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Efficacy Of Hyaluronic Acid Spray in Reducing Postoperative Pain, Swelling and Enhancing Soft Tissue Healing After Transalveolar Extraction of Endodontically Treated Mandibular Molars: A Comparative Study

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Abstract

Introduction: Transalveolar extraction of mandibular molars is a one of the common oral surgical procedure often associated with postoperative concerns such as pain, swelling, and delayed wound healing. To ensure the best possible patient comfort and recuperation, these issues must be effectively managed. A naturally occurring glycosaminoglycan, hyaluronic acid (HA) has drawn interest in oral and maxillofacial surgery because of its biocompatibility anti-inflammatory qualities, and tissue regeneration potential.

Aim and Objectives: The aim of this study is to study efficacy of hyaluronic acid spray after transalveolar extraction of endodontically treated mandibular molars in reducing postoperative complications like pain and swelling and inducing early soft tissue healing.

Materials And Methods: The study involves 60 individuals requiring transalveolar mandibular molar extractions, selection based on inclusion and exclusion criteria. Adhering to Helsinki Ethical Principles, patients were informed about the procedure, study goals, benefits, and risks. Written informed consent will be obtained. Complete case history was taken, and a treatment plan developed after evaluation and diagnosis. Patients are divided into two groups. In this study, patients divided into study group (n=30: HA sprayed) and control group (n=30: HA not sprayed).

Patients were selected randomly for both groups. The clinical postoperative parameters like pain was measured using VAS scale, swelling was measured using tape measure method described by Gabka and Matsumara and soft tissue healing index was evaluated by Landry R, Turnbull R and Howley T soft tissue healing index on 1^{s} ,3rd and 7th postoperative days.

Results: There was significant difference between the groups in reducing postoperative pain, facial swelling and soft tissue healing. (P ≤0.05).

Conclusion: Hyaluronic acid spray is useful for promoting early soft tissue healing and minimizing postoperative concerns related to pain and swelling following transalveolar extraction of Endodontically treated mandibular molars.

Keywords: Hyaluronic Acid, Spray, transalveolar extraction, pain, swelling, soft tissue healing

Introduction

In dental clinics, one of the most frequent procedures is a Dental extraction. The most typical reason it is done is for a tooth that has a poor prognosis or cannot be restored because of significant caries, periodontal disease. A sequence of ordered processes, including as inflammation, overlapping haemostasis phases, remodelling, and maturation, are involved throughout the healing process of dental sockets. Post-operative complications, such as discomfort and oedema, may accompany and last for a few days following the extraction. Numerous natural items, irrigation techniques, systemic drugs, and preservation materials have been considered in an effort to reduce these issues and hasten recovery(1). Dental extraction can impact a patient's daily life due to post-procedure pain, which may persist for days. One common complication is dry socket, also called alveolar osteitis, occurring in 0.5% to 5% of extractions. First described by Crawford in 1896, it is more frequent after mandibular molar extractions, particularly impacted third molars. Dry socket arises when the blood clot in the socket breaks down, exposing the bone and causing severe pain that typically starts within the first three days after extraction and does not respond to analgesics. The discomfort may radiate to the ear, temple, and neck, often accompanied by headache, dizziness, insomnia, and bad breath due to trapped food debris. This condition is distressing for both patients and dentists, requiring multiple visits for treatment and potentially leading to lost productivity and financial strain. Finding simple and effective preventive measures can help reduce pain and minimize the risk of dry socket(2).

To minimize postoperative inflammation and associated symptoms, proper anti-inflammatory medication is essential. Corticosteroids and anti-inflammatory drugs are commonly prescribed, with corticosteroids often used to reduce trismus and swelling after third molar surgery. However, their use may increase the risk of infection, delay healing, and cause adrenal suppression(3).

A biomaterial known as hyaluronan, or hyaluronic acid (HA), has been developed as a substitute strategy to promote wound healing. One of the biggest parts of the extracellular matrix, it is made up of comprises glucuronic acid, N-acetylglucosamine, and disaccharide

as a basic unit. Although it is present in many tissues, soft connective tissues, such as human synovial fluid and all vertebrate tissues and bodily fluids, contain the largest quantities of it. In critical -size bone lesions, the combination of hyaluronic acid with a scaffold made from collagen may promote bone repair. Furthermore, it has been shown to be essential for wound healing by encouraging the creation of granulation tissue early on, preventing harmful inflammation within the healing period, and both angiogenesis and re-epithelialization. As a result, HA has been utilised to halt or lessen inflammation and related symptoms after surgery. It is a safe substance to use in a variety of medical specialities, including rheumatology, dermatology, and ophthalmology, due to its non-immunogenicity and non-toxicity effects. HA can be given topically to the oral cavity in liquid or gel form(2).

Hyaluronic acid (HA) is a key component of the extracellular matrix, found in connective tissue, synovial fluid, skin, and other organs. It exhibits various pharmacological properties, including anti-inflammatory, wound healing, immune-modulatory, anticancer, anti-aging, and skin-repairing effects. HA is used in different forms, such as hydrogels, films, and

creams, for medical and cosmetic applications. Synthesized by hyaluronan synthase on the cell membrane, it is secreted into the extracellular space, creating a hydrated environment. HA is degraded by hyaluronidases and cleared via the lymphatic system and liver. Its main functions include expanding the extracellular space by attracting water, forming a stable extracellular matrix, and activating intracellular signalling pathways through receptors like CD44 and RHAMM(4).

Hyaluronic acid (HA) is one of the most water-retaining molecules found in nature. In aqueous solutions, hydrogen bonds form between its carboxyl and N-acetyl groups, providing structural stability and high water retention. Its viscoelastic properties help protect tissues by limiting bacterial and viral penetration. HA also plays a crucial role in wound healing across both mineralized and non-mineralized tissues, supporting inflammation, granulation, epithelial formation, and tissue remodelling. Due to its multifunctional properties, HA-based biomaterials have been developed for treating inflammatory conditions. Given the similarities in biological processes, HA is believed to contribute to the healing of both gingival and bone tissues in the periodontium (10)**.**

HA has many properties that make it an ideal molecule to facilitate wound healing, including early granulation tissue formation, inhibiting inflammation during the healing phase, and promoting re-epithelialization and angiogenesis. In addition, it has been shown to decrease the levels of inflammatory mediators, and it can be safely used as an anti-inflammatory agent. HA in the solid form is commonly used as a biocompatible, biodegradable, and non-immunogenic wound dressing.

Materials And Methods

1. SOURCE OF DATA:

• Study design: Comparative clinical in vivo study.

• Source: 60 Patients reporting for transalveolar extraction of endodontically treated mandibular molar teeth.

• Setting / Venue: Department of Oral and Maxillofacial Surgery, Maharashtra Institute of Dental Sciences & Research (Dental college), Latur**.**

2. Method Of Collection of Data

• Duration of study: 18 Months (2nd June 2023 to 2nd December 2024)

• Sampling technique: Random sampling

• Sample size: 60

• Total number of groups: 2

• Number of patients in each group: 30

(Study group: With hyaluronic acid spray & Control group: without hyaluronic acid spray)

The study was carried out for the duration of 18 months (2nd June 2023 to 2nd December 2024) in the Department of Oral and Maxillofacial Surgery. Sixty patients needed to undergo transalveolar extraction of endodontically treated mandibular molars and those who have fulfilled the inclusion and exclusion mentioned criteria will be selected. All of the patients will be informed about the procedure and the purpose, advantages and disadvantages of the study. Valid informed written consent will be obtained from every patient. Complete detailed case history was taken. A single operator will perform all procedures and record parameters. Standard aseptic precautions will be maintained. Mandibular molars will be extracted under 2 ml of 2% Lignocaine with 1:80,000 adrenaline using classical inferior alveolar, lingual and long buccal nerve blocks. The connective tissue fibres around the tooth will be sever using a periosteal elevator. Bone guttering and tooth sectioning will be done using surgical handpiece and straight fissure bur. After the transalveoar extraction, in first patient Hyaluronic acid spray was sprayed (study group) before wound closure was done and in second patient no spray will be sprayed (control group). Wound closure will be done with simple interrupted suture using 3-0 black braided silk. The patients were instructed not to eat or drink for 1 hour after the use of the spray & given postoperative analgesics.

In this study, patients divided into study group (Hyaluronic acid spray sprayed) and control group (Hyaluronic Acid spray not sprayed). Patients will be selected randomly for study group and control group. For example, amongst patients needed to undergo transalveolar extraction of endodontically treated mandibular molars, we will consider first patient in study group, second patient in control group. Similarly again third patient in study group and fourth patient in control group and so on.

Materials used in this study-

(1) 0.8% Hyaluronic acid spray

(2) 2 % Lidocaine hydrochloride with 1:80,000 adrenaline

(3) 5ml Disposable syringe with 26-gauge needle

(4) Standard extraction instruments

INCLUSION CRITERIA:

• Patients with endodontically treated mandibular molars which cannot be restored.

• Age group 18-50 yrs

• Sex –both male and female patients

• Patients must meet the American Society of Anaesthesiologists classification status I (ASA I- normal healthy patients).

• Patients with no unexpected oral habits, no smokers and with no intraoral pathology

EXCLUSION CRITERIA:

• Patients not willing to be part of the study.

• those who were pregnant or nursing a baby

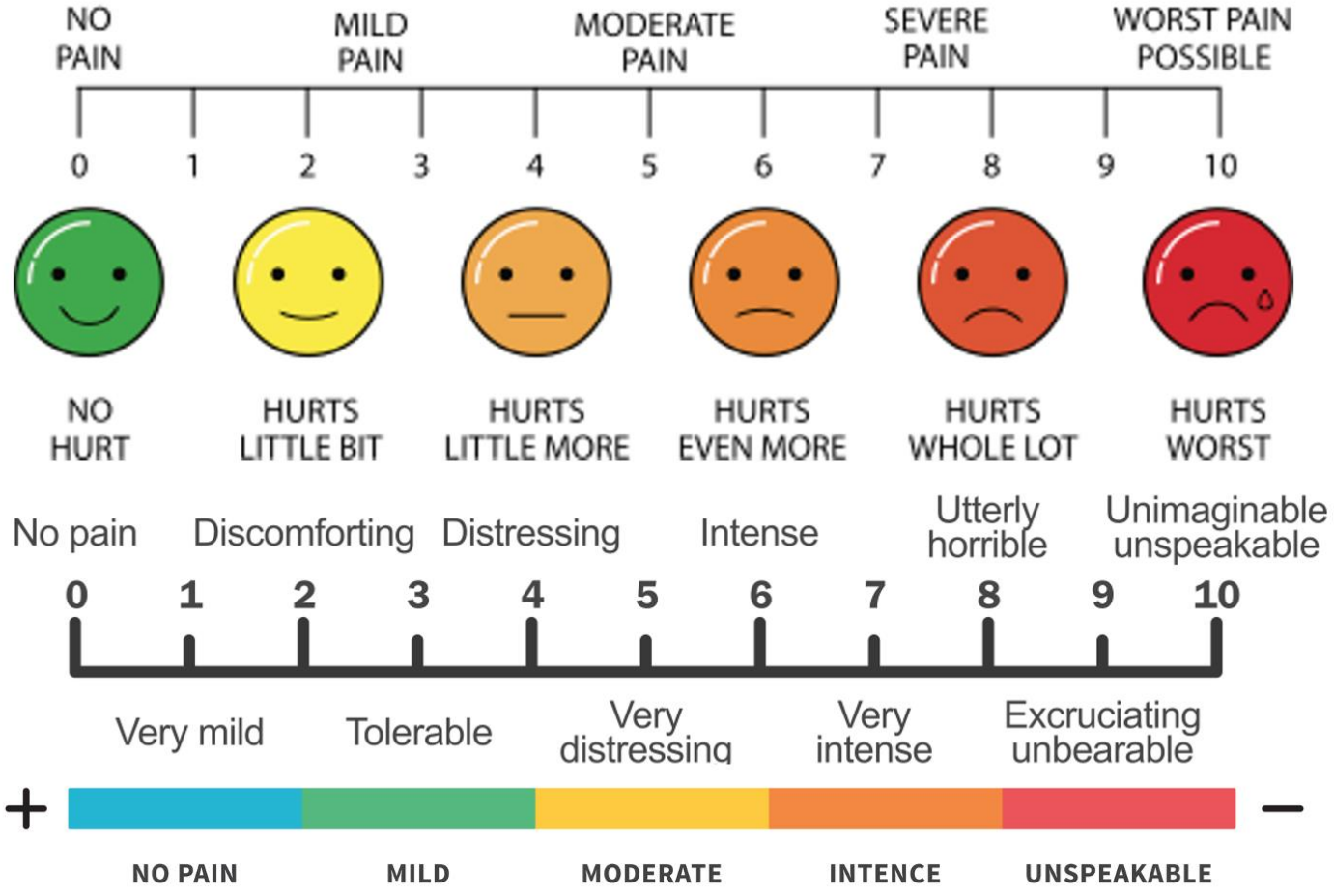
• those who had undergone antibiotic or other medication therapies during the preceding 2 weeks

• Those who had contraindications to the drugs or Anaesthetics used in the surgical protocol.

CLINICAL ASSESSMENT (POSTOPERATIVE)

1. PAIN:

Pain intensity will be assessed using a 10-point visual analogue 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'. It will be evaluated on 1st, 3rd and 7th day after surgery.



2. SWELLING:

The degree of facial swelling will be determined by a modification of the tape measure method described by Gabka and Matsumara.

Three measurements will be made between five reference points:

I. The distance between the lateral corner of the eye and angle of the mandible,

II. The distance between the tragus and soft tissue pogonion,

III. The distance between the tragus and outer corner of the mouth.

The mean of these three measurements will be calculated and measurements will be taken on 1st, 3rd and 7th postoperative day.

3. SOFT TISSUE HEALING:

The soft tissue healing would be evaluated and graded according to Landry R, Turnbull R and Howley T soft tissue healing index as on 1st,3rd and 7^{th} days postoperatively:

Has 2 or more of the following:

Healing Index 1-very poor;

1) Tissue colour >=50% of gingiva red

2) Response to palpation: bleeding

3) Granulation tissue: present

4) Incision margin: not epithelialized, with loss of epithelium beyond

incision margin

5) Suppuration present

Healing Index 2: Poor.

1) Tissue colour: >=50%of gingiva red

2) Response to palpation: bleeding

3) Granulation tissue: present

4) Incision margin: not epithelialized, connective tissue exposed

Healing Index 3: Good

1)Tissue colour: >=25% and <50% of gingiva red

2)Response to palpation: no bleeding

3) Granulation tissue: none

4) Incision margin: no connective tissue exposed

Healing Index 4-Very Good

1)Tissue colour: <25% of gingiva red

2) Response to palpation: no bleeding

3) Granulation tissue: none

4) Incision margin: no connective tissue exposed

Healing Index 5-Excellent

1) Tissue colour: all tissues pink

2) Response to palpation: no bleeding

3) Granulation tissue: none

4) Incision margin: no connective tissue exposed

FIGURE 1: INTRAORAL PERIAPICAL RADIOGRAPH

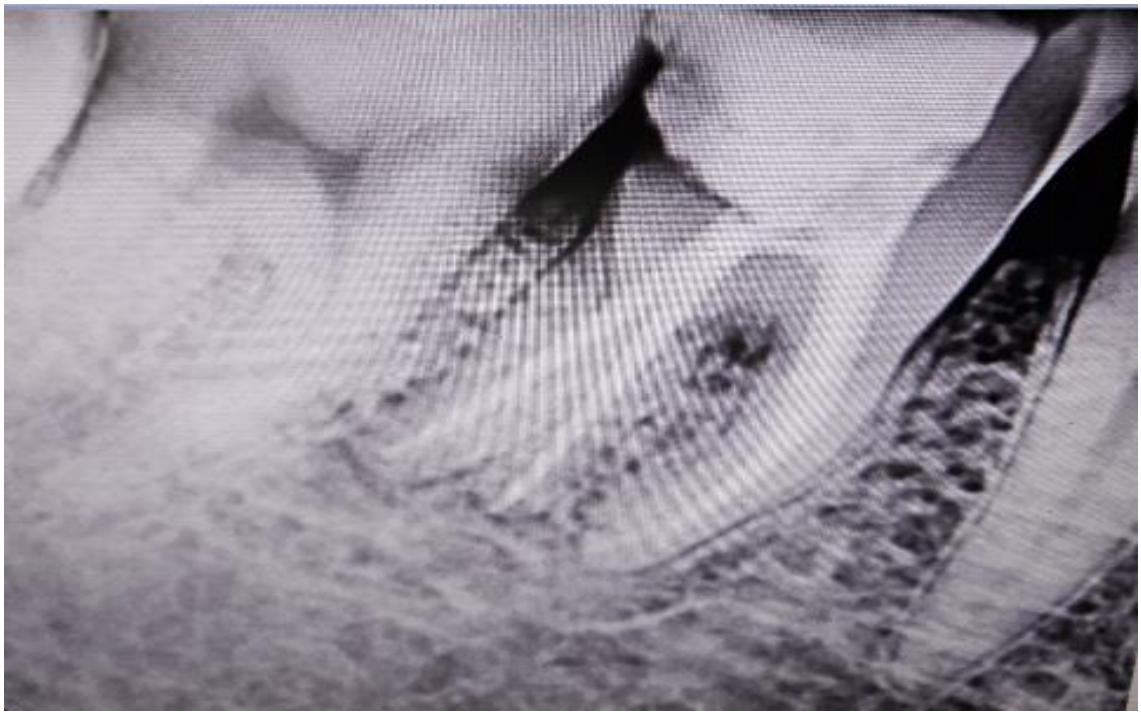


FIGURE 2: ENDODONTICALLY TREATED MANDIBUL AR MOLAR

FIGURE 3: BONE GUTTERING

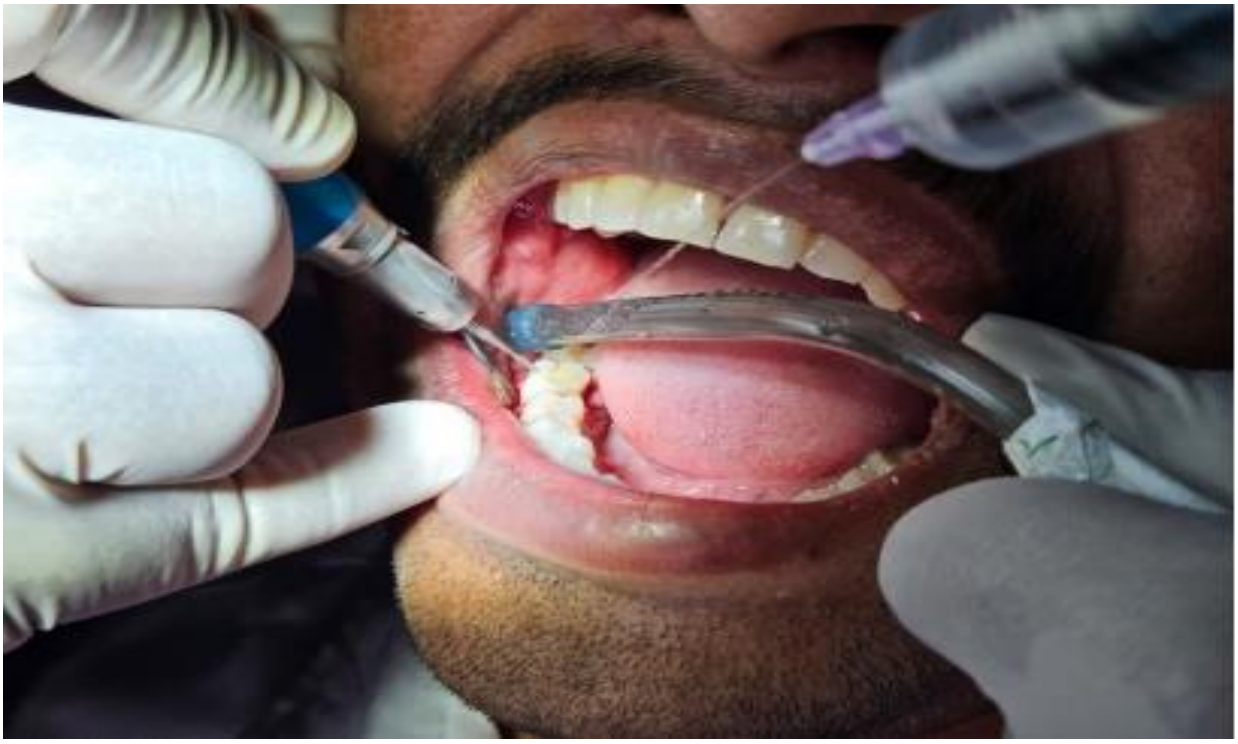


FIGURE 4: TOOTH SECTIONING

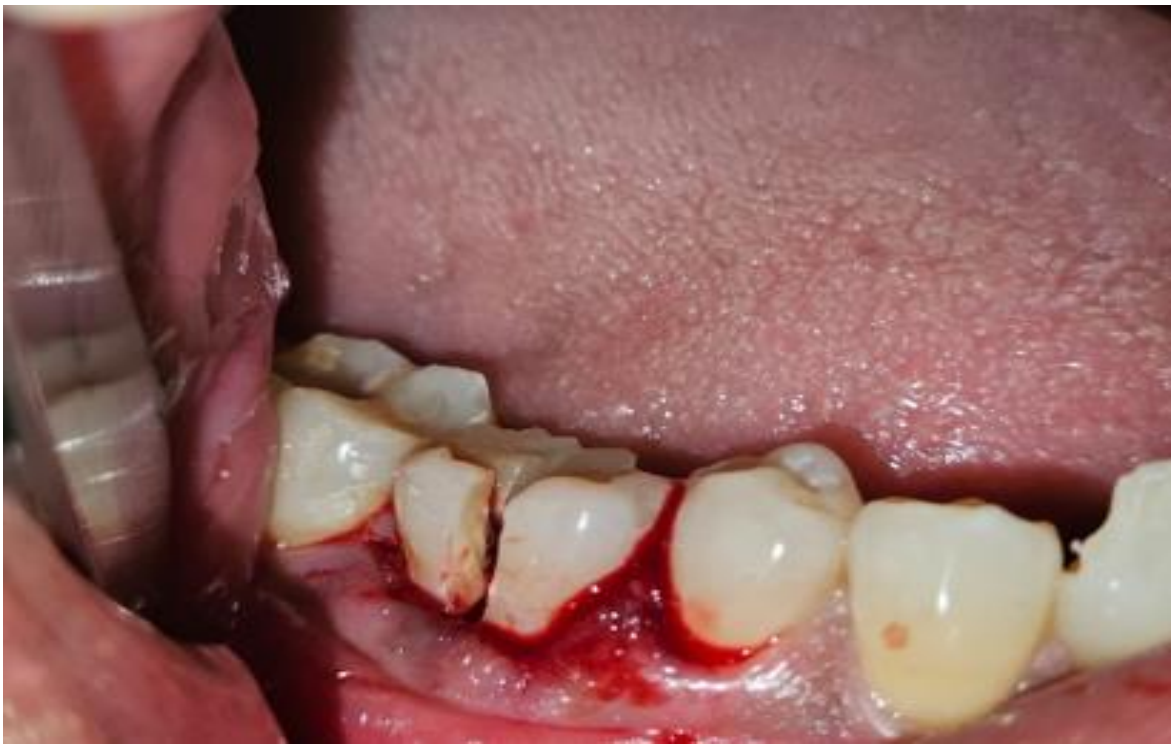


FIGURE 5: TOOTH REMOVAL

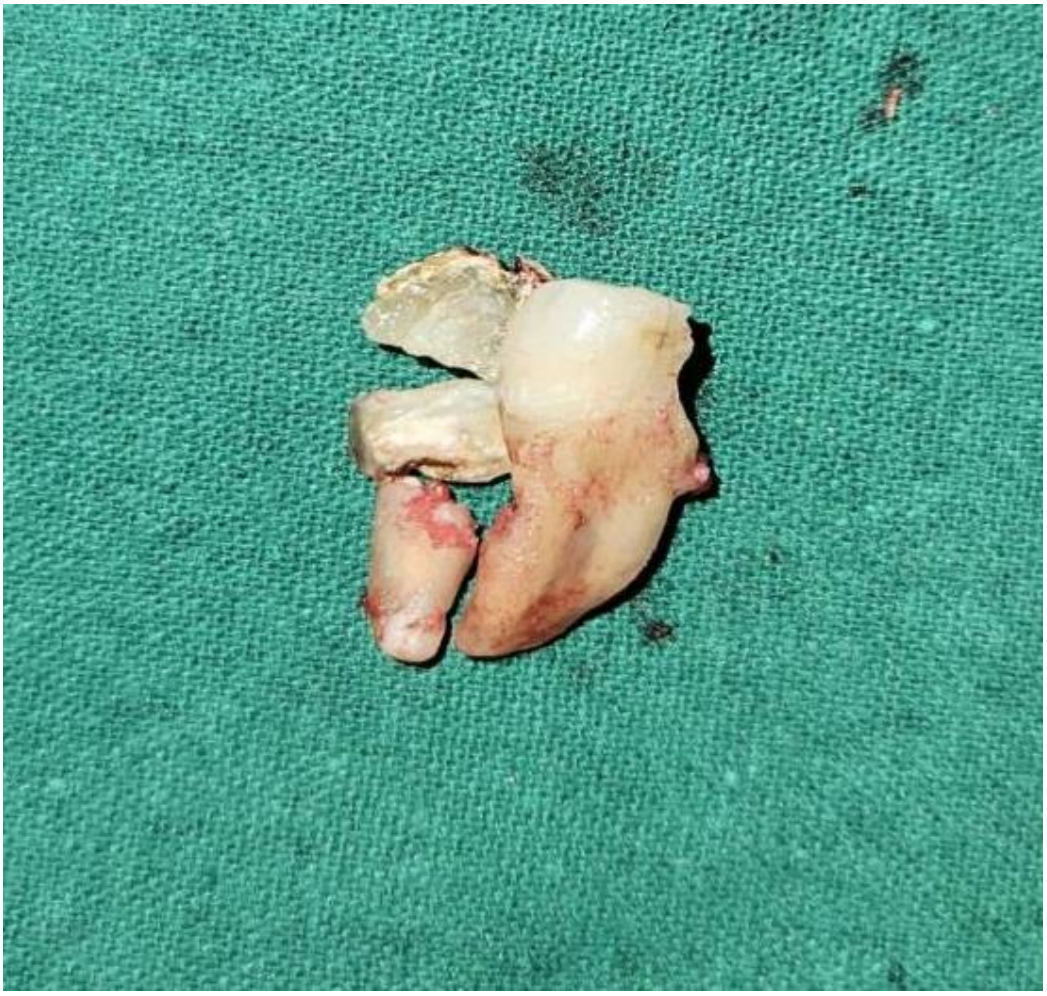


FIGURE 6: APPLICATION OF HYALURONIC ACID SPRAY TO THE EXTRACTION SOCKET

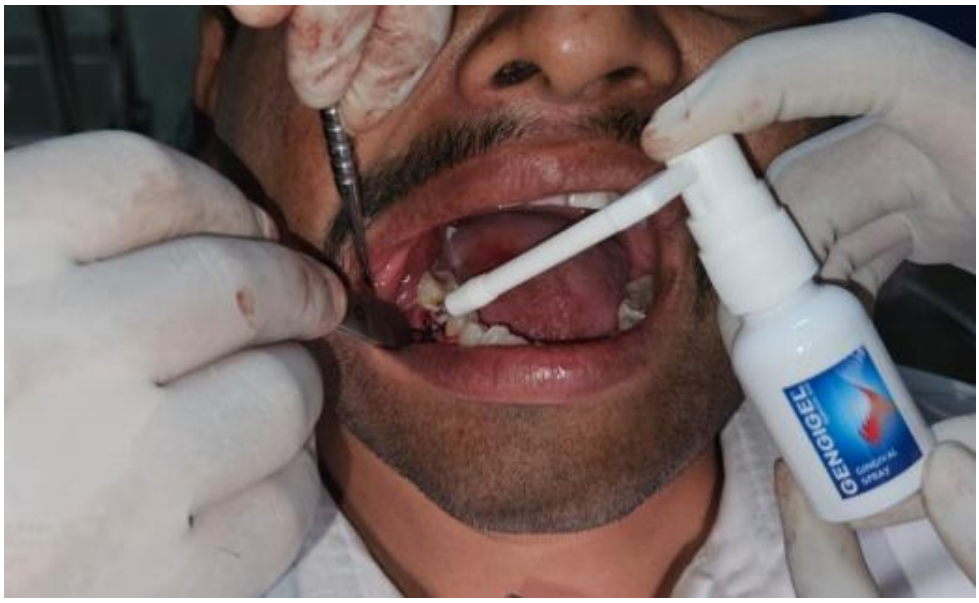


FIGURE 7: SWELLING MEASUREMENTS

LINE A: OUTER CANTHUS OF EYE TO ANGLE OF MANDIBLE

LINE B: TRAGUS TO POGONION

LINE C: TRAGUS TO CORNER OF MOUTH

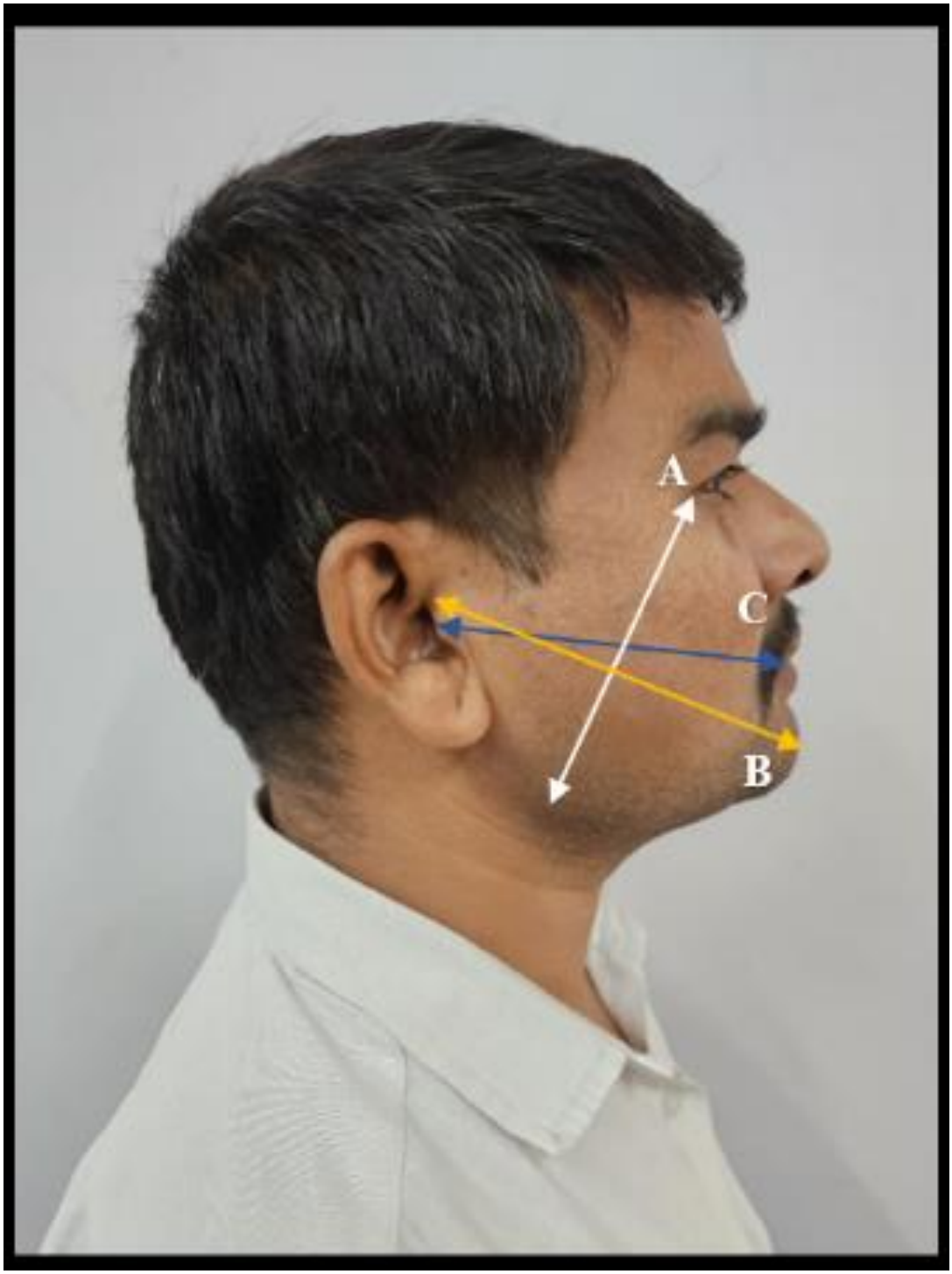
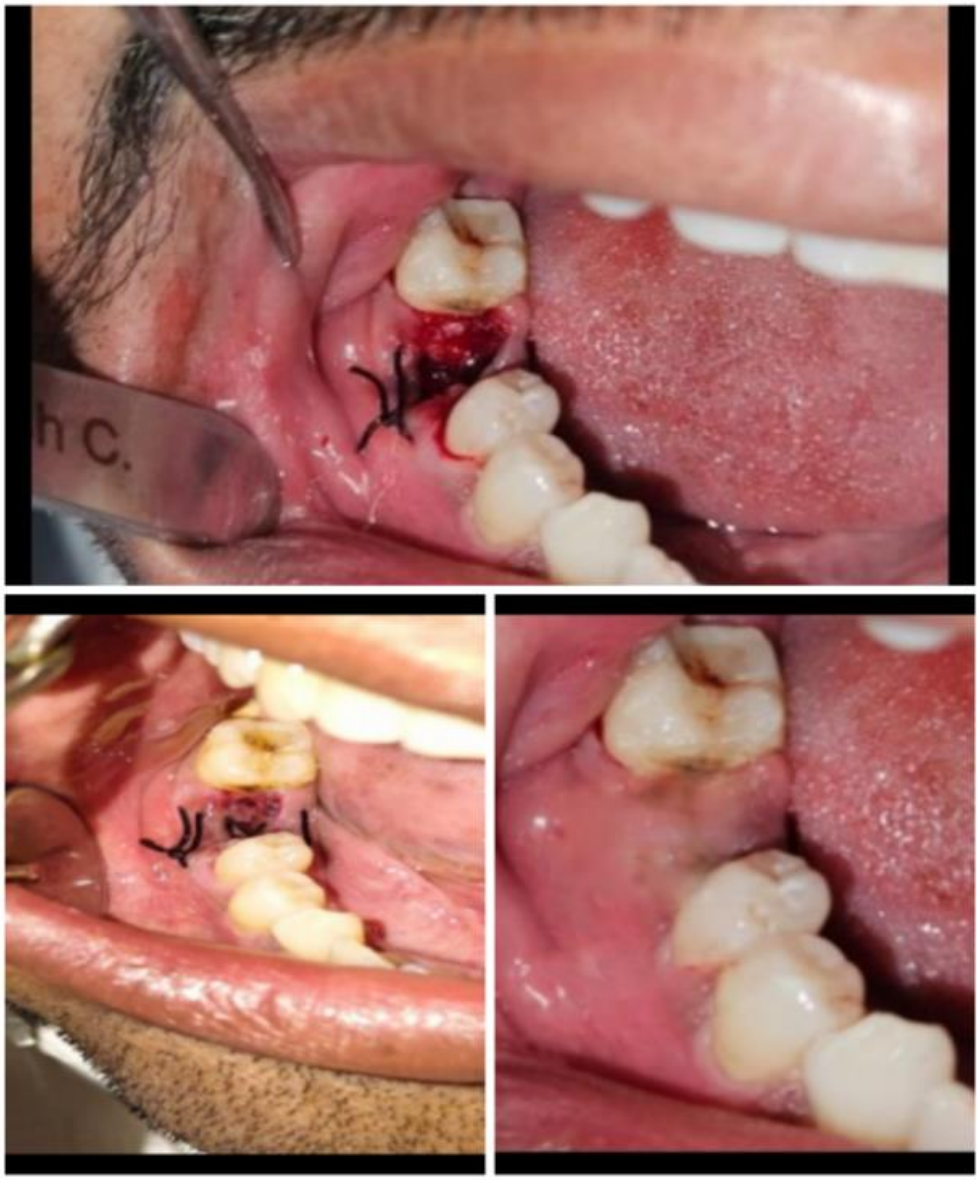


FIGURE 8: SOFT TISSUE HEALING

POST OP DAY 1

POST OP DAY 3

POST OP DAY 7



Results

A total of 60 patients were included in the study, wherein the mean age was 29.95 ± 6.25 and the male: female ratio was 36:24 respectively. The following tables & graphs shows the data representations of clinical parameters included in this study like post-operative pain, swelling and soft tissue healing & also demographic details.

TABLE 1: Normality assessment (Shapiro wilk test)

Group	VAS score			Swelling			Healing		
	Statistic	Df	Sig.	Statistic	df	Sig.	Statistic	df	Sig.
Day 1									
Study	0.876	30	0.002*	0.966	30	0.436	0.845	30	<0.001*

Control	0.902	30	0.009*	0.972	30	0.608	0.749	30	<0.001*
Day 3									
Study	0.876	30	0.002*	0.983	30	0.899	0.846	30	0.001*
Control	0.844	30	<0.001*	0.971	30	0.568	0.823	30	<0.001*
Day 7									
Study	0.87	30	0.002*	0.967	30	0.462	0.706	30	<0.001*
Control	0.823	30	<0.001*	0.97	30	0.538	0.808	30	<0.001*

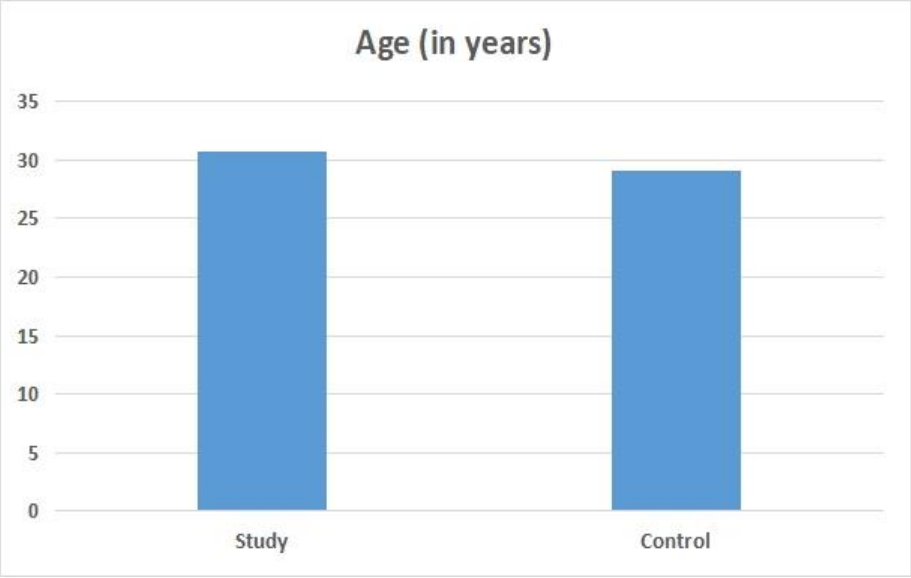
This table presents the results of the normality assessment using Shapiro Wilk test. It can be seen that the data of VAS score and healing score did not follow a normal distribution as evident from p value and the data of swelling measurement was normally distributed on all the time points (p>0.05).

TABLE 2: Demographic details

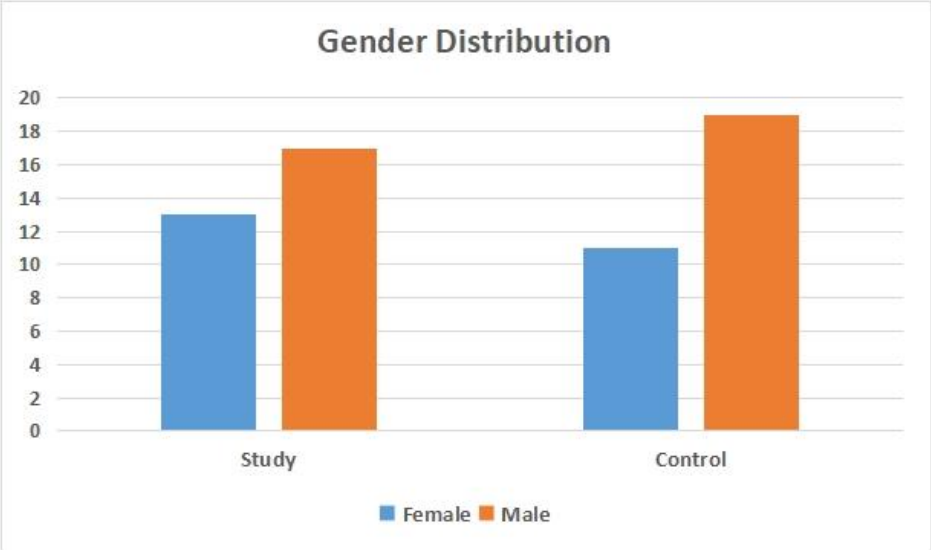
Variable	Study	Control
Age	30.77 (SD=6.43)	29.13 (SD=6.06)
Gender	F: 13 (43.3%) M: 17 (56.6%)	F: 11 (36.7%) M: 19 (63.3%)

This table presents the demographic details of the study participants. The mean age of the participants in the study group was 30.77 years whereas the mean age of the participants in the control group was 29.13 years. There were 13 females and 17 males in study group & 11 females and 19 males in control group.

GRAPH 1: AGE IN YEARS



GRAPH 2: GENDER DISTRIBUTION



1. PAIN:

The mean post-operative pain in the control group was 4.10 and that in the study group was 3.36. On the 1st postoperative day mean pain was 5.20 ± 0.96 and 7th post-op day 2.97 ± 0.96 in the control group and 4.40 ± 0.86 and 2.30 ± 0.88 in the study group (Table 3). This difference between the 2 groups was statistically significant (P = ≤0.05). Comparison of change in pain from at various time intervals in both groups indicate that the efficacy of hyaluronic acid spray in the extraction socket aided in decreasing patient's postoperative pain.

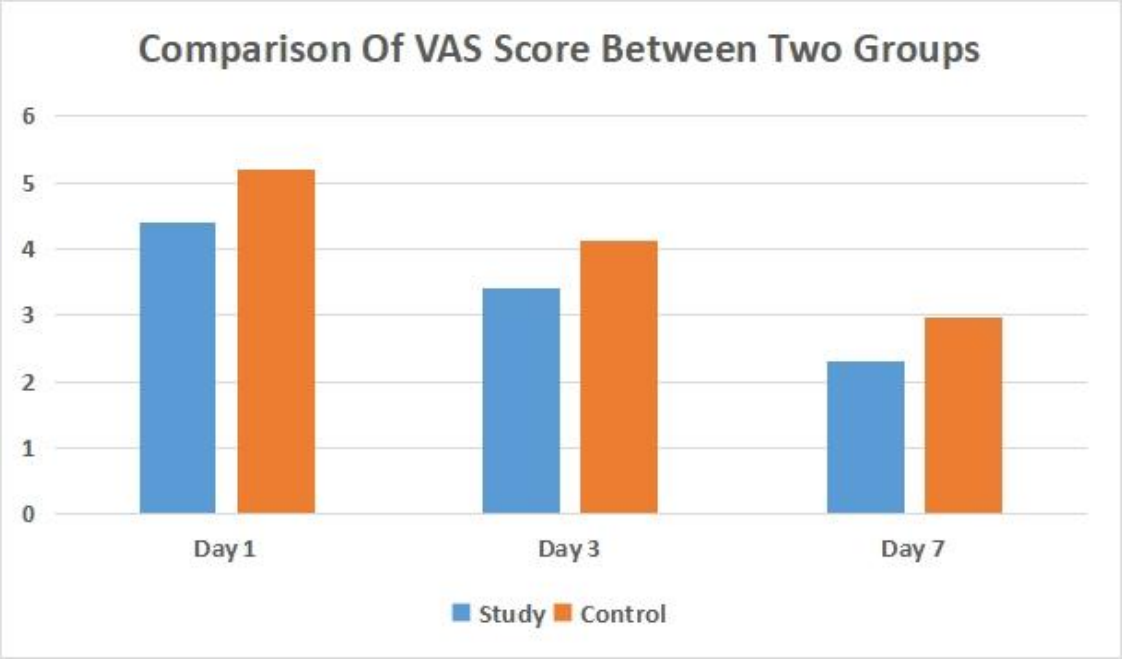
TABLE 3: Comparison of VAS score between two groups

Interval	Group	N	Mean	SD	Difference	z-value	p-value
Day 1	**Study**	30	4.40	0.86	-0.8	-3.141	0.002*
	Control	30	5.20	0.96			
Day 3	**Study**	30	3.40	0.86	-0.73	-2.918	0.004*
	Control	30	4.13	0.90			
Day 7	**Study**	30	2.30	0.88	-0.67	-2.541	0.011*
	Control	30	2.97	0.96			

Mann Whitney test; * indicates a significant difference at p≤0.05

This table compares the mean VAS score between the two groups. The mean VAS score in the study group was significantly lower than the mean VAS score in the control group on day 1, day 3 and day 7.

GRAPH 3: COMPARISION OF VAS SCORE BETWEEN STUDY AND CONTROL GROUP



2. SWELLING:

The mean post-operative swelling in the control group was 7.20 cm and that in the study group was 5.35 cm. On the 1st postoperative day, swelling was 7.53 ± 0.48 cm and 7th post –op day was 6.85 ± 0.42 in the control group & 5.69 ± 0.69 cm and 5.02 ± 0.65 cm in the study group (Table 4). Comparison of change in Swelling at various time intervals in between the 2 groups was statistically significant (p≤0.05), however the study group showed better results than the control group indicating that the efficacy of hyaluronic acid spray in the socket decreased the postoperative swelling experienced by the patients.

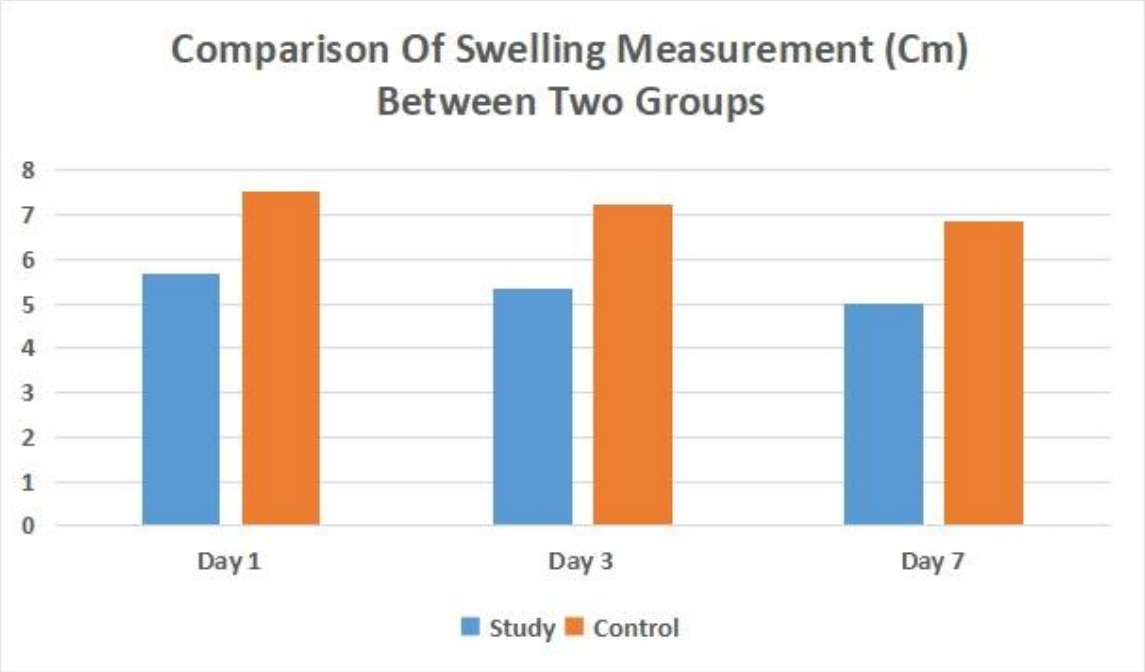
TABLE 4: Comparison of Swelling measurement (cm) between two groups

Interval	Group	N	Mean	SD	Difference	t-value	p-value
Day 1	**Study**	30	5.69	0.69	-1.84	-12.131	<0.001*
	Control	30	7.53	0.48			
Day 3	**Study**	30	5.35	0.68	-1.87	-12.577	<0.001*
	Control	30	7.22	0.45			
Day 7	**Study**	30	5.02	0.65	-0.183	-12.995	<0.001*
	Control	30	6.85	0.42			

Independent t test; * indicates a significant difference at p≤0.05.

This table compares the mean swelling measurement (cm) between the two groups. The mean swelling measurement (cm) in the study group was significantly lower than the mean swelling measurement (cm) in the control group on postoperative day 1, day 3 and day 7.

GRAPH 4: COMPARISION OF SWELLING(CM) BETWEEN STUDY AND CONTROL GROUP



3. SOFT TISSUE HEALING INDEX

The mean soft tissue healing index in the control group was 3.22 and the mean soft tissue healing index in the study group was 3.51. The mean index for control group on Day 1 was 2.40 ± 0.62 and for Day 7 was 4.00 ± 0.79. The mean index for study group on Day 1 was 2.53 ± 0.73 and for Day 7 was 4.50 ± 0.68. The Mann Whitney test was done and it indicates the results in the study group was better than the control and the result was statistically significant (p≤0.05) (Table 5)

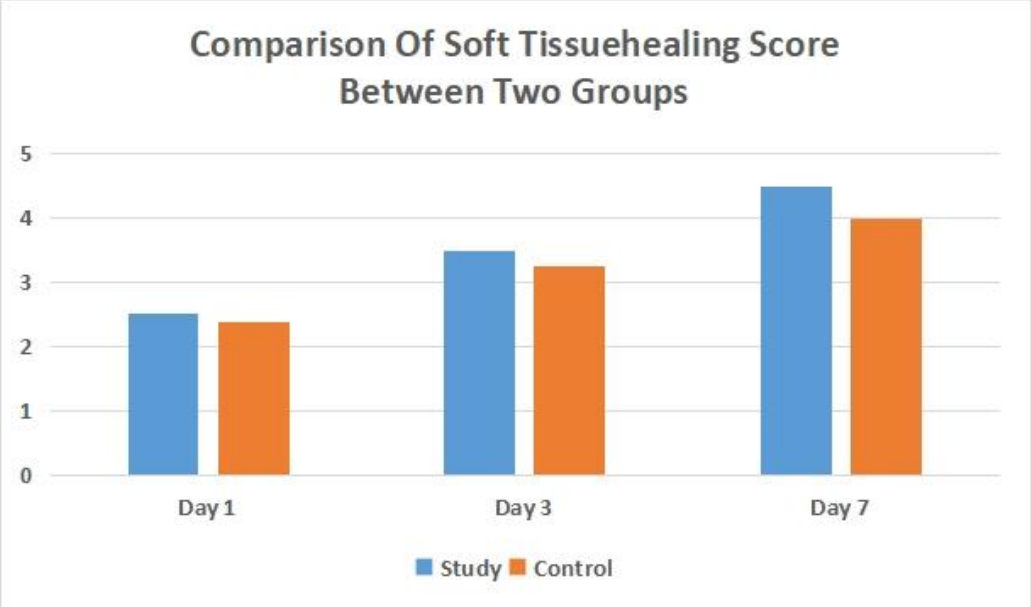
TABLE 5: Comparison of healing score between two groups

Interval	Group	N	Mean	SD	Difference	z-value	p-value
Day 1	**Study**	30	2.53	0.73	0.13	-0.687	0.492
	Control	30	2.40	0.62			
Day 3	**Study**	30	3.50	0.73	0.23	-1.302	0.193
	Control	30	3.27	0.69			
Day 7	**Study**	30	4.50	0.68	0.5	-2.514	0.012*
	Control	30	4.00	0.79			

Mann Whitney test; * indicates a significant difference at p≤0.05

This table compares the mean healing score between the two groups. The mean healing score in the study group did not differ significantly from that of the mean healing score in the control group on day 1 and day 3; however, on day 7, the mean healing score in the study group was significantly greater than the mean healing score in the control group.

GRAPH 5: COMPARISION OF SOFT TISSUE HEALING BETWEEN STUDY AND CONTROL GROUP



Discussion:

The endodontically treated mandibular molars commonly undergo transalveolar extraction as they have weakened(brittle) tooth structure, hypercementosis or root resorption, dense mandibular bone, etc. Once the decision is made to remove endodontically treated molars, clinical and radiographic findings become a tool for predicting the difficulty of removal. The results of the present study showed postoperative pain, swelling and soft tissue healing to be significantly improved in the Hyaluronic acid group (study group).

Hyaluronic acid (HA) has gained increasing attention as a biocompatible agent that can enhance wound healing and bone regeneration in various medical and dental applications. In the context of tooth extraction, numerous studies have examined its role in accelerating the healing process, reducing pain, and minimizing postoperative complications.

The application of HA in extraction sockets has been evaluated in both preclinical and clinical studies. Some studies have suggested that HA contributes positively to soft tissue healing by inducing early granulation tissue formation, re-epithelialization, and angiogenesis (1). Additionally, it has been shown to aid in bone repair by promoting the migration, adhesion, and differentiation of osteoblastic cells, which are critical for new bone formation(5).

However, the effectiveness of HA in reducing pain and preventing common complications such as alveolar osteitis (dry socket) has yielded mixed results. Some clinical trials report a reduction in pain perception and improved patient comfort, particularly after the surgical extraction of impacted third molars(6). Conversely, other studies suggest that HA does not significantly reduce the incidence of dry socket or postoperative pain(2).

A systematic review and meta-analysis concluded that while HA has a positive effect on soft tissue healing and pain reduction, it does not appear to significantly influence long-term bone regeneration (1). Notably, HA-based materials have been found to reduce swelling, trismus, and inflammation when applied postoperatively in third molar extraction cases(3).

Additionally, HA has been explored in regenerative medicine due to its role as a biomaterial for tissue engineering(7). Its use in various medical fields, such as dermatology and orthopaedics, highlights its versatility(8). Despite these promising applications, further randomized controlled trials are necessary to standardize protocols and establish conclusive evidence for its routine use after dental extractions.

Studies comparing HA to other anti-inflammatory agents, such as corticosteroids, suggest that while HA promotes healing, corticosteroids like dexamethasone and methylprednisolone may offer superior immediate postoperative pain relief(9–11). However, HA's non-immunogenic and biodegradable nature makes it a

favourable option for long-term healing and regenerative applications.

Our study has found a significant decrease in the VAS sore in the HA group compared to the control group. The mean post-operative pain in the control group was 4.10 and that in the study group was 3.36. On the 1st postoperative day pain was 5.20 ± 0.96 and 7th post-op day 2.97 ± 0.96 in the control group and 4.40 ± 0.86 and 2.30 ± 0.88 in the study group (Table 3). This difference between the 2 groups was statistically significant (P = ≤0.05). This study is in accordance with these studies as it had showed improved soft tissue healing which was assessed using the Larry and Turnbull soft tissue healing index. The mean soft tissue healing index in the control group was 3.22 and the mean soft tissue healing index in the study group was 3.51. The mean soft tissue healing index for control group on Day 1 was 2.40 ± 0.62 and for Day 7 was 4.00 ± 0.79. The mean soft tissue healing index for study group on Day 1 was 2.53 ± 0.73 and for Day 7 was 4.50 ± 0.68 (Table 5). It indicates the results in the study group were better than the control and the result was statistically significant (p≤0.05). The mean post-operative swelling in the control group was 7.20 cm and that in the study group was 5.35 cm. On the 1st postoperative day, swelling was 7.53 ± 0.48 cm and 7th post –op day was 6.85 ± 0.42 in the control group & 5.69 ± 0.69 cm and 5.02 ± 0.65 cm in the study group (Table 4). Comparison of change in Swelling at various time intervals in between the 2 groups was statistically significant (p≤0.05), however the study group showed better results than the control group indicating that the efficacy of hyaluronic acid spray in the socket decreased the postoperative swelling experienced by the patients.

Overall, while HA demonstrates promising benefits for reducing postoperative pain, swelling, wound healing and bone regeneration, its routine application after transalveolar extraction sites still requires further investigation to establish standardized protocols and confirm long-term clinical efficacy. Future research should focus on large-scale, randomized controlled trials with longer follow-up periods to assess its true impact.

Conclusion:

An oral and maxillofacial surgeon often performs the surgical extraction of endodontically treated mandibular molars, which can cause significant postoperative discomfort, edema, and trismus. Although there are many factors that contribute to these sequelae, many of them are linked to the inflammatory process that are initiated by the surgical trauma. A number of agents have been studied in an effort to determine one that minimizes these postoperative sequelae because numerous clinicians have emphasized the significance of choosing the best treatment strategies to limit these post-operative complications in patients undergoing transalveolar extraction of endodontically treated mandibular molars.

In order to determine whether there have been any changes in pain, edema, or soft tissue healing, we assessed the effectiveness of hyaluronic acid after transalveolar extraction of endodontically treated mandibular molars. In our comparative clinical in vivo trial, which had a substantial amount of evidence, we observed that hyaluronic acid spray significantly reduced discomfort and swelling while also promoting soft tissue recovery. After endodontically treated mandibular molar surgery, hyaluronic acid has been found to be a very promising adjuvant therapeutic agent and highly beneficial in enhancing the postoperative quality of life (QOL) of the patient.

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