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Efficacy of combined sea salt based oral rinse with xylitol in improving healing process and oral hygiene among diabetic population after oral surgery

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Diabetes may be considered a disease characterized by dysmetabolic and increased levels of blood glucose. The impaired metabolism of glucose, lipids, and proteins produces alterations in macro- and micro-vascular circulation, giving rise to the risk of several complications in patients with diabetes, including retinopathy, neuropathy, nephropathy, cardiovascular complications (1), and delayed wound healing (2). Periodontal disease is a chronic inflammatory disease of tissues that supports and affects the teeth and the jaws. Substantial evidence suggests a relationship between diabetes and periodontal disease (3). Many studies in several populations have demonstrated that diabetic patients tend to have a higher prevalence of and more severe periodontitis than non-diabetics (4). Hyperglycaemia, a key abnormality in diabetes, plays an important role in the development of inflammation in diabetic complications. It has been demonstrated that high blood sugar promotes inflammation and inhibits wound healing by altering angiogenesis (5). Periodontal lesions are observed in the presence of plaque and tartar and are more serious in diabetics. Therefore, it seems that proper hygiene and adequate plaque control can play a therapeutic role not only in bacterial control, but also in the resolution of oral surgery procedures (6). *In-vitro* studies have demonstrated the use of stem cells of oral origin to restore the integrity of tissues damaged by periodontitis, a difficult but certainly very innovative clinical practice (7). Recent researches have focused on Xylitol, that inhibits bacterial growth, reduces their number and the amount of plaque (8). Moreover, the presence of sea salt in the mouth increases its pH balance. The environment that results is very alkaline, and bacteria cannot survive in an alkaline environment. In fact, bacteria are only able to thrive in a very acidic atmosphere. The aim of this study was to evaluate

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a combined mouth rinse containing purified water, sea salt, xylitol, lysozyme, and menthol [H2Ocean Sea Salt Mouthwash (H2Ocean, Inc. FL. USA)] in improving the healing process and oral hygiene in a diabetic population after oral surgery procedures.

MATERIALS AND METHODS

Study design

The present study was conducted at the Faculty of Dentistry (FMD), University of Medicine (Tirana, Albania), in collaboration with the University of Bari Aldo Moro, Italy, and according to the Helsinki declaration. Twenty diabetic patients aged 55–65 years, with blood sugar levels ranging from 150 to 200 (mg/dl), were enrolled in the present study. Participants were selected as under clinical diabetic condition (according to American Diabetes Association risk assessment). Participants did not take any medications except for the oral anti-diabetic treatment, so as not to affect the blood chemistry and tissue reply. Patients who had undergone simple (not complicated) dental extraction were selected for the evaluation of the results. Simple "x" stitch design was used for the haemostasis. Written and verbal informed consent was obtained from each participant.

Experimental design

A randomized double-blind, placebo-controlled design was used for this study. Participants were stratified by gender and randomized into one of two groups: supplementation with H2Ocean Sea Salt Mouth rinse (2 rinses daily) or 2 rinses of a placebo (mint flavoured and coloured water) for 4 weeks, as per standard protocol. Twenty diabetic patients were enrolled as follows:

A) Placebo Group: 4 men and 6 women; B) Test group: 6 men and 4 women.

Patients undergoing tooth extraction were evaluated for wound healing at baseline and at 10, 20, 30 days after surgery.

Statistical analyses

Outcome measures of the exploratory study were analysed 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, USA) software, to detect significant differences between pre-test and post-test scores.

RESULTS

For the evaluation of the healing, in Placebo *vs* Test Group, we used modified Landry, Turnbull and Howley index to describe the extent of clinical healing (Tables I-III). Fig. 1 shows how the healing index changed in the Placebo group from time T0 to T3, then from baseline to 30 days after surgery. The Placebo group rinsed with a placebo substance (mint flavoured and coloured water) in the 4 weeks. At T0 all patients showed an index equal to 2, synonymous with the fact that they had recently undergone surgery, in fact the healing index increased to values equal to 3 and in a few patients even to 4.

The healing index values changed in the test group from baseline to 30 days after surgery (Fig. 2). The figures show that in the test group, there was a greater improvement. Also in this situation, all subjects at baseline had values of 2 which changed to values of 4 at T3. These data allow us to understand how in diabetic subjects a mouthwash combined formula with sea salt, lysozyme and xylitol can be a valid help. Unlike commonly used sucrose, xylitol is not fermented by bacteria in the oral cavity. As a result, the acid that damages the enamel of the teeth is not produced and the development of bacterial plaque seems to be limited, consequently, caries is less likely to form. As can be seen in the literature, the regular consumption of xylitol, present in some chewing-gums but above all in mouthwashes, is related to many effects including the regeneration of tooth enamel, the lower incidence of halitosis as well as to an improvement in gingivitis and related inflammation.

Some cases belonging to the Test Group have been documented, therefore they have undergone post-extraction rehabilitation with a mouthwash based on sea salt and xylitol. The figures show how proper oral hygiene can increase the success of wound healing. Fig. 3 shows a rehabilitation of a simple extraction. The site of surgical interest, after suturing with resorbable stitches, at 30 days, shows a complete scarring without signs of inflammation, redness and suppuration. The surrounding tissue shows no signs of injury, therefore a complete recovery.

It could be concluded that this new oral rinse contains important elements for adequate oral hygiene

Table I. *Healing index*

HEALING INDEX	CRITERIA
Very poor 1	Tissue colour: more than 50% of gingivae red Response to palpation: bleeding Granulation tissue: present Incision margin: not epithelialized, with loss of epithelium beyond margins Suppuration: present
Poor 2	Tissue colour: more than 50%of red gingivae Response to palpation: bleeding Granulation tissue: present Incision margin: not epithelized with connective tissue exposed
Good 3	Tissue colour: less than 50% of red gingivae Response to palpation: no bleeding Granulation tissue: none Incision margin: no connective tissue exposed
Very good 4	Tissue colour: less than 25% of red gingivae Response to palpation: no bleeding Granulation tissue: none Incision margin: no connective tissue exposed
Excellent 5	Tissue colour: all pink gingivae Response to palpation: no bleeding Granulation tissue: none Incision margin: no connective tissue exposed.

not only daily, but also in particular and complex conditions, such as those following tooth extraction.

DISCUSSION

In this study, we have shown that a mouthwash based on sea salt and xylitol helps in the healing of wounds and, above all, contributes to keeping the buccal environment clean in subjects who tend to have difficulty healing wounds after oral surgery, in order to avoid bacterial and especially viral infections (9). The current literature considers the use sweeteners and/or chewing-gum with xylitol as a safe and effective method in the prevention of dental caries and periodontitis. (1, 10).

The novelty of sea salt in oral clinical practice also in homecare has brought numerous benefits. Several studies have been conducted *in vivo* on both animals and human models. Studies conducted on humans, however, show that the use of xylitol, in the normal diet, can reduce caries by 30-85% and keep the oral cavity healthier (11). Xylitol is an anticariogenic agent because of its ability to be transported in oral pathogenic bacteria, inhibiting their fermentation process and bio-film adhesion. The use of sea salt has recently gained popularity in the homecare of oral wounds and more generally of mouth hygiene

Table II. *Healing index in the Placebo group at different times*

Placebo Group					
		Healing Index			
ID	*M/F*	*T0 Baseline*	*T1 10days after surgery*	*T2 20days after surgery*	*T3 30days after surgery*
AS	F	2	2	3	3
CLP	M	2	3	3	3
LE	F	2	3	3	3
BM	F	2	2	3	3
EU	M	2	2	3	3
PV	F	2	2	3	3
CE	F	2	3	3	4
MS	F	2	3	3	3
AC	M	2	3	3	4
CN	M	2	2	3	3

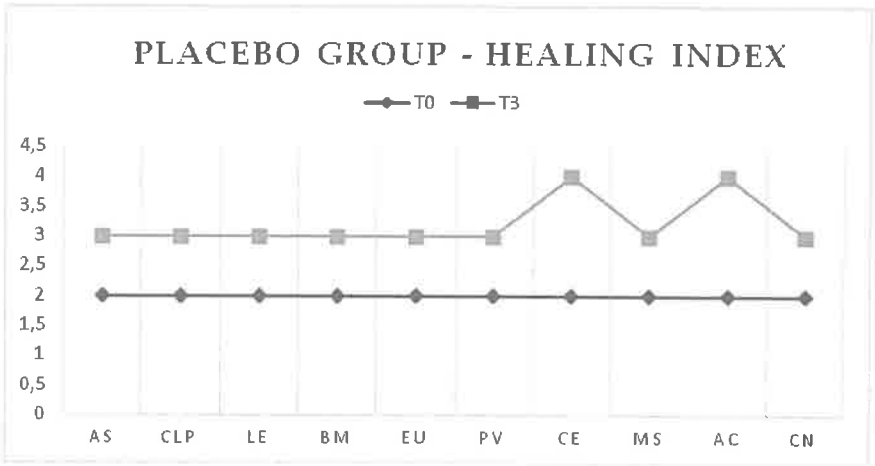

Fig. 1. *Healing Index Placebo Group*

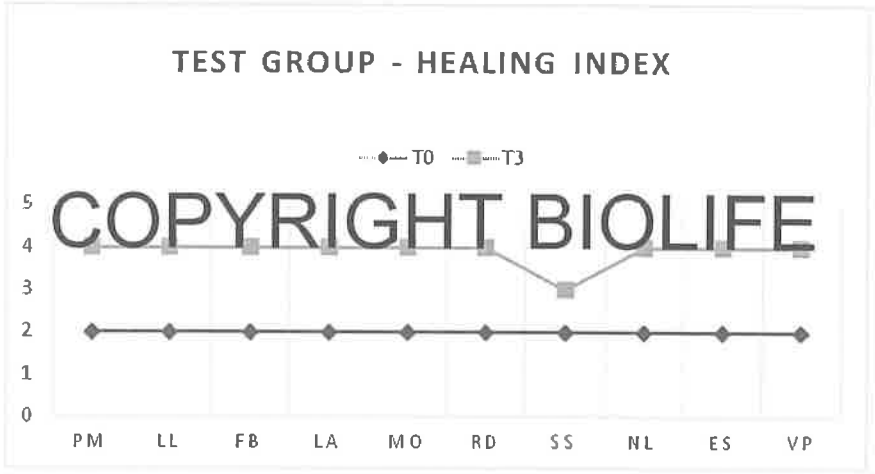

Fig. 2. *Healing Index Test Group*

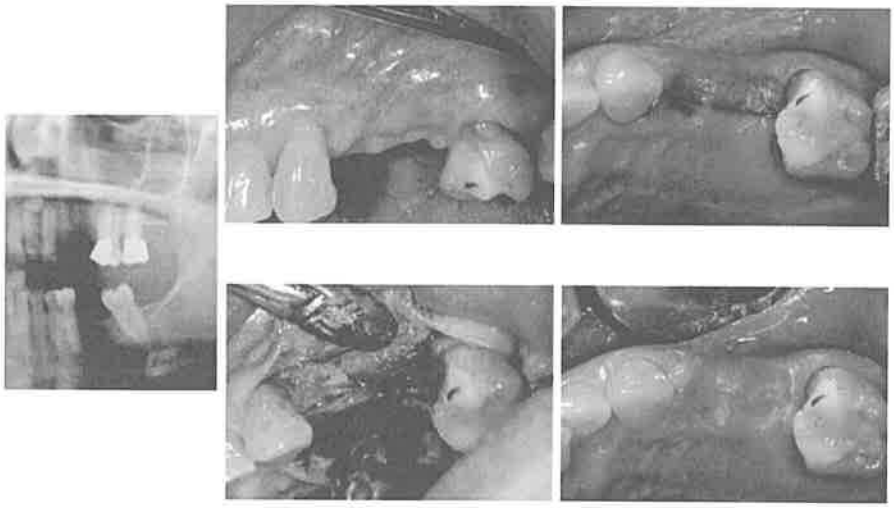

Fig. 3. *Radiographic image and clinical pictures before and after extraction; test group*

Table III. *Healing index in the Test group at different times*

Test Group Healing Index					
ID	*M/F*	*T0 Baseline*	*T1 10days after surgery*	*T2 20days after surgery*	*T3 30days after surgery*
PM	M	2	2	3	4
LL	F	2	3	4	4
FB	F	2	3	4	4
LA	M	2	3	4	4
MO	M	2	3	3	4
RD	M	2	3	4	4
SS	F	2	2	3	3
NL	F	2	2	3	4
ES	M	2	3	3	4
VP	M	2	3	4	4

(12). Numerous benefits have been observed; in fact, the use of salt water promotes simple healing by inducing vasodilation and encouraging phagocytes at the site of the injury. It also lowers the bacterial load from saliva and acts as an astringent agent. In conclusion, many studies have been carried out in the dental field for the treatment of post-operative wounds, and without doubt the use of drugs is more effective, but certainly the use of substances such as H2Ocean Sea Salt Mouth rinse seems to be highly recommended in the practice of oral hygiene immediately after oral surgery.

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