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Delayed infection after using bone wax in maxillofacial surgery: A rare complication after reduction mandibuloplasty

Bong-Kyoon Choi[a], Eun-Jung Yang[b,*]

[a] CBK Plastic Surgery Clinic, Seoul, South Korea
[b] Dept. of Plastic and Reconstructive Surgery, Cheil General Hospital & Women's Healthcare Center, Dankook University, 17 Seoero-1gil Jung-gu, Seoul, South Korea

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ABSTRACT

Background: Although several studies have reported various adverse reactions associated with the use of bone wax in the clinical setting, the incidence of complications after using bone wax during maxillofacial surgery via a transoral approach remains unclear. We aimed to address this scarcity of data and describe the incidence and nature of postoperative infections associated with bone wax treatment during reduction mandibuloplasty.

Materials and methods: A retrospective chart-review study was conducted among patients who underwent reduction mandibuloplasty performed by the same surgeon between January 2010 and December 2014. Delayed postoperative infection was diagnosed based on clinical manifestations, associated treatment strategy (additional antibiotic treatment with or without revision surgery), and results of microbiological investigation. Patients were divided into 2 groups according to whether or not bone wax had been applied during the reduction mandibuloplasty procedure.

Results: A total of 355 patients (44 men; average age, 31.0 years; age range, 19–53 years) underwent reduction mandibuloplasty during the study period. Of these, 19 patients (1 men; age, 26.0 ± 6.62 years) were treated with bone wax applied to the cut surface of the mandibular cancellous bone for controlling bleeding. The infection rate among patients not treated with bone wax was 1.5% (5/336; acute infection), compared to 21.0% (4/19; delayed infection) among patients treated with bone wax. The use of bone wax contributed to an increased risk of developing infection (odds ratio, 14.87 [95% confidence interval, 3.22–68.70], $P < 0.003$).

Conclusion: This is the first report describing the incidence of infection associated with the use of bone wax for controlling bleeding from the cancellous bone during maxillofacial surgery via a transoral approach.

1. Introduction

In maxillofacial surgery, bone wax is widely used to control bleeding from the cut surface of the cancellous bone, which often occurs after resection of the bony segment and exposure of the mandibular cancellous bone. The hemostatic effect of bone wax is based on its physical sealant effect rather than on its biochemical properties. Although bone wax achieves bone hemostasis and can suppress new bone formation in the resection area, adverse reactions have been reported. A foreign-body reaction to bone wax has been reported after orthopedic and dental surgery [1–3]. Furthermore, it has been proposed that bone wax may increase susceptibility to infection by acting as a nidus for infection and impairing clearance [4,5]. Our experience has also indicated that the use of bone wax may be associated with various degrees of local inflammation; specifically, during revision surgery for persistent mandibular pain several months after reduction mandibuloplasty, we found remaining bone wax in the resection area. Despite the wide use of bone wax to control bleeding during maxillofacial surgery, few case reports have described symptomatic complications associated with this practice, and the incidence of adverse reactions to bone wax after maxillofacial surgery remains unknown [3,6]. In the present study, we aimed to address this paucity of data and describe the incidence and nature of delayed soft-tissue infection after the use of bone wax to control cancellous bone bleeding caused by ostectomy during

* Corresponding author.
E-mail address: enyang7@gmail.com (E.-J. Yang).

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maxillofacial surgery. In addition to our findings, we herein provide specific recommendations regarding the use of bone wax in maxillofacial surgery.

2. Methods

2.1. Patients and study design

A retrospective chart review was performed for a series of consecutive patients who underwent reduction mandibuloplasty at a plastic surgery clinic in Seoul, Korea, between January 2010 and December 2014. Only patients with a complete medical chart and a follow-up of at least 6 months were included. The following data were extracted from the patients' medical records: sex, age, smoking status, dental health (presence or absence of carious disease), presence or absence of diabetes, use of bone wax, information regarding postoperative infection (time to initial symptoms, antibiotic treatment, additional surgical procedures, results of microbiological examination), and clinical course. Patients with medical comorbidities such as diabetes and dental caries were excluded. Reduction mandibuloplasty was performed in accordance with the protocol for mandibular angle resection. The same surgeon (BK Choi) performed all procedures. All patients provided informed consent for undergoing the surgical procedures. The requirement for the patients to provide informed consent for inclusion in the present study was waived by the Institutional Review Board of Cheil General Hospital and Women's Healthcare Center based on the retrospective design of the study.

All patients were evaluated based on pre- and postoperative photographs, cephalograms, and panoramic radiographs. Most patients received intravenous cefazolin (1 g) and gentamycin (1 g) on induction of general anesthesia, followed by repeated administration at 12-h intervals on the day of surgery and the day after surgery. In some patients, bone wax was applied on the cancellous bony section of the mandibular angle for hemostasis. Postoperatively, the patients were prescribed a 5-day course of oral third-generation cephalosporin and anti-inflammatory medicine. When discharged from the clinic, all patients received a prescription for oral third-generation cephalosporin and an anti-inflammatory medicine, together with a mouth gargle containing 0.1% chlorhexidine, to be used twice a day for 1 week. The patients were followed up at 7–10 days postoperatively, and at 3 weeks, 1month, 3 months, and 6 months thereafter.

In patients with postoperative infection, pus was swabbed from the infection site and sent for microbiological investigation. Management involved exploratory surgery and removal of affected tissue and residual bone wax. The patients received intravenous ciprofloxacin (1 g) upon induction of general anesthesia and administration was repeated at 12-h intervals for 3 days; the antibiotic prescription was altered according to the antibiotic sensitivity noted for each patient. When necessary, a silastic drain was placed through the overlying skin and maintained for 2 days. When discharged from the clinic, all patients received a prescription for oral antibiotics and an anti-inflammatory medicine as a 7-day course, as well as a mouth gargle containing 0.1% chlorhexidine, to be used twice a day for 1 week.

2.2. Study variables

The predictor variable was the use of bone wax on the cancellous bony surface of the mandible. The study population was divided into 2 groups as follows: if bone wax was not used during the surgical procedure, the patient was included in the wax$^-$-group; if bone wax was used, the patient was included in the wax$^+$-group.

The primary outcome variable was the incidence of postoperative infection, which was identified based on each patient's record of infection. The diagnosis of infection was established for patients with relevant clinical signs (e.g., unusual pain and edema around the surgical sites, erythematous color change in the mandible area) and fulfilling one or more the following criteria: 1) intravenous antibiotic treatment beyond the prophylactic surgical regimen; 2) surgical intervention for drainage, irrigation, or debridement; and 3) microbiological confirmation of infection. Other variables examined in the present study included age, sex and smoking status.

2.3. Statistical analysis

Data were analyzed using SPSS version 22.0 for Windows (SPSS Inc., Chicago, Ill). The differences between the 2 groups in terms of demographic and clinical characteristics were assessed using the Wilcoxon signed rank test, and Fisher's exact test. Statistical significance was defined at $P < 0.05$. The odds ratio in terms of postoperative infection were assessed using logistic regression analysis.

3. Results

A total of 355 patients underwent reduction mandibuloplasty during the study period and were included in this study (Table 1). Of these, 44 patients were men and 311 were women. The average age at the time of surgery was 31.0 years (range, 19–53 years). In the wax$^-$-group (mean age, 30.9 years; range, 20–53 years; 43 men and 293 women), a total of 5 patients (mean age, 25.6 years) developed acute postoperative infection within 6 weeks of surgery. In the wax$^+$-group (mean age, 26.0 years; range, 19–40 years; 1 men and 18 women), a total of 4 patients (mean age, 32.0 years) developed delayed postoperative infection (i.e., later than 6 weeks after surgery). The earliest postoperative infection potentially associated with the use of bone wax occurred at 3 months after surgery, and the latest at nearly 8 months postoperatively. The average time until the manifestation of the first symptom of delayed infection was approximately 6 months. While the 2 groups did not differ significantly in terms of demographic characteristics, the incidence of postoperative infection was significantly higher among the patients in the wax$^+$-group, who had undergone reduction mandibuloplasty with application of bone wax. The use of bone wax contributed to an increased risk of developing

Table 1
Characteristics of patients who underwent reduction mandibuloplasty, with or without the use of bone wax to stop bleeding from the cancellous bone.

	The wax$^-$-group (n = 336)	The wax$^+$-group (n = 19)	*P*-value
Age, years (mean ± SD)	30.9 ± 5.65	26.0 ± 6.62	0.0003[†]
Sex			
Male	43(12.8)	1(0.5)	0.488[‡]
Female	293(87.2)	18(94.7)	–
Smoking	40	2	1.000[‡]
Postoperative infection, n	5	4	–
Time to first symptom, months	0.5	6.0	
Infection rate, %	1.5	21.0	<0.0001[‡]

Unless otherwise specified, values are given as mean ± standard deviation or total number (percentage). The wax$^-$-group consisted of patients who underwent reduction mandibuloplasty without the use of bone wax, while the wax$^+$-group consisted of patients who underwent reduction mandibuloplasty with the use of bone wax.
SD, standard deviation.
[†] Wilcoxon signed rank test.
[‡] Fisher's exact test.