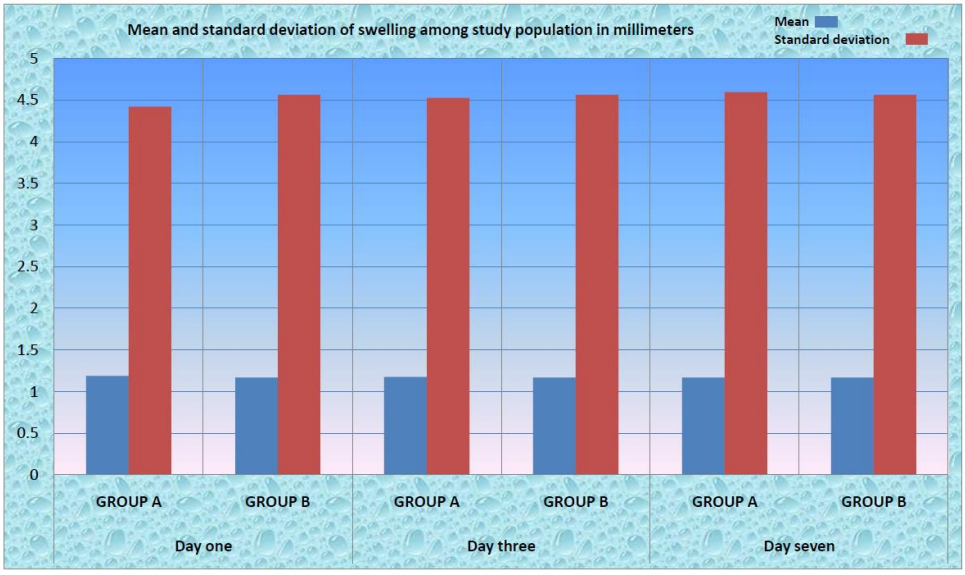

Fig. 5 Mean and standard deviation of facial swelling among study population in mm

Table 8. Mean and standard deviation of alveolar bone height between groups in mm

Variable	Mean (mm)	SD	t	p - value	95% Confidence interval	
					Upper	Lower
Group A pre op bone height	16.46	2.03	-0.52	0.61	-0.68	0.41
Group B pre op bone height	16.60	1.68				
Group A post op bone height	14.46	1.95	-12.91	0.00	-2.48	-1.77
Group B post op bone height	16.60	1.68				

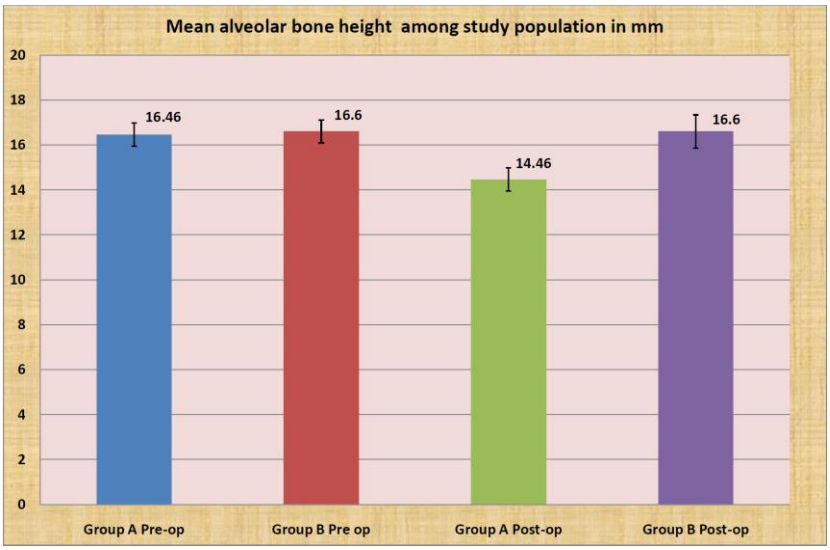

Fig. 6 Mean alveolar bone height among study population in mm

Table 9. Mean of duration of surgery between groups in minutes

	Group A	Group B	p – value
Mean time	33±3	28±3	0.001

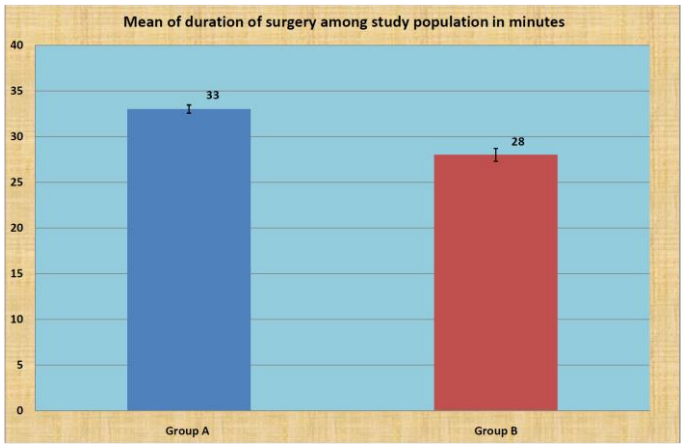

Fig. 7 Mean of duration of surgery among study population in minutes

Table 10. Incidence of complications among study population in percentage

Complications	Group A	Group B	Percentage
Infections	0	0	0
Wound dehiscence	8	NA	53.30
Paraesthesia	2	0	13.30

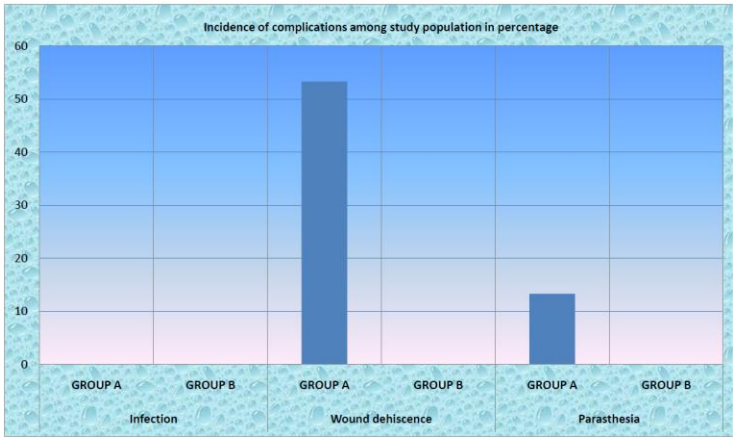

Fig. 8 Incidence of complications among study population in percentage

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