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Article

Influence of Surgical Technique on Post-Operative Complications in the Extraction of the Lower Third Molar: A Retrospective Study

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Abstract: The surgical extraction of the impacted third molar is frequently associated with several complications. The purpose of this study is to assess how two different surgical protocols affect post-operative complications during the extraction of the lower third molars. In order to compare and evaluate two different techniques (triangular flap vs envelope flap), and the relative post-extraction complications, two groups of 150 patients each, underwent to surgical third molar extraction and 60 days of follow-up. A complication rate founded in two groups was respectively 14,00% in group A and 17,33% in group B. There was a strong association between smoking (OR:2.8) and the use of oral contraceptives (OR:1.75) with complications. The age and sex-related incidence of complications in hard tissue healing finds great variability in the literature; the analysis performed on our data did not show a statistically significant association between them. Even though related to a higher incidence of transient changes in sensitivity, it was found that the envelope flap saw a lower percentage of complications. There is still no clarity on which is the best protocol for the extraction of the lower third molar, and the choice often depends on the surgeon's experience.

Keywords: third molar; complications; triangular flap; envelope flap

1. Introduction

Mandibular third molars are found in 90% of the general population, with 33% of the people having at least one impacted molar [1,2].

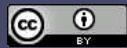
The surgical extraction of impacted mandibular third molars is the most common procedure in oral and maxillofacial surgery [3–5], frequently associated with considerable postoperative adverse effects [6,7].

The high prevalence of impacted third molar might be attributed to both genetic and environmental factors [8].

The indications for extracting lower third molars include pericoronitis, periodontal defects posterior to the second molars[9], caries of the second or third molars, neurogenic and myofascial pains, odontogenic cysts and tumors, and surgical indications noted by general dentistry, oropharyngeal hygiene, prosthodontic and orthodontic considerations [10].

The surgical technique may present variables such as flap design, bone removal coronectomy or root separation, and every procedure must be performed without damaging the surrounding anatomical structures [11].

Some of the most frequent postoperative complications in impacted third molar extraction are pain, swelling, trismus, prolonged bleeding, dry socket, alveolar osteitis, surgical site infections, abscess and sensory alterations of the inferior alveolar nerve (IAN) or lingual nerve (LN) [4,5,7,10,12,13]. The frequency of these postoperative complications for lower impacted third molars varies in the literature between 0% and 30% [4,14–16].



Smoking, the female sex, the use of oral contraceptives (OCPs), age, the surgeon's technique, the level of tooth impaction, and an increase in operating time have been suggested as potential risk factors for postoperative morbidity [17–19].

The results of the Meta-analysis confirmed that the use of oral contraceptives (OCP) is a risk factor for alveolar osteitis (AO) after extraction of the third molar. The lack of a significant difference between females and males who did not take OCPs suggests that female gender is not a risk factor for AO. [20].

The incidence of postoperative complications and the risks of permanent sequelae increase with age. Therefore, once the decision to extract an impacted mandibular third molar has been made, the surgery should be performed as soon as possible and well before the age of 24 [5]. Several articles in the literature suggested that neither the design of the flap or its extension affect postoperative symptoms, signs and complications [6,21].

In addition, it is essential to note that the flap design is a crucial factor in the surgery of the third molar, as it affects the visibility and accessibility of the impacted tooth, as well as the subsequent healing of the surgical defect created by the surgery.[2,22]. The envelope flap and triangular flap, both described since 50s of the last century [23], are the most commonly used flap designs for impacted lower third molar surgeries [11,21,24,25]. Several studies suggest that an envelope flap may reduce postoperative pain and swelling compared to the triangular flap [23,26]; indeed, the conventional envelope flap remains the gold standard for the exposure and removal of the impacted lower third molar [27]. The triangular flap was more efficacious when we consider the postoperative periodontal status of the adjacent second molar and the dehiscence following the wound healing in comparison to the envelope flap [22].

It has been suggested that flap design not only determines the accessibility and visibility of the impacted tooth, but also influences the healing of the surgical defect[11].

During tooth extraction surgery, the manipulation of hard and soft tissues for mucoperiosteal flap reflection and subsequent bone removal involves various factors that can affect the patient's postoperative course in terms of pain, swelling, trismus, and healing. In this context, the choice of surgical access flap can affect the postoperative outcomes of third molar surgery, including the development of numerous complications[13,22].

The purpose of this study is to assess how two different surgical protocols affect post-operative complications during the extraction of the lower third molars.

2. Materials and Methods

In this study, patients underwent surgical extraction of the lower third molar from March 2013 to March 2019, at the Unit of Maxillo-Facial Surgery and Dentistry of the University Hospital of Verona (Italy), and the surgeries were performed by two different operators, M.A. and D.B.

Patients with systemic diseases and/or drug therapies known to interfere with soft and hard tissue healing following surgery, have been excluded from the study. The exclusion criteria were pregnancy, have not undergone oral and/or periodontal surgery during the previous 12 months, patients with chronic periodontal disease. Were included nonsmokers and patients with healthy dental status.

Based on the inclusion criteria, 300 patients aged between 11 and 80 years were enrolled in the study; all patients complied till a follow-up period of 60 days. The demographic data were recorded, a thorough history was taken and informed written consent was obtained from the patients.

Patients were examined with CBCT examination before surgery[28]. The third molars were classified according to Pell and Gregory (1933)[29], those classified as IA were excluded from the study; radiographical inclination and root form were not considered an exclusion criteria.

Patients undergoing surgery were divided into two groups, according to which the operator had performed the extraction of the third molars. Each operator performed the extraction with a different type of flap: operator A with the Triangular Flap, operator B with the Envelope Flap.

The nature and aim of the study, together with the anonymity in the scientific use of data, were clearly presented in a written informed consent form, obtained from all subjects involved in the

study; appropriate forms were regularly filled in by parents or related legal guardians also for patients <18 years. The study was also conducted in accordance with the

Declaration of Helsinki and good clinical practice guidelines for research on human beings. The University Institutional Review Board approved the retrospective study (Protocol "POST-ESTR.LEMBI", Prog. 3921CESC). The study presents compliance with the STROBE checklist guidelines.

2.1. Pre-Surgical procedures

Patients were given antibiotic prophylaxis with 875 mg amoxicillin + 125 mg clavulanic acid two tablets 1 hour before surgery. Before surgery the patient rinsed with 0.20% Chlorhexidine for 1 minute.

2.2. Surgical Procedures

3,6 ml of mepivacaine HCl 2% with 1:100,000 epinephrine used as the local anesthetic agent for inferior alveolar and lingual nerve block (1,8 ml), In association with a buccal injection (1,8 ml).

In patients undergoing **protocol A** was performed Triangular flap. An incision was made from the anterior border of the mandibular ramus to the distal surface of the distobuccal cusp of the mandibular second molar. It was extended along the buccal sulcus until the medial corner of the second molar crown. The relieving medial vertical incision, oblique into the mandibular buccal fornix, aligned with the mesiobuccal cusp of the second molar. A full thickness flap was then elevated. Osteotomy was performed with rose head burr and odontotomies with fissure burr by using a surgical straight handpiece. Finally, the tooth was extracted with the use of levers of Bein and forceps.

In patients undergoing **protocol B** was performed Envelope flap. An incision was made from the anterior border of the mandibular ramus to the distal surface of the distobuccal cusp of the mandibular second molar. It was extended along the sulcus to the distobuccal corner of the second and first molar crown. The incision was continuous, without relieving the incision. A full thickness flap was then elevated. Osteotomy was performed with rose head burr to expose the dental crown, then the tooth was removed with levers of Bein and forceps without odontotomy.

After tooth extraction bony irregularities were corrected, the post-extraction site was curetted with a Volkmann spoon and rinsed with saline solution 0,9% (125 ml). Surgical wounds were closed using braided absorbable sutures (Vicryl 4.0; Ethicon, Somerville, NJ, USA).

2.3. Post-Surgical Procedures

Antibiotic therapy was prescribed with 875 mg amoxicillin + 125 mg Clavulanic acid tablets every 8 hours for 5 days.

Sutures were removed 14 days after surgery.

During the post-operative observation period were detected delayed healing, alveolitis, osteitis, and osteomyelitis were identified according to the timing of onset and the duration of complication.

2.4. Statistical analysis

The two cohorts were merged into a single database and were analyzed using Stata v.15.1 (Statacorp., College Station, TX, USA). The variables considered were all categorical (or binary) except the age that was divided into two classes (age < 25 and age >=25). The chi-square test compared the percentages obtained by both cohorts on the variables sex, age, smoking and oral contraceptive intake to verify that there was no statistically significant difference between the two cohorts, so that the two homogeneous patient pools can be defined. Complication rates in the two cohorts were then compared using the Fisher test. Through logistic linear regressions, the strength of association between the variables of sex, age, smoking and contraceptives with the percentages of complications was analysed. Significance level was set at 0.05.

3. Results

Procedural times were analyzed in both groups reporting an average surgical time over than 45 minutes for Protocol A and less than 45 minutes for Protocol B; the average osteotomy time was 1'26" for Protocol A and 0'36" for Protocol B.

The two groups were 150 patients each; patients operated under protocol A were 54.67% female and 45.33% male, while those operated under protocol B were 48.00% female and 52.00% male. The average age of patients was 28 for group A and 26 for group B. A complication rate founded in two groups was respectively 14,00% in group A and 17,33% in group B. Since no osteomyelitis was found in either patient pool, the proportion of osteomyelitis (=%0) was omitted from the tables below (Table 1).

Table 1. Complications sorted by sex.

Complications by sex		Female		Male		Total	
group A		%	n	%	n	%	n
Purulent alveolitis	0,00%	0	1,33%	2	1,33%	2	2
Alveolitis sicca dolorosa	4,00%	6	0,67%	1	4,67%	7	7
Alveolar osteitis	2,00%	3	0,67%	1	2,67%	4	4
Delayed healing	2,67%	4	2,67%	4	5,33%	8	8
Total	8,67%	13	5,33%	8	14,00%	21	21
Complications by sex							
group B		%	n	%	n	%	n
Purulent alveolitis	1,33%	2	2,00%	3	3,33%	5	5
Alveolitis sicca dolorosa	0,00%	0	2,00%	3	2,00%	3	3
Alveolar osteitis	0,67%	1	0,00%	0	0,67%	1	1
Delayed healing	3,33%	5	2,67%	4	6,00%	9	9
LN paresthesia*	2,00%	3	0,67%	1	2,67%	4	4
IAN paresthesia*	2,00%	3	0,67%	1	2,67%	4	4
Total	9,33%	14	8,00%	12	17,33%	26	26

* IAN: inferior alveolar nerve; LN: lingual nerve.

The percentages of complications were calculated by dividing the two populations into two subgroups based on the age of 25 years or older (Table 2).

Table 2. Complications sorted by age.

Complications by age		Over 25		Under 25		Total	
group A		%	n	%	n	%	n
Purulent alveolitis	0,67%	1	0,67%	1	1,33%	2	2
Alveolitis sicca dolorosa	3,33%	5	1,33%	2	4,67%	7	7
Alveolar osteitis	0,00%	0	2,67%	4	2,67%	4	4
Delayed healing	4,00%	6	1,33%	2	5,33%	8	8
Total	8,00%	12	6,00%	9	14,00%	21	21
Complications by age							
group B		%	n	%	n	%	n
Purulent alveolitis	1,33%	2	2,00%	3	3,33%	5	5
Alveolitis sicca dolorosa	0,67%	1	1,33%	2	2,00%	3	3
Alveolar osteitis	0,00%	0	0,67%	1	0,67%	1	1
Delayed healing	2,00%	3	4,00%	6	6,00%	9	9

LN paresthesia*	1,33%	2	1,33%	2	2,67%	4
IAN paresthesia*	2,00%	3	0,67%	1	2,67%	4
Total	7,33%	11	10,00%	15	17,33%	26

* IAN: inferior alveolar nerve; LN: lingual nerve.

3.1. Group A

Smoking patients were 23.33% (35 patients) of whom 17 were female and 18 male. In the patient pool there were 13 females (8.67%) taking oral contraceptives and 3 of these were also smokers (2.00%). The percentages of complications in these sub-groups have been calculated and it has been found that in female smokers the % of complications is 29.41% (5/17 patients); in non-smoking females the % of complications is 12.30% (8/65 patients); in females taking oral contraceptives the % of complications is 23.08% (3/13 patients); in females taking oral contraceptives and smoking the % of complications is 33.33% (1/3 patients); in smoking males the % of complications is 22.22% (4/18 patients); in non-smoking males the % of complications is 8.00% (4/50 patients).

3.2. Group B

26.66 percent (40 patients) were smokers, 16 of whom were female and 23 males. 16 females (10.67%) patients were taking oral contraceptives and of these 7 were also smokers (4.66%). The percentages of complications in the female-smokers group were 50.00% (8/16 patients); in non-smoking females the % of complications was 10,71% (6/56 patients); in females taking oral contraceptives the % of complications was 31.25% (5/16 patients); in females taking oral contraceptives and smoking the % of complications was 42.86% (3/7 patients); in male smokers the % of complications was 26.09% (6/23 patients); in non-smoking males the % of complications was 10.90% (6/55 patients).

3.3. Statistical analysis

The average age of group A patients was 27.9 ± 14.07 with the youngest of 12 years and the oldest of 80 years; the average age of group B is 26.2 ± 12.00 with the youngest of 11 years and the oldest of 74 years.

The chi-square test showed that the two cohorts of patients were evenly distributed by sex, smoking habit, age, oral contraceptive intake (Table 3).

Table 3. Chi-square test.

		Group A		Group B		Statistical significance
		n	%	n	%	
Sex	Male	68	45,33%	78	52,00%	0,202
	Female	82	54,67%	72	48,00%	
Age	Under 25	82	54,67%	88	58,67%	0,413
	Over 25	68	45,33%	62	41,33%	
Smoke	Yes	35	23,33%	40	26,66%	0,592
	No	115	76,67%	110	73,34%	
ACP	Yes	13	15,85%	16	22,22%	0,293
	No	69	84,15%	56	77,78%	

Using the Fisher test, the total percentages of dry alveolites, purulent alveolitis and osteitis in the two groups were compared and no statistical significance was found (p-value = 0.732).

Taking into account, at moment of extraction, non-smoking patients and those that did not take oral contraceptives, by comparing percentages of dry and purulent alveolites and osteitis, there was no statistically significant difference between the two groups (p-value = 0.339).

Linear regressions showed the strength of association between smoking and oral contraceptives with complications. the strength of association between risk factors and complications has been

calculated. The odds ratio for smoking was 2.8, while for oral contraceptives was 1.75; analyzing the association of the two risk factors the odds ratio was 3.53. Gender (p-value=0.599) and age (p-value=0.952), were not found to be significantly associated with complications in this study.

Using the Fisher test, we compared the percentages of paresthesia in the two cohorts (0% in group A and 5.33% in group B), and the difference was statistically significant (p-value = 0.007).

4. Discussion

The purpose of this study is to evaluate the influence of the surgical protocol on the healing complications after the lower third molar extraction. Based on the time of onset and resolution, the rates of delayed healing, alveolitis sicca dolorosa, dry alveolitis, purulent alveolitis, osteitis, and osteomyelitis were evaluated in this study. However, these parameters had to be assigned arbitrarily because the literature does not offer specific documentation about delayed healing and does not separate osteitis from alveolitis; as regards osteomyelitis, only case reports were found as available documentation, given the rarity of its frequency. In this study no osteomyelitis was found in either pool.

The patients were checked following extraction of the lower third molars at 1, 3, 5, 7, 14, 28 days and 60 days; the sutures were removed 7 days after surgery. During post-operative examinations, the healing condition of the soft tissues, the presence of pain, suppuration and the absence or presence of sensory changes in the territories innervated by the IAN and LN homolateral extraction were detected.

During post-operative examinations, according to the state of alteration of the healing, diagnoses were made with the following criteria:

- delayed healing: red soft tissue not well bound was still present when the suture was removed; the situation was normalised at the next control.

- alveolitis: from the first to the fifth day after surgery, there were signs of infection of the post-extractive site, with or without associated pus; the resolution occurred with appropriate treatment within 20 days.

- osteitis: episodes of pain and infection of the site after 30/40 days, associated with *restitutio ad integrum* within two months of surgery.

- osteomyelitis: episodes of pain and infection for more than two months after the extraction operation, associated with the pathological sign of bone seizure.

- paresthesia: local sensitivity alteration appearance, associated with numbness, tingling or burning. It may be temporary or permanent.

The present study presented some limits, including the sample size. In addition, during the analysis of complications the parameters of swelling, oedema, reduction of mouth opening, inflammation in the masticatory muscles, haematoma and pain were not examined, firstly because they were considered physiological in the post-operative course and also because, for these signs and symptoms, is far more complicated due to the number of measures needed, and may be prone to errors.

4.1. Alveolitis

Post-extraction alveolitis (sicca or purulent) is one of the most frequent complications after a surgical extraction.

It can arise at the site of any dental element, but being much more frequent at the level of the lower third molar, it is often referred to as 'post-extraction complication of the lower third molar'. [30-32] The incidence after an extraction of a lower molar is 1% to 68.4% [5,32,33].

In this study, which analyze only impacted lower third molars, the prevalence of alveolitis was found to be 6.00% in group A patients and 5.33% in group B patients.

4.2. Osteitis

The incidence of alveolar osteitis in literature range from 0.4% to 17% [10].

In our study, the incidence of osteitis was 2.67% in group A and 0.67% in group B; The most affected population were female, as regards age, those under 25 seem to be most affected.

When considering the initial phases of healing, AO can be considered as a relatively frequent complication; in particular the incidence of AO was greater in the lower third molars when compared with the maxillary [13,34].

4.3. Age

Patients were divided according to age in two groups (< 25 and ≥ 25 years).

The pool of the first operator sees an incidence of 1.33% of healing delays and 2.00% of alveolitis in patients under the age of 25; an incidence of 4.00% of delayed healing and 4.00% of alveolitis in patients aged 25 years or older.

In the pool of the second operator, the incidence of healing delays was found to be 4.00% and that of alveolitis 3.33% in patients under the age of 25; on the other hand, in patients aged 25 years or older, the incidence of healing delays is 2.00%, while that of alveolitis is 2.00%.

In support, the age-related incidence of complications related to hard tissue healing finds great variability in the various studies in the literature [31,35,36] and the statistical analysis performed on the data of these two cohorts under examination did not show statistically significant association strength ($p = 0.952$).

In the literature we didn't find uniqueness with respect to age as a risk factor. We can consider age as a risk factor from the physiological point of view due to increased bone density, complete root formation and reduced healing capacity, but we must not underestimate the power of association with defined confounding factors, such as cigarette smoking habit, the use of oral contraceptives in women, poor oral hygiene for decreased interest compared to the younger population.

4.4. Sex

When patients were divided into males and females, the complication rate in group A was 8.67% in females and 5, 34% in male and in group B was 9,33% in female and 8,00% in male.

These values are in agreement with the literature as several authors report that it is estimated that alveolitis occurs twice as often in the female gender as in the male gender [5,37,38].

The female sex is reported in the literature as a risk factor for AO. The correlation is still controversial and the use of OCP remains a confounding factor of considerable impact [20].

Despite the evidence reported in the literature, in our study probably due to the limited number of patients, the statistical analysis carried out through logistic regression did not show a significant association between sex and complications ($p = 0.599$).

4.5. Smoke

We therefore wanted to investigate some of the most well-known confounding factors: first of all, cigarette smoking. In the pool of the first operator, the percentage of smokers is 26,47% in males and 20,73% in females; for group B the percentage of smokers is 29,49 in male and 22,22% in female. In both groups the incidence of complications significantly increased when smoking habit was present.

In agreement with the literature, we can also state that cigarette smoking is one of the factors that significantly influences the healing process after surgery [39,40] and, to confirm this, the statistical regression test demonstrated that there is a significant association strength between smoking and hard tissue complications ($p = 0.004$).

4.6. Oral contraceptives

Another risk and confounding factor evaluated is the use of the contraceptive pill in the group of female patients of both operators. Many authors agree that female hormones, in particular, estrogen affect healing, which is why in addition to the use of the pill also the period of the menstrual cycle during which the extraction is performed seems to lead to different results [41].

In the study by Almeida et al. the difference in incidence of post-operative complications between women taking contraceptives and women not taking contraceptives was statistically significant (37.9% vs 8.9%) [42].

Eshghpour et al. obtained statistical significance from its data with an incidence of 24.2% in women who took contraceptives compared to 11.5% in women who did not [43].

In accordance with the literature, in this study the incidence was found to be 23.08% in the pool of the first operator and 31.25% in the pool of the second.

The exact mechanism by which estrogens influence the healing process is not yet fully understood, but already in the 1960s it was discovered that they were involved in the mechanism of fibrinolysis, in particular, it was seen that they were able to indirectly activate the fibrinolytic system (by increasing the production of factor II, VII, VIII, X and plasminogen) and consequently increased blood clot lysis [44].

A correlation between female hormones and the incidence of post-extraction complications has therefore begun, and several studies have verified the association. It can probably be said that risk factors such as sex and age must be questioned as there are different variables that can act as confounding factors and some of these have a high scientific relevance to be able to bypass them.

4.7. Association of smoke and oral contraceptives

The analysis of these factors was concluded by verifying how much the incidence increased by combining the smoking risk factor and the contraceptive risk factor: the reported incidences are 33.33% and 42.86%, in accordance with the latest literature reviews such as that of Taberner et al. , and that of Mamoun et al. [16,45].

From the statistical analysis, the strength of association of these two combined factors was found to be statistically significant ($p > = 0.016$) with an odds ratio of 3.53. This means that a woman who takes an oral contraceptive and smokes has more than three times the risk of undergoing a pathological recovery process.

4.8. Flap design

According to two recent systematic reviews, Da Silva et al. (2020) and De Marco et al. (2021), there are no statistically significant differences regarding postoperative clinical morbidities when comparing the use of different access flaps for third mandibular molar surgery. Cumulative evidence suggests that flap selection is related to surgical difficulty which is mainly determined by the location of the tooth to be extracted. Therefore the dental surgeon chooses the technique based on his clinical experience or surgical preference [13,21].

The ideal flap should provide good visibility and accessibility to the tooth, with minimal impact on adjacent structures.

Important variables in the postoperative course after the surgery of the third molar are the degree and type of inclusion, the amount of bone to be removed and the time spent for the procedure, which is the most influential [27].

4.9. Overheating of bone

Defining the two surgical protocols, it can be seen that the operator A uses a round bur mounted on a straight handpiece at a speed of 400000 rpm in a relevant way, freeing as much as possible the dental element from the encumbrance of the surrounding bone in order to it can be easily extracted at a later time with the use of the pliers. Often he resorts to odontotomy, that is the splitting first of the crown and then of the roots of the tooth, with a diamond bur also mounted on a straight handpiece, and then proceeds with the removal with minimal effort of lever and forceps. Operator B, on the other hand, also uses a round bur mounted on a straight handpiece at a speed of 400000 rpm for the osteotomy, but in a much more 'conservative' way: that is, it removes that minimum of bone that allows it to insert a lever and make strength by it; the use of odontotomy is reserved for rather rare cases, when, for example, the roots embrace the inferior alveolar nerve and then merge below it

(in this study, out of 150 cases, only one odontotomy was applied time). The force transmitted by the lever is for obvious reasons much higher than the previous technique; this operative way is reported in the literature under the name of 'buccal approach techniques' and allows to minimize the osteotomy, in opposit to the 'rotary instrument technique'.

The literature agrees that one of the major causes that lead to pathological healing of hard tissues after a dental extraction is the use of rotary instruments or, to be precise, the heat generated by them. In particular, it has been seen that, during the removal of bone tissue, the resistance offered by the cortex causes an increase in the temperature of the bone itself, by generating what is called frictional heat [46,47].

What results seems to be precisely 'thermal bone necrosis' [48].

Several studies have investigated what the threshold was and most agree that a temperature above 47 ° C that lasts for more than 1 minute leads to irreversible cell damage and permanent replacement of bone with fat [49].

To decrease the fundamental temperature is irrigation which is usually performed with physiological, thanks to which it is possible to stay below the limit temperature. However, in the animal study by Morris et al. in 1985 it was seen that the temperature of the tissues and the duration of exposure to that temperature are linked by an 'Arrhenius relationship', a linear differential equation. In fact, this study showed that for temperatures above 42.5 ° C, for every 1 ° C increase in temperature, half the exposure time (factor 2) was enough to have the same biological effects [50].

Given that the use of simultaneous irrigation is now an undisputed protocol to lower the temperature, it is considered necessary in order to minimize the possibility of creating damage to focus on the duration of the surgery, in particular of the osteotomy. As early as 1975 Horton et al. concluded in his study that healing in post-extraction sites of dogs appeared histologically better when the avulsion was performed with the use of levers than when it was performed with the use of burs [51].

Thus, in the study by Singh et al. of 2013 which compared the avulsion technique with levers to that with rotating water instruments, it was shown, in agreement with this study, that the incidence of alveolitis was higher in the second group [52].

Further supporting evidence found in this is the different average surgical timing of an osteotomy: 1 '26' for operator 1, 0' 36 " for operator 2.

4.10. Paresthesia

The incidence of lesions of the lower alveolar nerve varies in literature between 0.4% and 8.4% [5,10,53].

The literature's index for lingual nerve lesions 0.2% to 2%, but several studies show that lesions are almost entirely temporary damage with total symptom resolution within 12-13 weeks [10,12,54].

Permanent damage seems to be very rare.

Furthermore, it is appropriate to emphasise the difference in the incidence of paresthesia in the two groups of patients.

The collected data revealed an incidence of 5.34% of paresthesias in pool 2, compared to an incidence of 0% in pool 1;

5.34% is equivalent to 8 patients and in particular 4 were paresthesias referred to the NAI (inferior alveolar nerve) and 4 referred to the LN (lingual nerve). These data were also subjected to statistical analysis, using the chi-square test and there was statistical significance. All reported paresthesias were temporary, and at 60 days, no patients showed symptoms of transient nerve damage.

In support of this, also in the study by Singh et al. a higher incidence of paraesthesia using the lever was shown, compared to when the osteotomy with burs was performed [52].

The rationale behind this cause-effect correlation, use of levers-paraesthesia, is not fully clarified in the literature. Nowadays it is known that one of the factors that can lead to temporary paraesthesia is the pressure exerted by the blood clot in those third molars with roots very close to the mandibular canal. Perhaps, as pressure is a confirmed causal factor in complications related to nerve structures,

the vigorous and marked / long-lasting use of the lever transmits pressure to the nerve that leads to stretching and consequently to paresthesia, in the same way that the blood clot acts.

Given the limitations of the studies reported in literature, further evaluations are necessary in order to affirm with more certainty and scientific support the correlation between use of the lever and damage, albeit temporary, to the nervous structures.

5. Conclusions

The goal of this study was to assess the difference, when compared two different surgical protocols, in the appearance of post-operative complications. Hence the need to create two pools of patients as homogeneous as possible on which to verify which was the most suitable surgical protocol to help the professional to identify, as far as possible, the best choice that can adhere to ensure the patient the best post-operative course. Even though related to a higher incidence of transient changes in sensitivity, it was found that the second operator's protocol saw a lower percentage of complications in the healing of hard and soft tissues (12,00% in group B vs 14,00% in group A). In the literature there is still no unambiguous clarity on which is the best protocol for the extraction of the lower third molars and the choice often falls on the technique that is better managed, for training and personal skills, by the surgeon who performs it.

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