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Effectiveness of Chlorhexidine Gel Versus Chlorhexidine Rinse in Reducing Alveolar Osteitis in Mandibular Third Molar Surgery

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Purpose: Chlorhexidine is an antimicrobial agent used in the prevention of postextraction alveolar osteitis, tooth decay and periodontal diseases.
There are various forms of chlorhexidine application. The most extensively studied is one that uses the rinse as the form of application.
Recently, a bioadhesive gel form has become available. Its main advantage is that it prolongs the bioavailability of chlorhexidine in the application area.
The purpose of this study was to compare the effectiveness of chlorhexidine gel versus a chlorhexidine rinse in reducing postoperative alveolar osteitis after the extraction of mandibular third molars.

Materials and Methods: The experimental or gel group (n = 41) applied the bioadhesive 0.2% chlorhexidine gel to the wound during the first postoperative week and a control or rinse group (n = 32) used a 0.12% chlorhexidine rinse during the first week postextraction.

Results: We observed a 70% decrease in postoperative alveolar osteitis in the gel group ($P = .040$). The rinse group had 25% incidence postoperative alveolar osteitis, while the gel group had 7.5%.

Conclusions: It was concluded that the topical application of bioadhesive chlorhexidine gel to the surgical wound during the postoperative week may decrease the incidence of alveolar osteitis after extraction of the mandibular third molars.

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Alveolar osteitis (AO) is a postextraction complication that was first defined by Crawford[1] in 1896. Throughout the years, various synonyms for AO have been used, such as alveolitis sicca dolorosa (dry socket), alveolalgia, osteomyelitis or fibrinolytic osteitis, postextraction osteomyelitis syndrome, fibrinolytic alveolitis, and localized alveolar osteitis.[2-5]

The most recent of these terms was provided by Blum, who defines AO as a postoperative pain in and around the dental alveolus, which increases in severity at some stage between the first and third day postextraction, accompanied by a partial or total disintegration of the intra-alveolar blood clot, and which may be accompanied by halitosis.[6]

The frequency of AO appearance ranges from 1% to 70%.[6,7-12] The average rate of AO for all dental extractions is 3% to 4%, according to various authors.[7,13,14] The highest incidence generally occurs following the extraction of impacted third molars. In these cases, it may occur in 20% to 30% of these extractions,[15-19] ie, 10 times more than for other dental extractions.[6]

Epidemiological studies linked to AO have identified various risk factors: difficulty of extraction, surgeon's inexperience, use of oral contraceptives,

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advanced age, female gender, smoking, immunosuppression, and surgical trauma.[18,20]

AO causes increased psychological harm to the patient and the health professionals, because the painful symptoms which accompany this pathology are extremely uncomfortable for the patient.[21]

Chlorhexidine (CHX) is a biguanide antiseptic agent that has been proven effective in the prevention of AO in the form of a mouth rinse and bioadhesive gel. The method of administration of this gel has the main advantage of providing a greater bioavailability in the application area, and therefore the medication has a more prolonged release.[12,21] The objective of this study is to compare the effectiveness of these two forms of CHX (0.2% bioadhesive gel and 0.12% rinse) in the prevention of postoperative AO after the extraction of retained third molars, by means of topical application to the wound during the 7 days after the intervention.

Materials and Methods

This clinical study was a randomized, prospective clinical trial with parallel groups in a single center. It was carried out in the Faculty of Odontology at the University of Seville and in the Oral and Maxillofacial Surgery Service of the Virgen de Rocio University Hospitals, Seville. The study involved the treatment of 73 patients of both genders, between the ages of 18 and 60 years old, from June 2005 to November 2005. These patients presented with a mandibular third molar with a difficulty index ranging between 4 and 7, inclusive, according to the Koerner scale.[22] The degree of difficulty was rated by a single investigator who performed all preoperative patient selection. Extraction of the molar was required. The patients could not take any type of antibiotic or analgesic in the 4 days preceding the procedure. Exclusion criteria included the following: nonfulfillment of 1 or all of the inclusion criteria, patients with any other disease which would contraindicate oral surgery, patients with AIDS or any type of immunosuppression, pregnant or lactating women, patients allergic to chlorhexidine, articaine, paracetamol or ibuprofen, patients in whom the administration of epinephrine is contraindicated, patients who required the simultaneous extraction of two wisdom teeth, patients who presented with a jawbone associated pathology, patients in whom the extraction of the retained wisdom tooth lasted for more than 30 minutes and noncooperative patients (psychic-motor dysfunction and behavior disorders).

All of the patients in the study gave their informed consent, and were covered by public liability insurance. The study was approved by the Ethics Committee of the University of Seville and followed the principles of the Helsinki Declaration.

Two pharmaceutical forms of CHX were studied: 0.2% bioadhesive gel and 0.12% mouth rinse (Laboratorios Lácer SA, Barcelona, Spain). The aim was to compare the decrease in postoperative AO incidence among the group of patients who received application of CHX bioadhesive gel, and those who received CHX rinse, both in the topical form, during the postoperative period after surgery to extract the mandibular third molar.

The patients underwent intervention of the inferior alveolar nerve and buccal nerve under local anesthesia (articaine 4% epinephrine, Laboratorios Inibsa, Barcelona, Spain). A bayonet incision was performed in order to gain access to the wisdom tooth, carrying out osteotomy in all cases and dental sectioning when necessary. Once the tooth had been extracted, the alveolus was cleaned, the bone edges were smoothed, and bioadhesive 0.2% chlorhexidine gel was applied inside the alveolus. Finally, the wound was sutured with simple 4/0 silk stitches.

The patients were randomly classified into 2 groups by means of a simple allocation using a computer program: the gel group and the rinse group, according to the pharmaceutical form of CHX used during the postoperative period. Having carried out the procedure, the envelope corresponding to the patient code was opened, and this indicated the group to which the patient had been assigned. By way of postoperative treatment, the patients took 600 mg ibuprofen (1 tablet every 8 hours) and 500 mg of 14.05 mg paracetamol codeine (1 tablet every 8 hours; Cod-efferalgan®, Bristol-Myers-Squibb, Madrid, Spain).

The patients in the gel group continued topical treatment with bioadhesive CHX gel, applied to the surgical wound twice a day (morning and night time) during the first postoperative week, beginning on the same day as the intervention. The patients in the rinse group continued topical treatment with CHX mouthwash, used twice a day (morning and night time) during the postoperative week, beginning on the same day as the intervention.

The independent variable was the application of CHX bioadhesive gel or CHX rinse during the postoperative period. The main dependent variable was the appearance of postoperative AO according to Blum's standardized criteria.

Subjects were evaluated on the third and seventh postoperative day. Diagnosis of AO was considered positive when patients presented with postoperative pain in and around the dental alveolus, that had increased in severity sometime between the first and third postoperative day, and was accompanied by partial or total loss of the intra-alveolar blood clot. In addition, the link between the appearance of postoperative AO and the risk variables described in the

literature were analyzed: age, gender, smoking, oral contraceptives, and degree of difficulty of extraction.

All clinical assessment was carried by a single blind investigator, trained by the directors of this study in previous studies sharing the same AO criteria. All study subjects reported using the medication prescribed to them. Compliance assessment was achieved by intention-to-treat analysis. Tolerance to the treatment, defined as the frequency that patients developed 1 or more adverse effects was assessed on a verbal score of 1 (maximum tolerance) to 5 (minimum tolerance or maximum intolerance) during the third and seventh postoperative day. The χ^2 test was applied for the comparison of the proportions between the 2 groups (gel and rinse), and Student *t* test for the comparison of the mean values in quantitative variables.

Results

A total of 73 patients underwent intervention (73 mandibular third molars). There were 41 patients in the gel group and 32 patients in the rinse group. The progress of a total of 70 were followed until the end of the study, because 2 patients from the gel group and 1 from the rinse group did not complete the study. The average age was 29 years old (ranging from 18 to 59). Fifty-four patients were female and 19 were male. Eight women were taking oral contraceptives. Twenty-nine patients were smokers (16 females and 10 males). Details of both groups regarding age, gender, smoking habits, use of oral contraceptives, and degree of difficulty are displayed in Table 1 (significant statistical differences were not found between the two groups).

In the gel group, 7.5% of AO incidence was found, while in the mouthwash group, there was 25%; the difference was statistically significant, $P = .040$ for the χ^2 test (Table 1). None of the patients displayed adverse effects to the treatment, and there was adequate tolerance in both groups.

Table 1. DATA ON DEMOGRAPHICS, DIFFICULTY INDEX OF EXTRACTION, ALVEOLAR OSTEITIS INCIDENCE, AND TOLERANCE OF THE TREATMENT CARRIED OUT

	Gel Group (n = 41 Patients; 56.2%)	Rinse Group (n = 32 Patients 43.8%)
Age, mean (yr)	28	26
Age, range (yr)	59-18	49-18
Gender		
Female, n (%)	27 (65.8)	27 (84.4)
Male, n (%)	14 (34.2)	5 (15.6)
Smoker		
Yes, n (%)	16 (39.9)	10 (31.3)
No, n (%)	25 (60.1)	22 (68.7)
Contraceptives		
Yes	6 (14.6)	2 (6.3)
No	35 (85.4)	30 (93.7)
Difficulty index of extractions*		
4	6 (14.7)	5 (15.6)
5	20 (48.7)	16 (50)
6	14 (34.1)	11 (34.4)
7	1 (2.5)	0
Tolerance†		
1	28 (68.3)	25 (79.1)
2	6 (16.6)	4 (14.5)
3	3 (8.3)	1 (3.2)
4	2 (6.8)	1 (3.2)
5	0	0
Alveolar osteitis‡		
Yes	3 (7.5)	8 (25)
No	37 (92.5)	24 (75)

Data are n (%) except where noted.

*●●●

†Verbal scale from 1 meaning totally tolerable, to 5 meaning totally intolerable.

‡Student *t* test, $P = .040$.

Iglesias et al. Chlorhexidine Gel vs Rinse and Osteitis. J Oral Maxillofac Surg 2007.

Discussion

Currently, there are two main etiopathogenic theories about AO: Birn's fibrinolytic theory and the bacterial theory.[3,15-19,21] With respect to these etiopathogenic theories, the prevalence of one theory over the other has not been generally accepted, as there is no conclusive data to definitively reject or accept one of the two. The origin of AO probably lies in an interactive mix of both theories.

Epidemiological studies related to AO have identified various risk factors in the development of AO, mainly: difficulty of extraction, surgeon's inexperience, use of oral contraceptives, advanced age, female gender, smoking, immunosuppression, and surgical trauma.[18,22]

The preventative measures taken in the therapeutic management of AO are summarized as follows: washing with saline solution, eugenol dressings to provide relief, antifibrinolytic agents, antibiotics, and antiseptic agents. These last 2 measures are, probably, those that have had the most success in the prevention of AO.[20,23,24,29] Antibiotics are more expensive, may create resistance and their efficiency in the prevention of AO has been questioned by several authors.[19]

The contributions which support the validity of CHX in the control of bacterial plaque[25] and the relation between oral hygiene and the prevention of alveolitis sicca[26] have been numerous to date.

CHX has been shown to be a good preventative agent of AO. Various application protocols have been studied, both in mouth rinse and in the postoperative intra-alveolar application of bioadhesive gel, although

there are no studies which simultaneously compare the effectiveness of CHX bioadhesive gel with CHX rinse following the extraction of retained mandibular third molars.

In a recent meta-analysis by Caso et al[21] on the use of CHX on impacted third molars in the postoperative period, the authors concluded that the use of CHX mouth rinse from the day of intervention and during the postoperative period produce a decrease in AO incidence. The minimum postoperative period of time during which mouthwash should be applied could not be determined in this study.

Berwick and Lessin[17] did not discover differences in AO incidence in the 2 study groups (CHX 0.12% and cetylpyridinium 0.05%). Delilbasi et al[27] found similar percentages of AO, using 0.2% CHX mouth rinse and saline solution. Ragno and Szkutnik[16] discovered a 17.5% decrease in the group that used 0.2% CHX mouth rinse after the extraction of retained third molars compared with 36% of AO in the control group (placebo).

Larsen[28] found 16% of AO in the control group (placebo) compared with 8% in the experimental group (0.12% CHX mouth rinse during the pre and postoperative weeks). Other authors have found a 50% decrease of AO incidence using 0.12% CHX mouth rinse. Torres et al[29] discovered an 11% decrease of AO in the experimental group (intra-alveolar bioadhesive 0.2% CHX gel) after the extraction of retained mandibular third molars, compared with 30% in the experimental group (intra-alveolar medication versus placebo).

The only study that we have found which compares various proportions of chlorhexidine did not show significant differences between the 0.1% and 0.2% CHX groups. There was a significant improvement between both chlorhexidine groups and the control group.[25] Although the concentration of chlorhexidine was different in the gel group and in the mouthwash group, previous data supports the comparability of both groups.

The number of patients in this study is sufficient to assess the main variable: appearance or absence of AO postextraction. In other studies, this number ranges between 20 and 67 per group.[15,17,18,25,27] The average age of the patients was higher than that obtained by other authors. With respect to the proportion of males/females, there are studies such as those by Torres et al[29] and Hermesch et al,[30] which coincide with our data, while other authors had a similar proportion of males/females[30] in their studies. With respect to the use of oral contraceptives (14%), we obtained similar results to those of Torres et al.[29] In other studies such as those by Larsen[28] and Hermesch et al,[30] the results showed percentages of 53% and 32% respectively for women who were taking the oral contraceptives, while in the study by Bonine,[31] this value did not surpass 6%.

The percentage of patients who smoked, was higher than in studies by other authors such as Torres et al[29] (25% of smokers in their sample) and Larsen[28] (28.16% of smokers). Nevertheless, these percentages are within the limits found in other literature (16.3%, 15.12% and 25.42%).[27,30,31] We have not found significant statistical differences in AO incidence in groups of smokers and nonsmokers, nor have we found significant differences between patients who take contraceptives and those who do not.

In the experimental group (gel), we found a statistically significant decrease (70%, $P = .05$) in the incidence of postoperative AO compared with the mouthwash group. These results may be explained by the bioadhesive properties of the gel, which prolong the release of CHX at the application site. No adverse effect was recorded in the patients treated, as referred to in other similar studies.[31]

The results of this clinical study show that the application of bioadhesive 0.2% CHX gel to the postoperative wound after the extraction of retained mandibular third molars decreases AO incidence compared with the application of 0.12% CHX mouthwash under similar circumstances.

Acknowledgments

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AUTHOR QUERIES

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AQ9— Please confirm 68.7% is correct for non-smoking rinse group.

AQ10— For Tolerance, and Alveolar osteitis, please add comment in footnote as to why the number of patients in the gel group do not add to 41, and for Tolerance, rinse group, why the number of patients does not add to 32. Please check that percentages are correct for these categories.

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