

Clinical Paper
Oral Surgery

Efficacy of methylprednisolone injected into the masseter muscle following the surgical extraction of impacted lower third molars

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E. Vegas-Bustamante, J. Micó-Llorens, J. Gargallo-Albiol, M. Satorres-Nieto, L. Berini-Aytés, C. Gay-Escoda: Efficacy of methylprednisolone injected into the masseter muscle following the surgical extraction of impacted lower third molars. *Int. J. Oral Maxillofac. Surg.* 2008; 37: 260–263. © 2008 Published by Elsevier Ltd on behalf of International Association of Oral and Maxillofacial Surgeons.

Abstract. The aim of this study was to demonstrate the efficacy of methylprednisolone, as a single 40-mg dose, injected into the masseter muscle upon completion of extraction of impacted lower third molars. A prospective, randomized cross-over study was made of 35 healthy patients. The difficulty of extraction was similar in all cases. The study group received 40 mg of methylprednisolone injected into the masseter muscle via the intrabuccal approach, immediately after suturing of the surgical wound. The control group received no intramuscular corticoid. Evaluations were made of postoperative pain, trismus and swelling. Oral aperture was measured, along with the following distances for the assessment of swelling: tragus–lip commissure, gonion–lip commissure and gonion–external canthus of the eye, before and 2 and 7 days after surgery. The patients administered methylprednisolone showed superior results after surgery in terms of oral aperture, pain and all the facial swelling parameters, with statistically significant differences versus the controls ($p < 0.05$). The results obtained show that 40 mg of methylprednisolone injected into the masseter muscle in the immediate postoperative period reduces swelling, trismus and pain.

Key words: corticoids; methylprednisolone; oral surgery; extraction; impacted lower third molars.

Accepted for publication 13 July 2007

The extraction of impacted lower third molars is the most common operation in oral surgery, and usually produces pain, trismus and facial swelling in the postoperative period²¹.

In 1949, Hench and Kendall used corticosteroids as anti-inflammatory agents for the treatment of rheumatoid arthritis⁹. Their use in dental practice began in the early 1950s, when SPIES et al.²⁶ and STREAN &

HORTON²⁷ administered hydrocortisone to prevent inflammation in oral surgery.

A single glucocorticoid dose inhibits the synthesis and/or release of pro-inflammatory and inflammatory mediators in a

variety of surgical procedures¹², with a reduction of fluid transudation and therefore oedema^{5,17,19}. This effect is well known and has been widely used to reduce swelling associated with the surgical extraction of impacted third molars^{3,20,22,29}. Prolonged corticosteroid use can delay healing and increase patient susceptibility to infection. With brief treatments, such as those typically contemplated in oral surgery, these effects are not clinically significant¹.

The glucocorticoids most widely used in oral surgery are dexamethasone (p.o.), dexamethasone sodium phosphate (i.v. and i.m.), dexamethasone acetate (i.m.), methylprednisolone (p.o.), and methylprednisolone acetate and methylprednisolone sodium succinate (i.v. and i.m.)¹.

The present study involves the injection of a single 40-mg dose of methylprednisolone into the masseter muscle via the intrabuccal approach following the surgical extraction of impacted lower third molars under local anaesthesia. The efficacy of this treatment in controlling typical postoperative complications (i.e. trismus, locoregional pain and swelling of the facial soft tissues) is evaluated.

Materials and methods

A prospective, randomized cross-over study was made of 40 patients between March 2003 and September 2004. The inclusion criteria were: healthy subjects, aged over 18 years, of either sex and without contraindications for corticosteroid treatment, and who required extraction of both lower third molars. The extractions were all of similar technical difficulty, and orthopantomography showed positioning of the teeth to be symmetrical. All patients required osteotomy and tooth sectioning to achieve extraction. Informed consent was obtained in all cases for both surgical extraction and inclusion in the study.

The extractions were carried out by two third-year residents. Each resident performed both extractions on the same patient, with an interval of 1 month between extractions. No pre-medication was provided. Surgery was carried out under local anaesthesia, using a maximum of three 1.8-ml carpules of 4% articaine with adrenalin 1:100,000. The duration of surgery was considered to be the time elapsed from initial incision to placement of the last suture. The following postoperative medication was prescribed: amoxicillin 750 mg p.o. every 8 h during 7 days or erythromycin 500 mg p.o. every 8 h during 7 days for patients allergic to penicillin; metamizol 575 mg p.o. every

6 h during 3 days, and 0.12% chlorhexidine mouth rinses twice a day for 15 days.

The patients were randomized to receive corticosteroids in the first or second surgical extraction. Following removal of the third molar in the corticoid group, 40 mg of methylprednisolone was injected into the masseter muscle via the intrabuccal approach. The control group received no corticoid. Injection of the drug was carried out by the person in charge of randomization control, thus ensuring double blinding of the study. The patients rated pain on a 10-cm visual analog scale, the extreme scores being 'no pain' and 'worst pain imaginable'. Pain was assessed every hour for 6 h from the end of surgery, and then during the next 3 days once in the morning and again at bedtime.

Postoperative swelling and trismus were in turn evaluated by a person different from the surgeon who performed the extraction. Unforced oral aperture was measured with calipers, and silk thread was used to record the following distances: tragus–lip commissure, gonion–lip commissure and gonion–external canthus of the eye. The measurements were made before and 2 and 7 days after surgery.

The Student's *t*-test for related samples was used to compare qualitative means. The SPSS version 11.0 statistical package was used throughout.

Results

Of the 40 patients enrolled in the study, 5 were finally excluded because of allergy to metamizol¹ and failure to present for the second extraction⁴. There were no complications in the form of infection, and no adverse events attributable to corticosteroid use.

The overall mean age was 25 years (SD 5). Males predominated slightly over females (53% versus 46%). The preoperative data relating to oral aperture and facial swelling are summarized in Table 1. There were no differences between the two groups in terms of the different preoperative measurements made, or in the duration of surgery.

The patients administered methylprednisolone showed superior results after 2 and 7 days in terms of oral aperture and the distances tragus–lip commissure and gonion–lip commissure, with statistically significant differences versus the controls ($p < 0.05$). The distance gonion–external canthus of the eye showed no significant inter-group differences 7 days after extraction (Tables 2 and 3).

As regards postoperative pain, a statistically significant decrease was noted in 6 h immediately after surgery and 3 days after extraction in the corticosteroid group (Table 4).

Table 1. Preoperative data relating to oral aperture and facial swelling

	Corticoid group (mm)	Control (mm)	<i>p</i>
Oral aperture	47.63 ± 3.96	47.81 ± 3.60	0.363
Tragus–commissure	107.84 ± 4.94	108.19 ± 4.89	0.118
Gonion–commissure	95.66 ± 6.95	95.97 ± 6.74	0.357
Gonion–external canthus	110.78 ± 4.67	110.59 ± 5.09	0.707

Table 2. Oral aperture and swelling 2 days after surgery

	Corticoid group (mm)	Control (mm)	CG – Ctrl (mm)	SD	<i>p</i>
Oral aperture	37.56	33.03	+4.53	3.16	<0.000
Tragus–commissure	111.25	113.25	–2.00	2.00	<0.000
Gonion–commissure	99.03	101.66	–2.63	2.78	<0.000
Gonion–external canthus	113.66	115.03	–1.38	3.12	0.018

Table 3. Oral aperture and swelling 7 days after surgery

	Corticoid group (mm)	Control (mm)	CG – Ctrl (mm)	SD	<i>p</i>
Oral aperture	43.41	40.38	+3.03	3.59	<0.000
Tragus–commissure	108.75	109.63	–0.88	1.36	0.001
Gonion–commissure	96.41	97.53	–1.13	1.93	0.002
Gonion–external canthus	111.25	111.66	–0.41	2.66	0.395

Student's *t*-test for related samples. CG – Ctrl: mean of corticoid group minus mean of control group.

Table 4. Pain scores according to visual analog scale, corresponding to different time points after surgical extraction

		Mean		Difference of means (CG – Ctrl)	SD	p
		CG	Ctrl			
Day 0	5 h	12.31	29.25	–16.94	19.32	<0.000
	6 h	13.66	31.44	–17.78	21.85	<0.000
Day 1	Morning	8.97	19.59	–10.63	11.80	<0.000
	Night	12.41	18.50	–6.09	0.84	0.015
Day 2	Morning	10.22	18.06	–7.84	13.18	0.002
	Night	11.16	18.63	–7.47	15.35	0.010
Day 3	Morning	9.09	16.34	–7.25	16.70	0.020
	Night	8.97	18.09	–9.13	15.03	0.002

CG: corticoid group, Ctrl: control group.

Discussion

The administration of corticosteroids effectively reduces trismus, pain and facial swelling, but review of the literature has revealed few reports of administration of these drugs in the region adjacent to surgical trauma (the masseter muscle in the present case). The selected corticosteroid should have scant mineralocorticoid effects and great biological activity²¹. Methylprednisolone meets these requirements, since it has no mineralocorticoid activity, the half-life is approximately 18–36 h, and the drug is 5-fold more potent than hydrocortisone^{5,6,11,20,24}.

Methylprednisolone has been used at a constant dosage in most studies^{5,8,10,14,15,19,28,29}. ESEN et al.⁸ reported that a single intravenous dose of 125 mg of methylprednisolone reduces the swelling, pain and trismus associated with third molar surgery. This coincides with the present observations, although involving a different dose and route of administration. HUFFMAN¹⁴ compared the intravenous administration of 40 mg and 125 mg of methylprednisolone in extractions of impacted lower third molars. Although the increase in dose further reduced swelling, the difference was not statistically significant. USTÜN et al.²⁹ evaluated the effects of 1.5 mg/kg and 3 mg of methylprednisolone via the intravenous route in terms of the postoperative complications (pain, swelling and trismus) recorded after third molar surgery. No significant differences were observed between the two groups, and the authors concluded that administration of a higher methylprednisolone dose affords no clinical benefit.

Different administration routes have been used for these drugs in oral surgery. The oral route is more comfortable for the patient and ensures rapid and almost complete absorption, but its efficacy compared with parenteral administration is question-

able. The studies conducted to date involved low doses and brief periods of observation^{6,20}. The intramuscular route affords good plasma drug concentrations and prolonged anti-inflammatory action with a single pre- or postoperative dose²⁰. The expertise of the dental professional, the patient discomfort caused, and the need for specific material for administering the drug are factors that may limit use of this route⁸. MICÓ-LLORENS et al.¹⁸ injected 40 mg of methylprednisolone into the gluteal zone following the extraction of impacted third molars, and reported good results 2 days after the operation in terms of swelling, pain and trismus, but after 7 days the differences were no longer significant. MESSER & KELLER¹⁷ injected dexamethasone into the masseter muscle and reported a decrease in pain, swelling and trismus, similarly to the present results with methylprednisolone. The technique is convenient for the surgeon, since injection is carried out in proximity to the surgical area, and also for the

patient, since injection is performed in a region that is still anaesthetized. The intravenous route affords excellent and immediate plasma drug levels, although some experience is required for administration. Studies that employ the intravenous route suggest that while a single preoperative dose offers almost immediate benefit in terms of pain, swelling and trismus, supplemental dosing is usually needed via either the oral or intramuscular route, in order to ensure optimum clinical efficacy²⁰. USTÜN et al.²⁹ recommend preoperative administration via the intravenous route, because it offers immediate therapeutic blood drug concentrations before actual surgical trauma.

The absolute contraindications to corticosteroid use include patients with tuberculosis, active viral or fungal infections, active acne vulgaris, primary glaucoma, a history of acute psychosis or psychopathic tendencies and allergies²⁰. While these contraindications refer to chronic corticosteroid use³, it is felt that such drugs should be avoided in patients with these problems. All of the present patients were healthy (American Society of Anesthesiologists, physical status 1), with no adverse reactions or complications attributable to corticoid use.

As to postoperative pain, and coinciding with the present observations, ESEN et al.⁸ reported a decrease with the administration of methylprednisolone. BAXENDALE et al.⁴, using dexamethasone, reported a statistically significant reduction in pain 4 h after surgery, but not at the subsequent controls. BYSTEDT & NORDENRAM⁶ in turn reported improvements in pain in the immediate postoperative period. MICÓ-LLORENS et al.¹⁸ observed a statistically

Table 5. Controlled trials evaluating efficacy of methylprednisolone following the surgical extraction of impacted lower third molars

Authors	Year	Steroid	Dose and route of administration
WARE et al. ³⁰	1963	Dexamethasone	9 mg y 13.5 mg/oral
LINENBERG ¹⁶	1965	Dexamethasone	6 mg/oral
HOOLEY & FRANCIS ¹³	1969	Betamethasone	14.4 mg/oral total daily dose
MESSER & KELLER ¹⁷	1975	Dexamethasone	4 mg/IM
CACI & GLUCK ⁷	1976	Prednisolone	400 mg/oral. Total dose/3 días
HUFFMAN ¹⁴	1977	Methylprednisolone	40 y 125 mg/IV
SKJELBRED & LOOKEN ²⁵	1985	Betamethasone	9 mg /IM
SISK & BONINGTON ²⁴	1985	Methylprednisolone	125 mg/IV
BEIRNE & HOLLANDER ⁵	1986	Methylprednisolone	125 mg/IV
TROULLOS et al. ²⁸	1990	Methylprednisolone	125 mg/IV 100 mg/oral
HOLLAND ¹¹	1987	Methylprednisolone	40 mg/IM
BAXENDALE et al. ⁴	1993	Dexamethasone	8 mg/oral
MILLES & DESJARDINS ¹⁹	1993	Methylprednisolone	16 mg/oral y 20 mg/IV
HYRKAS et al. ¹⁵	1993	Methylprednisolone	40 mg/IV
SCHULTZE-MOSGAU et al. ²³	1995	Methylprednisolone	32 mg/oral
ESEN et al. ⁸	1999	Methylprednisolone	125 mg/IV
USTÜN et al. ²⁹	2003	Methylprednisolone	1.5–3 mg/IV
MICÓ-LLORENS et al. ¹⁸	2006	Methylprednisolone	40 mg/IM

significant reduction 6 h after surgery, but not at the subsequent controls. In the present study pain reductions were recorded in 6 h after extraction and also over the subsequent 3 days. Likewise, TROULLOS et al.²⁸ compared flurbiprofen and ibuprofen with methylprednisolone in relation to pain, oedema and trismus as common complications of impacted third molar extraction. Their results showed the non-steroidal anti-inflammatory drugs to afford greater initial analgesia than the corticosteroid, although the latter afforded superior anti-oedema action with lesser patient functional loss (Table 5).

The method used in this study to measure facial swelling and trismus (calipers and silk thread) is valid, easy to use and inexpensive. Other methodological approaches have also been described, such as clinical observation, subjective palpation^{14,17}, and the use of malleable metal rods, a compass², photographic techniques, stereophotography and computed tomography^{19,23}.

In conclusion, the results of this study show that the intraoperative injection of 40 mg of methylprednisolone via the intrabuccal approach into the masseter muscle significantly reduces swelling, trismus and postoperative pain. This technique therefore offers a low-cost solution for the typical patient discomfort associated with the surgical extraction of impacted lower third molars.

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