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Comparative Evaluation of Hyaluronic Acid Gel and Conventional Postoperative Care Following Surgical Removal of Impacted Mandibular Third Molars - A Randomized Controlled Trial

[1]Dr. Sapam Shinttoo Devi, Postgraduate Student, Department of Prosthodontics, Crown & Bridge, Teerthanker Mahaveer Dental College and Research Centre, Moradabad, Uttar Pradesh.

[2]Dr. Deepashree Paul, Associate Professor, Department of Dentistry, IQ CITY Medical College, Durgapur, West Bengal.

[3]Dr. Sakina Sattar, Assistant Professor, Department of Orthodontics and Dentofacial Orthopaedics, Rural Dental College (PIMS-DU), Loni, Maharashtra.

[4]Dr. K Harshith, Consultant Oral and Maxillofacial Surgeon, Nagari, Andhra Pradesh.

[5]Dr. Yugal Kishor, Reader, Department of Periodontology, Chhattisgarh Dental College and Research Institute, Rajnandgaon, Chhattisgarh.

[6]Dr. Shaik Sumairuddin, Assistant Professor, Department of Prosthodontics and Implantology, Sri Sai Dental College and Hospital, Vikarabad, Telangana-501102.

Corresponding Author: Dr. Sapam Shinttoo Devi, Postgraduate Student, Department of Prosthodontics, Crown & Bridge, Teerthanker Mahaveer Dental College and Research Centre, Moradabad, Uttar Pradesh.

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Abstract

Background: Surgical removal of impacted mandibular third molars is one of the most commonly performed procedures in oral and maxillofacial surgery and is frequently associated with postoperative pain, facial swelling, and trismus. Hyaluronic acid (HA), a naturally occurring glycosaminogly can with anti-inflammatory and wound-modulating properties, has been proposed as an adjunctive agent to reduce postoperative morbidity. This study aimed to compare the effectiveness of topical Hyaluronic acid gel with conventional postoperative care following surgical removal of impacted mandibular third molars.

Materials and Methods: A prospective, randomized controlled clinical trial was conducted among 60 healthy patients aged 18–35 years requiring surgical extraction

of impacted mandibular third molars. Participants were randomly allocated into two groups (n = 30 each). Group A received topical 0.2% Hyaluronic acid gel applied to the extraction socket immediately after surgery in addition to conventional postoperative care, whereas Group B received conventional postoperative care alone. Postoperative pain was assessed using a 10-cm Visual Analog Scale (VAS), facial swelling was measured using standardized extra oral facial reference points, and trismus was evaluated by measuring the maximum interincisal mouth opening with a digital Vernier caliper. Assessments were performed preoperatively and on postoperative days 1, 3, and 7. Data were analyzed using appropriate statistical tests with the level of significance set at $p < 0.05$.

Results: Patients treated with topical Hyaluronic acid gel demonstrated significantly lower postoperative pain scores and reduced facial swelling compared with the control group. The Hyaluronic acid group also exhibited significantly less reduction in maximum interincisal mouth opening, indicating decreased postoperative trismus. Statistically significant differences between the groups were observed during the early postoperative period ($p < 0.05$).

Conclusion: Topical application of Hyaluronic acid gel appears to be an effective adjunct to conventional postoperative care following surgical removal of impacted mandibular third molars. Its use significantly reduces postoperative pain, facial swelling, and trismus, thereby improving early postoperative recovery and patient comfort.

Keywords: Hyaluronic acid, Impacted mandibular third molar, Oral surgery

Introduction: Impacted mandibular third molars are among the most frequently encountered developmental anomalies in dental practice, with surgical removal being one of the most commonly performed procedures in oral and maxillofacial surgery.[1] Indications for extraction include recurrent pericoronitis, dental caries, periodontal disease, cystic lesions, orthodontic considerations, and prophylactic removal to prevent future complications. Despite advances in surgical techniques and postoperative care, patients commonly experience pain, facial swelling, trismus, and delayed soft tissue healing following third molar surgery.[2,3] These postoperative sequelae may impair mastication, speech, oral hygiene, and overall quality of life during the recovery period.[4,5]

The postoperative inflammatory response is initiated by tissue trauma sustained during flap reflection, bone removal, and tooth sectioning.

The release of inflammatory mediators, including prostaglandins, cytokines, and histamine, contributes to pain, edema, and restricted mouth opening. Conventional postoperative management typically includes analgesics, non steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, antibiotics when indicated, cryotherapy, and antiseptic mouth rinses. Although these measures effectively control symptoms, they may not completely prevent postoperative morbidity and, in some cases, are associated with adverse effects or contraindications.[4,5]

Hyaluronic acid (HA) is a naturally occurring, high-molecular-weight glycosaminogly can that constitutes an essential component of the extracellular matrix in connective tissues. It plays a critical role in tissue hydration, cell migration, angiogenesis, modulation of inflammation, and wound healing. Owing to its bio compatibility, biodegradability, and anti-inflammatory properties, Hyaluronic acid has been widely used in various medical disciplines, including orthopedics,

ophthalmology, dermatology, and regenerative medicine. In dentistry, topical Hyaluronic acid has shown promising results in the management of periodontal defects, oral ulcers, peri-implant mucositis, and extraction socket healing.[6-8]

The therapeutic effects of Hyaluronic acid are attributed to its ability to maintain tissue moisture, facilitate fibroblast proliferation, stimulate collagen synthesis, promote angiogenesis, and regulate the inflammatory response. These biological properties may accelerate soft tissue repair while reducing postoperative pain, swelling, and trismus after oral surgical procedures. Furthermore, topical application allows localized delivery of the agent with minimal systemic exposure, making it a safe adjunct to routine postoperative care.

Several studies have investigated the use of Hyaluronic acid following oral surgical procedures and have reported encouraging outcomes. However, variations in study design, Hyaluronic acid concentration, application protocols, follow-up periods, and outcome measures have resulted in inconsistent findings.

Moreover, there remains limited evidence from randomized controlled clinical trials evaluating its effectiveness in reducing postoperative morbidity after impacted mandibular third molar surgery, particularly in diverse patient populations.

Therefore, the present randomized controlled clinical trial was designed to compare the effectiveness of topical Hyaluronic acid gel with conventional post operative care following surgical removal of impacted mandibular third molars.

Materials and Methods

Study Design

This prospective, parallel-arm, randomized controlled clinical trial was conducted in the Department of Oral and Maxillofacial Surgery over a period of six months. The study protocol was reviewed and approved by the Institutional Ethics Committee and all procedures were performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment.

Sample Size

The sample size was calculated using G*Power software (Version 3.1, Heinrich Heine University, Düsseldorf, Germany) based on postoperative pain (Visual Analog Scale) as the primary outcome. Assuming an effect size of 0.75, a power of 80%, and a significance level of 5%, a minimum of 27 participants per group was required. To compensate for possible dropouts, 30 participants were recruited in each group, resulting in a total sample size of 60 patients.

Participant Selection

Inclusion Criteria

- Patients aged 18–35 years.
- Systemically healthy individuals (ASA Physical Status I or II).
- Presence of a single impacted mandibular third molar requiring surgical extraction.
- Mesioangular, vertical, horizontal, or distoangular impactions.
- Patients willing to participate and provide written informed consent.

Exclusion Criteria

- Acute pericoronitis or odontogenic infection at the time of surgery.
- Pregnancy or lactation.
- Smokers or tobacco users.
- History of systemic diseases affecting wound healing (e.g., uncontrolled diabetes mellitus, immuno deficiency).

- Allergy to Hyaluronic acid or study medications.
- Patients receiving corticosteroids, immunosuppressive therapy, or anticoagulants.
- Previous surgery involving the same surgical site.

Randomization and Allocation

Sixty eligible participants were randomly allocated into two equal groups (n = 30 each) using a computer-generated randomization sequence. Allocation concealment was achieved using sequentially numbered, opaque, sealed envelopes that were opened immediately before surgery.

Group A (Hyaluronic Acid Group)

Surgical extraction followed by topical application of 0.2% Hyaluronic acid gel into the extraction socket before suturing, along with conventional postoperative care.

Group B (Control Group)

Patients underwent surgical extraction followed by conventional postoperative care, which included socket irrigation with sterile normal saline, wound closure using black silk sutures, standard postoperative instructions, and prescription of oral medications. No hyaluronic acid gel or any other adjunctive wound-healing agent was applied to the extraction socket.

The examiner responsible for postoperative assessments was blinded to the treatment allocation.

Surgical Procedure

All surgical procedures were performed by the same experienced oral surgeon under standardized clinical conditions using 2% lignocaine with 1:80,000 adrenaline for local anesthesia. A standard Ward's incision was made, followed by mucoperiosteal flap reflection. Bone removal and tooth sectioning were carried out when necessary, using a sterile surgical bur under copious saline irrigation. After tooth removal, the socket was irrigated thoroughly with sterile normal saline.

In Group A, approximately 1–2 mL of 0.2% hyaluronic acid gel was applied uniformly into the extraction socket before wound closure. In Group B, no adjunctive material was placed in the socket. The flap was repositioned and sutured using 3-0 black silk interrupted sutures.

Postoperative Care: All participants received identical postoperative instructions. The prescribed medications included:

- Amoxicillin 625 mg three times daily for 5 days (or an appropriate alternative according to institutional protocol).
- Diclofenac sodium 50mg, Serratiopeptidase 10 mg three times daily as required for pain.
- Chlorhexidine gluconate 0.12% mouth rinse twice daily for 7 days.

Patients were instructed to avoid vigorous rinsing during the first 24 hours, maintain adequate oral hygiene, and report immediately if excessive pain, swelling, bleeding, or other complications occurred.

Outcome Measures

Postoperative outcomes were assessed by evaluating pain, trismus, and facial swelling. Pain intensity was measured using a 10-cm Visual Analog Scale (VAS), where 0 represented "no pain" and 10 represented the "worst imaginable pain." Patients were instructed to record their pain scores on postoperative days 1, 3, and 7.

Postoperative trismus was assessed by measuring the maximum interincisal mouth opening using a calibrated digital Vernier caliper. The distance between the incisal edges of the maxillary and mandibular central incisors at

maximum mouth opening was recorded in millimeters preoperatively and on postoperative days 3 and 7.

Facial swelling was evaluated using standardized linear facial measurements with a non-elastic thread and a millimeter scale. Measurements were obtained between three predetermined extra oral anatomical landmarks: (1) tragus to the angle of the mouth (cheilion), (2) tragus to the soft tissue pogonion, and (3) lateral can thus of the eye to the angle of the mandible. Baseline measurements were recorded before surgery and repeated on postoperative days 3 and 7. The differences between the preoperative and postoperative measurements were used to determine the degree of facial swelling.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

Results

A total of 60 participants were enrolled in the study and randomly allocated into two groups: Group A (Hyaluronic Acid Gel, n = 30) and Group B (Control, n = 30). All participants completed the study, and no dropouts or protocol deviations were recorded. The demographic characteristics, including age and sex distribution, were comparable between the two groups, with no statistically significant differences ($p > 0.05$).

The mean postoperative pain scores, measured using the Visual Analog Scale (VAS), were significantly lower in Group A than in Group B on postoperative days 3 and 7 ($p < 0.05$). Although pain scores on postoperative day 1 were lower in the hyaluronic acid group, the difference was not statistically significant ($p > 0.05$). Pain intensity decreased progressively over time in both groups.

Facial swelling increased after surgery in both groups, reaching its maximum on postoperative day 3 and decreasing by postoperative day 7. However, participants treated with hyaluronic acid gel exhibited significantly less facial swelling than those receiving conventional postoperative care on both postoperative days 3 and 7 ($p < 0.05$).

Maximum interincisal mouth opening decreased in both groups following surgery, indicating postoperative trismus. The reduction in mouth opening was significantly less in Group A than in Group B on postoperative days 3 and 7 ($p < 0.05$), suggesting faster functional recovery in patients treated with Hyaluronic acid gel.

No adverse reactions related to the application of Hyaluronic acid gel were observed during the study period, and postoperative healing was uneventful in all participants.

Table 1: Comparison of Postoperative Outcomes Between the Study Groups

Outcome	Group A (Hyaluronic Acid) Mean ± SD	Group B (Control) Mean ± SD	p-value
VAS Pain Score			
Day 1	5.8 ± 1.0	6.1 ± 1.1	0.284
Day 3	3.2 ± 0.8	4.5 ± 1.0	<0.001*
Day 7	0.9 ± 0.6	1.8 ± 0.8	<0.001*
Facial Swelling (mm)			
Day 3	14.3 ± 2.6	18.7 ± 3.1	<0.001*

Day 7	6.2 ± 1.8	9.8 ± 2.2	<0.001*
Maximum Interincisal Opening (mm)			
Preoperative	45.2 ± 3.4	45.0 ± 3.2	0.842
Day 3	33.8 ± 3.1	29.9 ± 3.4	<0.001*
Day 7	41.6 ± 2.8	37.9 ± 3.1	<0.001*

*Statistically significant at $p < 0.05$.

Discussion

Surgical removal of impacted mandibular third molars is one of the most frequently performed procedures in oral and maxillofacial surgery and is commonly associated with postoperative pain, facial swelling, and trismus due to tissue trauma and the subsequent inflammatory response.[9] These postoperative sequelae may impair patients' daily activities and quality of life during the early healing period. Therefore, identifying adjunctive therapies that can minimize postoperative morbidity remains an important objective in oral surgery. The present randomized controlled clinical trial evaluated the effectiveness of topical Hyaluronic acid gel as an adjunct to conventional postoperative care in reducing pain, facial swelling, and trismus following surgical removal of impacted mandibular third molars.[10]

The findings of the present study demonstrated that patients treated with topical Hyaluronic acid gel experienced significantly lower postoperative pain scores compared with those receiving conventional postoperative care alone. The reduction in pain became more evident during the early postoperative period and continued throughout the follow-up period. These findings may be attributed to the anti-inflammatory properties of hyaluronic acid, which modulates the inflammatory cascade by reducing the release of pro-inflammatory cytokines and inflammatory mediators while maintaining a hydrated extracellular matrix that promotes tissue repair. In addition, Hyaluronic acid provides a protective biological barrier over the surgical wound, thereby reducing irritation of exposed tissues and facilitating patient comfort.

Facial swelling is an expected consequence of surgical trauma resulting from increased vascular permeability and inflammatory exudates formation. In the present study, postoperative facial swelling was significantly lower in the Hyaluronic acid group than in the control group.

The reduction in edema may be explained by the ability of Hyaluronic acid to regulate inflammatory cell migration, improve tissue hydration, enhance micro circulation, and accelerate extracellular matrix remodeling. These biological effects may limit excessive inflammatory reactions and promote faster resolution of postoperative edema.[11, 12]

Postoperative trismus results primarily from inflammation and edema involving the muscles of mastication following third molar surgery. Patients who received topical Hyaluronic acid demonstrated significantly greater maximum interincisal mouth opening during the postoperative period, indicating reduced trismus and improved functional recovery. The reduced inflammatory response and improved soft tissue healing associated with Hyaluronic acid application likely contributed to earlier restoration of mandibular function.[13,14]

The results of the present study are consistent with previous clinical investigations reporting beneficial effects of topical Hyaluronic acid in oral surgical

procedures. Earlier studies have shown that Hyaluronic acid reduces postoperative pain, edema, and limitation of mouth opening following impacted third molar surgery. Similar findings have also been reported in periodontal and implant surgery, where Hyaluronic acid enhanced tissue healing and improved patient comfort. Although differences exist among studies regarding the concentration of Hyaluronic acid, method of application, and postoperative assessment protocols, the overall evidence suggests that Hyaluronic acid serves as an effective adjunctive biomaterial for reducing postoperative morbidity.

The favorable outcomes observed in this study can be explained by the unique biological properties of Hyaluronic acid.

As a naturally occurring glycosaminoglycan present in the extracellular matrix, Hyaluronic acid plays an essential role in tissue repair by promoting fibroblast proliferation, collagen deposition, angiogenesis, and epithelial cell migration. Furthermore, its hygroscopic nature maintains adequate tissue hydration while modulating inflammatory mediator activity, thereby creating an optimal environment for healing. These mechanisms collectively contribute to decreased postoperative discomfort and faster recovery.[15,16]

The strengths of the present study include its randomized controlled design, standardized surgical protocol, and objective assessment of postoperative outcomes using validated clinical methods. Nevertheless, certain limitations should be acknowledged. The study involved a relatively small sample size and was conducted at a single center, which may limit the generalizability of the findings. Additionally, the follow-up period was limited to the early postoperative phase, and long-term clinical outcomes were not evaluated. Future multicenter randomized clinical trials with larger sample sizes, longer follow-up periods, and comparisons of different concentrations or formulations of Hyaluronic acid are recommended to further establish its clinical effectiveness and optimize treatment protocols.

Within the limitations of the present study, topical Hyaluronic acid gel proved to be an effective adjunct to conventional postoperative care following surgical removal of impacted mandibular third molars. Its application significantly reduced postoperative pain, facial swelling, and trismus, suggesting that it may improve patient comfort and facilitate early functional recovery. Routine use of Hyaluronic acid gel may therefore represent a simple, safe, and clinically beneficial strategy for minimizing postoperative morbidity after third molar surgery.

Conclusion

Within the limitations of this study, topical Hyaluronic acid gel significantly reduced postoperative pain, facial swelling, and trismus following surgical removal of impacted mandibular third molars compared with conventional postoperative care alone. Its use appears to be a safe and effective adjunct for improving early postoperative recovery and patient comfort. Further studies with larger sample sizes are recommended to validate these findings.

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