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Research Article

A Comparative Evaluation Between Traditional Scalpel Incision Versus Laser in Mandibular Third Molar Removal Surgery

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Abstract

Background: *One of the most frequent operations performed by oral and maxillofacial surgeons around the world is the surgical removal of impacted teeth. It entails the handling of both soft and hard tissues, which may result in several postoperative problems such pain, edema, and trismus. The primary shortcoming of the scalpel is its inability to establish haemostasis, which is essential in a highly vascularized region like the oral cavity. Consequently, a replacement for soft tissue treatments is needed.[6] The diode laser closes blood vessels, blocks pain receptors at the site of the cut, and lowers the danger of tissue charring, which is more noticeable during electrocautery due to increased carbonization.[7]*

Materials and methodology: *20 healthy patients with bilateral surgical removal of mandibular third molars were selected for this study. Ten patients were randomly divided into two groups namely group 1 and group 2. Scalpel incision and laser incision were used in group 1 and group 2 respectively.*

Results: *After surgical removal of third molar different clinical parameters noted on 3^{rd}, $7^{th,}$ and 15^{th} post operative day. In which, group 1 showed highly significant pain scores at 3rd, 7th, and 15th day post-operatively than patients of group 2. Post operative swelling was more significant in group 1 at 3^{rd} and 7^{th} post operative day than group 2. Effective healing suggestive of significantly superior healing in group 1 as compared to group 2 on 3rd and 7th post operative days. At the 3^{rd} and 7^{th} postoperative days, group 1 experienced a more substantial reduction in postoperative mouth opening than group 2. The mean value of colony forming units on 2nd to 3rd post operative day suggested that growth of microorganism is higher in group 1 than group 2.*

Conclusion: *LASER incisions offer superior access and visibility compared to scalpel incisions, making them a safe and viable alternative technique in surgical procedures.*

Keywords: *Third molar removal surgery, Incision, Diode laser.*

I. INTRODUCTION

An impacted tooth, as per Archer (1975) "A tooth which is completely or partially unerupted and is positioned against another tooth, bone or soft tissue so that its further eruption is unlikely." Mandibular third molars being the most impacted worldwide at a rate of 24%. [1] Lower third molars typically finish erupting between the ages of 20 to 24, with their position remaining stable after 26 years. Evolutionary constraints in maxillary/mandibular space and a modern diet lacking proper jaw growth stimulation contribute to the increased prevalence of impacted and unerupted third molars in the contemporary population. [2]

Common local factors contributing to permanent tooth impaction include extended retention of deciduous teeth, improperly positioned tooth germs, arch-length discrepancies, the presence of supernumerary teeth within the alveolus and cleft lip and cleft palate conditions. [3] The primary reason for mandibular third molar removal beyond a certain age is

typically pericoronitis. Additionally, removal may be necessary for reasons such as dental caries, orthodontic needs, mandibular incisor crowding, interference with orthognathic surgery, association with pathologies like cysts and tumors, adjacent teeth root resorption, prosthetic considerations, and third molar auto-transplantation. [4]

Surgical removal of impacted teeth is common worldwide, but it can lead to post- operative complications like pain, swelling, and trismus, affecting the patient's quality of life. Effective management is essential for a better post-operative experience. [5] Traditionally, the scalpel has been the preferred tool for various procedures, but it lacks the ability to provide haemostasis, particularly in the highly vascularized area like oral cavity. Therefore, there is a need for alternatives in soft tissue procedures. [6]

Electrocautery's primary advantage lies in its ability to create a bloodless field through coagulation. However, it penetrates deeper than electrodesiccation/fulguration, potentially causing more tissue damage, lateral thermal injuries, delayed healing, increased risk of wound dehiscence, delayed bleeding, and the potential for scarring with hypopigmentation. [5]

Laser (Light amplification by stimulated emission of radiation) in oral and maxillofacial surgery is a monochromatic, collimated, coherent, and intense beam of light generated through stimulated emission of radiation. Among the various lasers used, diode lasers stand out as superior due to their compact, portable, efficient, and reliable nature. Operating within the 805– 910 nm wavelength range, diode lasers seal blood vessels, inhibit pain receptors at incision sites, and reduce the risk of tissue charring, a concern more pronounced with electrocautery due to increased carbonization. [7]

II. MATERIALS AND METHOD

A prospective study compared conventional scalpel incision to laser incision in the surgical removal of mandibular third molars, assessing their impact on post-operative outcomes. Conducted as a split-mouth in vivo study from 2020 to 2023, 20 healthy patients with bilateral third molar removal were selected from the Department of OMFS at the College of Dental Sciences and Research Centre (CDSRC), Ahmedabad. Group 1 received scalpel incisions, while group 2 received laser incisions, with site selection based on specific criteria.

INCLUSION CRITERIA:

1. Age group of 18-45 years
2. Patients requiring bilateral surgical removal of mandibular third molars with almost same angulation, depth, and difficulty level
3. Patients willing for regular follow ups

EXCLUSION CRITERIA:

1. Medically immune-compromised patients
2. Patients having oral destructive habits
3. Pregnant and lactating mothers

CLINICAL PARAMETERS

1. Pain (Visual analogue scale - VAS by Hayes and Patterson 1921)
2. Swelling (Gabka and Matsumura technique)
3. Early wound healing score (EHS) (Marini et al. 2018)
4. Mouth opening (Inter incisal distance)
5. Growth of microorganism (Colony Forming Unit - CFU)

ARMAMENTARIUM (Figure 1):

1. Metal suction tip No. 2 and 3
2. Normal saline and betadine
3. Gloves
4. Surgical drape
5. Towel clips
6. Sterile gauze pieces
7. Diagnostic instruments
8. 26 gauze needle and 2cc syringe
9. Local anaesthesia (2% lignocaine hydrochloride with adrenaline 1: 80,000)
10. Minesota and long L retractor
11. No. 9 Molt’s periosteal elevator
12. Bite block (Rubber base No. 1, 2 and 3)

13. Micromotor and high speed straight rotary handpiece
14. Bone cutting burs (Round bur No. 6 and 8, Straight fissure bur No. 701,702,703)
15. Coupland elevator (Straight and angulated)
16. Cryer's elevator
17. Halstead's mosquito artery forceps
18. Bone rongeur
19. Bone file
20. Lucas curette
21. Adams tissue holding forceps – Toothed and Non-toothed
22. Tissue cutting scissor
23. Needle holder
24. 3-0 silk suture material
25. Mayo's suture cutting scissor

FIGURE 1: ARMAMENTARIUM FOR THIRD MOLAR SURGERY

A. ARMAMENTARIUM FOR CONVENTIONAL THIRD MOLAR SURGERY
B. ARMAMENTARIUM FOR DIODE LASER SURGERY

METHODOLOGY

➢ **Pre-operative preparation of patient,**

A thorough patient history was documented, followed by clinical and radiographic examinations to determine the diagnosis. Routine hematological tests were conducted, and a pre-operative panoramic radiograph (OPG) was taken for tracing to assess angulation, depth, and the difficulty index using Pederson's scale (table 1) and WHARFE's assessment (table 2), serving as the foundation for the surgical treatment plan.

Table 1: Difficulty index for removal of impacted lower third molar (Pell and Gregory – 1933)	
Classification Angulation	**Difficulty Index value**
Mesioangular	1 Easiest to remove
Vertical	2
Horizontal/Transverse	3
Distoangular	4
Depth	
Level A	1
Level B	2
Level C	3
Ramus Relationship/Space Available	
Class I	1
Class II	2
Class III	3

Difficulty score for removal of impacted lower third molar	
Difficulty	Difficulty score
Minimally Difficult	3-4
Moderately Difficult	5-7
Very Difficult	7-10

Table 2: WHARFE's assessment by MacGregor (1985)	
Category	Score
Winter's Classification	
Horizontal	2
Distoangular	2
Mesioangular	1
Vertical	0
Height of the mandible	
1-30 mm	0
31-34 mm	1
35-39 mm	2
Angulation of third molar	
1-50°	0
60-69°	1
70-79°	2
80-89°	3
90° + +	4
Root Shape	
Favourable Curvature	1
Complex	2
Unfavourable Curvature	3
Follicles	

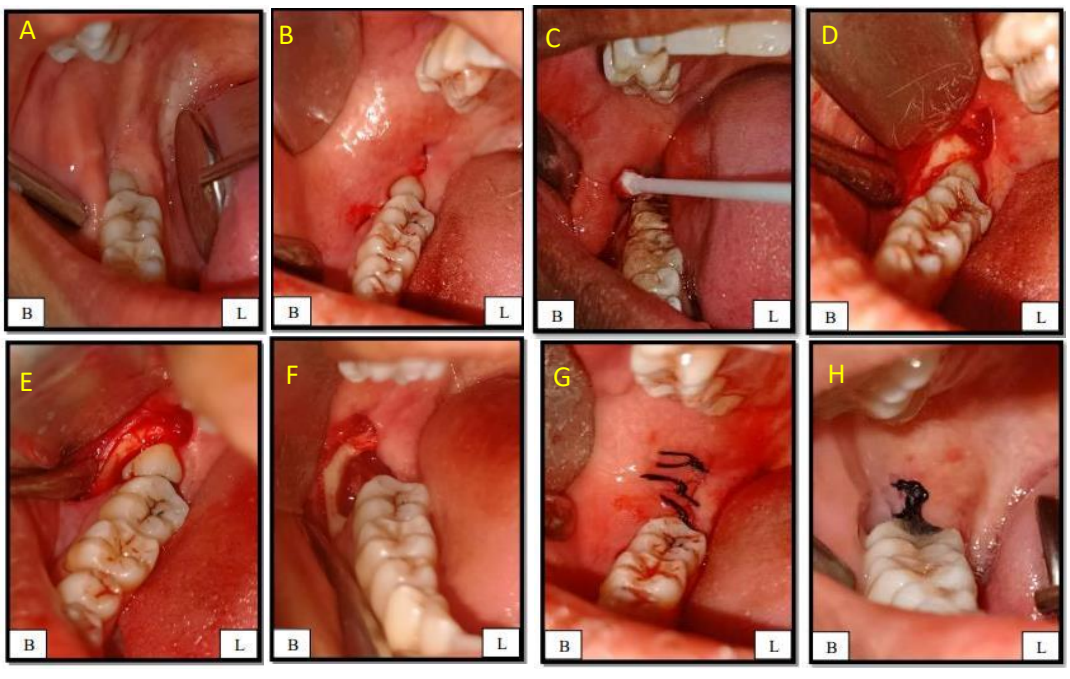
Normal	0
Possibly Enlarged	1
Enlarged	2
Exit Path	
Space Available	0
Distal cusps covered	1
Mesial cusps covered	2
Both the cusps covered	3
Total	**33**

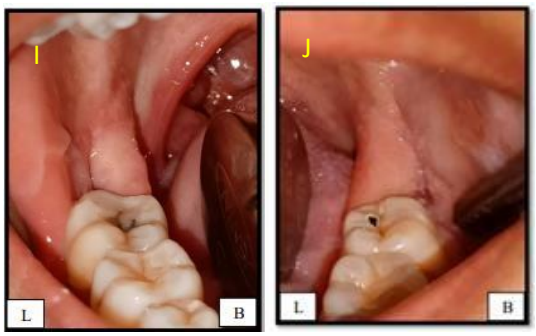
➢ **Surgical method for surgical removal of third molar,**

1. Group 1 and group 2 sides were selected based on the random method. In the conventional group side scalpel incision was given [FIGURE 2] while on opposite side laser incision was given [FIGURE 3] for surgical removal of third molar.
2. The patient's face was painted with betadine solution and draped by sterile drapes.
3. Local anaesthesia was achieved on the group 1 and side by direct technique of inferior alveolar nerve block and long buccal nerve block using 2% Lignocaine Hydrochloride with Adrenalin bitrate in the concentration of 1:80,000.
4. Ward's incision placed and a full thickness mucoperiosteal flap was reflected to expose the tooth and bone with Molt's No. 9 periosteal elevator.
5. Swab is taken from the incision site and dip into 1 ml of saline for inoculation into culture media.
6. Bone guttering was done via Moore and Gillbe's technique along buccal and distal aspect of tooth using 702 straight fissure bur at a rotary speed of 35,000 rotation per minute constant copious saline irrigation.
7. Tooth was sectioned according to the level of difficulty assessed during the pre- operative assessment and was delivered using Coupland elevator.
8. The tooth follicle remnants attached to the socket curetted by Lucas curette.
9. Sharp bony margins were smoothened up with bone file.
10. Socket thoroughly debrided with betadine and saline to clear the debris.
11. Reflected flap was re-approximated to their original position and primary closer achieved by simple interrupted suturing with non-absorbable 3-0 black braided silk.

Both surgical procedures, conventional scalpel incision on one side and laser incision on other side were performed by same surgeon.

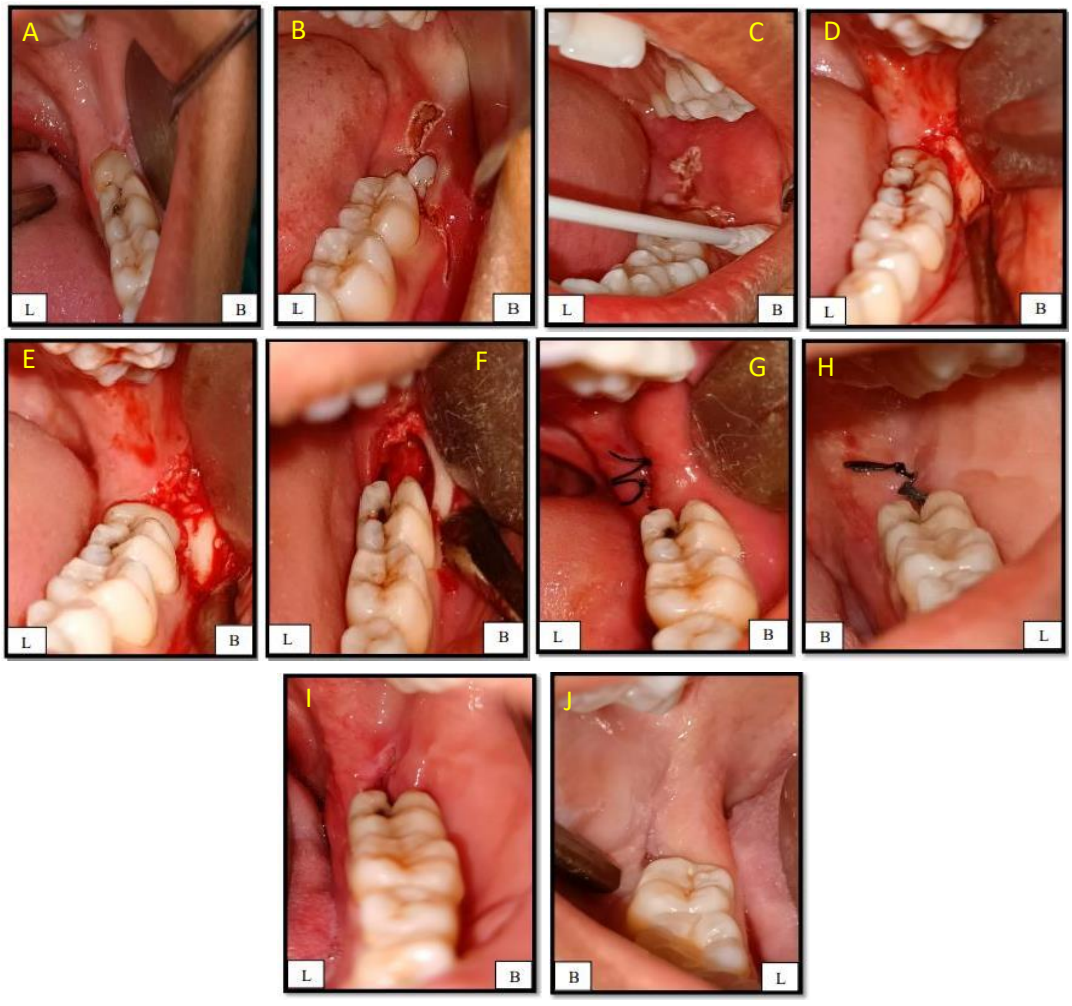
FIGURE 2: GROUP 1 CASE- CONVENTIONAL SCALPEL INCISION





A- PREOPERATIVE IMAGE
B- STANDARD WARD'S INCISION WITH SCALPEL
C- SWABBING AT SCALPEL INCISION SITE
D- MUCOPERIOSTEAL FLAP REFLECTION
E- BONE GUTTERING
F- EXTRACTION SOCKET
G- SIMPLE INTERRUPTED SUTURING
H- SCALPEL INCISION SITE 48-3RD DAY POST OPERATIVE
I- AFTER SUTURE REMOVAL AT 48 (SCALPEL)- 7TH DAY POST OPERATIVE J- HEALING AT SCALPEL SITE- 15TH DAY POST OPERATIVE

FIGURE 3: GROUP 2 CASE- INCISION WITH DIODE LASER



A-PREOPERATIVE IMAGE
B-STANDARD WARD'S INCISION WITH LASER C-SWABBING AT LASER INCISION SITE
D-MUCOPERIOSTEAL FLAP REFLECTION E-BONE GUTTERING
F-EXTRACTION SOCKET
G-SIMPLE INTERRUPTED SUTURING
H-LASER INCISION SITE 38-3RD DAY POST OPERATIVE
I- AFTER SUTURE REMOVAL AT 38 (LASER)- 7TH DAY POST OPERATIVE
J-HEALING AT LASER SITE-15TH DAY POST OPERATIVE

III. RESULTS:

The statistical analysis was performed in SPSS version 23.0. Intra group comparison was done using Student 't' test Unpaired and for inter group comparison Student 't' test Paired, Mann-Whitney Test, Wilcoxon-Signed Rank Test were used.

1. Pain (Visual analogue scale - VAS by Hayes and Patterson 1921)
   Post-operative pain was subjectively assessed on the 3rd, 7th, and 15th days post- operatively in both groups using the Visual Analog Scale (VAS). On the 3rd day, the mean VAS score for Group 1 was 4.65, while for Group 2, it was 2.35. On the 7th day, Group 1 had a mean VAS score of 1.65, while Group 2 scored 0.20. By the 15th day, Group 1 had a mean VAS score of 0.35, and Group 2 had a score of 0.00. Comparative analysis revealed that Group 1 patients had significantly higher VAS scores on the 3rd, 7th, and 15th days post-operatively compared to Group 2 (p-value: <0.001, <0.001, and 0.008, respectively).
2. Swelling (Gabka and Matsumura technique)
   Pre-operative facial measurements served as baseline data for assessing post-operative swelling in both groups. The mean pre-operative facial measurement was 12.32 mm for both Group 1 and Group 2. Post-operative swelling was evaluated on the 3rd, 7th, and 15th post-operative days. For inter-group comparison, on the 3rd day, Group 1 had a mean post-operative swelling score of 14.19 mm, while Group 2 had 12.93 mm. On the 7th day, Group 1 scored 13.10 mm, and Group 2 scored 12.36 mm, while on the 15th day, Group 1 had 12.37 mm, and Group 2 had 12.32 mm of swelling. These findings indicate a more significant difference in swelling on the 3rd and 7th post-operative days compared to the 15th day in both groups (p-value: <0.001, <0.001, and 0.037, respectively).
3. Early wound healing score (EHS) (Marini et al. 2018)
   The mean EHS score on 3rd post operative day for group 1 was 6.60 and for group 2 was 6.0. On 7th post operative day for group 1 was 10.0 and for group 2 was 6.70. On 15th post operative day for group 1 was 10.0 and for group 2 was also 10.0. So, the group 1 showed significantly higher healing score on 3rd post-operative day (p value- <0.005) and on 7th post-operative day (p value- <0.001) in terms of soft tissue healing but result was not significant on 15th post-operative day (p value- 1.000).
4. Mouth opening (Inter incisal distance)
   On the 3rd post-operative day, Group 1 had a mean post-operative mouth opening score of 28.40 mm, while Group 2 scored 37.85 mm. On the 7th day, Group 1 measured 36.35 mm, and Group 2 recorded 42.95 mm. Notably, marked trismus was observed in Group 1 patients on the 3rd and 7th post-operative days compared to Group 2. By the 15th post-operative day, Group 1 had a measurement of 42.35 mm, and Group 2 measured 44.65 mm, nearly reaching the baseline. These findings indicate a more significant difference in mouth opening on the 3rd and 7th post-operative days for Group 1 compared to the 15th day (p-value: <0.001, <0.001, and 0.037, respectively).
5. Growth of microorganism (Colony Forming Unit - CFU)
   Post-operative microbial growth was assessed subjectively between the 2nd and 3rd post-operative days in both groups using Colony-Forming Units (CFU). The mean CFU value for Group 1 was 201, while for Group 2, it was 43. These results indicate that microbial growth was significantly higher in Group 1 compared to Group 2 (p-value: <0.001).

IV. DISCUSSION:

The scalpel, often referred to as the cold knife, has long been the gold standard cutting tool in surgery due to its ease of use, precision, and minimal damage to surrounding tissues. However, scalpel incisions are susceptible to bleeding, which can hinder the surgical field. Consequently, advanced technologies have been developed to enhance haemostasis, patient comfort, ease of use, and visibility. The clinical adoption of instruments like lasers and electrosurgery units, which coagulate vessels during incisions, has increased in both medical and dental practices.[7]

The diode laser, introduced in the mid-90s by Harris and Pick in 1995, has gained attention for soft tissue surgery in the oral cavity due to its wavelengths ranging from 810 to 980 nm in continuous or pulsed modes. The heat generated during laser use leads to coagulation, protein denaturation, drying, vaporization, and carbonization at the energy absorption site, resulting in blood vessel sealing, enhanced visualization, and inhibition of pain receptors at the incision site. Diode lasers

offer advantages such as improved control, potentially reduced pain and inflammation, and enhanced wound healing compared to the scalpel, with the additional benefit of instant wound disinfection.[7]

In Ward's incision, the anterior part of the incision (Limb A) is positioned within the sulcus and is typically made just distal to the first molar. This placement allows for improved access during the procedure and facilitates proper closure. It has been observed that larger wounds in this location tend to heal efficiently. [8]

In a study conducted by Babu A et al. involving thirty patients requiring surgical removal of impacted mandibular third molars, a comparison of envelop, Ward's, and modified Ward's incisions was conducted. The study revealed that both Ward's and modified Ward's flap designs led to an improvement in the periodontal health status of the mandibular second molar after the surgical removal of the impacted mandibular third molar. [5]

In other side ward's incision was made with the use of diode laser with wavelength of 980 nm. Petron et al. reveals that diode lasers are commonly accepted by patient because of fast and bloodless procedure. Whereas, carbon dioxide lasers have high rate of absorption towards moisturized surface. [8]

The wound closure was performed using simple interrupted sutures with 3-0 silk material, a commonly used suturing method. Simple interrupted sutures offer precise anatomic repositioning of the flap with initial stabilization. One notable advantage of this technique is its aesthetic result: when correctly applied, the sutures leave no visible traces once healing is complete. Additionally, simple interrupted sutures are favoured for their speed and ease of application. [9]

Bhatsanghe A et al. (2016) noted that postoperative pain is closely linked to the extent of tissue manipulation and the surgical approach's aggressiveness, including the handling and manipulation of soft tissue during incision and flap reflection. Conversely, the reduced post- operative pain observed in laser groups may be attributed to the heat generated during laser use, leading to coagulation, protein denaturation, drying, vaporization, and carbonization at the energy absorption site. This process effectively seals blood vessels and inhibits pain receptors at the incision site. [7]

In clinical studies by Landucci et al. [9] and Mahmad M et al. [10], it was observed that swelling is primarily associated with factors like the incision, reflection of the mucoperiosteal flap, and the duration of the surgical procedure, likely due to prolonged manipulation of the open wound. Laser treatment influences cell membranes, leading to the absorption of photons by mitochondria, which, in turn, stimulates increased production of Adenosine triphosphate (ATP) and low levels of Reactive Oxygen Species (ROS). These changes activate transcription factors like NF-kappa B, which may induce gene transcript products responsible for reducing swelling. [11]

Jin et al. reported that while diode laser is effective for cutting oral mucosa, it tends to cause more tissue damage compared to a scalpel. The laser-induced thermal damage leads to more pronounced tissue alterations. They noted that the intensity of TNF-a immunostaining was highest on the 3rd day post-surgery and lowest on the 7th day for all groups. In scalpel wounds, there was lower TGF-b1 expression until the 3rd day post-surgery and a higher level from the 7th day, unlike laser wounds. These changes suggest an increased inflammatory response and initial delayed healing in the laser group. [14]

In a cross-sectional study conducted by Rawat M et al. (2021), 15 patients were included to compare the effectiveness of diode laser and the conventional scalpel technique for biopsies of soft tissue oral lesions. The researchers explained that during surgical cutting, the heat generated by the laser seals small blood and lymphatic vessels, reducing, or eliminating bleeding and edema. The denatured proteins within tissue and plasma create a protective surface layer known as a "coagulum" or "char" at the incision margin. This layer helps shield the surgical wound from friction. Consequently, patients in the laser group exhibited a greater degree of mouth opening compared to the conventional scalpel group, likely due to the presence of this tenacious (smooth) layer at the incision margin. [10]

Mahmoud M et al. observed that the rate of wound infection was reduced by 4% in the Laser incision group compared to the scalpel group. They attributed this reduction to the bactericidal effect of the Diode Laser, which was evident through a greater reduction in Colony- Forming Units per millilitre (CFUs/ml) of obligate anaerobes in the test group compared to the control group. [8]

V. CONCLUSION:

LASER incisions provide excellent access and a clear operative field compared to scalpel Incisions, making them a safe alternative technique. LASER incisions result in fewer adverse effects on postoperative pain, swelling, and mouth opening, leading to a better quality of life for patients. Additionally, LASER incisions reduce microbial growth, protecting the wound from infections. However, they may take slightly longer to heal compared to scalpel incisions, leading to delayed suture removal. The initial cost of LASER equipment and the need for technical skills are minor

drawbacks for practitioners. In conclusion, LASER incisions can serve as a viable alternative, but the study's smaller sample size limits its findings, and larger comparison groups are needed for clearer outcomes.

VI. REFERENCES:

1. Ryalat S, Airyalat SA, Kassob Z, Hassona Y, Al-Shayyab MH, Sawair F. Impaction of lower third molars and their association with age: Radiological perspectives. BMC Oral Health 2018;18(1):58.
2. Santosh P. Impacted mandibular third molars: Review of literature and a proposal of a combined clinical and radiological classification. Ann Med Health Sci Res 2015;5(4):229-34.
3. Raghoebar GM, Boering G, Vissink A, Stegenga B. Eruption disturbances of permanent molars: A review. J Oral Pathol Med.1991;20(4):159-66.
4. Lysell L, Rohlin M. A study of indications used for removal of the mandibular third molar. Int J Oral Maxillofac Surg 1988;17(3):161-4.
5. Bamgbose BO, Akinwande JA, Adeyemo WL, Ladeinde AL, Arotiba GT, Ogunlewe MO. Effects of co-administered dexamethasone and diclofenac potassium on pain, swelling and trismus following third molar surgery. Head Face Med 2005; 1:11.
6. Nagargoje GL, Badal S, Mohiuddin SA, Balkunde AS, Jadhav SS, Bholane DR. Evaluation of electrocautery and stainless-steel scalpel in oral mucoperiosteal incision for mandibular anterior fracture. Ann maxillofac Surg 2019;9(2):230-4.
7. Bhatsange A, Meshram EP, Waghamare A, Shiggaon L, Mehetre V, Shende A. A clinical and histological comparison of mucosal incisions produced by scalpel, electrocautery, and diode laser: A pilot study. j dent lasers 2016;10(2):37-42.
8. Fisher SE, Frame JW, Browne RM, Tranter RM. A comparative histological study of wound healing following CO2 laser and conventional surgical excision of canine buccal mucosa. Arch Oral Biol 1983;28(4):287-91.
9. Wewers ME, Lowe NK. A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health 1990;13(4):227-36.
10. Røynesdal AK, Björnland T, Barkvoll P, Haanaes HR. The effect of softlaser application on postoperative pain and swelling: A double-blind, crossover study. Int J Oral Maxillofac Surg 1993;22(4):242-5.
11. Bouloux GF, Steed MB, Perciaccante VJ. Complications of third molar surgery. Oral Maxillofac Surg Clin North Am 2007;19(1):117-28. 1
12. D'Arcangelo C, Nardo MF, Prosperi GD, Conte E, Baldi M, Caputi S. A preliminary study of healing of diode laser versus scalpel incisions in rat oral tissue: A comparison of clinical, histological, and immunohistochemical results. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103(6):764-73.
13. Aras MH, Güngörmüş M. The effect of low-level laser therapy on trismus and facial swelling following surgical extraction of a lower third molar. Photomed Laser Surg 2009;27(1):21-4.
14. Jin JY, Lee SH, Yoon HJ. A comparative study of wound healing following incision with a scalpel, diode laser or Er,Cr:YSGG laser in guinea pig oral mucosa: A histological and immunohistochemical analysis. Acta Odontol Scand 2010;68(4):232- 8.

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