



Effect of *tubulex* swabs on post-extraction wound healing

ANNA SZYSZKOWSKA, MANSUR RAHNAMA, JOANNA JAKIEL*, MARTA PUŁAWSKA,
JOANNA SZCZERBA, DAGMARA JENDA

* Oral Surgery Department, Medical University of Lublin, Poland

ABSTRACT

Socket healing after tooth extraction is a multistage process, often complicated by pain and inflammatory complications. To prevent complications in healing, many preparations of disinfecting, soothing and supporting the healing process activity are used. The effect of Tubulex swabs on wound healing was evaluated. Tubulex are sterile swabs, moistened with Tubulicid Blue, which contains benzalkonium chloride, amphoteric-2, disodium edetate dehydrate and phosphate buffer saline, giving it disinfectant and soothing properties. A positive effect of the use of Tubulex on the healing of post-extraction wounds has been proved.

Keywords: oral antiseptics, Tubulicid Blue, Tubulex, alveolar healing

INTRODUCTION

In dental practice complications are often observed after tooth extraction; these are usually inflammatory cases and improper healing of the alveolus. The main problem in the healing process is infection of the post extraction wound. Oral mucosa is an important protective barrier, which prevents penetration of bacteria into the tissues [9]. In the oral cavity more often than in other parts of the body the protective barrier gets broken due to extraction, surgical incision, and after various injuries in this area. Bacteria easily infect such open wounds of the mouth. Complications are the result of many factors, such as immune resistance, individual predisposition to complications in healing, the amount of micro-organisms present in the area and their virulence, and following the rules of aseptic and atraumatic techniques of the surgery [15].

Most complications occur after major oral surgery such as removals of the teeth with formation of mucoperiosteal flap and removal of a part of the alveolar bone. Soft tissue damage occurs during the surgery or because of dehiscence of the sutures. Inflammatory complications are often observed in wounds of large surface after multiple teeth or roots extractions. Other causes of local complications of alveolar healing include leaving infected granulation tissue within the alveolus, remnants of the tooth apex, dental calculus or sharp edges of the alveolar

bone. The incidence of complications of improper alveolar healing is also increased in smokers, patients suffering from diabetes and necrotizing periodontal disease – ulcerative gingivitis as well as in bone diseases or sclerosis reducing blood supply indispensable for formation of the clot, for example in Paget's disease, cemental dysplasia or after radiotherapy. Complications are also more common in middle-aged patients and in women receiving hormonal medication [3,15].

A typical clinical symptom of infected alveolus is sharp, strong, shooting pain. Locally in the alveolus there is no clot or the clot is decayed or disintegrated. Alveolus is covered with gray deposit. Soft tissues surrounding are hyperemic, sometimes swelling of submandibular lymph nodes appears [10]. The reason of pain after tooth extraction may also be dry socket inflammation as well. Dry socket (*alveolitis sicca*) appears due to loss of blood clot before it gets properly formed and stabilized by granulation tissue. The loss of the blood clot from the socket may occur because of washing out the clot of the patients fault or because of clot deficiencies for general reasons. Ailments associated with dry socket are persistent and last up to three weeks. On the basis of dry socket, or as a result of the initial bacterial infection, purulent alveolitis may develop. Therefore limited inflammation of the alveolar bone occurs, usually 2-3 days after the surgery. Because of persistent pain the patients are suffering; fever, swelling of the lymph nodes, lack of appetite and general weakness may also occur [14,17].

Corresponding author

* Oral Surgery Department, Medical University of Lublin,

e-mail: asia.koper@gmail.com

Prevention of post-surgical complications is atraumatic surgery under aseptic conditions, minimizing the possibility of bacterial infection in the operative area. In the postoperative period, it is vital to maintain the patient's oral hygiene and the use of appropriate post-operative oral antiseptics [6]. According to the literature, most commonly used oral antiseptics are rinses containing chlorhexidine. Other compounds found in mouth rinses recommended for oral cavity antiseptics include triclosan with a copolymer or zinc citrate and benzidamine hydrochloride. There is also increasing interest in the possibility of using plant materials in prevention of inflammations of the mouth, e.g. Eugenol-based dressings containing Peruvian balsam or alcohol-based rinse for oral use *Dentosept* containing herbal extracts made of raw materials, such as chamomile, arnica, peppermint, sage, thyme, couch grass, and oak bark [2,15].

Alternative to the above-mentioned preparations used in oral antiseptics recommended especially after tooth extraction may be *Tubulex*. It is a sterile, disposable non-woven fabric pad, impregnated with the Tubulicid Blue formulation. Tubulicid Blue contains benzalkonium chloride, amphoteric-2, disodium edetate dehydrate and phosphate buffer saline.

MATERIAL AND METHODS

The study group comprised of 228 patients, including 124 women and 104 men, aged from 18 to 65 years who had indications for tooth extraction (Fig. 1.). To collect data on age, gender, oral hygiene and smoking habit we used own poll. Indications for extraction were defined according to intraoral examination, dental intraoral and pantomographic images.

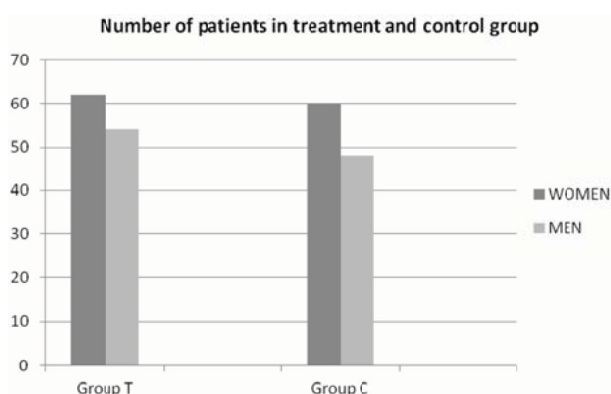


Fig. 1. Number of patients in group T and C

The subjects were divided into two groups: research and control. In the study group (Group T) involving 120 patients *Tubulex* swabs were used according to the manufacturer's instructions immediately after tooth extraction on the socket for 30 minutes, the product was also recom-

mended for use by the patient at home, placed over the socket after tooth extraction 3 times daily for a period of 30 minutes for 3 days. For at least half an hour after application it was recommended to refrain from taking food and drinks.

The control group (Group C) consisted of 108 patients, in whom none of the antiseptics was applied after tooth extraction additionally to daily tooth brushing procedures. Two groups of patients were included in the examination control after 3 and after 7 days, during which local status and healing of the alveolus was assessed, as well as the presence of edema of the surrounding tissues, purulent secretions, trismus or swollen lymph nodes. Furthermore, information was gained whether the patient suffered from pain, as well as whether there was the need for use of analgesics after the surgery, difficulty in eating and halitosis perception has been recorded.

RESULTS

Examination of the oral hygiene showed good oral health in 120 patients, while the poor in 108 (Fig. 2.). The habit of smoking was reported by 48 patients, while 180 people surveyed were free of addiction. All patients had a single tooth extraction, including extraction of 122 molars and 50 premolars, 12 canines and 44 extractions of incisors. The teeth were qualified for extraction due to the following causes: carious destruction of the tooth in 72 patients, difficult tooth eruption in 36 patients, periapical lesions in 58 patients, periodontal disease in 16 patients and 46 patients for orthodontic reasons (Fig. 3.). Depending on the type of surgery a simple tooth extraction took place in 106 cases, prolonged extraction in 64 cases and surgical extraction in 58 patients (Fig. 4.). After the extraction, sutures were placed in 154 cases, while in 74 cases there was only gauze dressing (Fig. 5.).

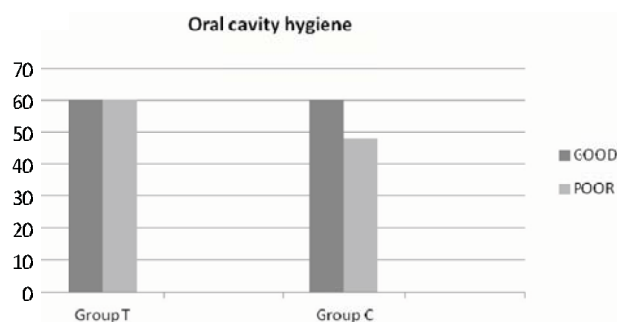


Fig. 2. Evaluation of oral hygiene in patients in Group T and Group C

Test results of control examination after 3 and 6 or 7 days after tooth removal were analyzed for signs of local complications in patients using swabs *Tubulex* (group T) (Fig. 6., Fig. 7.) and control group (Fig. 8., Fig. 9.). At follow-up visit 3 days after the surgery the need to use painkillers was reported by 44 patients from group T

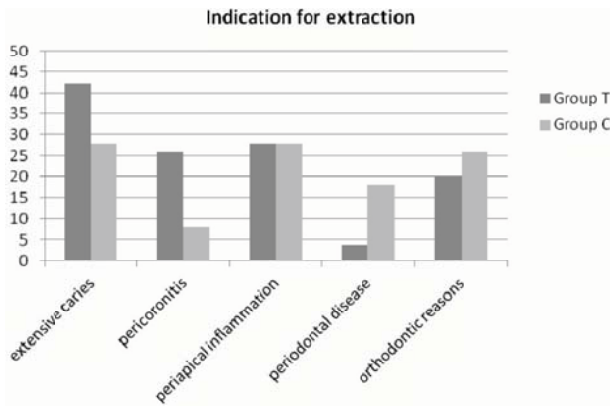


Fig. 3. Indications for tooth extraction in Group T and C

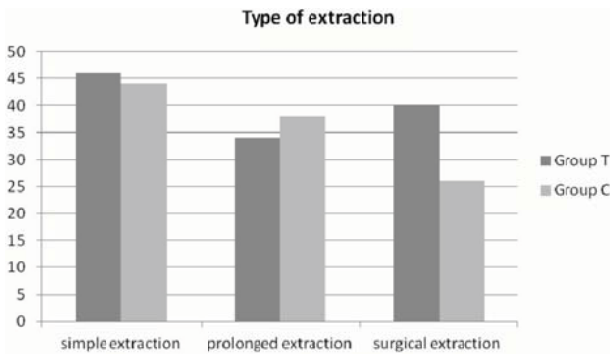


Fig. 4. Type of extraction in group T and C

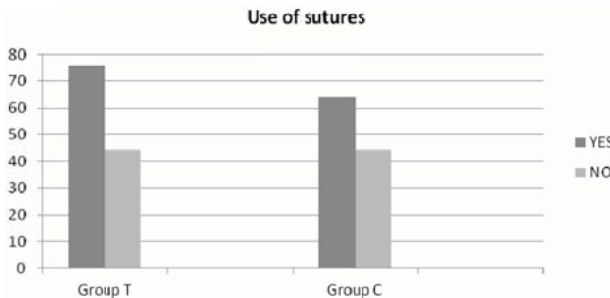


Fig. 5. Placement of sutures in group T and C

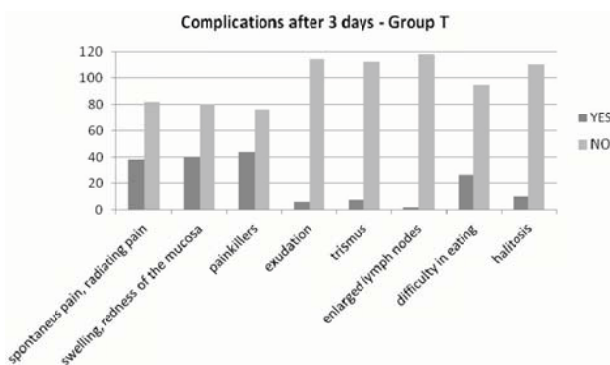


Fig. 6. Clinical examination after 3 days in group T

(36.7%) and 64 patients in the control group (59.3%). Subjective feelings of spontaneous or radiating pain were reported by 38 patients from group T (31.7%) and 64 patients in the control group (64.8%). In clinical intraoral examination swelling and redness of the mucosa was

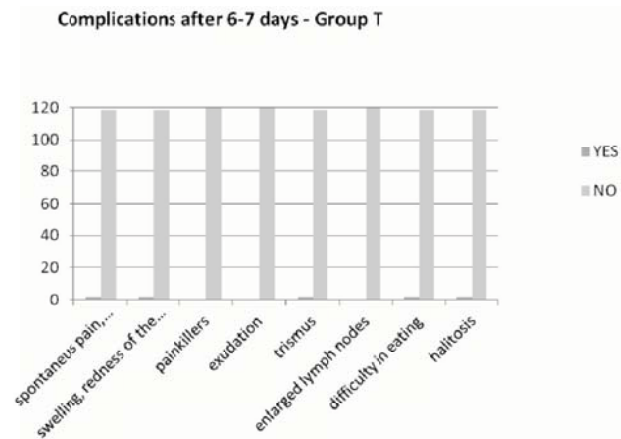


Fig. 7. Clinical examination after 6-7 days in group T

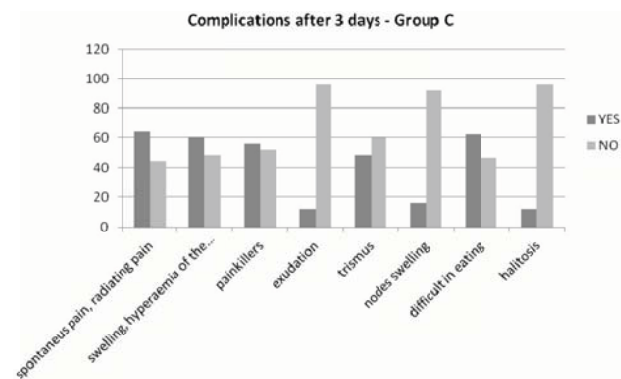


Fig. 8. Clinical examination after 3 days in group C

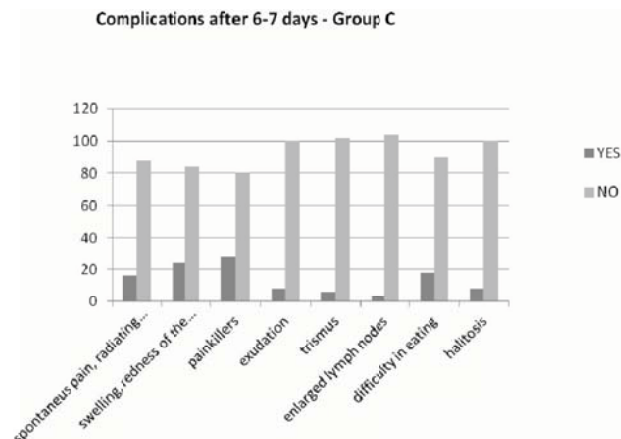


Fig. 9. Clinical examination after 6-7 days in group C

found in 40 patients from group T (33.3%) and 60 patients from the control group (55.6%). The presence of purulent exudation from the alveolus was noted in 6 patients in Group T (5.0%) and 12 control patients (11.1%). Trismus was observed in 8 patients from group T (6.7%), and swelling of lymph nodes in 2 patients from group T (1.7%) and respectively 48 (44.4%) and 16 (14.8%) patients in the control group. Difficulty in taking food was reported by 26 patients from group T (21.7%) and 62 patients in the control group (57.4%). 10 patients of the group T (8.3%) and 12 control patients (11.1%) complained for unpleas-

ant smell from the mouth. Inspection visit after 6 - 7 days in group T showed improvement in patients' clinical condition in the local area in relation to post-operative study of the control 3 days after surgery. Trismus, pain, difficulty in taking food and halitosis was observed in 2 patients only (1.7%). In the control group 7 days after the surgery 16 patients reported the need of using painkillers (14.8%), and the occurrence of spontaneous or radiating pain was reported by 24 patients (22.2%). Halitosis was reported by 8 patients (7.4%). Pus was found in 8 patients (7.4%), trismus in 6 patients (5.6%), and enlarged lymph nodes in 4 patients (3.7%). Complication in the form of swelling and redness of the mucous membrane was found in 28 patients (25.9%), however difficulty in eating was reported in 18 cases (16.7%). On the visit, positive impressions after the use of *Tubulex* swabs was reported by 112 patients (93.3%), and negative by 8 patients (6.7%).

Differences in clinical status in patients after 3 and 6-7 days after surgery between group T and the control group were statistically analyzed using Student's t-test. Statistically significant differences ($p < 0.05$) were noticed between group T and the control group. Analysis of the clinical observation of the results of the healing process of the wound after tooth extraction with the use of post-operative antiseptics in the form of *Tubulex* swabs shows the advisability of its application.

DISCUSSION

Alveolar healing process includes four stages: inflammation, epidermization, fibrosis and remodeling. After removal of the tooth the cavity is surrounded by cortical bone, covered by periodontal ligament fibers and oral epithelium (gingiva). Blood filling the alveolus after extraction forms a clot, which is a barrier separating the alveolus from oral cavity environment and is the source of processes leading to post-extraction wound healing.

In cases when a stable clot does not form, or it disintegrates because of infection, complications in the healing appear. The most common symptoms described by the patients, demonstrating a disruption of the healing process is severe pain, usually occurring 3-5 days after extraction, inducing the patient to re-visiting the dentist [11].

There are many factors predisposing to infections in the oral cavity: physiological (e.g. age, pregnancy, malnutrition, decreased salivary flow), general (hormonal disorders, systemic diseases, antibiotics) and local (loss of tissue integrity, injuries, and other treatment in the oral cavity area). Under such favorable circumstances microorganisms present in the oral cavity become pathogens, adjacent to the epithelium in a sustainable manner, impossible to be removed by saliva flow, breaking down the protective activity of constant micro-organisms, host immune system and eventually penetrating into the tissue.

Pathogenicity of the microorganisms is their own and relative ability to stimulate the disease, and their activity is related to virulence factors [13].

According to the literature, most commonly used oral antiseptics are rinses containing chlorhexidine. These solutions have a strong bactericidal effect against Gram-positive and Gram-negative bacteria, and antimycosal properties. It has been proved that topical use of 0.12% chlorhexidine solution before surgery and for two weeks afterwards reduces the incidence of dry socket [1,5]. A decrease in post-surgical complications has been observed after the use of aerosol containing 0.2% chlorhexidine bigluconate, applied topically prior to tooth extraction, and afterwards by the patient at home three times a day for 4 doses of application [14].

Other compounds found in mouth rinses recommended for oral cavity antiseptics include triclosan with a copolymer or zinc citrate and benzidamine hydrochloride. There is also increasing interest in the possibility of using plant materials in prevention of inflammations of the mouth. These raw materials in most cases do not cause side effects and resistance to the treatment, may therefore be an alternative to synthetic drugs [15].

Eugenol-based dressings containing Peruvian balsam have been used as an effective preventive medication after removal of lower wisdom teeth, together with chlorhexidine rinse before and after surgery. Such prophylaxis led to reduction of complications such as dry socket up to 8%, compared to 26% of complications in the untreated group [2].

It has also been proved that alcohol-based rinse for oral use *Dentosept* containing herbal extracts made of raw materials, such as chamomile, arnica, peppermint, sage, thyme, couch grass, and oak bark, used before tooth extraction as an antiseptic on the mucous membrane and also after surgery, reduces post-operative complications and intensity of pain during the healing and duration of analgesic medication [15].

Tubulex may be an alternative oral antiseptic recommended especially after tooth extraction. It is a sterile, disposable non-woven fabric pad, measuring 22 x 22 mm, which can be spread up to dimensions of 10 x 8.5 cm. *Tubulex* is impregnated with the Tubulicid Blue formulation. The pad does not stick to the wound; it is flexible, soft, non-fraying. It neither irritates the oral mucosa nor the skin, disinfects oral mucosa and skin, accelerates wound healing and prevents inflammation after surgery. It is recommended for antiseptics and cleansing the wound before, during and after the treatment. It is used for treatment of inflammations, cuts, erosions due to prosthetic and orthodontic appliances, as well as a dressing after periodontal surgery and treatment of post-surgical complications.

Tubulicid Blue contains benzalkonium chloride, amphoteric-2, disodium edetate dehydrate and phosphate buffer saline.

Polish microbiological and clinical studies have shown that bacterial growth inhibition zone around the disk filled by Tubulicid Blue was 34-42 mm, which confirms antimicrobial properties of the solution [4]. On the basis of further clinical observations it was noticed that Tubulicid Blue does not show either irritating or toxic effects on the pulp of the teeth and other body tissues [4,19,20]. It has physiological pH 7.3 [16].

Benzalkonium chloride is a surfactant (anionic detergent) which irrespective of the environment forms stable salts. Benzalkonium chloride is an anti-bacterial, anti-mycosal and disinfectant compound. It is easily biologically degradable. It has bacteriostatic and bactericidal effect on Gram-positive bacteria, and to a lesser extent on Gram-negative bacteria, viruses, fungi and Mycobacterium tuberculosis. Bacteriostatic and mycostatic activity increases with increasing concentration of the substance [8].

The mechanism of benzalkonium chloride activity is due to its connection to bacterial cytoplasmatic membrane, which increases its permeability leading to its destruction. This causes also inhibition of enzymatic reactions in the cells of the microorganisms and reduction of the surface tension [7,18].

This compound does not act on microbial spores, but facilitates their removal from the mucosal surface [7].

Pharmacological effect of benzalkonium chloride increases in alkaline environment, decreases in acidic environment, and in pH below 3 disappears [18].

Amphoteric-2 contained in Tubulex is an amphoteric surfactant commonly used in cosmetic formulations. It is foaming and cleansing, it has also a protective and irritations soothing effect, and that it shows weak antibacterial activity [12].

EDTA disodium salt (EDTA) has a bactericidal activity; it combines divalent cations (Mg^{++} and Ca^{++}) by improving the permeability of the membrane and changing the stability of the ribosome. EDTA has bactericidal activity against *Pseudomonas aeruginosa* by chelating metal ions, which are necessary for integrity of the cell membrane, through the inactivation of the pump in the wall of Gram-negative bacteria and inactivation of enzymes produced by *Pseudomonas*, which can cause ulceration and tissue necrosis [16].

CONCLUSIONS

Tubulex swabs applied after tooth extraction according to the manufacturer's recommendations give a good antibacterial and soothing effect, leading to a decline in the number of post-operative complications, reduction in pain intensity during the healing of the wound and reduction of duration of admission of painkillers.

Medical progress focuses on developing non-invasive healing methods. It is aimed to minimize the treatment

time and eliminate complications associated with the surgery. The overriding objective in the course of the treatment became a desire to minimize tissue trauma, iatrogenic complications and elimination of the body burden resulting from the reparations of damaged tissues.

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