Research article

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Effects of sea salt rinses on subjects undergone to oral surgery: a single blinded randomized controlled trial

S. Cantore[1,2], A. Ballini[3,4*], Rajiv Saini[1], V. Altini[2], D. De Vito[3§], F. Pettini[1], G. Dipalma[1§], F. Inchingolo[1§]

[1]Department of Interdisciplinary Medicine , School of Medicine, University "Aldo Moro", Bari; [2]Sorriso e Benessere Ricerca e Clinica S.r.l., Bari; [3]Department of Biosciences, Biotechnologies and Biopharmaceutics, University of Bari "Aldo Moro", Bari; [4]Department of Basic Medical Sciences, Neurosciences and Sense Organs, University of Bari "Aldo Moro", Bari

Abstract

Purpose. It has been customary to explain the dentally beneficial effects of xylitol and certain other natural compound as lysozyme and seas salt in terms of microbiological effects only.

Several studies have tested the use of natural ingredients, alcohol and fluoride free, in mouthwashes. The purpose of this study was to evaluate a combined mouthwash formulation containing natural antibiofilm agents in oral care wound healing after routinely oral surgery (extraction) procedures.

Methods. Patients were assigned following a blinded randomized controlled trial and divided into two groups, an experimental group (I = 15) and a control (placebo) group (II = 15). Any infectious complications, wound healing, plaque accumulation in the stitches, and presence of trismus and inflammation were evaluated at ten and thirty days after extraction procedure. Pain and swelling were evaluated using the well-known visual analogue scale (VAS) scale throughout study period following extraction. The mean difference in Pre and Post values were compared among the groups. The change in pre–post score was analyzed using the paired t test.

Results. An appreciable wound healing was seen in the experimental group when compared to the control sites, with no reported adverse effects. Four weeks postoperative patient's satisfaction level, to subjective and objective outcome measurements in documenting the result of a mouthwash treatment showed an interesting difference between groups.

Conclusions. Since combined mouthwash formulations, containing natural/bioactive substances, could provide a cheap, safe and acceptable alternative in oral care, further studies will also be required to study these effects and their mechanism of action in detail. ***Clin Ter 2020; 171(1):e46-52. doi:10.7417/CT.2020.2188***

Key words: *xylitol, lysozyme, seas salt, mouthwash, wound healing, oral surgery*

Introduction

Clinical procedures in dental practice usually achieved include dental extractions and, after extraction, the only way to relieve pain and further complications is using antibiotics and analgesics. Post-surgical wound healing monitoring is mainly performed by wound inspection after careful food and plaque debridement (1).

All tissues follow an essentially identical pattern to complete the healing process with minimal scar formation. The oral cavity is a remarkable environment in which wound healing occurs in warm oral fluid containing millions of microorganisms (2).

In first intention procedures, soft tissue flaps are repositioned to perfectly cover the underlying hard tissue, while, in secondary intention procedures, surgical flaps are placed in close proximity to the remodelled hard tissue to allow best new soft tissue attachment (3). Suture monitoring and removal after proper evaluation of soft tissue healing progression is also an integral part of wound healing management.

Several current therapeutic protocols for treatment or prevention of post-operative complications comprise application of antibiotics or antiseptics using gels or mouthwashes, (4) while not all studies agree on the appropriateness of such procedures (5).

Besides, preoperative infections increase the risk of dry socket (4,6). Thus, it seems maintenance of a proper level of sanitation and plaque control in domiciliary oral hygiene can play a therapeutic role in bacterial control, lead to the success of oral surgeries procedures (4,6-7).

Recent researches have focused on new combinations in mouthwash solutions in the view to inhibiting bacterial growth and reducing the plaque accumulation.

As an example, the use of a well-known and effective antimicrobial, chlorhexidine gluconate could result in temporary loss of taste sensation, staining of teeth, restorations and mucosa, dryness and soreness of oral mucosa, and a slight increase in supragingival calculus (8). There have also been reports of chlorhexidine-related allergies including anaphylaxis (9).

Salt water based oral rinses alkalinize the mouth (opposite of acidification, which is what the pathogenic bacteria mechanism), gaining the oral environment to increase its pH balance (8). Furthermore, salt water is astringent and speeds wound healing through reducing inflammation and contracting the tissues (8).

§ These authors contributed equally to this work as co-last Authors

Correspondence: Dr. Andrea Ballini, School of Medicine, University of Bari "Aldo Moro", Bari, Italy. E-mail: andrea.ballini@uniba.it

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Lysozyme is a natural antimicrobial enzyme that targets the gram-positive bacteria, effectively limiting their growth, while leaving the beneficial bacteria unharmed, which is the most advantageous method of maintaining the immune system (10).

Xylitol decreases the incidence of dental caries by increasing salivary flow and pH and reducing the number of oral pathogenic bacteria, plaque levels, xerostomia, gingival inflammation, and erosion of teeth (11).

Nowadays, the patients' perspective is gaining more attention in research and quality improvement, increasing the need for valid and reliable instruments for the measurement of patient-reported experiences and outcomes (12). Patient satisfaction becomes more important in our modern health care system. The assessment of satisfaction is difficult because it is a multifactorial item for which no golden standard exists. One of the potential methods of measuring satisfaction is by using the well-known visual analogue scale (VAS) (13).

The use of natural/bioactive substances that thus support oral soft tissue wound healing/regeneration is of major clinical interest. Therefore, the aim of the present study was to investigate the specific role of a commercially available mouthwash formulations in affecting soft tissue wound healing and VAS satisfaction following dental extraction surgery procedures.

Material and methodology

Design overview

This study was a single blinded randomized controlled trial in which the outcome assessor was blinded to the treatment received by the subjects.

Participants

The present study was conducted at a dental community cabinet in collaboration with the University of Bari ALDO MORO, Italy.

A total of 30 patients between the ages of 20 and 50 years (mean age 33±2) were enrolled and divided under two categories. In order to have the unbiased and accurate clinical data, was followed a single-blind protocol for enrolment of the patients in terms of treatment plan and further categorization into study group.

Participants who underwent oral surgery procedures were included in the study while patients having major systemic diseases, and who did not want to participate during the follow-up were excluded from the study group. The two groups of the patients were called for follow-up after treatment on the day ten and the following 30 days to check the tissues response on the Mouthwash or Placebo treatment. Data obtained were recorded on a proforma specially designed for the purpose.

Random allocation and interventions

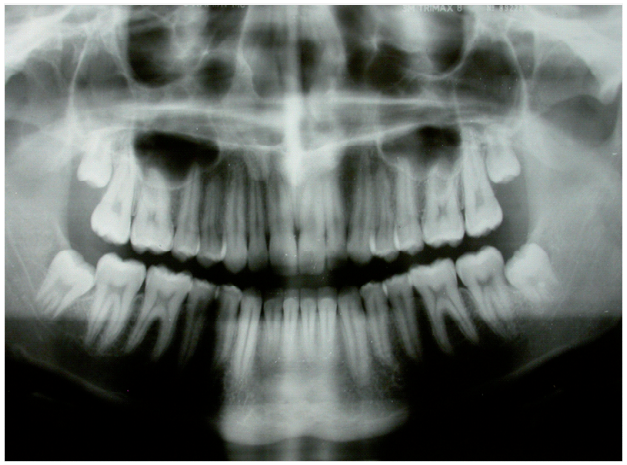
A computer-generated simple randomization sequence was carried out by an investigator who was not directly involved in the treatment and the assessment of the subjects. Subjects were evaluated at baseline and at the end of treatment by the dental investigator, who was blinded to the treatment given to the subjects.

The subjects were randomly allocated into two treatment regimes in groups I and II.

Group I (n = 15): *H2Ocean Sea Salt Mouth rinse (H2Ocean, Inc. FL. USA);*

Group II (n = 15): Placebo mouth rinse (physiologic saline solution with no mouthwash dilution added).

To achieve a truthful unbiased data, we decided to involved a total of fifteen subjects in both groups, with same typology of intervention, i.e. bilateral third molar removal at the opposite side (see clinical images), for a final result of 30 treatments between test and placebo. Then the second intervention was programmed after 1 week (for the components washout and in respect to the protocol) after the first 4 weeks study period with *H2Ocean Sea Salt Mouthrinse* (Figure 1 A-C).



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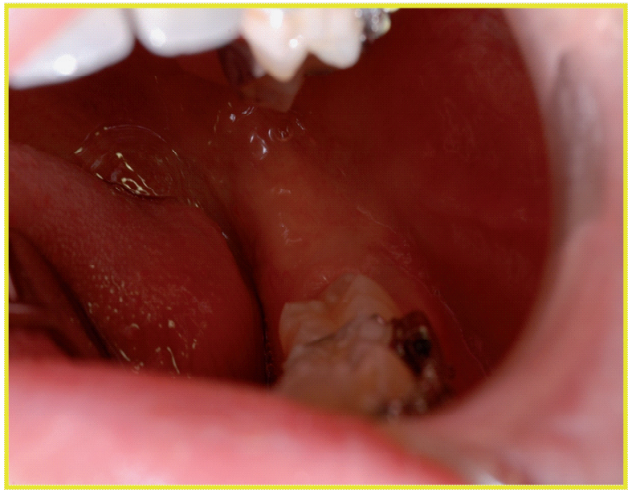

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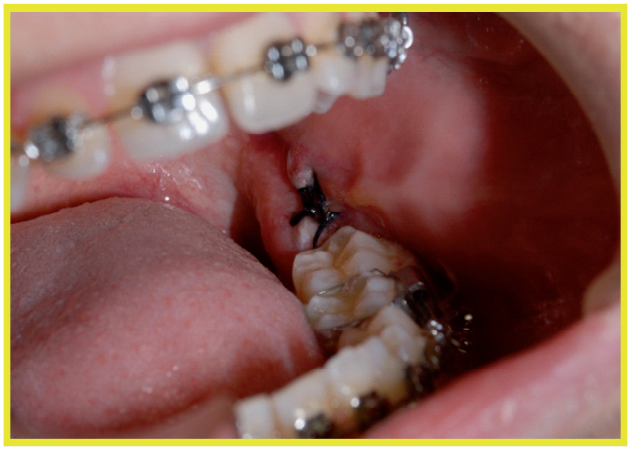

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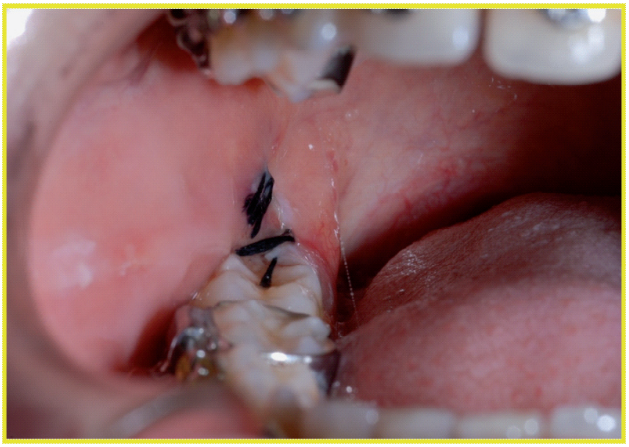

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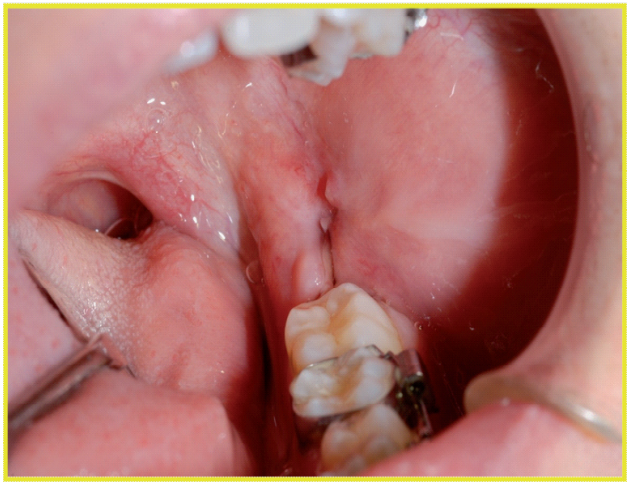

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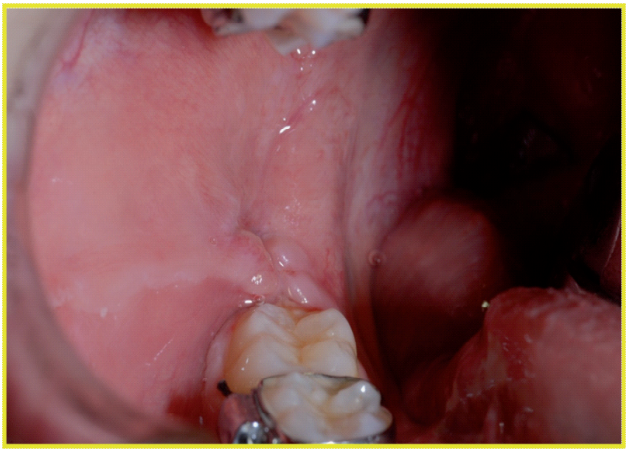

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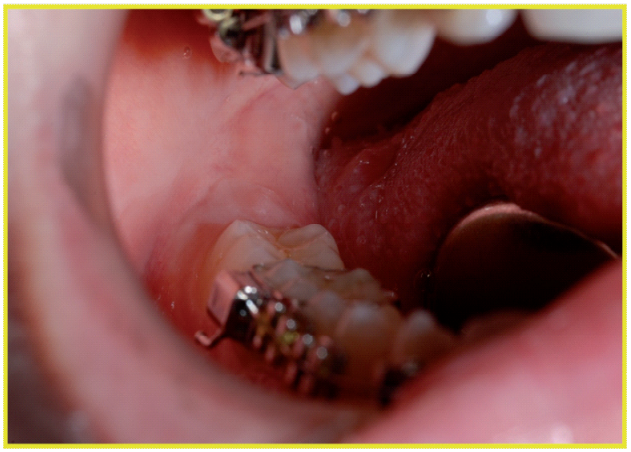


C1

Fig. 1 A-C: Clinical Pictures - A-) Radiographic image that denote bilateral third molar Extraction;
B-) Placebo group Before (B.1) and After 10 (B.1) and 30 days (B.2);
C-) H2Ocean Mouth Rinse Group Before (C.1) and After 10 (C.2) and 30 days (C.3)

Participants were asked to rinse twice a day in the morning and night before sleep after brushing for 4 weeks. Patients were instructed to rinse with 15 mL of the solution for at least 1 min followed by expectoration of the residual mouth rinse and avoid drinking and eating till 30 minutes. To avoid the effect of new variables, subjects were asked to continue their usual daily brushing method during the study period. Written instructions were provided explaining how to use the mouthwash. Rinsing was performed at home without supervision. To check for compliance, subjects were asked to note the times of day when they rinsed (14).

All eligible subjects were asked to give oral information about the products and the purpose of the study and received an informed consent, in accordance with the ethical principles originating in the Declaration of Helsinki and

consistent with good clinical practices (15,16). Prior the study period, the volunteers received an oral soft and hard tissue examination and a professional scaling and polishing to remove all calculus, plaque and extrinsic tooth stain. This was performed using hand instruments, mechanical scalers, rotating brushes with polishing paste, and dental floss in the interproximal areas (15).

All candidates were screened for suitability by the research team. Selection criteria were a dentition with ≥20 evaluable teeth (minimum of five teeth per quadrant), no oral lesions, no severe periodontal problems (no probing depth ≥5 mm) and no removable prostheses. Persons allergic to several mouthwash components were excluded from the study (15,16).

Clinical Parameters

Wound healing was assessed using Landry, Turnbull, and Howley index, and a score was given ranging from 1 to 5 where 1 indicated very poor and 5 indicated excellent healing (17,18).

Ten days after surgery, sutures (if present) were removed and the area irrigated thoroughly with saline. Symptoms regarding discomfort, pain, and sensitivity were asked to the patient. Any signs of infection including pain, swelling, flap displacement, hematoma, and necrosis were noted (17,18).

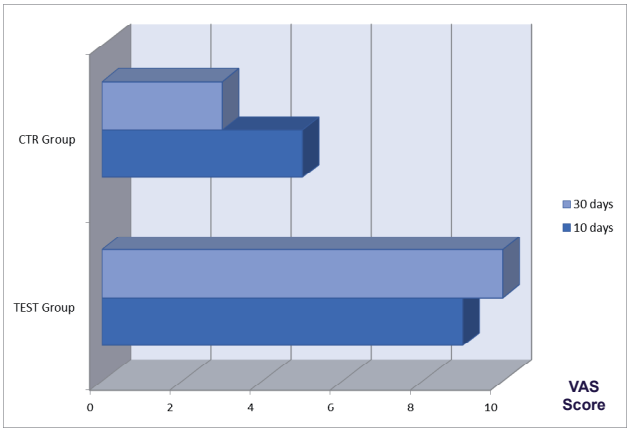
Visual analog scale (VAS)

Before administration of the mouth rinse, each patient was instructed by the operator on the visual analogue scale (VAS), to measure the experienced relief of pain and related satisfaction, at different intervals post-operative days, according to following the criteria: the VAS method used, was composed of a 10 mm line (0–10 mm, where 0 represents no satisfaction and 10 maximum satisfaction) at 10 days postoperative period in terms of comfortable/ uncomfortable in routine activities, mood, speech, sleep and interaction with other routine activity. Four weeks postoperative patient's satisfaction level was also assessed by the VAS scores ranging from not satisfied (score-0) to fully satisfied (score-10) with the treatment outcomes (19).

Statistical analysis

Outcome measures of the exploratory study were analyzed with a *t-test* for paired samples for pre–post differences with time as the factor using Statistical Package for Social Sciences (SPSS for Windows, Version 11.5, Chicago, Ill) software, to detect significant differences between pre-test and post-test scores.

Table 1.Visual analogue scale (VAS), to measure the experienced related satisfaction, at different intervals post-operative day.



Results

All subjects (N = 30) completed the trial, and there were no missing values. The amounts of mouthwashes used indicated good compliance with the instructions. No adverse events or side effects were reported or observed. Results (shown in Tables) were reported in terms of difference scores (pre-post).

Content validity

A strong ceiling effect of the satisfaction VAS is present. The VAS satisfaction scores of patients were significantly higher in the test group compared to the placebo. Fifteen test group patients (100 %) scored 10 on the VAS satisfaction, meaning very satisfied. The distribution of the VAS satisfaction is shown in Tab. 1.

The improvement was from 10 days to end (30 days) of the study respectively for the experienced related satisfaction, at different intervals post-operative day of 55% (10 days) and 70% (30 days), with a percentage difference of 50 % for control group and 10.5263% for test group.

Post-operative healing was evaluated by healing index (Tab.2) and improved healing was detected in test group in which patients were enough satisfied with the healing.

The improvement was from 10 days to the end (30 days) of the study respectively for the postoperative healing index (according to Landry, Turnbull and Howley) of 33% (10 days) and 25% (30 days) with a percentage difference of 40% for control group and 28.5714 % for test group.

The construct validity of the satisfaction VAS was tested using the Spearman rho correlation coefficients, which compares the patient satisfaction VAS with the pain VAS at rest and during activity (mood, speech, sleep and interaction with other routine activity), SF-36 and the improvement of the scores from preoperative to follow-up scores (Tab.3).

Table 2. Postoperative healing index (according to Landry, Turnbull and Howley).

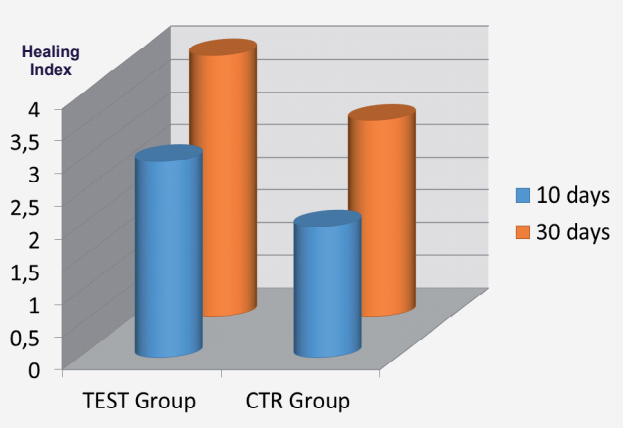


Table 3. Improvement after Mouthwash for the scores, construct validity, Spearman rho is shown for the VAS satisfaction against the different scores and their improvement. For all correlation coefficients, p<0.01.

SF36	Mean	Standard deviation
VAS pain in rest	27.8	29.5
VAS pain during routine activity	48.9	29.7

Discussion

Reliability is usually measured by obtaining the same outcome under identical circumstances. In our study, we chose to obtain the better unbiased data form patient's satisfaction using a sample of the same. One of the statements against using these single question satisfaction scores is that the patients tend to score more satisfaction since they are more or less dependent of their surgeon for continuity of their treatment (20). The VAS is a simple and frequently used method to evaluate variations in pain intensity (21-27).

Our test–retest reliability shows that it is not relevant where the satisfaction VAS is filled in and that obtaining it on the outpatient clinic is a reliable method (20,21).

In this study, we showed that the *H2Ocean Sea Salt Mouthrinse* results in a satisfaction VAS with a good validity and reliability, with a ceiling effect of 100 % in our sample. The VAS satisfaction is a simple and valid instrument to quantify the satisfaction of a patient after an oral surgery procedure but cannot be used as the only outcome measurement. In addition, the clinical healing measurement in test group showed an effective improved result compared to control group (17).

As adaptation by biofilm communities has resulted in the failure of multiple antimicrobials, synergistically acting antimicrobials have the greatest likelihood of remaining efficacious in the clinic (28).

The novel idea of compounding the key ingredients found in seawater, which has been used as a cleansing agent for centuries, into an easy-to-use Mouthwash to promote healing in oral care is a promising concept. The application of lysozyme, a natural antimicrobial, has been scientifically shown to reduce bacterial loads, provide a protective barrier against possible pathogens, and prevent pathogens from recolonizing in wound healing (28).

The effect of oral bacteria causing a clot breakdown is thought to be significant. Recently, it has been demonstrated that lactoferrin can act synergistically with the xylitol to inhibit growth of established biofilms of a clinical wound isolate *Pseudomonas aeruginosa 215* (29-31).

Salt provides 2 life-essential elements: sodium and chlorine. Chloride, the ionic form of chlorine, derived exclusively from dietary absorption and constituting the most abundant anion in the human body, plays critical roles in many vital physiologic functions, from fluid retention and secretion to osmotic maintenance and pH balance. However, an often-overlooked role of chloride is its function in innate host defense against infection. Chloride serves as a substrate for the generation of the potent microbicide chlorine bleach by stimulated neutrophils and also contributes to regulation of ionic homeostasis for optimal antimicrobial activity within phagosomes (32).

On one hand, the clinical interpretation of results obtained in this case-control study should be further substantiated incorporating a larger sample size in order to conclude most statistically significant data. On the other hand, the current reported data demonstrates that a combined mouth rinse with natural compounds as *H2Ocean Sea Salt,* has the potential for use as an antiadherence agent in mouthwash and prevents dental biofilm formation after oral surgery procedures. In addition, we reported no side effects during the study, with the additional benefit of no alcohol presence in the solution.

It could be concluded that this new class of mouth rinse, in combination formula, contains useful daily oral hygiene agents, and its use should be promoted based on the present and previous scientific knowledge of its benefits and proper use, as reported in previous studies (33,34).

We can also accomplish that the VAS satisfaction is probably a useful addition to subjective and objective outcome measurements in documenting the result of a mouthwash treatment (i.e. *H2Ocean Sea Salt Mouthrinse)* in oral surgery studies (35,36).

Support in the literature for and against the effectiveness of antimicrobial solutions for irrigation or rinsing as a preventive measure in formation of alveolitis is questionable.

In an extensive review of the concepts and controversies of alveolar osteitis, Kolokythas *et al*. did not include saline mouth rinse as one of the measures to prevent this complication during healing process (37). Some authors, however, have recommended saline oral rinse as one of the ways to prevent the development of alveolar osteitis and to promote a smooth recovery after dental extraction (38-40).

In the present study, all possible measures were taken to ensure the study had low level of bias including randomization, allocation concealment, blinding of the outcome assessor, similar baseline characteristics and sample size calculation.

No secondary effects, as referred to in other similar studies, were seen, and no adverse effect was detected. New lines of investigation could be opened by means of clinical studies with a view to achieve a greater reduction in the incidence of post-extraction complications.

Conclusions

Despite many years of research, little progress has been made in addressing this commonly encountered and unpleasant post-operative condition in patients. The literature regarding post-surgical healing management after oral surgery procedures is not consistent and often conflicting. Sometimes, studies with mouth rinse supplementation for the management after oral surgery procedures are poorly designed, have varying designs and statistical biases, lack analysis, or consist of individual opinions. As it is a short-term study, the results can be used as a baseline data for future studies with similar study design.

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