

# Comparative Evaluation of Post-operative Sequelae Using Diode Laser and Conventional Scalpel Blade for Soft Tissue Incision in Impacted Mandibular Third Molar Surgery- A Prospective Split Mouth Study

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## Abstract

**Aim:** This study aims to compare the surgical outcome using diode laser with conventional scalpel blade for soft tissue management during surgical removal of impacted mandibular third molars.

**Objective:** The objective of the study is to compare soft tissue incision making by diode laser with conventional scalpel and blade, to evaluate the ease of surgical incision making using diode laser, to evaluate the post-operative sequel such as pain, swelling, and trismus in both groups, and to evaluate post-operative complication like incidence of dry socket.

**Specifications of Efficacy Parameters:** The intensity of post-operative pain, swelling, trismus, and incidence of dry socket: on post-operative days 3, 5, 7 and 15.

**Study Group:** The sample size estimated is 30 sites, that is, 15 in Group 1 (Conventional Scalpel Blade group) and 15 in Group 2 (Diode laser group). Since this research employs split mouth design, total subjects to be included will be 15.

**Conclusion:** Diode laser was well tolerated by the patients, and it is more successful than conventional treatment methods. Therefore, diode lasers treatment can form an integral part of oral surgery therapy in the future. However, further longitudinal studies are required to evaluate the long-term effects of diode laser on clinical as well as microbiological parameters.

**Key words:** Mandible, Molar, Surgery

## INTRODUCTION

Third molar surgery is the most common procedure performed in oral and maxillofacial surgery practice. They are directly or indirectly, the underlying cause of numerous disorders in the jaw and facial regions. It has been well documented that impacted third molars, either partial

or complete, are associated with several complications according to the work of Oikarinen in 1991 and Kim in 2006, including pericoronitis, regional pain, odontogenic abscesses, dry socket, trismus, distal caries in second molar, cysts, tumors, and arch crowding. The highest incidence of impaction has been shown in mandibular wisdom teeth. Early removal of these teeth to prevent the above mentioned problems is widely approved. Therefore, symptomatic or asymptomatic impacted third molars are often extracted to reduce the above mentioned clinical symptoms and complications.<sup>[1-5]</sup>

Diode lasers seem to have numerous applications in the field of oral and maxillofacial surgery in view of soft

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tissue applications including incision, hemostasis, and coagulation. Many advantages of the laser vs. the scalpel blade have been discussed in the literature. These include a bloodless operating field, minimal swelling, scarring, and much less or no postsurgical pain.<sup>[5-8]</sup>

Due to its characteristics, as well as to other known advantages, the diode laser has been compared to the other conventional methods. It has been subject of a diversity of studies intended to evaluate its potential in relation to its biocompatibility.

Diode lasers have opened up a new age as an alternative to conventional blade scalpel in oral and maxillofacial surgery. As well as being selective, the incision performed through lasers maximizes surgical precision, resulting in minimal damage to soft tissue. In addition, a blood less surgical site provides maximum intraoperative visibility.<sup>[9-14]</sup>

Few studies compared, diode lasers with the conventional scalpel blade surgical technique and found that pain, swelling, trismus and incidence of dry docket were significantly decreased in the laser group patients but patients undergoing surgery with lasers experienced longer surgery time whereas significantly shorter time with conventional techniques.<sup>[15-19]</sup>

**Aim**

The study aims to compare the surgical outcome using diode laser with conventional scalpel blade for soft tissue management during surgical removal of impacted mandibular third molars.

**MATERIALS AND METHODS**

Local anesthesia with adrenaline in 1:200,000 will be administered by the inferior alveolar, lingual and long buccal nerve blocks.

Appropriate incision will be taken in conventional group by scalpel blade on one side of the jaw and in study group by diode laser on other side of the jaw and flap reflected. Impacted tooth will be surgically exposed. Straight handpiece will be used at 35,000 rpm for trephination and guttering at the buccal or distal aspect of the tooth, or both. A straight fissure bur will be used to section the tooth when needed. At all times cutting of bone and tooth will be accompanied by copious irrigation with saline solution. Tooth extracted by help of an appropriate forceps or luxator. Extraction socket irrigated and fresh bleeding induced. Flap will be sutured with non-resorbable (3-0) silk suture. Antibiotics and analgesics will be given in regular fashion. Patient will be recalled after 2 weeks for removal of the impacted tooth on the contra-lateral side.

**RESULTS**

A total of 15 patients with symmetrical bilateral impacted mandibular third molars requiring surgical removal were incorporated in the present study.

Various criteria's viz, ease of incision (Duration of the Surgery and Bleeding from Soft tissue), pain, swelling, trismus, and incidence of dry socket were assessed using statistical analysis through SPSS version 23. Descriptive statistics, Paired *t*-test was done for intergroup comparison at different time intervals and Independent *t*-test was done for intergroup comparison at different intervals.

**Ease of Incision**

*Duration of surgery*

Average duration of the surgery in control group (Group 1 = Conventional Group) mean 21.32 ± 9.02 and study group (Group 2 = Diode Laser) mean was 44.84 ± 10.54.

Inference: There is statistically highly significant difference present between both the groups (*P* < 0.001)

*Bleeding from soft tissue*

Average bleeding from bone in control group (Group 1 = Conventional Group) mean 4.60 ± 0.56 and study group (Group 2 = Diode Laser) mean was 2.52 ± 0.51.

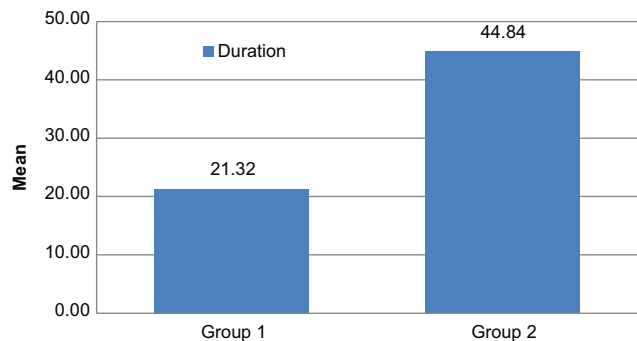
**PAIN (VISUAL ANALOGUE SCALE [VAS])**

Average pain in control group (Group 1 = Conventional Group) mean on 3<sup>rd</sup> day was 3.68 ± 1.6, 5<sup>th</sup> day 1.68 ± 1.7, 7<sup>th</sup> day 0.32 ± 0.74, 15<sup>th</sup> day 0.00 ± 0.00 and study group (Group 2 = Diode Laser) mean on 3<sup>rd</sup> day was 1.60

**Table 1: Intergroup comparison of duration of procedure**

Parameter	n	Group 1		Group 2		Mean difference	P value
		Mean	SD	Mean	SD		
Duration	25	21.32	9.02	44.84	10.54	-23.52	<0.001**

\*\*-Highly significant (*P*<0.001)



$\pm 1.41$ , 5<sup>th</sup> day  $0.48 \pm 0.87$ , 7<sup>th</sup> day  $0.00 \pm 0.00$ , 15<sup>th</sup> day  $0.00 \pm 0.00$ .

**Swelling (Digital Caliper/Manual Measuring Tape)**

Average comparison of swelling in control group (Group 1 = Conventional Group) from lateral canthus of the eye to gonion (LCG) mean on 3<sup>rd</sup> day was  $10.65 \pm 1.22$ , 5<sup>th</sup> day  $11.79 \pm 0.73$ , 7<sup>th</sup> day  $10.43 \pm 1.44$ , 15<sup>th</sup> day  $8.87 \pm 1.19$  and study group (Group 2 = Diode Laser) swelling measured from lateral canthus of the eye to gonion mean on 3<sup>rd</sup> day was  $9.58 \pm 1.07$ , 5<sup>th</sup> day  $9.46 \pm 0.96$ , 7<sup>th</sup> day  $9.82 \pm 1.25$ , 15<sup>th</sup> day  $9.02 \pm 1.13$ .

There is statistically significant difference present in mean distance from lateral canthus of eye to gonion in both the groups postoperatively at day 3, 5 with less swelling in Group 2 postoperatively when compared between both groups ( $P < 0.05$ ), and statistically non-significant when compared between pre-operative, 7<sup>th</sup> day and 15<sup>th</sup> day ( $P > 0.05$ ).

Average comparison of swelling in control group (Group 1 = Conventional Group) measuring from tragus to corner of the mouth (TM) mean on 3<sup>rd</sup> day was  $13.16 \pm 1.79$ , 5<sup>th</sup> day  $14.47 \pm 1.41$ , 7<sup>th</sup> day  $13.64 \pm 1.45$ , 15<sup>th</sup> day  $11.89 \pm 0.63$  and study group (Group 2=Diode Laser) swelling measuring from tragus to corner of the mouth (TM) mean on 3<sup>rd</sup> day was  $11.75 \pm 1.02$ , 5<sup>th</sup> day  $12.67 \pm 1.04$ , 7<sup>th</sup> day  $11.77 \pm 0.74$ , 15<sup>th</sup> day  $11.32 \pm 1.18$ .

There is statistically highly significant difference present in mean distance from tragus to corner of the mouth in both the groups postoperatively at day 5 and 7 ( $P < 0.001$ ) while statistically significant day 3 and 15 ( $P < 0.05$ ) with less swelling in Group 2 postoperatively when compared between both the groups.

Average comparison of swelling in control group (Group 1=Conventional Group) measuring from tragus to pogonion (TP) mean on 3<sup>rd</sup> day was  $16.07 \pm 1.02$ , 5<sup>th</sup> day  $17.33 \pm 1.43$ , 7<sup>th</sup> day  $15.41 \pm 0.94$ , 15<sup>th</sup> day  $14.59 \pm 1.68$  and study group (Group 2=Peizosurgery) swelling measuring from TP mean on 3<sup>rd</sup> day was  $15.40 \pm 0.86$ , 5<sup>th</sup> day  $15.50 \pm 2.16$ , 7<sup>th</sup> day  $15.45 \pm 1.40$ , 15<sup>th</sup> day  $14.82 \pm 1.60$ .

There is statistically highly significant difference present in mean distance from TP between both the groups postoperatively at day 7 ( $P < 0.001$ ), statistically significant difference present on post-operative day 3 ( $P < 0.05$ ) while nonsignificance difference seen on comparison of pre-operative day and day 7, 15 ( $P > 0.05$ ) with less swelling in Group 2 postoperatively when compared between both the groups.

**Trismus (Mouth Opening- Inter Incisal Distance)**

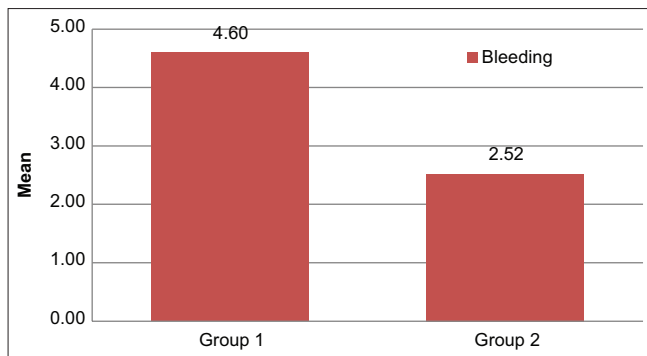
Average comparison of Trismus (mouth opening) in control group (Group 1=Conventional Group) mean on 3<sup>rd</sup> day was  $18.24 \pm 4.59$ , 5<sup>th</sup> day  $25.16 \pm 4.54$ , 7<sup>th</sup> day  $32.56 \pm 5.01$ , 15<sup>th</sup> day  $41.72 \pm 3.48$  and study group (Group 2 = Diode Laser) Trismus (mouth opening) mean on 3<sup>rd</sup> day was  $28.80 \pm 6.21$ , 5<sup>th</sup> day  $35.48 \pm 4.64$ , 7<sup>th</sup> day  $40.52 \pm 4.13$ , 15<sup>th</sup> day  $41.88 \pm 3.56$ .

There is statistically highly significant difference present in mean mouth opening on day 3, 5, 7 ( $P < 0.001$ ) and nonsignificant difference seen on preoperative and day 15 postoperatively ( $P > 0.05$ ) when compare between both groups [Tables 1-8].

**Table 2: Intergroup comparison bleeding index**

Parameter	n	Group 1		Group 2		Mean Difference	P value
		Mean	SD	Mean	SD		
Bleeding index	25	4.60	0.56	2.52	0.51	2.08	<0.001**

\*\*-Highly significant ( $P < 0.001$ ). Inference: There is statistically highly significant difference present between both groups in terms of bleeding from bone index



**DISCUSSION**

An impacted tooth is one which is completely or partially unerupted and is positioned against another tooth, bone, or soft tissue so that its further eruption is unlikely described according to anatomic position. Among the human dentition mandibular third molar is the second most common tooth to be impacted, next to maxillary third molar.<sup>[20-24]</sup>

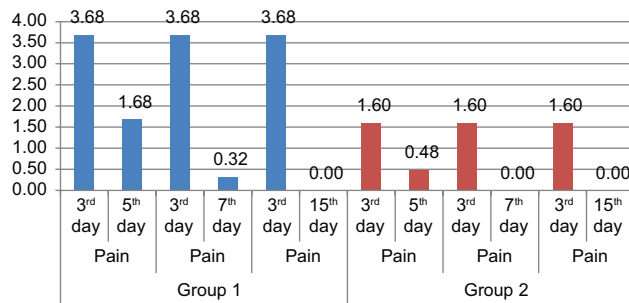
Impacted teeth are held responsible for spectrum of pathologies ranging from simple periodontal defects posterior to the second molar to odontogenic cysts and tumors, including caries in the second and third molars, pericoronitis, neurogenic pain, crowding of the dentition. Therapeutic or prophylactic indications make the surgical removal of the impacted third molar a commonest procedure performed in private Dental clinics, Dental colleges, or Hospital setting by an Oral and Maxillofacial Surgeon.

Some of the most frequent complaints following third molar surgery are pain, swelling and trismus. Few authors found that trismus and swelling are closely associated with acute inflammation following third molar surgery. Inferior

**Table 3: Intragroup comparison of pain at various durations**

Group	Parameter	Duration	Mean	n	std. deviation	Std. error mean	Mean difference	P value
Group 1	Pain	3 <sup>rd</sup> day	3.68	25	1.6000	0.3200	2.0000	<0.001**
		5 <sup>th</sup> day	1.68	25	1.7010	0.3402		
	Pain	3 <sup>rd</sup> day	3.68	25	1.6000	0.3200	3.3600	<0.001**
		7 <sup>th</sup> day	0.32	25	0.7483	0.1497		
		15 <sup>th</sup> day	0.00	25	0.0000	0.0000		
Group 2	Pain	3 <sup>rd</sup> day	1.60	25	1.4142	0.2828	1.1200	<0.001**
		5 <sup>th</sup> day	0.48	25	0.8718	0.1744		
	Pain	3 <sup>rd</sup> day	1.60	25	1.4142	0.2828	1.6000	<0.001**
		7 <sup>th</sup> day	0.00	25	0.0000	0.0000		
	Pain	3 <sup>rd</sup> day	1.60	25	1.4142	0.2828	1.6000	<0.001**
		15 <sup>th</sup> day	0.00	25	0.0000	0.0000		

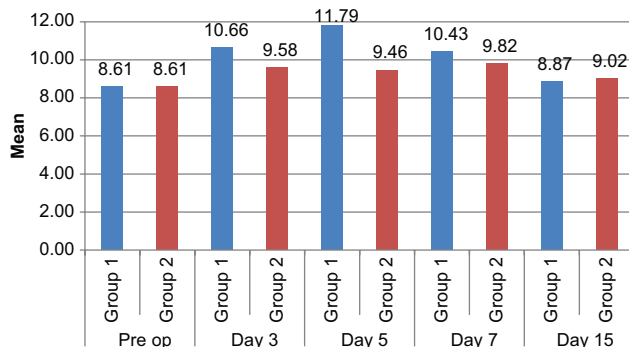
\*\*-Highly significant (P<0.001). Inference: There is statistically highly significant difference present in pain intensity at various durations. Group 2 has lower pain intensity in all durations than in Group 1



**Table 4: Intergroup comparison of swelling distance between lateral canthus of eye to gonion (LCG)**

Duration	Group	n	Mean	Std. deviation	Std. error mean	Mean difference	P value
Pre op	Group 1	25	8.61	1.1543	0.2309	0.0000	1 NS
	Group 2	25	8.61	1.1543	0.2309		
Day 3	Group 1	25	10.66	1.22582	0.24516	1.08200	0.002*
	Group 2	25	9.58	1.07714	0.21543		
Day 5	Group 1	25	11.79	0.73899	0.14780	2.33000	<0.001**
	Group 2	25	9.46	0.96195	0.19239		
Day 7	Group 1	25	10.43	1.4409	0.2882	0.6080	0.118 NS
	Group 2	25	9.82	1.2563	0.2513		
Day 15	Group 1	25	8.87	1.19442	0.23888	-0.15400	0.642 NS
	Group 2	25	9.02	1.13331	0.22666		

NS: Not significant (P>0.05),\*\*-Highly significant (P<0.001), \*-Significant (P<0.05)



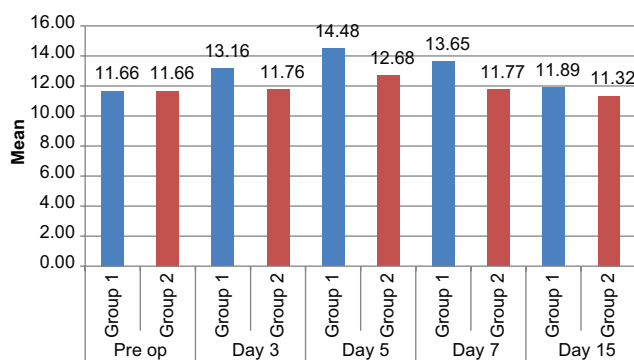
alveolar nerve injury is a well-documented complication of maxillofacial procedures viz. third molar surgery. Several therapeutic protocols have been evaluated to support improvements in the post-operative sequelae.<sup>[25-29]</sup>

Morbidity following surgery of lower third molar is always unpredictable and remains a greater concern to surgeon in the post-operative period. Surgical procedures may produce severe post-operative pain, edema, trismus, development of

**Table 5: Intergroup comparison of distance between tragus of ear to corner of the mouth**

Duration	Group	n	Mean	Std. deviation	Std. error mean	Mean difference	P value
Pre op	Group 1	25	11.6584	0.65084	0.13017	0.00000	1 NS
	Group 2	25	11.6584	0.65084	0.13017		
Day 3	Group 1	25	13.1636	1.79630	0.35926	1.40520	0.001*
	Group 2	25	11.7584	1.02945	0.20589		
Day 5	Group 1	25	14.4796	1.41465	0.28293	1.80000	<0.001**
	Group 2	25	12.6796	1.04143	0.20829		
Day 7	Group 1	25	13.6476	1.45710	0.29142	1.87560	<0.001**
	Group 2	25	11.7720	0.74471	0.14894		
Day 15	Group 1	25	11.892	0.6383	0.1277	0.5680	0.040*
	Group 2	25	11.324	1.1844	0.2369		

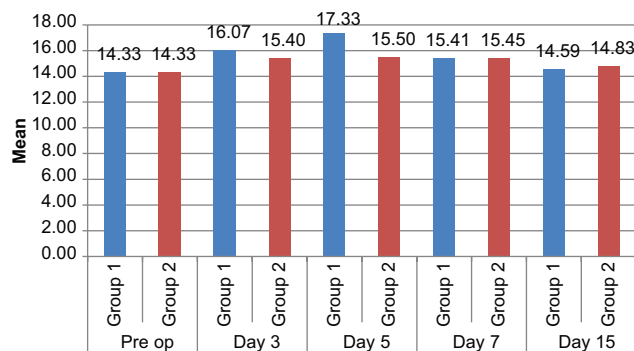
NS: Not significant ( $P>0.05$ ),\*\*Highly significant ( $P<0.001$ ), \*-Significant ( $P<0.05$ )



**Table 6: Intergroup comparison of distance between tragus to pogonion**

Duration	Group	n	Mean	Std. deviation	Std. error mean	Mean difference	P value
Pre op	Group 1	25	14.3316	1.58326	0.31665	0.00000	1 NS
	Group 2	25	14.3316	1.58326	0.31665		
Day 3	Group 1	25	16.0732	1.02815	0.20563	0.66880	0.016*
	Group 2	25	15.4044	0.86102	0.17220		
Day 5	Group 1	25	17.332	1.4300	0.2860	1.8320	0.001**
	Group 2	25	15.500	2.1645	0.4329		
Day 7	Group 1	25	15.412	0.9479	0.1896	-0.0400	0.906 NS
	Group 2	25	15.452	1.4036	0.2807		
Day 15	Group 1	25	14.5924	1.68965	0.33793	-0.23560	0.616 NS
	Group 2	25	14.8280	1.60503	0.32101		

NS: Not significant ( $P>0.05$ ), \*Significant ( $P<0.05$ ), \*\*Highly significant ( $P<0.001$ )



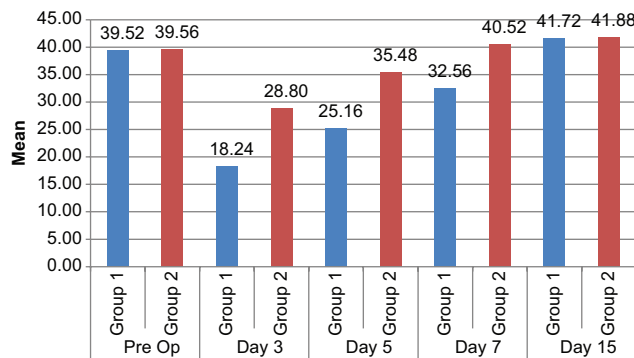
infections, dry socket, periodontal defects posterior to the second molar and other possible potential complications like temporomandibular joint dysfunction.

An otherwise uncomplicated surgical procedure will inflict surgical trauma which initiates a local inflammatory response. Inflammation commences the wound healing

**Table 7: Intergroup comparison of mean mouth opening**

Duration	Group	n	Mean	Std. deviation	Std. error mean	Mean difference	P value
Pre Op	Group 1	25	39.52	5.1730	1.0346	-0.0400	0.979 NS
	Group 2	25	39.56	5.3235	1.0647		
Day 3	Group 1	25	18.24	4.5942	0.9188	-10.5600	<0.001**
	Group 2	25	28.80	6.2183	1.2437		
Day 5	Group 1	25	25.16	4.5431	0.9086	-10.3200	<0.001**
	Group 2	25	35.48	4.6469	0.9294		
Day 7	Group 1	25	32.56	5.0173	1.0035	-7.9600	<0.001**
	Group 2	25	40.52	4.1344	0.8269		
Day 15	Group 1	25	41.72	3.4823	0.6965	-0.1600	0.873 NS
	Group 2	25	41.88	3.5628	0.7126		

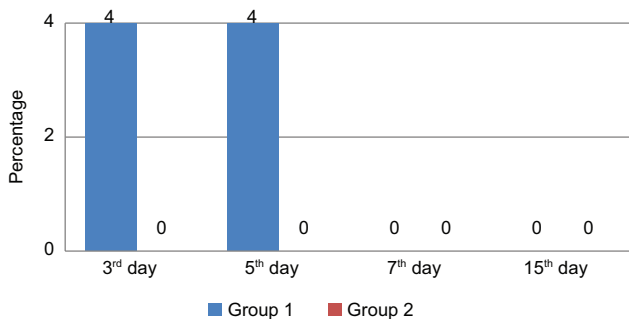
NS: Not significant ( $P>0.05$ ),\*\* Highly significant ( $P<0.001$ )



**Table 8: Intergroup comparison of incidence of dry socket**

Duration	Group 1	Group 2
3 <sup>rd</sup> day	2	0
5 <sup>th</sup> day	2	0
7 <sup>th</sup> day	0	0
15 <sup>th</sup> day	0	0

Inference: There is statistically non significance difference among both groups in relation to incidence of dry socket at different post-operative interval in group 1 3<sup>rd</sup> day (4%), 5<sup>th</sup> day (4%), and 7<sup>th</sup> day (0%), 15<sup>th</sup> day (0%) compared to group 2 (0%) at different post-operative interval



processes and protects the damaged tissues from the exposed environment. The product of inflammation is exudate which is a result of vascular changes and constituent of intravascular components, cellular elements and various growth factors, swept into the intercellular

spaces. The clinical manifestation of this inflammatory process is swelling and pain in the operated region.

Trismus is due to inflammation around the masseter muscle, which is objectively seen as decrease in the inter-incisal distance. Amount of inflammation developed will govern the post-operative swelling, pain and trismus and is the index of surgical trauma inflicted to the tissue, so these parameters are taken into methodology of this study.

Pain and swelling are individual dependent variables correlated to body's response to tissue insult and type of wound. The severity and perception of pain might vary among individuals. Risk of error is present when later factors are compared in different individuals. The present study is of a split-mouth study design so that the subjects themselves will act as controls. The intensity of the inflammatory reaction depends on severity of tissue trauma, to avoid errors within the study, bilaterally symmetrical type of impacted mandibular third molar teeth, as assessed by radiographs, were considered. This study was aimed at evaluating the efficacy of two surgical techniques, one is the conventional scalpel blade instrument and another is diode laser device in surgical removal of impacted teeth. The surgical method should be one with minimum intraoperative and post-operative complications.

Diode lasers come in different wavelengths of 810, 940, and 980nm, and have become very popular in general dentistry because of their compact size, fiber-optic delivery, and ease of use for minor surgery of oral soft tissues. The energy from these lasers target pigments such as hemoglobin and melanin in the soft tissue.

The present study was done to compare soft tissue incision with diode laser and conventional scalpel blade in surgical removal of impacted mandibular third molar teeth. A study sample of 15 patients was selected, of which 8 were males and 7 females with mean age of 26 years and ranged from 18 to 40 years. Parameters taken for the study to achieve the aim are ease of incision making (duration of surgery, bleeding), pain (VAS), swelling, trismus, and incidence of dry socket.

Time taken for the operative procedure is the first parameter of the study and was recorded from the time of incision to last suture placed.

In our study, the mean of duration of surgery among conventional group (Group 1) was  $21.32 \pm 9.02$  and study group (Group 2) mean was  $44.84 \pm 10.54$ . There is statistically highly significant difference present between both the groups ( $P < 0.001$ ). It was found that diode laser group consumes more time for surgery as compared to conventional group

In our study, mean of bleeding from soft tissue among conventional group (Group 1) was  $4.60 \pm 0.56$  and study group (Group 2) was  $2.52 \pm 0.51$ . There is statistically highly significant difference present between both the groups ( $P < 0.001$ ). It was found that diode laser group has significantly less bleeding from tissue as compared to conventional group ( $P < 0.001$ ).

Pain was second parameter of the present study. Level of pain was measured by asking the patients and was marked on a ten point VAS scoring scale.

In our study, on comparison of frequency of pain among conventional group and diode laser group using the VAS, it was found that in conventional group the mean on 3<sup>rd</sup> day was  $3.68 \pm 1.6$ , 5<sup>th</sup> day  $1.68 \pm 1.7$ , 7<sup>th</sup> day was  $0.32 \pm 0.74$ , 15<sup>th</sup> day was  $0.00 \pm 0.00$  and study group mean on 3<sup>rd</sup> day was  $1.60 \pm 1.41$ , 5<sup>th</sup> day was  $0.48 \pm 0.87$ , 7<sup>th</sup> day was  $0.00 \pm 0.00$ , 15<sup>th</sup> day was  $0.00 \pm 0.00$ . As  $P < 0.001$  which suggests statistically highly significant difference present in pain intensity at various durations. Group 2 has lower pain intensity in all durations than in Group 1.

Swelling is a clinical manifestation of the operative procedure because of the inflammatory exudate that had been escaped from the intravascular component. Cheek

swelling was measured in three dimensions recorded from each patient, Tragus to Corner of the Mouth, TP and Corner of Eye to Soft tissue Gonion. These dimensions were recorded preoperatively and compared on the post-operative follow-up days.

In the present study, swelling parameter revealed statistically highly significant difference ( $P < 0.001$ ) between the groups wherein diode laser group had lesser swelling compared to conventional group.

Trismus is the fourth parameter in this study which is inability to open the mouth following the surgical removal of impacted third molar and is due to the inflammation around the masseter muscle which produces this clinical manifestation.

In the present study, there is statistically highly significant difference present in mean mouth opening on day 3, 5, 7 ( $P < 0.001$ ) and nonsignificant difference seen on day 15 postoperatively ( $P > 0.05$ ) when compared between both groups.

In the present study, incidence of dry socket is the last parameter which is statistically non significance difference among both groups in relation to incidence of dry socket at different post-operative interval in group 1 3<sup>rd</sup> day (4%), 5<sup>th</sup> day (4%), and 7<sup>th</sup> day (0%), 15<sup>th</sup> day (0%) compared to group 2 (0%) at different post-operative interval.

The main results of our study were that the laser assisted surgery resulted in significant improvement in reducing swelling and pain and in reduction of dry socket incidence in the immediate postoperative period compared with control group. The response rate to the study was high, indicating the high feasibility of using patient-centered outcome measures in oral surgery.<sup>[30-34]</sup>

The use of diode laser has predictable results in oral surgery with certain advantages such as, ease of application, adequate coagulation, less inflammation and pain, better repair and recovery of tissues and rare intra- and post-operative complications. Our study revealed that it is an effective and predictable tool when performing surgeries in oral soft tissues, superior to the conventional scalpel blade with few limitations including longer duration of surgery and high cost. However, further comparative studies are needed with more number of samples to assess the efficacy.<sup>[35-38]</sup>

## CONCLUSION

The diode laser as a modern therapeutic method proved to be a simple, elegant, and clean way for surgery with

minimum bleeding. It is far gentler than scalpel surgery; unlike electro surgery lasers do not require the placement of a grounding plate. Tissue separates gently and easily with the laser and hemostasis is achieved rapidly and there was minimal post-operative sequelae and complications. Diode laser was well tolerated by the patients, and it is more successful than conventional treatment methods. Therefore, diode lasers treatment can form an integral part of oral surgery therapy in the future. However, further longitudinal studies are required to evaluate the long-term effects of diode laser on clinical as well as microbiological parameters.

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