Research Article

Submitted: Dec 12, 2023
Accepted: Feb 05, 2023
Published: Feb 27, 2024

# Comparison of Serratiopeptidase and Dexamethasone in Controlling Oedema Following Surgical Extraction of Impacted Mandibular Third Molar

**Bikash Chaudhary,[1] Sirjana Dahal,[2] Yashuma Tiwari,[3] Rajesh Twyana,[4] Deepa Gurung,[5] Niroj Bhattarai[6]**

[1,3,4,6]Department of Oral and Maxillofacial Surgery, Dental Programme, Kathmandu Medical College, Duwakot, Bhaktapur, Nepal; [2]Department of Community Dentistry, Tribhuvan University Teaching Hospital, Maharajgunj Medical Campus, Maharajgunj, Kathmandu , Nepal; [5]Department of Oral and Medicine and Radiology, Dental Programme, Kathmandu Medical College, Duwakot, Bhaktapur, Nepal.

Correspondence:
Bikash Chaudhary. Email: bikash47@yahoo.com

## ABSTRACT

**Introduction:** The extraction of the lower impacted third molar teeth is always associated with varying degrees of inflammation that may have a social impact for the patients.

**Objective:** To compare the effectiveness of dexamethasone and serratiopeptidase in the control of swelling following surgical extraction of impacted mandibular third molar.

**Methodology:** This non-randomised controlled trial was conducted among 180 individuals undergoing extraction of mandibular third molar in the Oral Surgery department of Kathmandu Medical College and Teaching Hospitals (KMCTH) at Duwakot, Bhaktapur and at Sinamangal, Kathmandu, Nepal from 2021 October to 2022 February. Among them, 90 patients received dexamethasone and 90 received serratiopeptidase. Effectiveness of these drugs in post-operative swelling were evaluated. Data were analysed in SPSS version 20. Mean standard deviation, median, frequency and percentage were calculated. Wilcoxon Sign Rank test was done for pairwise comparison of each medication. Mann-Whitney U test was done for comparing pre- and post-operative swelling among two medications.

**Result:** Significant differences were observed in both the groups when preoperative gonion to corner of mouth ($p < 0.001$), tragus to corner of mouth ($p < 0.001$), outer canthus to gonion ($p < 0.001$), and cheek girth measurements ($p < 0.001$) were compared with three consecutive post-operative period measurements. However, when two groups were compared, there was no significant differences observed in these measurements in either preoperative or three post-operative observation periods.

**Conclusion:** The findings of this study showed that both dexamethasone and serratiopeptidase were equally effective in controlling the post-operative swelling.

**Keywords:** Dexamethasone; impaction; oedema; serratiopeptidase.

## INTRODUCTION

Surgical extraction of impacted mandibular third molar is routine procedures with inevitable post-operative complications like facial swelling, trismus, pain which adversely affects quality of life.[1-3] Post-operative facial swelling depends upon nature of surgery and patient factors.[4] Tissue injury prompts inflammation, releasing mediators like bradykinin, serotonin, and histamine, which cause vasodilation, increased vessel permeability, and fluid accumulation in interstitial spaces, resulting in oedema.[5,6]

**Citation**
Chaudhary B, Dahal S, Tiwari Y, Twyana R, Gurung D, Bhattarai N. Comparison of serratiopeptidase and dexamethasone in controlling oedema following surgical extraction of impacted mandibular third molar. J Nepal Dent Assoc. 2023 Jul-Dec;23(37):81-7.

The swelling is maximum at second and third post-operative day and begins to reduce by fourth day.[3,7,8] Post-operative oedema can be managed with cold therapy, drains, and pharmacological agents like antihistamines, steroids, and enzyme or combinations of these based on severity. No single modality fully controls post-operative swelling.[3] Steroids are considered to be best in controlling swelling.[3,9] Dexamethasone is a long acting potent glucocorticoid, with minimal mineralocorticoid action, acts as an anti-inflammatory agent interfering the pathways that release inflammatory mediators and vasodilation.[5,10] Short term use of steroids, does not cause adrenal suppression with clinically insignificant side effects.[4,11,12] Serratiopeptidase, a proteolytic enzyme, breaks down bradykinin, powerful vasodilator, thus minimise post-operative oedema.[6,13] Limited studies have examined the effectiveness of these two pharmacotherapies in managing post-operative swelling, however, there have been no publications focussing on the Nepali population as of yet. This study aims to compare the effectiveness of dexamethasone and serratiopeptidase to control oedema following surgical extraction of impacted mandibular third molar.

## METHODOLOGY

This quantitative non-randomised controlled trial was conducted among 180 individuals who visited the Oral and Maxillofacial Surgery Department of Kathmandu Medical College and Teaching Hospital (KMCTH) at Duwakot, Bhaktapur and at Sinamangal, Kathmandu, Nepal from 2021 October to 2022 February. Ethical approval was obtained from the Institutional Review Committee of the same institute (Ref. 0410202105). Informed consent was taken from all the study participants prior to the study. A convenience sampling method was used for selection of study participants. Individuals with bony impaction, partially erupted third molars and individuals willing to participate were included in the study. Those with contraindications of extractions such as haemangioma, haemophilia, recent history of myocardial infarction, recent swelling, or infection in the area of surgery, patients under proteolytic drugs or steroids, pregnant patients and patients with contraindication for use of steroids such as peptic ulceration, hypertension, immunocompromised patients were excluded.

The sample size was calculated using the following formula:

With reference to the study done by Kumar et al.,[7] the sample size of 180 was calculated using formula: $n = 2SD^2(Z_{1-\alpha/2} + Z_\beta)^2/(m_1-m_2)^2$ ; where, $Z_{1-\alpha/2}$ =1.96 at 95% confidence interval; $Z_\beta$ = 0.84 at 80% power; $m_1$= mean swelling size of dexamethasone group at day-3 after surgical extraction = 113.62; $m_2$ = mean swelling size of serratiopeptidase group at day-3 after surgical extraction = 116.30; SD = standard deviation where, $SD = (SD_1 + SD_2)/2 = (6.53+5.94)/2 = 9.5$.

Applying these values in the formula provided above, the sample size (n) = 84.90. Now, adding 5% of attrition rate, final sample size in each group was around 90 (180 in total). Oral examination was done by the investigator himself and data were recorded on every follow up visits. Patients were divided into two groups, Group A and Group B and prescribed with Serratiopeptidase and Dexamethasone alternatively as they undergo surgical extraction with time until the sample size in each group was reached. Group A received 1 mg dexamethasone, half hour preoperatively and then at every eighth hour post-operatively for three days. Group B received 10 mg serratiopeptidase eighth hourly for three days. The facial volume was measured from corner of mouth to tragus, corner of mouth to gonion and outer canthus to gonion both preoperatively and post-operatively immediately, first, second, third day post-operatively using vernier caliper. The obtained data was entered into the Microsoft Excel sheet and analysed using SPSS software, version 20 (IBM Corp., Armonk, N.Y., USA). Mean standard deviation, median, frequency and percent were calculated. Wilcoxon Sign Rank test was done for pairwise comparison of each medication. Mann-Whitney U test was done for comparing pre-and post-operative swelling among two medications.

## RESULT

Among the 180 participants divided in two groups, mean age of Dexamethasone group was 30.07±7.97 years, among them males were 44 (48.89%) and females 46 (51.11%). In Serratiopeptidase group, mean age was 27.21±7.98 years with 37 (41.11%) males and 53 (58.89%) females. The extraction site of study participants' showed similar distribution (Figure 1). On comparison of preoperative gonion to corner of mouth, tragus to corner of mouth, outer canthus to gonion and cheek girth measurements with three consecutive post-operative period measurements (Figure 2), significant differences were observed for both the dexamethasone and serratiopeptidase groups (Tables 1-4). However, there was no any significant difference observed in these measurements between two groups in either preoperative or three post-operative observation periods (Table 5).

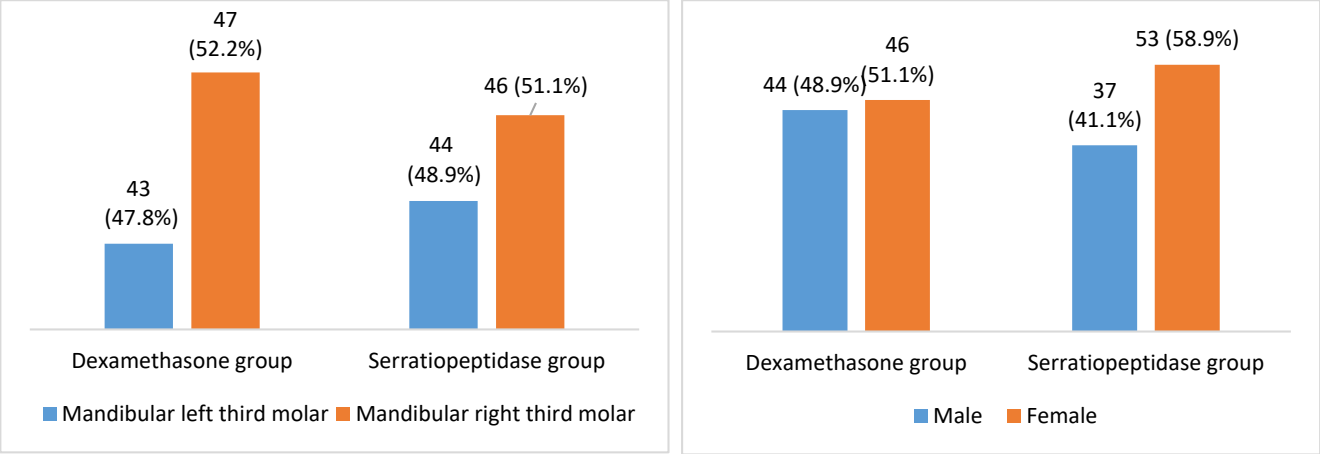


**Figure 1: Distribution of extraction site and study participants.**

**Table 1: Gonion to corner of mouth measurement (mm) of dexamethasone group (N = 92).**

| Time of measurement | Mean ± SD (median) | Difference from preoperative measurement (median) | p-value |
|---|---|---|---|
| **Dexamethasone group (n = 90)** | | | |
| **Preoperative (Baseline)** | 96.32 ± 1.89 (96) | - | - |
| **Post-operative (Day 1)** | 110.93 ± 4.74 (111) | 14.61 ± 4.39 (15) | <0.001 |
| **Post-operative (Day 2)** | 104.30 ± 3.23 (104) | 7.98 ± 3.0 (9) | <0.001 |
| **Post-operative (Day 3)** | 102.0 ± 3.32 (102) | 5.68 ± 3.06 (5.50) | <0.001 |
| **Serratiopeptidase group (n = 90)** | | | |
| **Preoperative (Baseline)** | 96.71 ± 1.87 (97) | - | - |
| **Post-operative (Day 1)** | 111.52 ± 3.84 (112) | 14.81 ± 3.42 (15) | <0.001 |
| **Post-operative (Day 2)** | 105.7 ± 3.14 (105.50) | 8.46 ± 2.59 (8.5) | <0.001 |
| **Post-operative (Day 3)** | 102.61 ± 3.15 (103) | 5.90 ± 2.65 (6) | <0.001 |

*Wilcoxon Sign Rank Test; Statistically significant at p <0.05

**Table 2: Comparison of Preoperative with post-operative tragus to corner of mouth measurement (mm).**

| Time of measurement | Mean ± SD (median) | Difference from preoperative measurement (median) | p-value |
|---|---|---|---|
| **Dexamethasone group (n = 90)** | | | |
| **Preoperative (Baseline)** | 105.19 ± 3.40 (105) | - | - |
| **Post-operative (Day 1)** | 111.20 ± 5.62 (110) | 6.01 ± 4.11 (6) | <0.001 |
| **Post-operative (Day 2)** | 105.73 ± 4.81 (106) | 0.54 ± 3.67 (1) | <0.001 |
| **Post-operative (Day 3)** | 102.46± 3.92 (103) | -2.73 ± 3.63 (-3) | <0.001 |
| **Serratiopeptidase group (n = 90)** | | | |
| **Preoperative (Baseline)** | 104.82 ± 3.00 (105) | - | - |
| **Post-operative (Day 1)** | 112.14 ± 5.73 (112) | 7.32 ± 3.99 (8) | <0.001 |
| **Post-operative (Day 2)** | 107.10 ± 4.23 (107) | 2.28 ± 2.20 (2) | <0.001 |
| **Post-operative (Day 3)** | 103.43 ± 3.48 (103) | -1.39 ± 2.90 (-2) | <0.001 |

*Wilcoxon Sign Rank Test; Statistically significant at p <0.05

**Table 3: Comparison of Preoperative with post-operative gonion to outer canthus measurement (mm).**

| Time of measurement | Mean ± SD (median) | Difference from preoperative measurement (median) | p-value |
|---|---|---|---|
| **Dexamethasone group (n = 90)** | | | |
| **Preoperative (Baseline)** | 106.41 ± 2.77 (106) | - | - |
| **Post-operative (Day 1)** | 111.72 ± 4.10 (112) | 5.31 ± 3.62 (7) | <0.001 |
| **Post-operative (Day 2)** | 106.66 ± 5.40 (108) | 0.244 ± 5.53 (2) | <0.001 |
| **Post-operative (Day 3)** | 103.30 ± 5.30 (104) | -3.11 ± 5.26 (-2) | <0.001 |
| **Serratiopeptidase group (n = 90)** | | | |
| **Preoperative (Baseline)** | 106.23 ± 2.69 (106) | - | - |
| **Post-operative (Day 1)** | 112.53 ± 3.88 (112.50) | 6.30 ± 2.75 (7) | <0.001 |
| **Post-operative (Day 2)** | 108.39 ± 3.29 (108) | 2.16 ± 1.82 (2) | <0.001 |
| **Post-operative (Day 3)** | 104.79 ± 3.97 (105) | -1.44 ± 2.64 (-1.0) | <0.001 |

*Wilcoxon Sign Rank Test; Statistically significant at p <0.05

**Table 4: Comparison of Preoperative with post-operative cheek girth measurement (mm).**

| Time of measurement | Mean ± SD (median) | Difference from preoperative measurement (Median) | p-value |
|---|---|---|---|
| **Dexamethasone group (n = 90)** | | | |
| **Preoperative (Baseline)** | 68.01 ± 2.56 (68) | - | - |
| **Post-operative (Day 1)** | 72.64 ± 4.03 (72) | 4.63 ± 4.79 (5) | <0.001 |
| **Post-operative (Day 2)** | 66.52 ± 4.16 (67) | -1.49 ± 4.98 (-1) | <0.001 |
| **Post-operative (Day 3)** | 64.71 ± 4.14 (65.50) | -3.30 ± 4.69 (-3) | <0.001 |
| **Serratiopeptidase group (n = 90)** | | | |
| **Preoperative (Baseline)** | 67.98 ± 2.24 (68) | - | - |
| **Post-operative (Day 1)** | 72.16 ± 3.79 (71) | 4.18 ± 4.15 (3) | <0.001 |
| **Post-operative (Day 2)** | 66.17 ± 4.14 (66) | -1.81 ± 4.66 (-1.0) | <0.001 |
| **Post-operative (Day 3)** | 64.10 ± 4.17 (64) | -3.88 ± 4.31 (-4) | <0.001 |

*Wilcoxon Sign Rank Test; Statistically significant at p <0.05

**Table 5: Comparison between dexamethasone and serratiopeptidase group measurements.**

| Time of measurement | Medication | Mean ± SD (median) | p-value |
|---|---|---|---|
| **Preoperative** | | | |
| **Gonion to corner of mouth** | Dexamethasone | 96.32 ± 1.89 (96) | 0.166 |
| | Serratiopeptidase | 96.71 ± 1.87 (97) | |
| **Tragus to corner of mouth** | Dexamethasone | 105.19 ± 3.40 (105) | 0.477 |
| | Serratiopeptidase | 104.82 ± 3.00 (105) | |
| **Outer canthus to gonion** | Dexamethasone | 106.41 ± 2.77 (106) | 0.728 |
| | Serratiopeptidase | 106.23 ± 2.69 (106) | |
| **Cheek girth** | Dexamethasone | 68.01 ± 2.56 (68) | 0.769 |
| | Serratiopeptidase | 67.98 ± 2.24 (68) | |
| **Post-operative day 1** | | | |
| **Gonion to corner of mouth** | Dexamethasone | 110.93 ± 4.74 (111) | 0.365 |
| | Serratiopeptidase | 111.52 ± 3.84 (112) | |
| **Tragus to corner of mouth** | Dexamethasone | 111.20 ± 5.62 (110) | 0.314 |
| | Serratiopeptidase | 112.14 ± 5.73 (112) | |
| **Outer canthus to gonion** | Dexamethasone | 111.72 ± 4.10 (112) | 0.310 |
| | Serratiopeptidase | 112.53 ± 3.88 (112.50) | |
| **Cheek girth** | Dexamethasone | 72.64 ± 4.03 (72) | 0.175 |
| | Serratiopeptidase | 72.16 ± 3.79 (71) | |

| | | | |
|---|---|---|---|
| **Post-operative day-2** | | | |
| **Gonion to corner of mouth** | Dexamethasone | 104.30 ± 3.23 (104) | 0.089 |
| | Serratiopeptidase | 105.7 ± 3.14 (105.50) | |
| **Tragus to corner of mouth** | Dexamethasone | 105.73 ± 4.81 (106) | 0.074 |
| | Serratiopeptidase | 107.10 ± 4.23 (107) | |
| **Outer canthus to gonion** | Dexamethasone | 106.66 ± 5.40 (108) | 0.118 |
| | Serratiopeptidase | 108.39 ± 3.29 (108) | |
| **Cheek girth** | Dexamethasone | 66.52 ± 4.16 (67) | 0.246 |
| | Serratiopeptidase | 66.17 ± 4.14 (66) | |
| **Post-operative day-3** | | | |
| **Gonion to corner of mouth** | Dexamethasone | 102.0 ± 3.32 (102) | 0.201 |
| | Serratiopeptidase | 102.61 ± 3.15 (103) | |
| **Tragus to corner of mouth** | Dexamethasone | 102.46± 3.92 (103) | 0.113 |
| | Serratiopeptidase | 103.43 ± 3.48 (103) | |
| **Outer canthus to gonion** | Dexamethasone | 103.30 ± 5.30 (104) | 0.095 |
| | Serratiopeptidase | 104.79 ± 3.97 (105) | |
| **Cheek girth** | Dexamethasone | 64.71 ± 4.14 (65.50) | 0.117 |
| | Serratiopeptidase | 64.10 ± 4.17 (64) | |

Mann-Whitney U test; Statistically significant at $p < 0.05$.

## DISCUSSION

Post-operative facial oedema is a common side effect of most surgical procedures. The swelling often reaches its peak 48-72 hours after the surgery. It starts to lessen in the late post-operative phase. The surgeon can manage the degree of oedema allowing surgery by executing the procedure in a way that minimises the tissue damage.[6] In this study, a comparison of the effect of dexamethasone and seratiopeptidase in reducing the post-operative facial oedema among the 180 individuals was done. One mg of dexamethasone was given half an hour before the surgery and continued thrice daily for three post-operative days in one group. The administration of the preoperative dose of dexamethasone maintains an adequate amount of drug in the blood before, during, and after the surgery, as dexamethasone is a long-acting corticosteroid. Since the appearance of swelling has been around four to five hours after surgery, preoperative administration of the drug would be very effective in preventing swelling.[4] In another group 10 mg of serratiopeptidase was prescribed thrice daily for three post-operative days resulted in the reduction of swelling after the third post-operative day.

In the present study, it was observed that post-operatively in dexamethasone group the facial swelling measured from corner of mouth to gonion was statistically significant ($p < 0.001$) on first, second, and third post-operative days as compared to preoperative findings. Similar findings were seen with serratiopeptidase group post-operatively at first, second, and third day. In dexamethasone group the facial swelling measured corner of mouth to tragus was statistically significant ($p < 0.001$) on post-operative day first, second, and third and similar findings with serratiopeptidase group was found post-operatively at day first, second, and third which was statistically significant ($p < 0.001$) as compared to preoperative findings this finding was consistent with the study done by Krishna BP et al.[6] Statistically significant ($p < 0.001$) results were seen when preoperative value from outer canthus to gonion was measured as compared to post-operative findings at day first, second, and third on both groups. Cheek girth measurement was found to be statistically significant on both groups ($p < 0.001$) when preoperative and post-operative datas were compared at day first, second, and third. This finding was consistent with the finding done by Krishna BP et al.[6]

In the present study, while comparing inter group preoperative data in both dexamethasone and serratiopeptidase, no statistically significant result was observed ($p > 0.05$). At post-operative day first, second, and third, comparing the values of facial oedema (corner of mouth to tragus, corner of mouth to gonion, outer canthus to gonion) between dexamethasone and serratiopeptidase group no statistically results was observed ($p > 0.05$). The findings were not consistent with other studies conducted by Kumar et al.[7] As the majority of the participants had facial swelling preoperatively which might

affect the results comparing the effects of two drugs preoperatively and post-operatively.

Comparing cheek girth preoperatively and post-operatively at day first, second, and third between serratiopeptidase and dexamethasone group, no statistically significant results were observed ($p > 0.05$). In this study, it was noticed that both dexamethasone and serratiopeptidase were effective in minimising the post-operative inflammation. It was seen that both dexamethasone and serratiopeptidase were equally effective in reducing the facial oedema at post-operative days, first, second, and third. It was observed that there was no significant reduction in swelling when both the dexamethasone and serratiopeptidase groups were compared and this finding were not similar to the study conducted by Kumar et al.[7] who observed significant reduction of swelling on the first and third post-operative days in patients taking dexamethasone than serratiopeptidase group.[7] In the present study, there was a significant reduction in the extent of cheek swelling in the serratiopeptidase group at the second, and third post-operative days which was similar to the findings of Al-Khateeb et al.[14]

Similar studies were conducted comparing the administration of preoperative and post-operative dexamethasone and its effect on post-operative complications like facial oedema, trismus and pain. The results had proven that preoperative administration was superior when compared to post-operative administration regarding oedema.[4] Other studies showed co-administration of dexamethasone and diclofenac sodium led to a significant reduction in both post-operative pain and swelling on days one and two when compared with diclofenac sodium alone.[10] Nandini et al.[11] showed that dexamethasone injected to masseter was associated with a significant reduction in swelling on days one and two post-operatively compared with controls, which agrees with the previous studies. Syed et al.[12] concluded that there is a significant reduction of pain, swelling, and improvement in mouth opening following submucosal injection of dexamethasone at the end of the first post-operative day with statistically significant results. Moraissi et al.[13] concluded that preemptive submucosal injection of chymotrypsin yields a comparable effectiveness in decreasing post-operative sequelae following impacted mandibular third molars surgery when compared to oral serratiopeptidase and corticosteroids.

The limitation of the study is the small sample size of the study participants. Study was conducted among those patients undergoing surgical extraction of impacted third molars and single center for performing the study would not allow generalisation of the research findings.

## CONCLUSION

The research findings showed dexamethasone and serratiopeptidase are equally effective in controlling post-operative facial oedema. This study will be helpful to provide knowledge on administration of dexamethasone and serratiopeptidase preoperatively and post-operatively in patient undergoing surgical extraction of impacted third molars and to prescribe the drugs more effectively with minimal adverse effects.

## ACKNOWLEDGEMENT

The authors would like to acknowledge Dr. Sujaya Gupta for her support and motivation.

**Conflict of interest:** None.

## REFERENCES

1. Zhang W, Li J, Li ZB, et al. Predicting post-operative facial swelling following impacted mandibular third molars extraction by using artificial neural networks evaluation. Sci Rep. 2018 Aug 16;8(1):12281. [PubMed | Full Text | DOI]
2. Ibikunle AA, Adey emo WL, et al. Oral health-related quality of life following third molar surgery in an African population. Contemp Clin Dent. 2017 Oct-Dec,8(4):545-51. [PubMed | Full Text | DOI]
3. Osunde OD, Adebola RA, Omeje UK. Management of inflammatory complications in third molar surgery: A review of the literature. Afri Health Sci. 2011Sep;11(3):530-7. [PubMed | Full Text]

4. Al-Shamiri HM, Shawky M, Hassanein N. Comparative assessment of preoperative versus post-operative dexamethasone on post-operative complications following lower third molar surgical extraction. Int J Dent. 2017;2017:1350375. [PubMed | Full Text | DOI]
5. Ngeow WC, Lim D. Do corticosteroids still have a role in the management of third molar surgery? Adv Ther. 2016 Jul,33(7):1105-39. [PubMed | Full Text | DOI]
6. Krishna BP, Reddy BP, Yashavant Kumar DS, et al. Role of serratiopeptidase and dexamethasone in the control of post-operative swelling. Ann of Maxillofac Surg. 2020 Jan-Jun;10(1):108-13. [PubMed | Full Text | DOI]
7. Kumar N, Nagar N, Bhutiani H, Velugu GR, et al. A comparative study of serratiopeptidase and dexamethasone in control of inflammation and trismus following impacted third molar – A double blind study. IOSR Journal of Dental and Medical Sciences. 2019;18(4):78-84. [Full Text | DOI]
8. Imon AA, Akhter M, Costa PD, et al. comparative study for effectiveness of oral dexamethasone for assessment of pain, swelling and trismus following impacted 3rd molar surgery. SVOA Dentistry. 2021;2(1):20-4. [Full Text]
9. Brignardello-Petersen R. Dexamethasone seems to reduce pain, swelling, and mouth opening reduction compared with diclofenac after third-molar extraction. J Am Dent Assoc. 2017 Oct;148(10):e154. [PubMed | Full Text | DOI]
10. Bamgbose BO, Akinwande JA, Adeyemo WL, et al. Effects of co-administered dexamethasone and diclofenac potassium on pain, swelling and trismus following third molar surgery. Head Face Med. 2005 Nov 7;1:11. [PubMed | Full Text | DOI]
11. Nandini GD. Eventuality of dexamethasone injected intra-massetrically on post-operative sequel following the surgical extraction of impacted mandibular third molars: A prospective study. J Maxillofac Oral Surg. 2016 Dec;15(4):456-60. [PubMed | Full Text | DOI]
12. Syed KB, AlQahtani FH, Mohammad AH, et al. Assessment of pain, swelling and trismus following impacted third molar surgery using injection dexamethasone submucosally: A prospective, randomised, crossover clinical study. Journal of International Oral Health. 2017 May-Jun;9(3):p 116-21. [Full Text | DOI]
13. 13. Al-Moraissi EA, Al-Zendani EA, Al-Selwi AM. Efficacy of submucosal injection of chymotrypsin, oral serratiopeptidase and oral dexamethasone in reducing post-operative complications following impacted lower third molars surgery. A prospective, randomised, double-blind, controlled clinical trial. Front Oral Health. 2020 Dec 8;1:57516. [PubMed | Full Text | DOI]
14. Al-Khateeb TH, Nusair Y. Effect of the proteolytic enzyme serrapeptase on swelling, pain and trismus after surgical extraction of mandibular third molars. Int J Oral Maxillofac Surg. 2008 Mar; 37(3):264-8. [PubMed | Full Text | DOI]