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Comparing Chlorhexidine Gel and Rinse, Which Is More Effective in Reducing Alveolar Osteitis in the Mandibular Third Surgery on the Molars

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Purpose Chlorhexidine is an antimicrobial agent commonly used to prevent post-extraction alveolar osteitis, tooth decay, and periodontal diseases. It is available in different forms, with the chlorhexidine rinse being the most researched. Recently, a bioadhesive gel version has been introduced, offering the benefit of extending the duration of chlorhexidine's presence in the treated area. This study aims to compare the effectiveness of chlorhexidine gel and rinse in reducing the occurrence of postoperative alveolar osteitis following the removal of mandibular third molars.

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

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

The study concluded that applying bioadhesive chlorhexidine gel to the surgical wound during the postoperative week may help reduce the incidence of alveolar osteitis following the extraction of mandibular third molars

introduction

Alveolar osteitis (AO) is a post-extraction complication first described by Crawford in 1896. Over time, various synonyms have been used for AO, including alveolitis sicca dolorosa (dry socket), alveolalgia, osteomyelitis, fibrinolytic osteitis, post-extraction osteomyelitis syndrome, fibrinolytic alveolitis, and

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localized AO. The most recent definition, provided by Blum, describes AO as a postoperative pain around the dental alveolus that intensifies between the first and third day after extraction, often associated with partial or complete breakdown of the intra-alveolar blood clot and sometimes accompanied by halitosis. The occurrence of AO varies widely, with reported rates ranging from 1% to 70%. 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, 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 2 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 trial with parallel groups conducted at a single center. It took place at the department of oral and maxillofacial surgery RAMA DENTAL COLLEGE AND HOSPITAL AND RESERCH CENTRE MANDANA KANPUR. The study involved 73 patients, aged 18 to 60, of both genders, who were treated between 2023- 2024. These patients had a mandibular third molar extraction planned, with a difficulty index between 4 and 7 according to the Koerner scale. The degree of difficulty was

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assessed by a single investigator who handled all preoperative patient selection. The patients were required to refrain from taking any antibiotics or analgesics for 4 days prior to the procedure. Exclusion criteria included failure to meet one or more of the inclusion Exclusion criteria for the study included patients with conditions that would contraindicate oral surgery, such as those with AIDS or other forms of immunosuppression, pregnant or lactating women, individuals allergic to chlorhexidine, articaine, paracetamol, or ibuprofen, patients for whom the use of epinephrine was contraindicated, those requiring the simultaneous extraction of two third molars, patients with jawbone-related pathologies, individuals whose extraction procedure lasted more than 30 minutes, and noncooperative patients with psychiatric or behavioral disorders. All patients provided informed consent, and the study was covered by public liability insurance. It was approved by the Ethics Committee of the University of Seville and adhered to the principles outlined in the Helsinki Declaration.

The study focused on two forms of chlorhexidine (CHX): 0.2% bioadhesive gel and 0.12% mouth rinse, both supplied by Laboratorios Lácer SA, Barcelona, Spain. The objective was to compare the reduction in postoperative alveolar osteitis (AO) incidence between patients who received the CHX bioadhesive gel and those who used the CHX mouth rinse, both applied topically after mandibular third molar extraction.

Patients in the gel group continued with the topical application of 0.2% bioadhesive CHX gel to the surgical wound twice a day (morning and night) for the first postoperative week, starting the same day as the surgery. Patients in the rinse group used the 0.12% CHX mouthwash twice a day (morning and night) during the postoperative week, also starting on the day of the surgery. The independent variable in this study was the type of CHX treatment (bioadhesive gel or mouthwash) administered during the postoperative period.

The primary dependent variable was the occurrence of postoperative alveolar osteitis (AO), diagnosed based on Blum's standardized criteria. Patients were evaluated on the third and seventh postoperative days. AO was considered present if patients experienced increasing pain around the dental alveolus between the first

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and third postoperative day, accompanied by partial or total loss of the intra-alveolar blood clot.

Additionally, the study analyzed the association between the occurrence of AO and known risk factors such as age, gender, smoking, oral contraceptive use, and the degree of difficulty of the extraction. All clinical evaluations were carried out by a single blind investigator, who had been trained by the study directors in previous research that used the same AO criteria. All participants confirmed they had adhered to the prescribed medication regimen.

Compliance was evaluated through an intention-to-treat analysis. Treatment tolerance, defined by the frequency of adverse effects experienced by patients, was measured using a verbal scale from 1 (maximum tolerance) to 5 (minimum tolerance or maximum intolerance). This assessment was conducted on the third and seventh postoperative days. To compare the proportions between the two groups (gel and rinse), the chi-square (χ^2) test was used, while the Student's t-test was employed for comparing the mean values of quantitative variables**.**

Results

A total of 73 patients underwent the intervention, corresponding to 73 mandibular third molar extractions. Of these, 41 patients were in the gel group and 32 in the rinse group. The progress of 70 patients was followed through to the study's conclusion, as 2 patients from the gel group and 1 from the rinse group did not complete the study. The average age of the participants was 29 years, with a range from 18 to 59. Among the participants, 54 were female and 19 were male, with 8 women taking oral contraceptives. Additionally, 29 patients were smokers, consisting of 16 females and 10 males. Details on age, gender, smoking habits, oral contraceptive use, and extraction difficulty were provided in Table 1, and no significant statistical differences were found between the two groups.

In terms of the primary outcome, the incidence of alveolar osteitis (AO) was 7.5% in the gel group, compared to 25% in the mouthwash group. This difference was statistically significant, with a P-value of 0.040 for the chi-square test (Table 1). No patients experienced adverse effects from the treatment, and both groups showed adequate tolerance.

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Discussion

There are currently two main etiopathogenic theories regarding alveolar osteitis (AO): Birn's fibrinolytic theory and the bacterial theory. However, there is no consensus on which theory is more prevalent, as there is insufficient conclusive data to definitively support or reject either one. It is likely that the origin of AO results from a combination of both theories. Epidemiological studies have identified several risk factors that contribute to the development of AO, including the difficulty of extraction, the surgeon's level of experience, the use of oral contraceptives, advanced age, female gender, smoking, immunosuppression, and surgical trauma

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)

Preventive measures in the therapeutic management of alveolar osteitis (AO) include saline solution washes, eugenol dressings for relief, antifibrinolytic agents,

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antibiotics, and antiseptic agents. Of these, antibiotics and antiseptic agents are likely the most successful in preventing AO. However, antibiotics are costly, can lead to resistance, and their effectiveness in preventing AO has been debated by several authors. Numerous studies have supported the use of chlorhexidine (CHX) in controlling bacterial plaque and the link between oral hygiene and the prevention of alveolitis sicca. CHX has been shown to be an effective preventive agent for AO.

Various application protocols for CHX, including mouth rinses and postoperative intra-alveolar bioadhesive gel, have been explored. However, no studies have directly compared the effectiveness of CHX bioadhesive gel and CHX rinse following the extraction of retained mandibular third molars. In a recent meta-analysis by Caso et al., it was concluded that CHX mouth rinse, started on the day of the procedure and continued during the postoperative period, reduced AO incidence. However, the minimum duration of postoperative mouthwash use required for effectiveness was not determined. Other studies have found mixed results. For example, Berwick and Lessin found no differences in AO incidence between CHX (0.12%) and cetylpyridinium (0.05%) mouthwashes. Delilbasi et al. reported similar AO rates using 0.2% CHX mouth rinse and saline solution. Ragno and Szkutnik observed a 17.5% decrease in AO in the group using 0.2% CHX mouth rinse, compared to 36% in the control group. Larsen found 16% AO in the placebo group and 8% in the CHX (0.12%) group after both pre- and postoperative mouthwash use. Other studies have reported a 50% reduction in AO with the use of 0.12% CHX mouth rinse.

Torres et al. found an 11% reduction in AO with intra-alveolar 0.2% CHX bioadhesive gel, compared to 30% in the control group. The only study comparing different concentrations of CHX found no significant differences between the 0.1% and 0.2% CHX groups, although both concentrations showed significant improvements compared to the control group.

Although the concentrations of CHX were different between the gel and mouthwash groups in this study, previous data suggest the comparability of both treatment forms. The sample size in this study (73 patients) is sufficient to assess the primary variable: the presence or absence of AO after extraction, with numbers in previous studies typically ranging from 20 to 67 patients per group. The average

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age of patients in this study was higher than in some other studies. Regarding gender distribution, our findings align with those of Torres et al. and Hermesch et al., while other studies showed a similar male-to-female ratio. The use of oral contraceptives (14%) in our study was consistent with the findings of Torres et al.

In other studies, such as those by Larsen and Hermesch et al., the percentage of women using oral contraceptives was 53% and 32%, respectively, while in Bonine's study, this figure was only 6%. The percentage of smokers in our study was higher compared to studies by Torres et al. (25%) and Larsen (28.16%). However, these values are still within the range reported in other research (16.3%, 15.12%, and 25.42%). We did not find significant statistical differences in the incidence of AO between smokers and nonsmokers, nor between patients who used oral contraceptives and those who did not.

In the experimental group (gel), there was a statistically significant 70% decrease ($P < 0.05$) in the incidence of postoperative AO compared with the mouthwash group. This result can likely be attributed to the bioadhesive properties of the gel, which help prolong the release of chlorhexidine (CHX) at the application site. No adverse effects were reported in the patients treated with either form of CHX, consistent with findings from other similar studies.

Overall, the results of this clinical study suggest that the application of 0.2% bioadhesive CHX gel to the postoperative wound following the extraction of retained mandibular third molars significantly reduces the incidence of AO compared to the application of 0.12% CHX mouthwash under similar conditions.

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