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The role of mylohyoid flap in the treatment of bisphosphonate-related osteonecrosis of the jaws

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ABSTRACT

Introduction: Surgical treatment of bisphosphonate-related osteonecrosis of the jaws (BRONJ) combines excision of adequate damaged bone and watertight coverage by appropriate vascularized tissue. Local tissues are preferred when possible. This study compares local mucoperiosteal flaps with mylohyoid flaps with special emphasis on their influence on wound healing.
Material and methods: A total of 195 patients with BRONJ in the mandible were included in this prospective study. The control group ($n = 169$) were treated with a mucoperiosteal flap, whereas patients of the study group ($n = 26$) received a mylohyoid flap.
Results: Recurrence of BRONJ was significantly reduced ($p = 0.023$) as was extent of necrosis ($p = 0.001$) in patients with mylohyoid flaps.
Discussion: This study demonstrates the importance of a sufficient mucosal coverage in surgical treatment of BRONJ. The mylohyoid flap provides an additional tissue coverage, which seems to account for the significantly reduced rate of disease recurrence.
Conclusion: The vascularized mylohyoid flap is an important tool in the complex and challenging surgical care of BRONJ.

1. Introduction

Since the first descriptions of bisphosphonate-related osteonecrosis of the jaws (BRONJ) many reports regarding proposed hypotheses, risk factors, and possible treatment modalities have been published (Marx, 2003; Migliorati, 2003; Wang et al., 2003). BRONJ is often assumed to be primarily a bone condition although these drugs also have a direct effect on mucous membranes. The perceived limitations of surgical therapy for BRONJ have been discussed extensively in the literature, and recommendations have largely been to offer conservative therapy to patients (Badros et al., 2006; Boonyapakorn et al., 2008; Marx et al., 2005; Migliorati et al., 2005; Ruggiero et al., 2004; Woo et al., 2006). Surgical treatment including local debridement, bone-contouring procedures, or segmental osteotomies are recommended only for severe cases (Greenberg, 2004; Marx, 2003; Marx et al., 2005; Mücke et al., 2009; Ruggiero et al., 2004; Vogel et al., 2002). After complete debridement of necrotic bone, there is a need for a watertight defect closure to minimize the risk of microbial contamination of the wounds and the exposed bone (Chuah et al., 2005; Otto et al., 2010). Additionally, these patients may be immunosuppressed or have carcinomatosis which also contributes to a prolonged and complicated healing of all wound defects. This is demonstrated by a very high relapse rate of patients after completion of therapy of BRONJ (Mücke et al., 2011). The relapse rate varies between 11 and 50% in these patients observed mostly over a 2-year period. The need for effective treatment which is acceptable in conjunction with their oncological treatments and does not further damage their remaining quality of life is challenging (Miksad et al., 2011).

In view of this there are several options for defect closure dependent on several factors which should be considered in the choice of treatment (Mücke et al., 2009; Nocini et al., 2009; Stockmann et al., 2010; Voss et al., 2012). If the bone can be completely debrided and there are enough soft tissues available, a simple technique should be favored (Mücke et al., 2011).

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Techniques using local tissue in conjunction with a standardized routine conservative treatment (antibiotics, mouth rinse, omit dentures, soft diet or in some extensive cases naso-gastric tube) are of value (Ruggiero et al., 2009).

The mandible is more often affected than the maxilla. BRONJ affecting the lingual aspect of the mandible are problematic due to tension on the wound. For this purpose, the mylohyoid flap can be used for watertight defect closure (Lemound et al., 2012).

The purpose of this article was to compare the outcome of conventional mucoperiosteal flaps and mylohyoid flaps combined with conservative therapy at similar BRONJ stages and their influence on the course of wound healing.

2. Material and methods

2.1. Patients

Subjects were recruited from the Department of Oral and Maxillofacial Surgery of the Technische University of Munich from 2007 to 2015. All surgical procedures were performed by the same surgical team following the same surgical protocol. The patients were evaluated prospectively and examined at least twice. The final examination was at least three months ago. We used the definition for BRONJ outlined by the American Association of Oral and Maxillofacial Surgeons. Criteria included current or previous treatment with BP, exposed, necrotic bone in the maxillofacial region that persisted for more than 8 weeks, and no history of radiation therapy to the jaws (AAOMS, 2007).

Exclusion criteria were having inadequate information or presence of confounding variables (e.g. corticosteroids in the medication, history of radiation, metastases within the gingiva or jaws).

2.2. Diagnostics

The diagnosis of BRONJ was carried out on the basis of digital panoramic tomograms and computed tomography (CT) scans, and the clinical diagnosis was based on the patient's clinical stage according to the classification of Ruggiero et al. (2004). Complete clinical data were collected and classified. Intention to treat conservatively or surgically was based on the symptoms of each patient. Surgical treatment was performed if the patient reported pain and/or neurological deficits of the inferior alveolar nerve, progression to a higher stage of the disease was observed, or non-healing exposed bone in mandible or maxilla for longer than 8 weeks without any change of the stage of disease.

2.3. Conservative treatment

Antibiotics were individualized depending on the previous therapy. An appropriate antibiotic was selected and given intravenously in each case. The standard regimen consisted of amoxicillin/sulbactam (3 g, three times daily) or clindamycin (600 mg, three times daily) if penicillin allergies were present (Mücke et al., 2011). Antibiotic therapy was modified according to culture and sensitivity following appropriate sampling. Antiseptic mouth rinses with Chlorhexidine, were performed three times a day and additional rinsing was performed at least once daily by the surgical staff.

2.4. Surgical treatment

Surgery was carried out 2 weeks after the last dose of bisphosphonates (if not discontinued), and recommenced no sooner than 2 weeks after surgery. This did not seem to cause any disturbances in wound healing. Biopsy of the bone was routinely performed in all cases to confirm the diagnosis and to exclude metastatic disease.

The treatment of patients with BRONJ included sequestrectomy, surgical debridement or wound debridement, depending of the stage and extent of the disease.

In the control group, wound closure was carried out without tension on the local mucoperiosteal flap after incision of the periosteum. In the study group, wound closure was performed by a mylohyoid flap combined with a local mucoperiosteal flap. Interrupted sutures were performed with resorbable suture material (Vicryl 3-0, Ethicon, Norderstedt, Germany).

2.5. Mylohyoid flap

The mylohyoid muscle flap was prepared according to the description by Trauner in 1952 (Trauner, 1952). The mylohyoid flap is a myofascial flap which is accessible at the lingual border of the mandible, inserting at the mylohyoid line. The muscle is detached from here, mobilized and placed over the mandible with interrupted sutures without tension (Lemound et al., 2012). Care was taken not to harm the lingual nerve or the sublingual gland which course on the mylohyoid muscle. Important steps of the procedure are presented in Fig. 1.

2.6. Postoperative care

After surgery, the patients were fed using a naso-gastric tube for at least 5 days. The wounds were checked daily for signs of infection, wound breakdown, or recurrence of the disease. In cases of wound breakdown, the lesion was reassessed and either conservative or surgical therapy was performed depending on the extent of wound healing. Sutures and enteral feeding tube were routinely removed 10 days after surgery.

2.7. Statistical analysis

Descriptive statistics for quantitative variables are given as the mean ± standard deviation. If appropriate, medians and ranges were also computed. The data were analysed with the “Statistical Package for the Social Sciences” (SPSS for Windows, release 17.0.0. 2009, SPSS Inc.). Figures are generated with SPSS.

Multiple logistic regression analysis was used to determine factors independently associated with the dependent variable – wound dehiscence. Covariates in this model were treatment dependent variables of wound healing (fistulas, recurrent BRONJ, bleeding, abscess), extent of necrosis, location, type of treatment (either mucoperiosteal or mylohyoid flap), and number of debridements carried out. 95% confidence intervals (95% CI) for estimated odds ratios (OR) approximating the relative risk are also given. *p*-Values are two-sided and subject to a significance level of 0.05.

3. Results

Between 2007 and 2015, 256 patients with initial occurrence of BRONJ were treated. Of these patients, 195 (76.17%) locations of BRONJ were found in the mandible and included into the analysis. There were 26 patients in the mylohyoid muscle group compared with 169 patients treated by mucoperiosteal flaps. The overall success rate of surgical therapy was 72.3%, as wound dehiscence or BRONJ recurrence were detected in 54 patients (27.7%). The mean age was 66.25 ± 12.58 years. The mean time of BP intake until the occurrence of BRONJ was 45.51 ± 29.56 (range 6–84) months. 32 patients were classified as stage 1 (16.4%), 85 as stage 2 (43.6%) and 78 patients as stage 3 (40%). The original pathology for which the