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Original Article

Effect of Local Dexamethasone on Pain, Swelling, and Trismus After Extraction of Impacted Mesioangular Third Molar

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Abstract

Background: Pain and inflammation are common problems after the third molar surgery. The purpose of this study was to compare the effect of ibuprofen and intra-muscular injection or the intra-socket placement of dexamethasone on pain, swelling, and trismus after the extraction of impacted third molar.

Methods: In this triple-blind randomized clinical trial study, 72 eligible patients were randomly divided into four groups of 18 subjects. The groups received dexamethasone powder (4 mg) inside the alveolar socket immediately before flap suturing, injection in the masseter muscle (4 mg/1 mL) immediately after the suture, the ibuprofen tablet from an hour before the surgery (400 mg every 6 hours for 1 day), and placebo. Three parameters of pain severity, swelling, and trismus were evaluated on the second and seventh days after the surgery. Data were analyzed using SPSS 17. Qualitative and quantitative data were expressed as a percentage and mean ± standard deviation, respectively. Chi-square, one-way analysis of variance (ANOVA) and, if necessary, the least significant difference tests were used for inter-group comparison. The findings were significant at $P<0.05$.

Results: Dexamethasone groups had significantly lower pain severity (second and seventh days), swelling (second day), and maximum mouth opening (MMO, alveolar socket: second and seventh days, masseter: second day) in comparison to the other groups ($P<0.05$). The ibuprofen group had significantly lower levels of pain (second and 7th days) and swelling (second day) in comparison to the control group ($P<0.05$). There was no significant difference between dexamethasone groups in any measurement for pain, swelling, and MMO.

Conclusions: The findings of this study suggest that the intra-oral administration of dexamethasone may have a better effect on pain, swelling, and trismus compared to ibuprofen and has no placebo effect.

Keywords: Dexamethasone, Molar, Surgery, Pain, Edema, Trismus

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Background

Averagely, more than 24% of adults in societies have at least one impacted third molar (1). Impacted teeth can be asymptomatic or may create complications such as pain, pressure, swelling, infection, and damage to adjacent teeth (2). Symptomatic impacted teeth disrupt daily functioning and the quality of life (3).

Third molar extraction surgery is one of the most common dental procedures. More than 60% of cases experience moderate to severe pain, swelling, and limitation of mouth opening after the surgery (4,5). These sequelae have an inflammatory nature (6). Fortunately, pain, swelling, and restriction of oral movements are self-limited in the absence of serious complications such as infection and alveolar nerve damage in many cases (7,8).

So far, various drugs have been introduced to manage pain and inflammation after the extraction of the third molar. Traditionally, acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs) are administered either separately or in combination, having various efficacies in the control of postoperative sequelae (4,9). To the best of our knowledge, the best drug for pain and inflammation management after the third molar extraction has not been introduced yet. Some studies suggest that glucocorticoids (GCs) can have a better effect on pain and inflammation control in comparison to NSAIDs although there are contrary findings in this regard (10,11). In addition, the combination of NSAIDs and GCs can bring a better result (12,13).

Highlights

- Intra-oral dexamethasone shows better effect on pain, swelling, and trismus compared to ibuprofen.
- There was no significant difference between injection of Dexamethasone and placement of powder in the socket.

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The intra-oral administration of GCs during the third molar extraction surgery is an easy and accessible way that can reduce the complications of its systemic administration. However, there is little evidence about the effect of intra-oral GC injection on the sequelae of the third molar extraction. It seems that the anatomical site of GC injection can affect their effectiveness (14).

This study aimed to compare the effect of intra-oral dexamethasone administration on pain, trismus, and swelling after the third molar extraction surgery in comparison to ibuprofen and placebo. The present findings can add to the available evidence and help in selecting an optimal administration route of GCs in this respect.

Materials and Methods

This triple-blind randomized clinical trial study (surgeon, examiner, and statistical analyst) was conducted in the Tehran dental clinic affiliated to Tehran University of Medical Sciences, Iran in 2012 after obtaining the approval of the Ethics Committee of Tehran University of Medical Sciences.

The inclusion criteria were >18 individuals with a painful impacted lower third molar and fully impacted third molar mesioangular deviation in imaging. On the other hand, the exclusion criteria included temporomandibular joint disorders, pregnant and lactating women, systemic diseases such as diabetes and hypertension, analgesic and anti-inflammatory drugs (e.g., NSAIDs and GCs) consumption at least one week before the surgery. The other criteria were the existence or development of infectious conditions such as abscess and surgical site infection, antibiotic use at least one week before the surgery, known psychiatric disorders, and surgery duration longer than 30 minutes.

After being matched in terms of age, gender, and severity of preoperative pain, 72 eligible patients were randomly assigned to 4 groups of 18 subjects. Simple individual randomization was applied with sealed envelopes. There were 72 sealed envelopes and each one included the group number and each patient chose between the envelopes and then he/she was included in one group.

Further, informed consent was obtained from all individual participants included in the study. Group 1 received dexamethasone powder 4 mg inside the alveolar socket after washing and before flap suturing (via a sterile hard gelatin capsule made in Jahan Pharmacy Company). Group 2 received dexamethasone 4 mg/mL in the masseter muscle through the oral mucosa. Group 3 was given ibuprofen 400 mg tablets one hour before the surgery and every 6 hours for 1 day. A hard gelatin capsule containing starch powder 1 g (Jahan Pharmacy Company) was considered as a placebo which was consumed orally one hour before the surgery (group 4).

Generally, the method of the injection of dexamethasone in the masseter muscle was similar to that of the previous study (15). After determining the location of the masseter muscle from the surface of the skin by pressing the teeth together, 3 divided doses (0.33 cc) were injected into the upper (45° degrees to the occlusal surface of the lower molar), middle (parallel with the occlusal surface of the lower molar), and lower (45° degrees to the occlusal surface of the lower molar) parts of the muscle by 1 mL insulin syringe.

One hour before starting the surgery, patients washed their mouths with chlorhexidine 0.12% for 1 minute. The inferior alveolar and buccal nerves were anesthetized by the injection of lidocaine 2% in combination with epinephrine 1: 100 000 (two 1.8 mL cartridges) and the conventional method (16). After creating anesthesia, a triangular flap was prepared from the mesial to the distobuccal area of the wisdom tooth. The surgery was completed by osteotomy and splitting of the tooth if necessary. After washing and suctioning the area with the physiological saline (sodium chloride 0.9%, 30 cc), the flap was continuously closed using a black silk suture 3-0.

Warm saline gargling was advised from the day after the surgery for all patients. Patients were allowed to take acetaminophen 500 mg tablet every 6 hours if they feel intolerable pain. Furthermore, preparing a timetable, patients were asked to insert the daily intake of acetaminophen, if they use it, to obtain more accurate information about the amount of acetaminophen consumption.

All surgeries were performed by a skilled surgeon without any knowledge of the type of drug intervention, which was done by a dentist who was informed about the plan and but was not involved in other steps of the study.

Clinical evaluations (i.e., pain, swelling, and maximal mouth opening) were performed for all patients once an hour before the surgery and then 2 and 7 days after the surgery in the mentioned clinic by another dentist who had no information about the study.

Pain

The patient's severity of pain was measured by the visual analogue scale (VAS). This is a 100-mm ruler through which the patient marks the pain severity on it from zero (painless) to 100 (maximum pain). After receiving training, patients expressed their severity of pain and recorded it as cm.

Swelling

To measure swelling, the distance of the tragus to the corner of the lip and tragus to gonion (17) was measured by a standard cloth ruler, and the obtained values were summed and divided by two to obtain the swelling mean in the surgery side in millimeter.

Trismus

To assess the maximum mouth opening (MMO), patients opened their mouth straight so that they had no jaw

deflection, pain, and discomfort. MMO was recorded by measuring the distance between the incisal edges of the upper and lower central teeth using a coulisse ruler in millimeter (13).

Statistical analyses

Data were analyzed using SPSS 17. Qualitative and quantitative data were expressed as a percentage and mean ± standard deviation, respectively. Chi-square, one-way analysis of variance (ANOVA) and, if necessary, the least significant difference tests were used for inter-group comparison and the findings were significant at $P < 0.05$.

Results

Three patients in the masseter muscle group and two patients in the alveolar socket group did not complete the study. Moreover, wound site infection occurred in a patient in the control group.

The mean age of all patients (N=72) was 22 ± 3.5 years, 44 (61.1%) patients were females, and the remaining cases were males. In general, 37 teeth (51.4%) undergone surgery on the left side and the rest of them on the right side, and 27 (37.5%) cases needed sectioning the tooth during the surgery.

Table 1 presents patients' basic information, along with the indexes of the severity of pain, swelling, and maximal mouth opening. All groups were similar in terms of age, gender, surgery side, tooth sectioning, pre-operative pain, swelling, and MMO and were well matched as well ($P > 0.05$).

Before the surgery, the pain severity was mild (VAS <4 cm) in all groups although it increased (VAS <6 cm) on the second day, and it was close to zero in dexamethasone groups on the seventh day. On the second and seventh days, the control group showed the highest pain severity. Based on the results of the one-way ANOVA test, the pain severity was significantly different between the ibuprofen/control and dexamethasone groups ($P = 0.000$) and ibuprofen and control groups ($P = 0.03$). On the seventh day, the same significant trend was observed among the groups. Conversely, the average pain severity was not significant between dexamethasone groups in terms of any measurements ($P > 0.05$).

On the second day, the control and ibuprofen groups had the highest levels of swelling, respectively. However, the masseter group demonstrated the lowest swelling. The difference between ibuprofen and other groups was significant on the second day ($P \leq 0.005$). Contrarily, the swelling decreased in all groups without any significant difference among them on the seventh day ($P > 0.05$).

On the second day, the control and ibuprofen groups had a higher restricted mouth opening, respectively, in comparison to other groups ($P \leq 0.005$) and this index was not significant between dexamethasone groups or control-ibuprofen groups. On the seventh day, the alveolar socket group had better MMO compared to masseter ($P = 0.4$), control ($P = 0.03$), and ibuprofen ($P = 0.007$) groups. Additionally, the MMO level was not significant among

Table 1. Basic Information, Clinical Evaluations, and the Amount of Acetaminophen Consumption for Each Group of the Study

Variables/Groups		Ibuprofen	Dexamethasone		Control	*P* Value
			Alveolar Socket	Masseter		
Basic Information						
Age (y), mean ± SD		21.7±2.9	22.2±1.5	21.5±1.9	22.4±5.9	0.9
Gender, No. (%)	Female	11 (61.1%)	9 (50%)	12 (66.7%)	11 (61.1%)	0.7
	Male	6 (33.3%)	9 (50%)	6 (33.3%)	7 (38.9%)	
Sectioning of tooth, No. (%)	Yes	6 (8.3%)	6 (8.3%)	7 (9.1%)	8 (11.1)	0.9
Surgery side, No. (%)	Left	8 (44.4%)	11 (61.1%)	7 (38.9%)	11 (61.1%)	0.5
	Right	10 (55.6%)	7 (38.9%)	11 (61.1%)	7 (38.9%)	
Clinical Evaluations						
Pain (cm), mean ± SD	Baseline	3.4±1.8	2.6±1.2	2.9±1.9	3.1±1.4	0.5
	Day 2	5.7±1.6	3.6±1	3.7±1.7	6.7±1.5	0.000
	Day 7	0.8±0.9	0.7±0.4	0.4±0.7	1.4±1.1	0.000
Swelling (mm), mean ± SD	Baseline	88.4±5.6	91.5±4.7	88.3±5.8	90.3±5.6	0.2
	Day 2	93.8±5.2	94.1±4.6	90.8±6.1	100.8±10.1	0.000
	Day 7	90±5.2	92±4.6	88.4±5.9	88.3±4.3	0.2
Maximal mouth opening (mm), mean ± SD	Baseline	48.4±4	49±3.1	47.9±2.3	48.3±3.2	0.8
	Day 2	33.8±7.7	42.7±4.5	39.7±7.1	33.1±6	0.000
	Day 7	44.9±6.6	48.1±3.1	46.8±3	44.1±3.4	0.03
Acetaminophen consumption, mean ± SD	Total	6.4±2.8	2.9±0.8	3±2.4	8.9±3	0.000

Note. SD: standard deviation.

control, masseter, and ibuprofen groups on the seventh day ($P>0.05$). Table 1 shows the pain severity, swelling, and MMO in the study groups.

The control, ibuprofen, masseter, and alveolar socket groups represented the highest levels of acetaminophen consumption, respectively. Finally, the observed difference was significant among the dexamethasone groups and other groups ($P=0.000$) and ibuprofen-control groups ($P=0.03$), the related data of which are presented in Table 1.

Discussion

The administration of NSAIDs is a common choice to control post-operative pain and the inflammation of the third molar extraction (18). In recent years, special attention has been paid to the administration of local GCs for pain and inflammation control after the extraction of impacted third molar. The findings of this study showed that the administration of dexamethasone 4 mg as intramuscular in the masseter muscle or as a powder in the residual alveolar socket, without a significant difference to each other, has a superior effect compared to ibuprofen on the control of pain severity, trismus, and swelling after the extraction of impacted third molar.

There are still limited studies on the intra-oral injection of GCs, the results of which are generally consistent with our findings. Moreover, in similar studies, submucosal dexamethasone injection has been investigated in most cases. The first experience of intra-oral dexamethasone injection in 1975 was accompanied by acceptable findings after the extraction of impacted mandibular third molar. Messer et al observed that patients experienced little trismus, pain, and swelling by dexamethasone 4 mg injection in the masseter muscle and then the mucosa adjacent to the surgery site. Unfortunately, their study had no control group, thus it cannot provide a proper understanding of the effect of intra-oral dexamethasone injection (15). In another study, Dereci et al found that the intervention caused a significant decrease in swelling compared to the placebo by the injection of dexamethasone 8 mg into the masseter muscle immediately after the extraction of impacted third molar. Nonetheless, they did not investigate postoperative pain and trismus (19). Similarly, Nandini reported that the injection of dexamethasone 8 mg in the masseter muscle immediately before the surgery significantly reduced swelling, trismus, and pain during 7 days after the surgery. Based on their results, the use of an additional analgesic agent was not significant between dexamethasone and control groups (20), which is not consistent with our findings. Antunes et al concluded that dexamethasone 8 mg orally or intra-masseter injection improved MMO on day two (second, seventh days evaluation) while significantly reducing analgesic consumption compared to the control group on day one after the surgery. In addition, swelling and pain severity were not significantly different between dexamethasone groups and the control group (21), which seems to be related to osteotomy or crown sectioning (severe invasion) in all cases. In contrast to the above-mentioned studies, dexamethasone 4 mg was used in the current study. In similar studies, a dose of 4 mg was effective (22) and was not preferred to the dose of 8 mg (23).

GCs have more anti-inflammatory mechanisms compared to NSAIDs. Selective and non-selective cyclooxygenase 1 and 2 inhibitors such as celecoxib and ibuprofen suppress the production of prostaglandins. GCs, in addition to the inhibitory effect on prostaglandins production, suppress various aspects of inflammation, including cytokine production and cell migration, which greatly reduces the immune response to the injury. Dexamethasone is a highly potent GC with a biologic half-life of 36-72 hours (24,25).

Intra-oral dexamethasone injection can bring some benefits. For example, it has similar anti-inflammatory effects as the systemic administration of the drug (26,27). No noticeable complications were reported in the studies that evaluated intra-oral dexamethasone injection. In other words, this may be a safe procedure. Further, the simultaneous administration of dexamethasone and anesthetic agents can enhance the anesthesia (28). Moreover, local dexamethasone administration can accelerate the recovery of the damaged nerve compared to systematic injection.

Our findings suggest that the placement of dexamethasone powder in the alveolar socket may be preferable because it is easy to work and needs no needling.

The limitations of this study include the lack of the evaluation of the wound healing process, and the examination of other types of drugs, including selective NSAIDs, which could provide further evidence.

Conclusions

In summary, the findings of this study indicated that the intra-oral dexamethasone injection or placement of dexamethasone powder in the alveolar socket has a better effect compared to ibuprofen in controlling pain, swelling, and trismus after the extraction of impacted third molar.

Authors' Contribution

FK and SE carried out the experiment. SFSJ wrote the manuscript with support from MK, and FK supervised the project.

Ethical Statement

This study was approved by the the Ethics Committee of Tehran University of Medical Sciences under the code of IR.TUMS.DENTISTRY.REC.1390.002

Conflict of Interest Disclosures

The authors declare that they have no conflict of interests.

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