Efficacy of intravenous, intramasseteric, and submucosal routes of dexamethasone administration after impacted third molar surgery: A randomized, comparative clinical study

G. K. Vivek, N. Vaibhav, Adil Shafath, Mohammad Imran

Department of Oral & Maxillofacial Surgery, Sri Rajiv Gandhi College of Dental Sciences, Bengaluru, Karnataka, India

Abstract

Purpose: The aim of the study is to compare the efficacy of intravenous (IV), intramasseteric (IM), and submucosal (SM) routes of dexamethasone administration post-impacted third molar removal surgery.

Materials and Methods: This prospective comparative study included 45 patients with Class II and position B type of impaction (according to Pell and Gregory’s classification). Patients were randomly divided into three groups. Group A, B, C patients received 8mg dexamethasone immediately post-surgical tooth removal through the IV, SM, and IM route, respectively. Assessment of swelling, mouth opening, and pain was done at intervals of 1st, 3rd, and 7th post-operative days.

Results: The average age of the patients was 27 years. The average time taken was 20 min 40 s. The IV group showed minimal swelling and better pain control on the 3rd post-operative day (statistically significant). All three routes showed comparable mouth opening results.

Conclusion: IV administration of dexamethasone post-third molar surgery has been the traditional way because of its faster onset of action and increased efficacy; the IM and SM routes are also comparably effective and have their own advantages.

Keywords
Dexamethasone, route of administration, third molar surgery

Introduction

The surgical extraction of impacted third molars is the most frequent minor surgical intervention in oral surgery. This invasive procedure elicits an inflammatory response which may manifest mainly as pain, swelling, trismus. Sometimes, an exacerbated response may lead to moderate to severe short-term transient effects on the quality of life. These post-extraction morbidities often become the reason for reluctance and hesitation in getting the tooth removed.

Reduction of these comorbidities using several strategies has been an area of interest in the field of minor oral surgery. Surgical strategies include using different flaps, bone cutting techniques, and sectioning techniques among others. However, these may not be effective in all clinical situations. Consequently, a lot of research has gone into the field of pharmacological agents to reduce post-extraction sequelae.

Corticosteroids are potent modulators of inflammation that act by inhibiting phospholipase A2, a chemical mediator that plays a vital role in the arachidonic acid pathway. Inhibition of this pathway leads to a reduction in production of inflammatory mediators, such as interleukin-1, prostaglandins, and leukotrienes.

Various studies have examined the influence of corticosteroids before or after the extraction of third molars, with good results observed. Dexamethasone has been employed for years in oral surgery due to its powerful mechanism of action and prolonged half-life. Several protocols for the administration of dexamethasone in the third molar surgery have been proposed. Route of administration of dexamethasone has been a topic of contention with researchers still unable to find a consensus on the most effective way to reduce post-extraction sequelae.

This study aims to compare three different routes namely intravenous (IV), intramasseteric (IM), and submucosal (SM) for administration of dexamethasone immediately post-operatively, which a very few researchers have done. The objective is to try and identify the simplest and the most effective route to
minimize post-operative discomfort and to ensure early return to normalcy.

Materials and Methods

Forty-five patients requiring lower third molar extractions who met the inclusion criteria were enrolled in the randomized controlled study.

Inclusion criteria

- Patients in the age group - 18 to 45 years
- Patients with Class II position B third molar according to the Pell and Gregory’s classification.

Exclusion criteria

- Patients with existing active infections
- Patients with systemic disorders
- Patients on long-term steroids
- Pregnant and lactating women.

Informed written consent was obtained from all the patients. They were then randomly divided into three groups:

- Group A: IV route
- Group B: SM route
- Group C: IM route.

Surgical technique

Initial pre-operative assessment was done for all patients. All the patients were operated on by a single surgeon. Following standard surgical and aseptic protocols, the patients were prepared for the surgical procedure. Classical inferior alveolar nerve block along with lingual nerve block was administered. A standard Ward’s incision was utilized to gain access, and the tooth was delivered after adequate bone cutting and tooth splits as was deemed necessary. Care was taken to ensure minimal trauma to the tissues. Post-extraction, the socket was copiously irrigated using 5% povidone-iodine solution diluted with equal parts of normal saline. The flap was sutured back with 3-0 silk sutures (BBS) using two interrupted sutures.

Group A patients: 8 mg dexamethasone IV was injected into the median cubital or the radial vein.

Group B patients: 8 mg dexamethasone was injected around the operated site SM.

Group C patients: 8 mg dexamethasone was injected into the IM muscle.

The patients were given standard post-operative instructions and were told to apply an ice pack on the region intermittently for the next 6 h. All patients were put on 500 mg of amoxicillin thrice daily for 5 days and paracetamol (500 mg) combination thrice a day for 3 days.

All patients were followed up at intervals of 1st, 3rd, and 7th post-operative days. Suture removal was done on the 7th post-operative day if the healing was deemed to be satisfactory.

The following were assessed:

- Swelling: Evaluated by a modification of tape measuring method described by Schultze-Mosgau et al.[14] Two measurements were made between three reference points: Tragus, pogonion, and the corner of the mouth [Figure 1]. The preoperative sum of the two measurements was considered as the baseline for that side.
- Trismus: Measured as the difference in maximal mouth opening (taken as the distance between upper and lower central incisors, assessed by a measuring tape to the nearest mm) before and after operation.
- Pain: Post-operative pain was evaluated using a visual analog scale (VAS) 100 mm long that ranged from 0 = "no pain" to 100 = "the worse possible pain."

Results

Data obtained were analyzed using SPSS™ 1.8 statistical software package. Of the 45 patients who met the inclusion criteria, 28 were males and 17 were females. The age of the patients ranged from 18 to 45 years, with the average age being 27 years. The average time taken from the placement of incision to completion of surgery (placement of the last suture) was 20 min 40 seconds. The duration of the surgery and number of rescue analgesics consumed by the patients were evaluated for the control of possible confounding factors that could influence responses regarding the three variables studied (swelling, pain, and trismus).

All the patients were followed up on the 1st, 3rd, and 7th post-operative days. The statistical tools used were mean values with standard deviation and one-way analysis of variance test to compare the mean values [Table 1].

Mean swelling on day 1 was comparable in all the three groups. However, on the 3rd day, reduction of swelling was marked in the IV and the intramucosal (SM) group as compared to the IM group, which was statistically significant.

Figure 1: Schultze-Mosgau et al.[14] method of assessing swelling
trend was observed on the 7th post-operative day with the swelling decreasing to day 1 measurements in the IV and SM groups [Figure 2].

On the 1st post-operative day, reduction in mouth opening was least in the IM group. However, on the 3rd post-operative day, a further decrease in mouth opening was observed in the IM group, but the IV and SM group patients showed marked improvement in mouth opening, with mean values higher than those observed in the IM group. On the 7th day, mouth opening had returned to normal baseline pre-operative values [Figure 3].

Mean pain score was lesser in the IV group on the 1st post-operative day. It was comparable in the IM and SM group. The same trend was seen on the 3rd post-operative day. The difference was statistically significant on both days. All patients had no pain on the 7th post-operative day [Figure 4].

Discussion

Surgical extraction of the third molar is one of the most common procedures performed by maxillofacial surgeons. Like any surgical procedure, these are also associated with post-operative sequelae such as pain, swelling, and trismus. The degree and severity of these depend on many factors such as individual physiologic response to the procedure, duration of surgery, amount of tissue trauma, and manipulation among many others.[15]

Although the phenomenon of inflammatory reaction plays a vital role in post-operative healing, an exaggerated response often leads to severe patient discomfort. Since maxillofacial region is richly vascularized and has areas of loose connective tissue, the inflammatory responses tend to be significant.[16]

Corticosteroids are well-known adjuvant to surgery for suppressing tissue mediators of inflammation, thereby reducing transudation of fluids and lessening edema. Dexamethasone...
is a highly selective, long-acting, synthetic corticosteroid, which has potent anti-inflammatory action. It exerts basic glucocorticoid action and is approximately 25 times more potent than hydrocortisone, 6 times than of prednisolone, 4 times that of methyl prednisolone and triamcinolone, and equipotent to betamethasone.\(^\text{[17]}\)

Effects of corticosteroids on pain control are still debated and not very clear. Studies have not been able to attribute definite analgesic properties to corticosteroids. However, thromboxane A2 levels decrease post-steroid administration, prostaglandin E\(_2\) levels, which are the main pain mediators remain unaltered.\(^\text{[18]}\) However, reduction in swelling and trismus is perceived by many as alleviation of pain. Several authors\(^\text{[5,12,13,18,19]}\) have reported a reduction in pain but have not found the analgesic effect to be statistically significant.

IM route is a relatively simple technique of administering corticosteroids to reduce exacerbated inflammatory responses. The site of injection is close to the already anesthetized region which makes it a painless procedure. IM\(^\text{[1]}\) as well as SM route also ensures immediate local availability; however, their absorption depends on the local blood flow in the area of administration and could also be influenced by the presence of infection, severe inflammation. A similar treatment strategy had already been proposed in 1975 by Messer and Keller,\(^\text{[20]}\) who administered 4 mg dexamethasone in three different parts of the masseter muscle and reported a significant reduction of pain, swelling, and trismus.

Local administration of steroids seems to be more advantageous due to the fact that eicosanoids act locally on the tissues from which they are released. Several of these eicosanoids are responsible for vasodilation, capillary permeability, and chemotaxis. The steroids act directly on such eicosanoids and hence prevent inflammatory processes. Moreover, locally applied glucocorticoids have direct inhibitory effect on signal transmission in nociceptive C-fibers and ectopic neuroma discharge in injured nerve.\(^\text{[21]}\) Intramuscular administration allows the use of repository (acetate) drug forms, which provide a slow absorption and a prolonged duration of effect. Intramuscular dosing studies suggest that this route of administration can be effective in a single dose given either pre- or post-operatively.\(^\text{[22]}\)

IV route offers faster onset of action and better bioavailability; however, its ability to ensure sustained pain control or improvement in swelling and trismus is still debated. Some patients consider IV injections to be another invasive procedure and exhibit reluctance. Administering IV injections itself can be challenging in certain cases and is also associated with complications of its own.

In our study, we found trismus to be least in the IM group. We hypothesize that this could be because of direct injection into the masseter muscle; spasm of which is one of the major causes for trismus in the third molar infections and surgeries. We surprisingly observed an increase in trismus on the third day in the IM group, which could be attributed to the trauma caused by the injection to the muscle. We recommend a one puncture technique with rate of drug administration less than 1 ml/min.

Pain is a subjective matter and very difficult to evaluate because of its multifactorial variance, but a VAS has a proven track record in providing a valid measure of pain. In our study, statistically significant reduction in pain was seen in the IV group on the 1\(^{\text{st}}\) day and 3\(^{\text{rd}}\) day. This could be attributed to quicker onset of action and instantaneous plasma steroid levels when given through the IV route.\(^\text{[23]}\)

Several authors\(^\text{[5,12,13,18,19]}\) have reported reduction in swelling with all the three routes; our study results indicated better control in the IV group and the SM group due to faster optimal plasma level attainment and better local bioavailability, respectively.

**Conclusion**

Dexamethasone is an effective pharmacological agent to reduce post-surgical third molar removal sequelae such as pain, swelling, and trismus. Although steroid injection through IV route has been the traditional preferred technique owing to its faster onset of action and better pain control, dexamethasone administered through local routes such as the SM route and IM route also provides comparable control of pain and swelling and has the advantage of being injected into previously anesthetized areas and requires less technical skill and better patient compliance/comfort.

**References**

4. Sortino F, Cicciù M. Strategies used to inhibit postoperative