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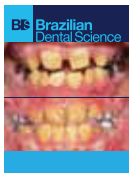

ORIGINAL ARTICLE

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The influence of single-dose dexamethasone on masseter and temporal muscles after impacted lower third molar extraction. Pilot study through electromyography evaluation

Estudo piloto da influência da dexametasona em dose única nos músculos masseter e temporal após exodontia de terceiros molares inferiores inclusos: avaliação por eletromiografia.

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ABSTRACT

This study aimed to evaluate the influence of dexamethasone (Decadron®) administered as preoperative single dose (8 mg) on the electrical activity of the masticatory muscles, superficial masseter and anterior temporal, through electromyographic analysis after lower third molar extraction. Twenty patients who required surgical treatment for extraction of these teeth were selected, treated and evaluated. Patients were randomly assigned to one of the following groups: experimental group that received a single dose of dexamethasone 8 mg 1 h before the procedure, or control group that underwent extraction without the use of medication. Ag/AgCl electrodes were used to record the electrical muscle activity before the procedure, after anesthesia, after root section, immediate postoperative and 7, 15 and 30 days postoperatively. EMG data collected were analyzed by analysis of variance and Tukey's test with a significance level of 5% for intra and intergroup comparisons. The results showed no statistically significant differences in the comparisons within and between groups ($p > 0.05$). Based on these findings, it can be concluded that the third molar extraction and the use of dexamethasone as a preoperative single dose may not interfere in the muscle electrical activity.

KEYWORDS

Anti-inflammatory drug; Tooth Avulsion; Dental extraction; Electromyography; Masticatory muscles.

RESUMO

Este estudo teve como objetivo avaliar a influência da dexametasona (Decadron®) administrada em dose única (8 mg) na atividade elétrica dos músculos mastigatórios bilaterais; masseter superficial e temporal anterior, por meio de análise eletromiográfica em procedimentos de exodontia de terceiros molares inferiores inclusos. Foram selecionados, tratados e avaliados 20 pacientes que necessitavam de tratamento cirúrgico para avulsão de terceiro molar inferior incluso e impactado. Os pacientes foram distribuídos, conforme ordem de chegada, para um dos seguintes grupos: Grupo Experimental que receberam dose única de dexametasona 8 mg 1 h antes do procedimento cirúrgico de exodontia de terceiro molar inferior; ou Grupo Controle que foram submetidos a exodontia sem a utilização da medicação. Para o registro eletromiográfico utilizou-se eletrodos de Ag/AgCl para coleta da atividade elétrica muscular previamente ao procedimento, pós-anestesia, pós-odontosecção, pós-cirúrgico imediato e 7, 15 e 30 dias pós-operatório. Os dados eletromiográficos coletados foram submetidos à análise de variância e ao teste de Tukey com nível de significância de 5% para comparação entre os lados operado versus o lado não operado, dentro de todos os tempos para os músculos masseter e temporal. Os resultados demonstraram que não houve diferença estatisticamente significante quando a comparação intra e intergrupos foram realizadas ($p > 0,05$). Baseado nisso, pode-se concluir que dentro dos limites do presente estudo, que a cirurgia de terceiro molar e o uso da dexametasona em dose única não interferem na atividade elétrica muscular.

PALAVRAS-CHAVE

Medicamento anti-inflamatório; Avulsão Dentária ; Extração dentária; Eletromiografia; Músculos mastigatórios.

INTRODUCTION

The extraction of third molars due to inclusion and impaction is one of the most performed procedures in Oral and Maxillofacial Surgery and Traumatology and frequently it is associated with either transitory or permanent postoperative morbidity. Among its most common accidents and complications are: hemorrhages, alveolitis, pain, swelling, trismus, damaging to alveolar inferior nerve, infections inside fascial spaces and damaging to the surrounding teeth. Among all complications, the most frequent is the alteration of the activity of masticatory muscles, so-called trismus, which is the mild-to-moderate difficulty in opening and closing the mouth because of a muscle contracture localized in the masticatory muscles. The trismus can be disseminated and involve many muscles, mainly masseter, within around 56% of the individuals subjected to this type of surgery during the postoperative phase which is frequently difficult. Generally, the trismus gradually decreases to cessation and the full capacity of opening the mouth should be reestablished from 10 to 14 post-surgery days [1,2]. Other commonly complication has been the marked facial surgical swelling, which is one of the reactive responses of the body against the surgical aggression. Extensive facial swelling not only retards the repairing of the surgical wound but also accounts for the postoperative pain [3].

The authors have still reported that the surgical procedure of the third molar removal involves modifications in orofacial motility [5]. Such modifications lead to difficulties in feeding and oral hygiene, restrict the access to oral procedures and they can even affect the speech and face appearance. In the most severe cases, they can put the pulmonary function at considerable risk in mouth breathers [6].

Based on the aforementioned exposed, it is of main importance the use of drugs aiming at controlling inflammatory reactions without damaging the repairing and healing processes, which can be a medicine resource to prevent postoperative complications. In this context, many clinical researches on the use of steroidal (SAIDs) and nonsteroidal anti-inflammatory drugs (NSAIDs) have been conducted to control postoperative inflammatory reaction decreasing phlogistic signs. Among the studied drugs, main attention is given to synthetic analogues of hydrocortisone, such as prednisone, methylprednisolone, betamethasone and dexamethasone [7-9]. Betamethasone and dexamethasone has been mainly employed because of their optimum therapeutic qualities, low sodium retention (consequently with low water retention) and slow incidence of adverse reactions and side effects when at single and high doses [1, 8-11].

Electromyography for the study of muscular kinesiology has been used for more than 40 years, aiding in the diagnosis and treatment following-up in patients with osteoarticular dysfunction. It has been firstly applied in the neurophysiology during the studies of bioelectrical phenomena occurring in the cellular membranes of the skeletal muscle fibers during resting, minimum effort and maximum contraction effort. From a physiologic point of view, during a voluntary muscle contraction the activity generated in the cerebral cortex activates the peripheral motor neuron localized in either the brainstem (motor nuclei of cranial nerves) or the spinal cord and this contacts the muscles through synapsis by depolarizing the motor plate (site of neuromuscular synapsis), generating the simultaneous contraction of many muscle fibers composing a motor unit [12].

The electromyographic (EMG) record detected by the electrode within the muscle is the sum of the action potentials of all muscle fibers of the motor unit that are together in action because they are innervated by the same motor neuron [13,14].

Because of its easy use, significant sensitivity and non-invasive approach, the surface electromyography has gained space in monitoring the electric activity coming from

the muscles, such as the motor behavior of the mandibular elevator muscles during the maximum masticatory effort [15], evaluations of intraoral devices [16], analysis of the masticatory force [17], speech and swallowing disturbs [18], evaluation of pain in surgical procedures [19], muscular spasm [20], among others.

Studies in literature have reported that 100% of individuals submitted to extraction of third molars showed trismus and reduction of mean RMS values of masseter. Still, they described that masseter of third molar extraction side, at rest, exhibited a statistically significant increasing of the electric activity, which could be related to the presence of both swelling and inflammatory process at the surgical site, since the contralateral side did not show any differences [2]. Another study following-up the post-surgical evolution after mandibular third molar extraction through electromyography at 4 moments (preoperative, 7, 14 and 21 day postoperative) found that the comparison between the extraction and contralateral sides was almost the same [21].

Thus, the aim of this study was to evaluate the influence of single-dose dexamethasone on the activity of masticatory muscles (superficial masseter and temporalis) at 7, 15 and 30 postoperative days following mandibular third molar extractions through electromyography analysis in order to contribute with the diagnosis of the stomatognathic system dysfunctions after long surgical procedures.

MATERIAL & METHODS

Research subjects

After the reading and signing of the Clarified Free Consent Form either by the individual or the legal responsible person, 20 patients referred to the Discipline of Oral and Maxillofacial Surgery and Traumatology of the School of Dentistry of the Science and Technology Institute of São José dos Campos (ICT-UNESP) for the extraction of mandibular third molars due to inclusion/impaction were invited to participate. All participants were subjected to anamnesis to establish the necessity and moment of the surgery.

All patients underwent preoperative routine examinations such as: bleeding time, clotting time and glycaemia.

A single dentist carried out all elective surgeries. Few moments before the procedures, the patients were submitted to physical examinations including measuring of blood pressure, heart and respiratory frequency, and temperature.

Sample characteristics

Patients were selected according to the following criteria:

- Inclusion criteria:

1. Free and clarified consent form to participate in the study according to which is established by the Brazilian Health Council guideline number 196/96;

2. Health patients referred to extraction of mandibular third molars due to inclusion.

- Exclusion criteria

1. Patients showing any systemic alteration impeding the surgical procedure;

2. Use of analgesic and anti-inflammatory drugs 10 days before the surgery;

3. Patients presenting Temporomandibular joint dysfunction (TMJ) diagnosed according to TMJ criteria for research [22]: report of bruxism, presence of pain in articular area; crackles during mouth's opening and closing; mouth opening limitation; mandibular shift during opening and closing movements and report of muscle fatigue after awakening;

4. Patients contraindicated to use dexamethasone or other drugs included in the study protocol.

Surgical procedures

Prior to the execution of the procedures, the patients were randomly divided into two groups:

GROUP 1 (CONTROL): 10 (ten) patients who did not receive SAID preoperatively.

GRUOP 2 (EXPERIMENTAL): 10 (ten) patients receiving SAID preoperatively (dexamethasone 8mg – SINGLE DOSE, 1 (one) hour before the surgery).

All patients were subjected to the same surgical procedures carried out by one single dentist at the Discipline of Oral and Maxillofacial Surgery and Traumatology of the School of Dentistry of the Science and Technology Institute of São José dos Campos (ICT-UNESP).

Pre- and postoperative procedures included the following basic care:

a) Anamnesis;

b) Request of imaging examination (panoramic radiograph) and preoperative laboratorial tests when necessary;

c) Postoperative drug therapy advised by the Discipline of Oral and Maxillofacial Surgery and Traumatology of the School of Dentistry of the Science and Technology Institute of São José dos Campos (ICT-UNESP):

1) Amoxicillin 500 mg – 1 capsule at every 8 hours for 7 days

2) Profenid 200 mg - 1 tablet, every day, for 3 days

3) Paracetamol 750 mg -1 tablet every 4 h only if in pain

d) Recall for clinical evaluations;

e) General instructions.

Drug protocol was used respecting individual therapeutic contraindications informed in the anamnesis.

Next, the patients were subjected to extra- and intraoral antisepsis with the aid of 0.12% chlorhexidine digluconate and covered by surgical drapes to restrict the contamination area. Local anesthesia comprised regional block of the alveolar inferior nerve through 2% mepivacaine with 1/100,000 epinephrine. Following, a straight retromandibular incision was made with the aid of a size 15 scalpel blade, slightly displaced to buccal side at its final portion, measuring about 1.0 cm; another intrasulcular incision reaching interdental papilla was executed between the second and first molars to allow the raising of a total flap with the aid of Molt elevators to expose an adequate surgical site. Then, osteotomy and odontotomy were executed with the aid of high speed handpiece and size 4 round drill, under copiously irrigation with 0.9% saline solution. With the aid of Straight and angled Seldin elevators or Potts elevators, the tooth was extracted followed by the removal of the pericoronal follicle, cleaning of the socket and the repositioning of the flap and suture with silk thread 4.0 (Ethicon – Johnson & Johnson).

Methods of obtaining of electromyographic data

After anamnesis and during pre- and postoperative phases, the participants were evaluated thorugh electromyography. To record the electromyographic sign of both the anterior part of the right (RT) and left temporal (LT) muscle and the superficial part of the right (RM) and left masseter (LM) muscle, it was used an electromyographic device model EMG-800C (EMG System do Brasil Ltd.) with eight channels, previously calibrated with a total amplification gain of 20 times, common mode rejection > 100 dB, analog-to-digital converter board of 16 bits of resolution of dynamic range, linked to the computer through Network Adapter Ethernet 10Mbits with connector RJ45 (10BASE T) using TCP/IP protocol; Butterworth type analog filter of two poles, of low pass (FPB) of 500 Hz and high pass (FPA) of 20 Hz; software of acquisition and analysis of electromyographic signs for Windows Vista /XP platform, simultaneous exhibition of the signs of the various channels and sign treatment (RMS value, mean, minimum, maximum and standard deviation, FFT (on line) with acquisition rate (sampling) of up to 2,000 samples / second per programmable channel per software (Figure 1).

Figure 1 – Electromyographic device model EMG-800C (EMG System of Brazil Ltd.)

The four input channels with active electrodes with amplification gaining of 20 times to collect the electromyographic sign, in triplicate, corresponded to each muscle studied: channel 1- anterior portion of left temporal muscle; channel 2 –superficial portion of left masseter muscle; channel 3 - portion of right temporal muscle; channel 4 - superficial portion of right masseter muscle.

To collect the action potentials of the muscles evaluated, it was used passive EMG surface electrodes composed by two Ag/AgCl discs (10 mm in diameter) placed 10 mm between each other, coupled to a polyethylene foam with a disposable hypoallergenic adhesive and solid gel (Meditrace® Kendall-LTP, model Chicopee MA01) adhering on the surface in contact with the individual. These allowed the collection of the electric activity of many motor units at the same time, providing a general approach of the muscular dynamics. The electrodes were coupled to a preamplifier with gaining of 20 times therefore characterizing a differential circuit.

A reference electrode (ground) was placed at the frontal area, greased with electroconductor gel to reduce the electric noises undesirable to the EMG sign.

Procedures

At the moment of the EMG evaluations, the individuals were seated with their eyes opened, at natural posture, and with their head at Frankfurt horizontal plane, so that they could not see the records on the computer screen. Prior to the collection of the EMG records, the participants' skin was cleaned with a cotton pellet embedded in 70% alcohol to reduce the skin impedance and to place the surface electrodes oriented by the direction of the muscle fibers [23,24].

Then the passive electrodes were fixed on the mean point of the studied muscle bellies [25,26].

EMG records were initiated with the evaluation at postural situation (baseline), followed by the maximum voluntary contraction (isometrics) of the studied muscles. The collection time was of 10 s, and each record was executed three times successively, with 1 min interval.

A single operator, previously calibrated, monitored EMG collections and records obtained at real time. In the presence of any undesirable interference in the reception of the electric potentials (unsolicited movement, for example), the examination was repeated. All EMG records were registered in computer's files.

The values of EMG amplitude were quantified through two measurements (response variables): Root Mean Square (RMS) – which is an electronic mean of the square root of the squared voltages of EMG sign and it has been recommended to represent the EMG amplitude of non-dynamic contractions such as isometric ones, according to SENIAM and ISEK [27, 28]. RMS values were expressed in microvolts (μV) [29-31].

RMS values were calculated through - EMGLab software V1.1 (EMG System do Brasil Ltd.), in specific binary language providing all mathematic and statistical information at time and frequency domains, also enabling to export the data collected for the numerical pattern, so-called ASCII, to be processed and analyzed through Matlab software (version 7.0 or above).

EMG collection was carried out at four different phases:

Initial phase – Prior to the surgical procedure – aiming to evaluate the motor behavior of the studied muscles at muscle resting and basal situation

Phase 1 – After the surgical procedure – aiming to evaluate the motor behavior of the studied muscles immediately after the surgical procedure.

Phase 2 - After the surgical procedure – aiming to compare the motor behavior of the studied muscles 7 days after the surgical procedure.

Phase 3 - After the surgical procedure – aiming to compare the motor behavior of the studied muscles 15 days after the surgical procedure.

Phase 4 - After the surgical procedure – aiming to compare the motor behavior of the studied muscles 30 days after the surgical procedure.

Clinical analysis

The participants were instructed to return at 7, 15 and 30 postoperative days for clinical evaluation, measurement and detection of possible adverse reactions of the treatment, which were recorded in their files.

Statistical analysis

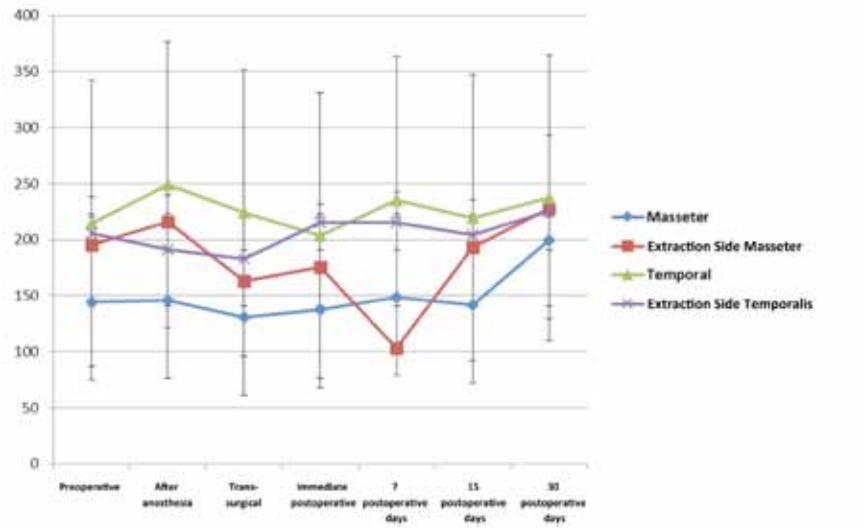
Each EMG measurement was performed three times and their mean was used for each phase evaluated. Mean and standard deviation was calculated.

Data distribution was evaluated by Shapiro-Wilks test. Intra e intergroup comparisons were applied. Data showing normal distribution was verified by ANOVA and Tukey test. Data presenting non normal distribution was verified by non-parametric variance tests followed by another post-hoc test. The level of significance adopted was 5%.

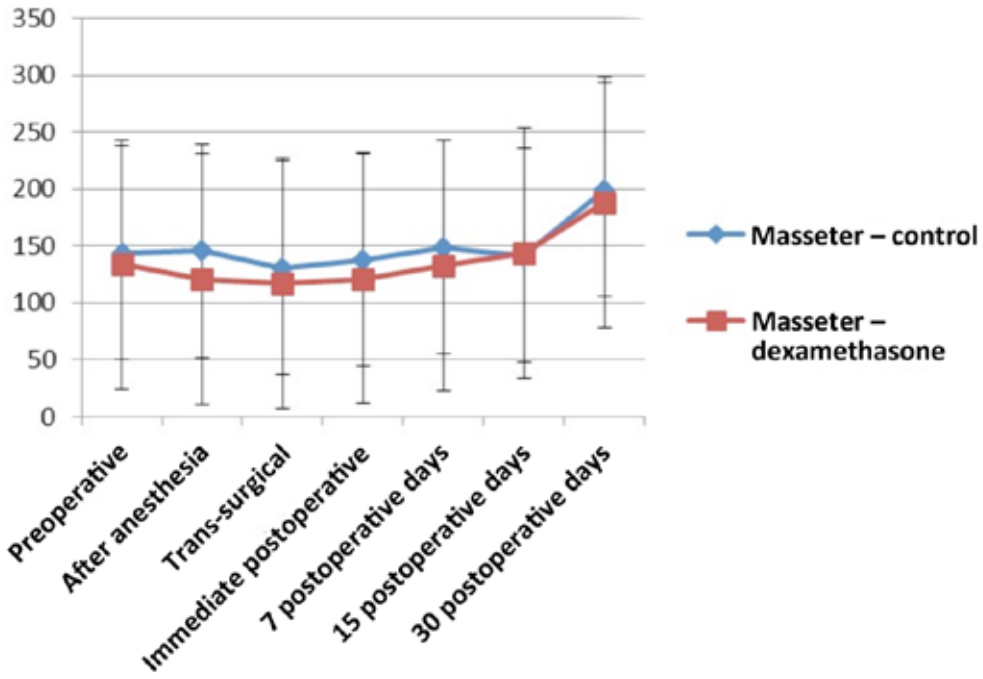
RESULTS

Postoperative period of all participants was uneventful. All individuals participated in all phases of the study. The evaluation of surgical procedure influence on the activity of each muscle group showed no statistically significant differences ($p > 0.05$) between the extraction and contralateral sides both for masseter and temporal muscles. Moreover, it was not observed the variation of activity of any muscles over time.

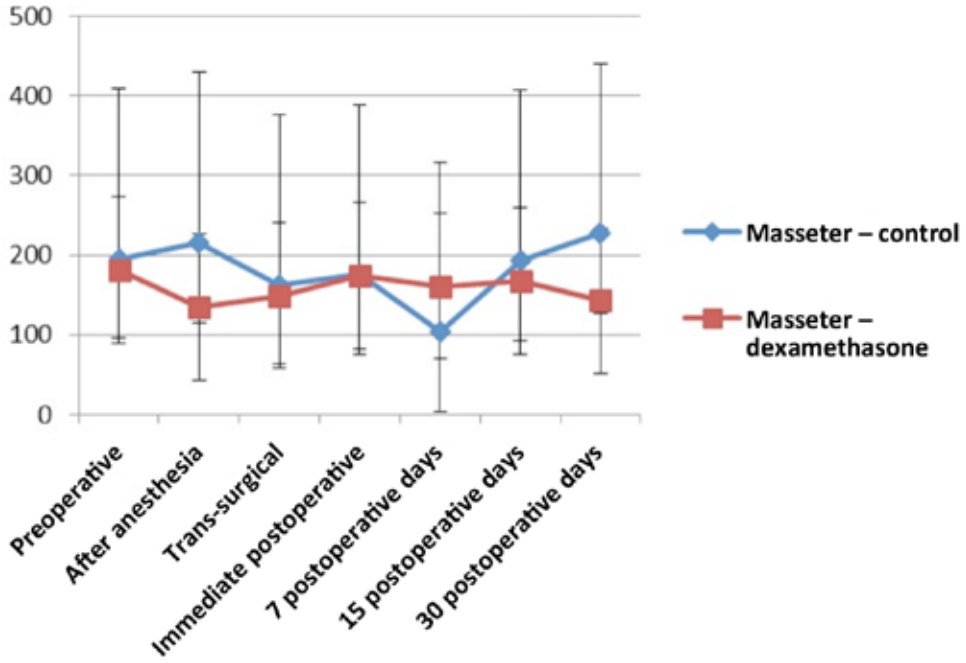
The evaluation of dexamethasone influence on masseter and temporal muscles compared with that of control group did not exhibit statistically significant differences ($p > 0.05$) (table 1), both for the extraction and contralateral side. The comparison between the extraction and contralateral sides after the use of dexamethasone and the activity variation of the muscles over time did not also present statistically significant differences ($p > 0.05$) (table 2).



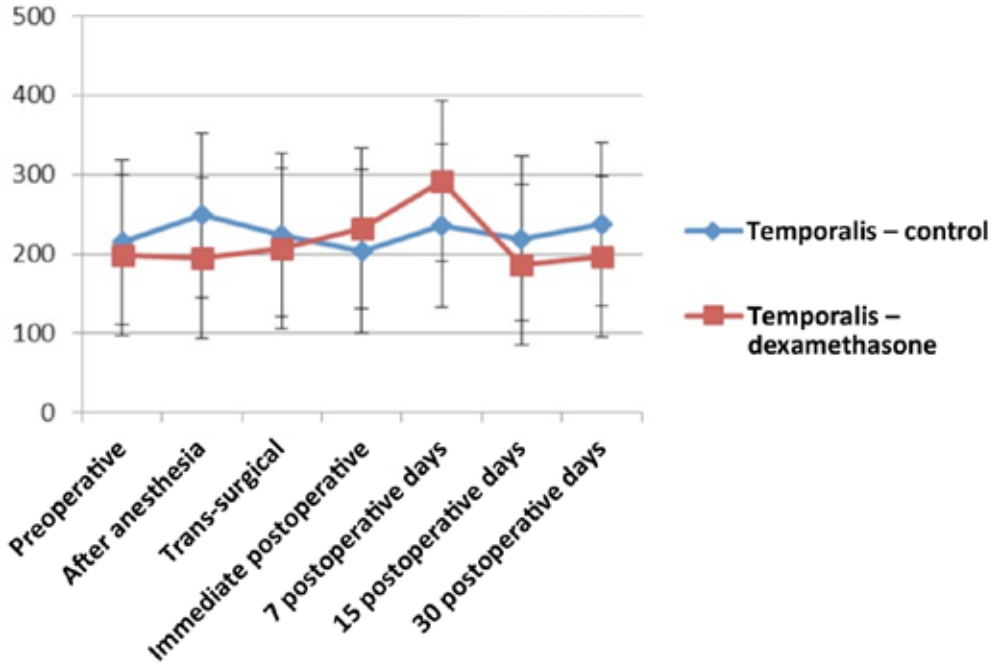
Graph 1 – EMG activity of control group muscles.



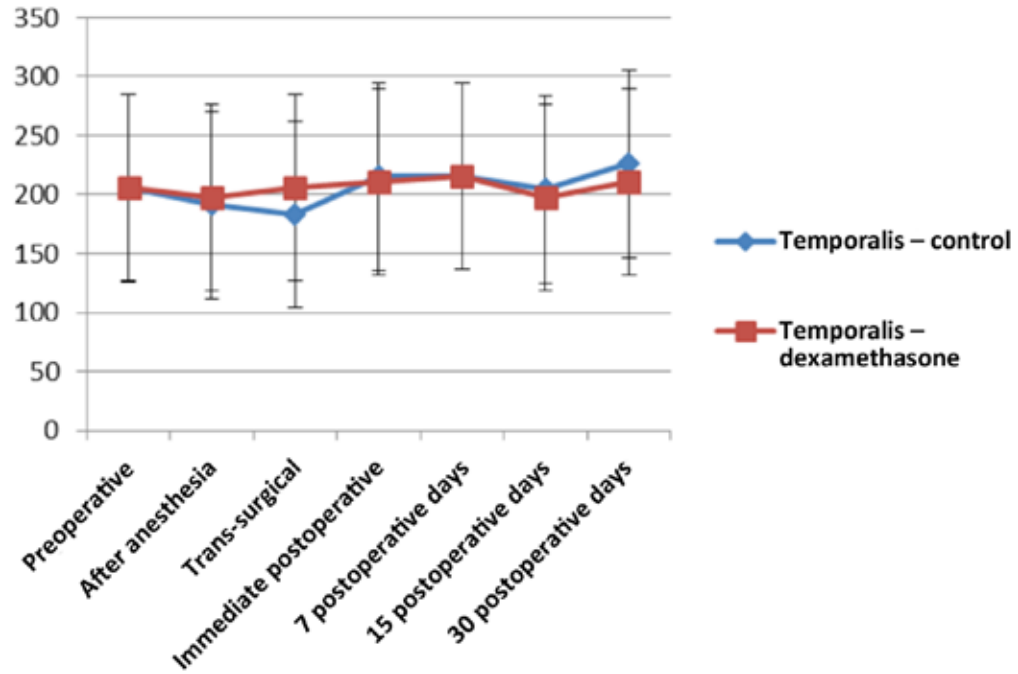
Graph 2 – Analysis of superficial masseter muscle after comparison of control with experimental (dexamethasone) groups, at contralateral side.



Graph 3 – Analysis of superficial masseter muscle after comparison of control with experimental (dexamethasone) groups, at extraction side.



Graph 4 – Analysis of anterior temporal muscle, after comparison of control with experimental (dexamethasone) groups, at contralateral side .



Graph 5 – Analysis of anterior temporal muscle, after comparison of control with experimental (dexamethasone) groups, at extraction side.

Table 1 – Mean and standard deviation (SD) of EMG measurements of control group

	Preoperative	After Anesthesia	Tran-surgical	Immediate post-operative	7 post-operative days	15 post-operative days	30 post-operative days
M	144.2 ± 93.9	144.2 ± 93.9	130.5 ± 65.4	137.8 ± 67.4	148.8 ± 85.3	141.6 ± 81.2	199.6 ± 93.9
Me	195.3 ± 198.1	215.7 ± 213.3	162.8 ± 119.4	175.2 ± 92.6	103.1 ± 61.3	193.3 ± 125.5	227.5 ± 105.5
T	214.6 ± 93.7	248.7 ± 96.3	223.9 ± 127.5	203.7 ± 103.1	235.5 ± 80.1	219.3 ± 71.1	237.5 ± 121.6
Te	205.5 ± 146.0	191.0 ± 78.9	183.2 ± 93.1	215.2 ± 117.6	215.6 ± 83.1	204.6 ± 61.2	225.9 ± 79.3

Mean and SD values did not show statistically significant differences. M: superficial masseter muscle; Me: superficial masseter muscle of extraction side; T: anterior temporal muscle; Te: anterior temporal muscle of extraction side.

Table 2 – Mean and standard deviation (SD) of EMG measurements of control and experimental groups

	Preoperative		Postoperative		Trans -surgical		Immediate postoperative	
	C	D	C	D	C	D	C	D
M	144,2 ± 93,9	133.6 ± 36.0	145.9 ± 69.6	121.1 ± 48.5	130.5 ± 65.4	117.2 ± 52.3	137.8 ± 67.4	121.4 ± 69.1
Me	195,3 ± 198	180.9 ± 59.1	215.7± 213	134.7 ± 38.8	162.8 ± 119.4	148.9 ± 58.5	175.2 ± 92.6	174.2 ± 91.5
T	214,6 ± 93,7	198.6 ± 54.5	248.7 ± 96.3	194.7 ± 47.3	223.9 ± 127.5	206.4 ± 42.8	203.7 ± 103	232.2 ± 101
Te	205,5 ± 146	205.5 ± 35.1	191.0 ± 78.9	198.1 ± 33.9	183.2 ± 93.1	205.7 ± 55.9	215,2 ± 117	210.9 ± 119

	7 postoperative days		15 postoperative days		30 postoperative days	
	C	D	C	D	C	D
M	148.8 ± 85	132.6 ± 43.3	141.6 ± 81	144.0 ± 62.4	199.6 ± 94	187.9 ± 127
Me	103.1 ± 61	161.1 ± 59.9	193.3 ± 125	167.3 ± 66.1	227.5 ± 105	142.8 ± 48.4
T	235.5 ± 80	292.1 ± 233	219.3 ± 71	186.4 ± 43.9	237.5 ± 121	197 ± 50.4
Te	215.6 ± 83	215.4 ± 78.9	204.6 ± 61	197.9 ± 48.4	225.9 ± 79	210.3 ± 49.9

Mean and SD values did not show statistically significant differences. M: superficial masseter muscle; Me: superficial masseter muscle of extraction side; T: anterior temporal muscle; Te: anterior temporal muscle of extraction side.

DISCUSSION

The use of steroidal anti-inflammatory drugs has been frequently used in Dentistry, mainly preoperatively in treatments with expectation of postoperative pain and discomfort [32]. These drugs act in the initial steps of the inflammatory chain and therefore are powerful inhibitors of the synthesis of inflammatory mediators who cause pain, swelling and discomfort. Some studies have observed a significant trismus reduction in patients receiving dexamethasone and undergoing mandibular third molar extraction [33].

However, based on the results of this present study, the null hypothesis is adopted, that is, dexamethasone did not interfere in the electrical activity of superficial masseter and anterior temporal muscles at none of the operative periods and postoperative following-up appointments. The action potential of the muscle (muscular electrical activity), measured through electromyography both at rest and maximum voluntary contraction, showed little alteration in both groups, suggesting that the patients did not experience trismus with or without medication.

Some factors could explain this lack of difference. Firstly, it could be the electromyography itself. Electromyography is a largely employed method of electric evaluation of the muscle of easy acceptance by the patient and well described in the literature [34]. It is non-invasive, painless but it requires the training of the operator. The electrodes should be correctly placed always on the central area of the muscle belly which represents the motor point of the muscle to be evaluated, without varying the distance from 10 to 20 mm between them (disposable electrodes). In all postoperative procedures, the electrodes were placed onto the same site, according to the morphology of each patient. A previous test to evaluate the functioning of the electrodes were performed for all measurements and caution was taken to avoid any difference in the execution of the technique, because this instrument has highly sensitivity and the least interference could generate changes in the obtained results. Although in this present study the electrodes had been placed always on a same site, following the pattern in the literature, templates or accurate anatomical demarcations were not executed, which could partially explain the high standard deviation found in the results.

Other possible factor that could have contributed to this lack of difference is related with the surgical procedure itself. In this present study, the operator had more than 20 years of clinical practice and carried out all procedures. Consequently, the operator's experience resulted in surgical procedures not longer than 20 min (in average), even including the trans-surgical evaluations. Moreover, the operator with this degree of expertise would tend to minimize tissue injuries. These two factors associated – reduced operative time and little tissue injury -, could have contributed for a decreased inflammatory process in both groups and make easy the matching of the results. The literature has demonstrated that the operator's expertise is an important factor for both the postoperative process of patients and wound healing [35].

A third factor contributing for the lack of difference between groups is the sample size (n = 10). Randomized control trials following the guidelines of CONSORT-STATEMENT have adopted a higher sample size. A small sample size increases the variability of data so that statistical differences are more difficult to be observed even when they exist (sample power). In this present study, the standard deviation was high, so that a greater sample size is recommended.

CONCLUSION

Within the limits of this present study, it can be concluded that the extraction of the impacted mandibular third molar did not interfere in the electrical activity of superficial masseter and anterior temporal muscles. Moreover, preoperative single-dose dexamethasone also did not seem to interfere in

the electrical activity of these muscles. Further studies with a greater sample size and comparing either different surgical techniques or different drugs are highly recommended.

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