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Efficacy of gelatamp in controlling the postoperative sequelae following mandibular posterior teeth extraction - A split-mouth study

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ABSTRACT

Purpose: This study aimed to evaluate the effectiveness of gelatamp on soft tissue healing, bleeding, and pain following mandibular posterior teeth extraction.

Methods: This study was designed as a split-mouth, prospective randomized double-blind controlled trial conducted in a single tertiary care center. Thirty-five subjects indicated for routine mandibular posterior teeth extraction were divided into two groups using the lottery technique: the experimental group (n = 30), which received gelatamp after extraction, and the control group (n = 30), which received no intervention. The primary outcomes included soft tissue healing(Landry, Turnbull, Howley index) and Pain(VAS score). The secondary outcomes assessed were bleeding(Maani et al. index) and swelling(Sauza and Consone assessment).

Result: The results showed a statistically significant difference in soft tissue healing on the third and seventh days in the experimental group ($p \leq 0.05$) than in the control group. A significant difference in bleeding scores at 5 min, 30 min, and 2 h postoperatively in the study group ($p \leq 0.05$) was noted. There was no significant difference between the groups for pain on the first, third or seventh day postoperatively ($p \leq 0.05$). The swelling assessment also showed no significant changes ($p = 0.831$) for the study and the control group.

Conclusion: Based on the findings of this study, gelatamp can be effectively used to reduce postoperative sequelae such as bleeding with better soft tissue healing following extractions and surgical removal of tooth.

1. Introduction

1.1. Background

Two very important aspects of wound healing are wound sepsis and hemostasis. Although many efforts have been made to develop novel antimicrobial medicines, wound management remains a critical clinical issue and a hotbed of research today. In addition, due to the costs and the complexity of treating post-extraction infections associated with biofilms, new and alternative strategies for effective treatment are required.[1] Gelatamp was thus introduced as a bactericidal hemostatic agent. It is made up of 95% foam gelatin sponge and 5% finely dispersed colloidal silver. Finely dispersed colloidal silver has an antibacterial effect at tiny doses and does not develop resistance. Gelatamp has a depot antibacterial action that lasts throughout the resorption process. It has been discovered to be particularly effective against antibiotic-resistant bacteria.[2]

However, to date, gelatamp has been studied primarily for its hemostatic properties.[3–5] Its bactericidal action in soft tissue or socket repair, as well as its postoperative consequences, were unknown. Thus, the purpose of this study was to evaluate the effect of gelatamp on soft tissue healing, bleeding, and pain following mandibular posterior teeth extraction.

1.2. Specific objectives

The specific aims of the study were to 1)To evaluate and compare soft tissue healing in extraction socket with and without gelatamp 2)To evaluate and compare pain in extraction socket with and without gelatamp 3)To assess post-operative control of bleeding in extraction socket with and without gelatamp 4)To assess post-operative swelling after extraction with and without gelatamp.

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2. Materials and Methods

2.1. Trial design

This study was designed as a split-mouth, prospective randomized double-blind controlled trial conducted in a single tertiary care center in India from December 2019 to October 2021. This study was done in accordance with Consolidated Standards of Reporting Trials (CONSORT) statement after being reviewed and approved by Institutional Review Board for ethical clearance (PMS/IEC/2019-20/05).

2.2. Participants

As the study was planned as a split-mouth, prospective randomized double-blind controlled trial, subjects reporting to outpatient Department of Oral and Maxillofacial Surgery, PMS College of Dental Science and Research, indicated for bilateral extraction of mandibular posterior teeth as part of their routine dental treatment plan based on following criteria: Inclusion criteria: a) Bilaterally impacted mandibular third molar teeth with similar conditions in terms of angulation (based on Winter's classification) and degree of impaction (based on Pell and Gregory classification) or orthodontic indication for bilateral mandibular premolar extraction; b) Male and female subjects of age 18–50 years, and c) Individuals under ASA I and II category. Exclusion criteria: a) Reported allergy or hypersensitivity to any of the products used in the study which include allergy or hypersensitivity to Silver or Paracetamol (Analgesic); b) Subjects with severe acute infections; c)Subjects having a habit of smoking and consuming alcohol; d)Women who are pregnant or lactating and e)An unwillingness to participate in the study.

2.3. Intervention

Standard extraction procedures were planned to be carried out in the study and control groups. The study side was selected using the lottery technique and the contralateral side was used as a control group after two weeks. Gelatamp (gelatin sponge with colloidal silver), which is commercially available as 'Roeko Gelatamp' manufactured by Coltene (Fig. 1) was planned to be placed in the extraction socket of the study side whereas the control side would not be augmented with any material. Post-operatively sutures would be given in both the groups with 3-0 black silk sutures. Analgesic (Tab Paracetamol 500 mg) was planned to be administered orally 1 tablet every 8 h for three days for both groups. Recall of patients was scheduled on the first, third, and seventh days in both groups as per the study protocol to assess soft tissue healing, pain, and bleeding. Postoperative swelling was to be recorded on the third day.

2.4. Outcomes

Preoperative information, including demographic details such as age, sex, and tooth to be extracted, was documented. The soft tissue healing index evaluated using Landry RG, Turnbull RS and Howley T analysis was considered the primary outcome of the study. The healing index had grades 1 to 5: grade 1(very poor), grade 2(poor), grade 3 (good), grade 4(very good), and grade 5(excellent) and was assessed based on tissue colour, response to palpation, granulation tissue and incision margin.[6] This was evaluated on the first and third postoperative days. On the seventh postoperative day, it was assessed after the suture was removed. The second primary outcome was pain which was evaluated and recorded using the VAS scale given by Seymour R, Charlton J and Phillips M. VAS scale was divided from 0 to 10. At one end you have unbearable pain(10) and at the other end no pain(0).[7] The subjects were requested to mark the intensity of the pain on this scale at 10 p.m. on the first and third postoperative days and after the removal of the suture on the seventh postoperative day. The VAS questionnaires and scales were collected by the research team on the seventh day.

Secondary outcomes were bleeding and swelling. Bleeding was assessed post-operatively at 5 min, 30 min, 2 h, on the third day and seventh day using Maani et al. bleeding index.[3] The bleeding index was assessed clinically and had grades 0 to 4: grade 0(very low), grade 1 (low), grade 2(normal), grade 3(high), and grade 4(very high).

The swelling was measured using Sauza and Consone assessment.[8] The distance between the corner of the mouth to the attachment of the ear lobe was measured and taken as a horizontal measurement. The distance between the outer canthus of the eye to the angle of the mandible by palpating and marking the inferior border was done and measured as a vertical measurement. Measurements were performed preoperatively and on the third post-operative day.

2.5. Sample size, randomization, and statistical analysis

The sample size was calculated based on a 5% significance level and 80% study power. A sample size of 30 individuals in each group was estimated. The study was planned to be carried out over a period of 2 years. Subjects were randomly allocated into the study group and control group based on the lottery technique with a 1:1 allocation ratio. The blinding was double, where the evaluator and statistician were blinded.

Statistical analysis was done using IBM SPSS software version 20 (IBM Corp., Armonk NY, USA). The level of significance was kept at 5%. Demographic details of the study participants were presented using descriptive statistics. Changes in each variable within each group were compared using Friedman's test and the Repeated measure ANOVA test. Intergroup comparison of each variable among two groups was done using the Mann-Whitney test and independent *t*-test.

3. Results

Thirty-five subjects were selected for the study from December 2019 to October 2021, based on inclusion and exclusion criteria but five were excluded as they were lost to follow-up, so the net sample size was thirty subjects as shown in CONSORT flow diagram (Fig. 2). They comprised of 13 males and 17 females with a mean age of 22.3 ± 4.09 years (Table 1). Standard extraction procedures were carried out in the study and control groups. The study side was selected using the lottery technique and the contralateral side was used as a control group after two weeks. Gelatamp was placed in the extraction socket of the study side whereas the control side was not augmented with any material (Fig. 3). Post-operatively, sutures were given in both the groups with 3-0 black silk sutures. Subjects in both groups were given analgesics: Tab Paracetamol 500 mg administered orally 1 tablet every 8 h for three days. Standard post-operative instructions were given. The patient was recalled on the first, third and seventh days in both groups as per the study protocol. Immediately, following extraction, the following parameters were recorded – Pain and bleeding. Posterior teeth extraction mainly involved mandibular premolars and six mandibular third molars and is equal between the study and control sides.

Fig. 1. Gelatamp(gelatin sponge with colloidal silver), which is commercially available as 'Roeko Gelatamp' manufactured by Coltene.

CONSORT
TRANSPARENT REPORTING of TRIALS

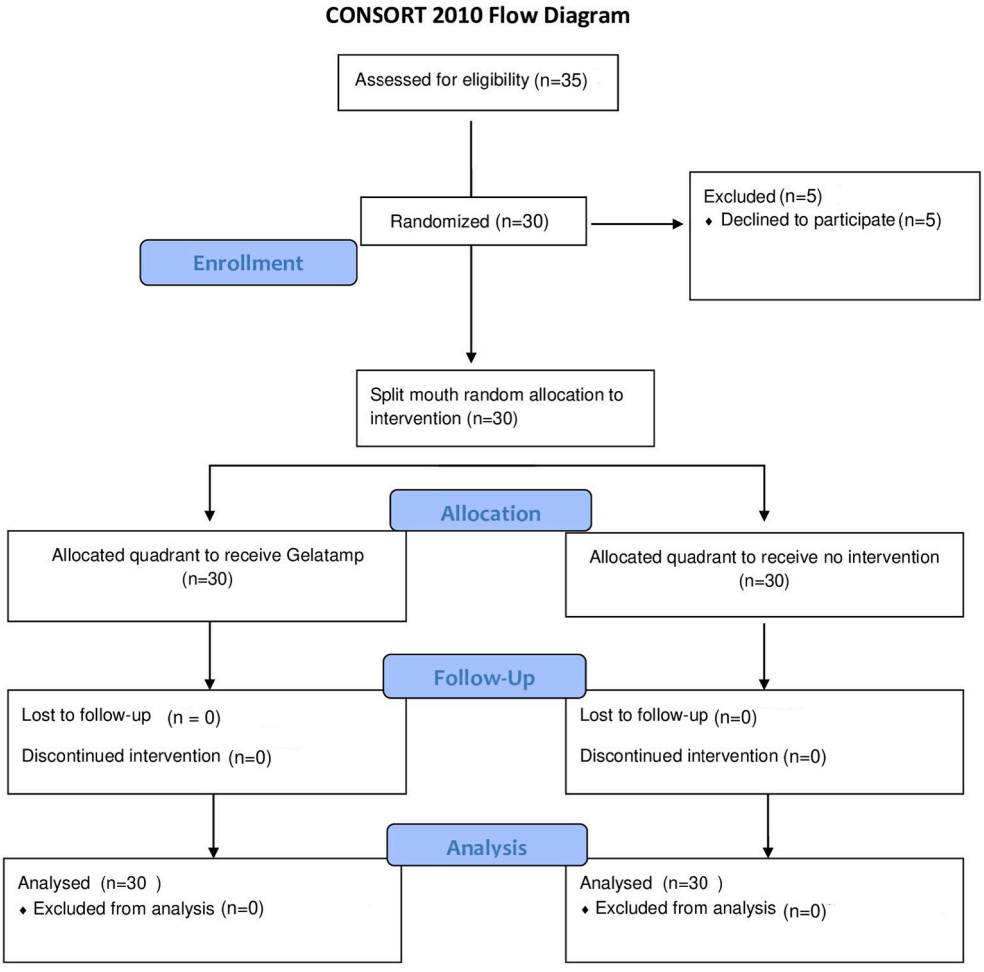

Fig. 2. CONSORT flow diagram.

Table 1
Demographic details of Study subjects.

Demographic details of Study Subjects		
Variable	Category	Mean ± SD/n(%)
Age	–	22.3 ± 4.09
Gender	Male	13 (43.3%)
	Female	17 (56.7%)

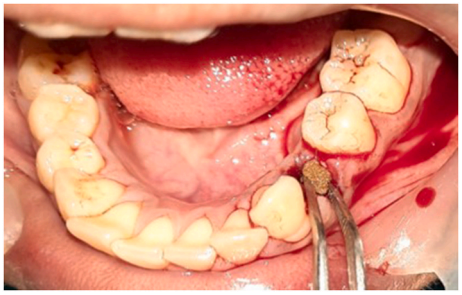

Fig. 3. Study side extraction socket augmented with gelatamp.

3.1. Primary outcome

i Soft tissue healing assessment

Soft tissue healing index was evaluated using Landry RG, Turnbull RS and Howley T analysis on the first, third and seventh postoperative days.[6] Soft tissue healing in the study group had an average score of 3.10 ± 0.31 on the first day, 4.10 ± 0.66 on the third day and 4.80 ± 0.41 on the seventh day whereas the control group had 3.03 ± 0.18 on the first day, 3.63 ± 0.49 on the third day and 4.40 ± 0.50 on the seventh day with a statistically significant difference ($p = 0.001$) within each group as seen from Fig. 4. On intergroup comparison, the study side (gelatamp) showed significantly better soft tissue healing scores on the third ($p = 0.005$) and seventh ($p = 0.002$) post-operative days (Table 2, Fig. 5).

ii Pain assessment

The pain was evaluated and recorded using the VAS scale on post-operative days using VAS scale given by Seymour R, Charlton J and Phillips M.[7] Pain measured on post-operative first, third and seventh days in the study group had an average of 1.83 ± 1.26, 0.73 ± 1.34, 0.07 ± 0.25 whereas the control group had an average of 2.17 ± 1.15, 2.17 ±

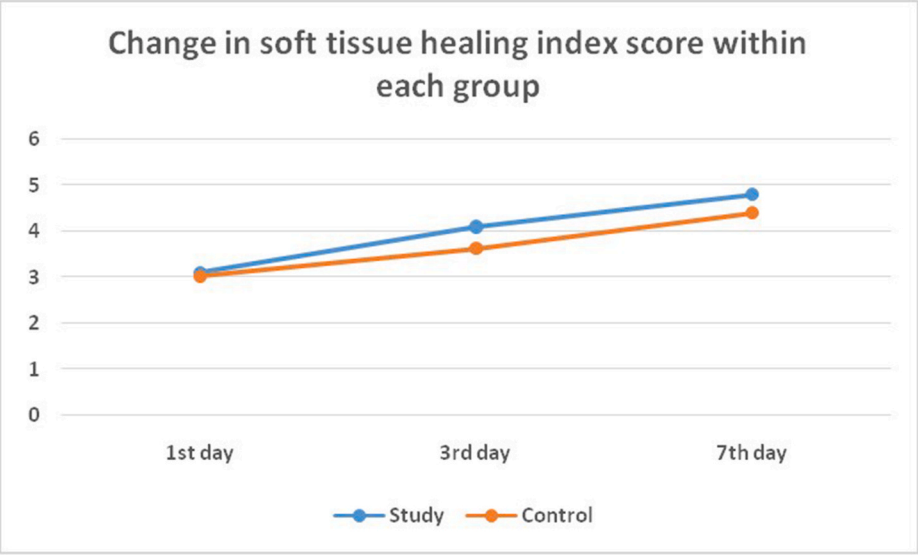

Fig. 4. Change in soft tissue healing index score within each group.

Table 2
Intergroup comparison of parameters between study and control groups.

Intergroup comparison of parameters between study and control groups					
Variable	Groups	Study Mean ± SD	Control Mean ± SD	Difference	p-value
Soft tissue healing index	First day	3.10 ± 0.31	3.03 ± 0.18	0.07	0.305 (NS)
	Third day	4.10 ± 0.66	3.63 ± 0.49	0.47	0.005*
	Seventh day	4.80 ± 0.41	4.40 ± 0.50	0.40	0.002*
Pain assessment	First day	1.83 ± 1.26	2.17 ± 1.15	−0.34	0.289 (NS)
	Third day	0.73 ± 1.34	0.97 ± 0.89	−0.24	0.430 (NS)
	Seventh day	0.07 ± 0.25	0.13 ± 0.43	−0.06	0.471 (NS)
Bleeding score	5 min	1.37 ± 0.56	1.80 ± 0.41	−0.43	0.002*
	30 min	0.27 ± 0.45	0.93 ± 0.52	−0.66	0.001*
	2 h	0.03 ± 0.18	0.20 ± 0.41	−0.17	0.046*
	Third day	0.00 ± 0.00	0.00 ± 0.00	0.00	1.000 (NS)
	Seventh day	0.00 ± 0.00	0.00 ± 0.00	0.00	1.000 (NS)
Swelling %	–	0.87 ± 1.88	0.76 ± 2.05	0.11	0.831 (NS)

Mann Whitney test; Independent *t*-test; * indicates significant difference at $p \leq 0.05$; NS: Non-significant difference.

1.15 and 0.13 ± 0.43 with a statistically significant difference within each group (Fig. 6). However, no significant change in pain was observed between the study and control group on the first ($p = 0.289$), third ($p = 0.430$) and seventh day ($p = 0.471$). (Table 2, Fig. 7).

3.2. Secondary outcome

i Postoperative control of bleeding

Bleeding was assessed post-operatively using Maani et al. bleeding index.[3] Bleeding measured in the study group had an average of 1.37 ± 0.56 at 5 min, 0.27 ± 0.45 at 30 min, 0.03 ± 0.18 at 2 h, 0.00 ± 0.00 at third day, 0.00 ± 0.00 at seventh day whereas the control group had an average of 1.80 ± 0.41 at 5 min, 0.93 ± 0.52 at 30 min, 0.20 ± 0.41 at 2 h, 0.00 ± 0.00 at third day, 0.00 ± 0.00 at seventh day. Bleeding was significantly reduced ($p = 0.001$) within each group from 5 min post-operatively to the seventh day post-operatively (Fig. 8).

However, bleeding was observed to be significantly reduced statistically in the study group at 5 min ($p = 0.002$), 30 min ($p = 0.001$) and 2 h ($p = 0.046$) post-operatively in comparison to the control group. However, both study and control groups showed similar scores on the third ($p = 1.000$) and seventh day ($p = 1.000$) post-operatively with no statistical significance (Table 2, Fig. 9).

ii) Post-operative swelling assessment

Swelling assessment by Sauza and Consone was used to assess the difference in swelling pre-operatively and post-operatively.[8] The percentage of facial swelling was calculated based on the difference between baseline measurements and measurements on the third post-operative day.

Intergroup comparison of swelling measured pre-operatively and post-operatively, did not show any statistically significant difference between the study and control groups (Fig. 10).

4. Discussion

Wound healing, as a normal biological process in the human body, is achieved through four precisely and highly programmed phases: hemostasis, inflammation, proliferation, and remodelling. For a wound to heal successfully, all four phases must occur in the proper sequence and time frame.[9] Usually, after extraction or surgical removal, only an anti-inflammatory is given to take care of the inflammatory part of wound healing without considering other factors. Over the last decade or so, there has been an unprecedented use of antibiotics in oral surgical procedures which often are not required and lead to resistance and toxicity in patients. It is always better to avoid unnecessary usage of such drugs and use drugs that have a local effect on the required site only, thus avoiding any systemic toxicity.[1,10] One such hemostatic agent is Gelatamp, which has a local bactericidal effect at the site due to the release of silver ions.

Thus, the purpose of this study was to evaluate the effect of gelatamp on post-operative sequelae following routine mandibular posterior teeth extraction. Most studies have found gelatamp to be an effective

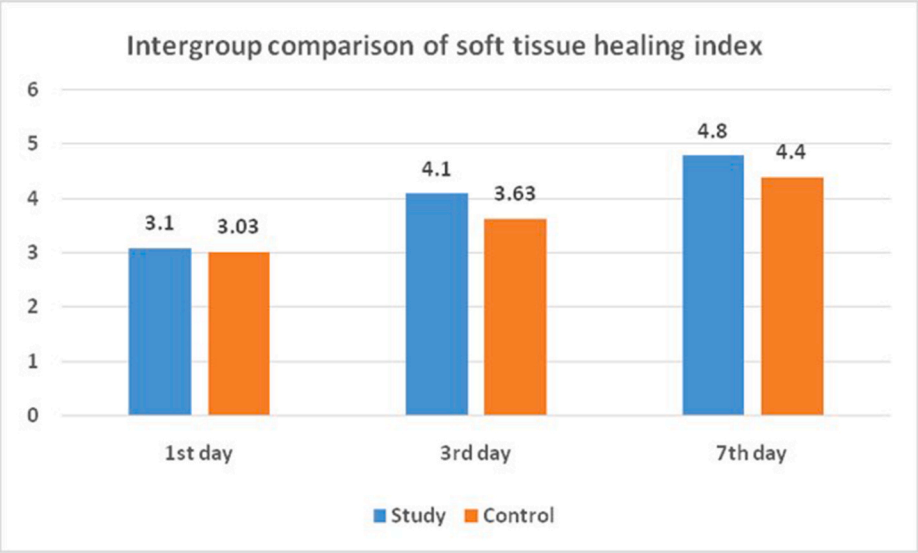

Fig. 5. Intergroup comparison of soft tissue healing index.

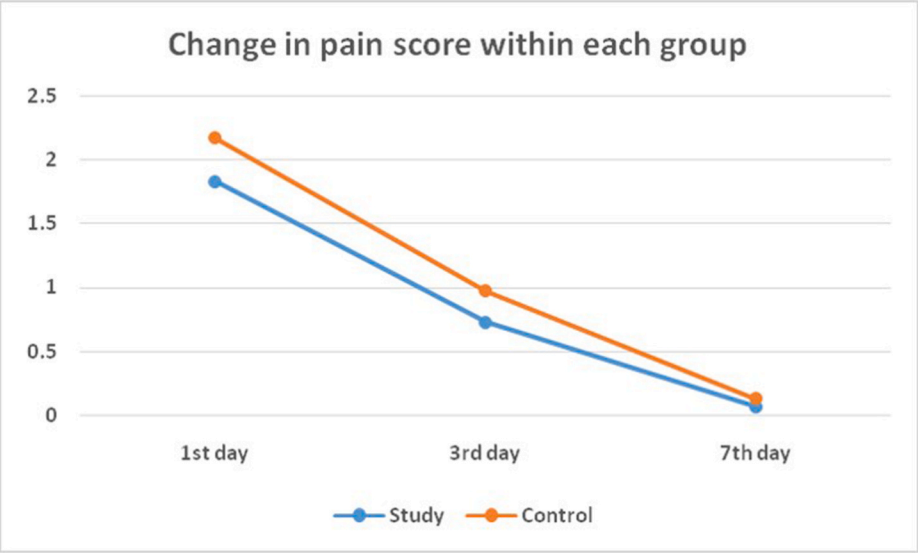

Fig. 6. Changes in pain score within each group.

hemostatic agent when used for controlling post-operative sequelae in third molar surgery and healing dry sockets. However, to date, there is little evidence regarding the effectiveness of gelatamp in routine extractions, especially on its bactericidal property.

Soft tissue healing scores were significantly better with gelatamp, on the third and seventh postoperative days. This is in accordance with previous studies conducted on gelatmp.[3-5,11-13] Better soft tissue healing in the study group can be attributed to the presence of colloidal silver in gelatamp which forms silver ions in moist conditions. These silver ions are antimicrobial in nature without developing any resistance. It is very effective against bacteria that are even resistant to antibiotics. The finely dispersed colloidal silver provides a large active surface for the continuous release of its ions. As silver does not dissolve quickly, it is not washed out of the gelatin sponge but is continually released as the sponge is resorbed. The huge surface area can promote platelet aggregation while packing the wound, forming a fixed solid clot embolism and prevent any blood clots that may arise due to contraction of the secondary cracks or due to bacterial infection caused by contaminated saliva.[14]

Pain is a subjective symptom and difficult to quantify, and most studies of silver-containing dressings evaluate pain as a secondary rather than a primary outcome. Among the various studies conducted from 2000 to 2021, it has been shown that silver dressings strongly reduced post-operative pain. However, on assessing pain scores within each group, we found no difference between the study side and control side. This can be attributed to the difference in study design. Previous studies have been conducted on surgical removal of the third molar which involves guttering of bone leading to more swelling and pain than routine extractions.[5,15]

Post-operative bleeding was significantly reduced with gelatamp than control side. Our results for bleeding are substantiated by the literature, thus reaffirming the excellent hemostatic properties of gelatamp. No significant difference was observed in post-operative swelling between the study group and control group which is in accordance with other studies.[4,5] Previous in vitro studies have also shown that gelatamp promotes bone healing in infected cranial defects of an animal model which demonstrated that gelatin/Ag treatment could effectively reduce the infection caused by Methicillin-resistant *Staphylococcus aureus*

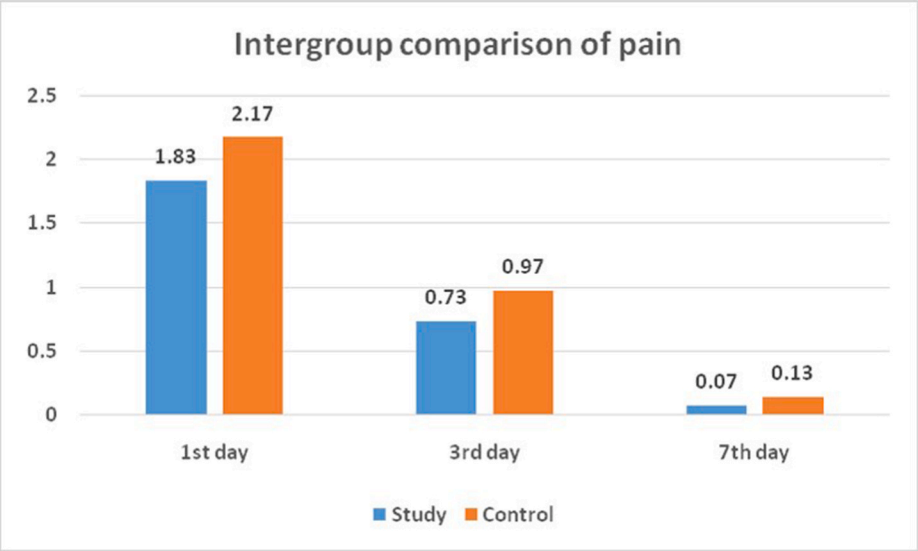

Fig. 7. Intergroup comparison of pain

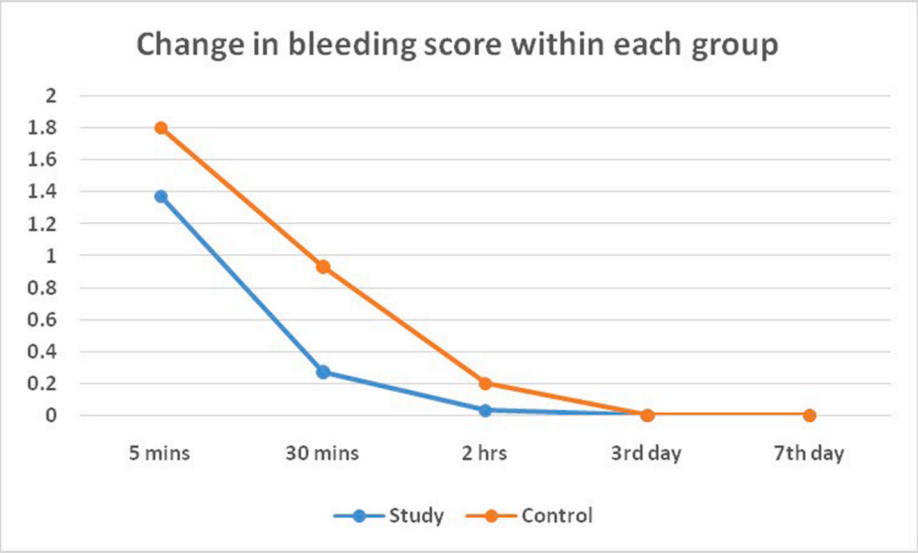

Fig. 8. Change in bleeding scores within each group.

(MRSA) and accelerate the infected bone healing process.[15,16]

An interesting finding during our study was a case of dry socket in one of our control groups. However, we did not have any post-operative complication on the extraction socket augmented with gelatamp on the contralateral side of the same subject. This further demonstrates the efficacy of gelatamp in preventing dry sockets on the lines of studies conducted by previous authors.[5,11,17,18]

Overall, we can conclude that for routine mandibular posterior tooth extractions, gelatamp can aid in bleeding control and soft tissue healing without the use of prophylactic antibiotics.

4.1. Strength, limitations and future research

One major advantage of this study is the split-mouth design. The split-mouth design has the significant benefit of removing intersubject variability from the calculated treatment effects. Due to the gelatamp sponge being locally inserted and sutured into the socket, the carry-over effect of the split-mouth design was minimal. Another benefit is that gelatamp's bactericidal effect on post-operative sequelae following routine extraction of the mandibular posterior teeth has been thoroughly explored for the first time. One significant drawback of the study is that soft tissue healing was investigated for a short duration. A longer time frame evaluation of the same might produce more accurate results. To evaluate the additional bactericidal efficacy of gelatamp, future studies can be carried out with larger sample size and in patients with co-morbidities such as diabetes.

5. Conclusion

Based on our results, gelatamp has an excellent soft tissue healing capability along with hemostatic properties. It can be used in routine clinical practice during the extraction of posterior teeth to avoid the misuse of antibiotics.

Other information

Registration: It has been registered in Clinical Trials Registry-India (CTRI) with the registration number CTRI/2020/03/024049.

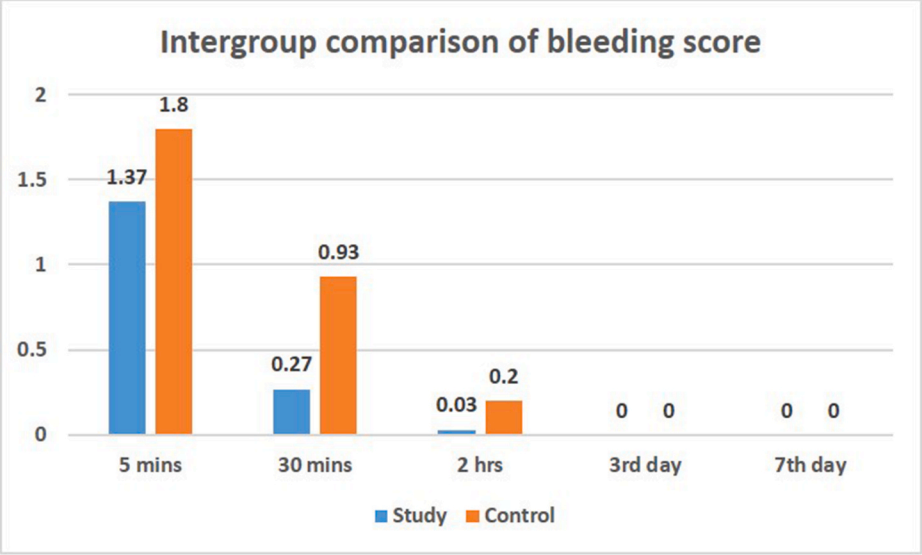

Fig. 9. Intergroup comparison of bleeding scores.

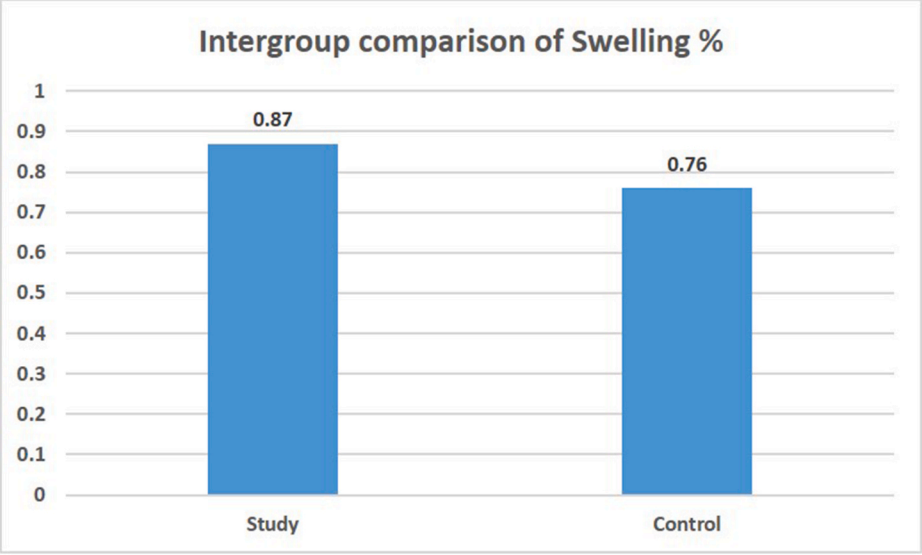

Fig. 10. Intergroup comparison of the swelling percentage.

Protocol: Full details of the trial protocol is available at the online portal of Clinical Trials Registry-India (CTRI - http://ctri.nic.in/Clinicaltrials/login.php).

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Conflicts of interest

The authors declare that there is no conflict of interest.

Acknowledgment

None to declare.

References

1 Lodi G, Azzi L, Varoni EM, et al. Antibiotics to prevent complications following tooth extractions. *Cochrane Database Syst Rev*. 2021;2:CD003811. https://doi.org/10.1002/14651858.CD003811.pub3.
2 Babitha GA, Shiva CYK, Sunil DC, Nirmala S, Shobha P. Gelatamp: a new promising hemostatic agent. *Adv Dent & Oral Health*. 2017;7(1), 555707.
3 Maani S, Saleh M, Melek L, Sadaka P. Evaluation of colloidal silver gelatin sponge (gelatamp) in patients receiving anticoagulant after tooth extraction. *Alexandria Dental Journal*. 2015;40:101–106.
4 Prabhusankar K, Balamùrugan L, Usha V, Varun M. Efficacy of gelatamp in reduction of post operative complication and soft tissue healing after impacted Mandibular third molar surgery. *International journal of current research*. 2017;9:48096–48101, 03.
5 Hassan O, Ea Allah, Fouda A. Evaluation of the role of gelatamp in comparison with gelatine sponge on postoperative complications following odontoctomy of impacted mandibular third molar. *Dent J*. 2011;57:3659.
6 Landry RG, Turnbull RS, Howley T. Effectiveness of benzydamine HCL in the treatment of periodontal post surgical patients. *Res Clin Forums*. 1988;10:105–118.
7 Seymour RA, Simpson JM, Charlton EJ, Phillips ME. An evaluation of length and end-phrase of visual analogue scales in dental pain. *Pain*. 1985 Feb;21(2):177–185.
8 Souza J, Consone D. Metodo para medida do edema facial. *Emposoperatorio de cirurgias bucais. RGO*. 1992;40:137–141.
9 Guo S, Dipietro LA. Factors affecting wound healing. *J Dent Res*. 2010;89(3):219-229.

10 Bhuvaraghan A, King R, Larvin H, Aggarwal VR. Antibiotic use and misuse in dentistry in India-A systematic review. *Antibiotics*. 2021;10(12):1459. https://doi.org/10.3390/antibiotics10121459. Published 2021 Nov 26.
11 Wang YZ, Guan QL, Li YX, et al. Use of "gelatamp" colloidal silver gelatin sponge to prevent dry socket after extracting mandibular impacted teeth. *Shang Hai Kou Qiang Yi Xue*. 2013 Feb;22(1):108–110. Chinese. PMID: 23552793.
12 Cai YH, Lu CS. A clinical study of gelatamp colloidal silver gelatin sponge on preventing the complication of teeth extraction. *Hua xi kou Qiang yi xue za zhi= Huaxi Kouqiang Yixue Zazhi= West China Journal of Stomatology*. 2008 Oct 1;26(5):519–521.
13 Ghavimi M, Ghoreishizadeh A, Samarein EH, Arta SA, Khorshidi R, Yazdani J. The effectiveness of gelatin resorbable sponge (Gelatamp) in dry socket prevention. *Medical Journal of Tabriz University of Medical Sciences*. 2013 Apr 24;35(1):64–67.
14 Abboud EC, Legare TB, Settle JC, et al. Do silver-based wound dressings reduce pain? A prospective study and review of the literature. *Burns*. 2014 Dec;40(Suppl 1):S40–S47.
15 Dong Y, Liu W, Lei Y, et al. Effect of gelatin sponge with colloid silver on bone healing in infected cranial defects. *Mater SciEng C Mater Biol Appl*. 2017;70:371–377.
16 Mena-Álvarez J, Quispe-López N, Zubizarreta-Macho Á, Rico-Romano C, Rodero-Villanueva R, Fernández-Aceñero MJ. Histological analysis of different local haemostatic agents used for periapical surgery: an experimental study with Sprague-Dawley rats. *Aust Endod J*. 2019 Dec;45(3):357–364.
17 Ragab HR, Melek LN. Comparison of two hemostatic agents in patients receiving anticoagulants without altering medication dosage. *Egypt Dent J*. 2019 Oct 1;65(4-October):3315–3321 (Oral Surgery)).
18 Yin IX, Zhang J, Zhao IS, Mei ML, Li Q, Chu CH. The antibacterial mechanism of silver nanoparticles and its application in dentistry. *Int J Nanomed*. 2020;15:2555–2562. https://doi.org/10.2147/IJN.S246764, 2020 Apr 17.