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DURATION OF POSTOPERATIVE ANTIMICROBIAL THERAPY FOR SAGITTAL SPLIT RAMUS OSTEOTOMY IN A SINGLE INSTITUTION

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SYNOPSIS

The incidence of surgical site infections (SSIs) in orthognathic surgeries ranges from 1.4–21.4%. Among these surgeries, sagittal split ramus osteotomy (SSRO) is associated with the highest frequency of SSIs (71%). In this study, we retrospectively investigated the differences in the incidence of SSIs after SSRO between patients undergoing postoperative antimicrobial therapy for long- and short-term periods at a single institution. This study aimed to determine the effectiveness of postoperative antimicrobial therapy of varying durations in patients who underwent orthognathic surgery. All patients received 1 g cefazolin (CEZ) 30 min before surgical incision. The long-term group received six doses of 1 g CEZ every 12 h for 72 h postoperatively. The short-term group received 1 g of CEZ twice for 12 h postoperatively. No differences in clinical factors were found between the two groups. Administering two doses of 1 g CEZ for up to 12 h postoperatively can prevent SSIs.

Key words: surgical site infection, sagittal split ramus osteotomy, postoperative antimicrobials

INTRODUCTION

Orthognathic surgery is classified as a semi-clean surgery because it is performed orally. Many previous studies have evaluated surgical site infections (SSIs) after orthognathic surgery, and the incidence has been reported to be 1.4–21.4%[1-9]. Among orthognathic procedures, sagittal split ramus osteotomy (SSRO) shows the highest frequency of SSIs and is associated with 71% of the reported SSIs[10].

The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) guidelines for the prevention of SSIs recommend the use of prophylactic antimicrobial agents preoperatively only because of the increase in drug-resistant bacteria with the increased use of antimicrobial agents[11, 12], while the American College of Surgeons, Society for Infectious Diseases (ACS/SIS) recommends the use of additional antimicrobial agents. On the other hand, the 2016 "Practical Guidelines for the Appropriate Use of Antimicrobial Agents in the Prevention of Postoperative Infections" recommend a single dose to 48 hours after orthognathic surgery[13]. A unified view is yet to be obtained.

In this study, we conducted a single-center, retrospective, observational study on the incidence of SSIs in orthognathic surgery patients who underwent SSRO after receiving postoperative antimicrobial therapy for different durations.

MATERIALS AND METHODS

Patients

We conducted a retrospective observational study of 145 patients (62 men and 83 women; age, 27.3 ± 9.9 years [mean ± standard deviation (SD)]; range, 16–59

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years) who were diagnosed with jaw deformities and underwent bilateral SSRO between July 2013 and March 2020 at the Department of Maxillofacial Surgery at our hospital (Figure 1). Patients were excluded if they met any of the following criteria: diabetes mellitus, history of steroid treatment, or other highly infectious underlying diseases.

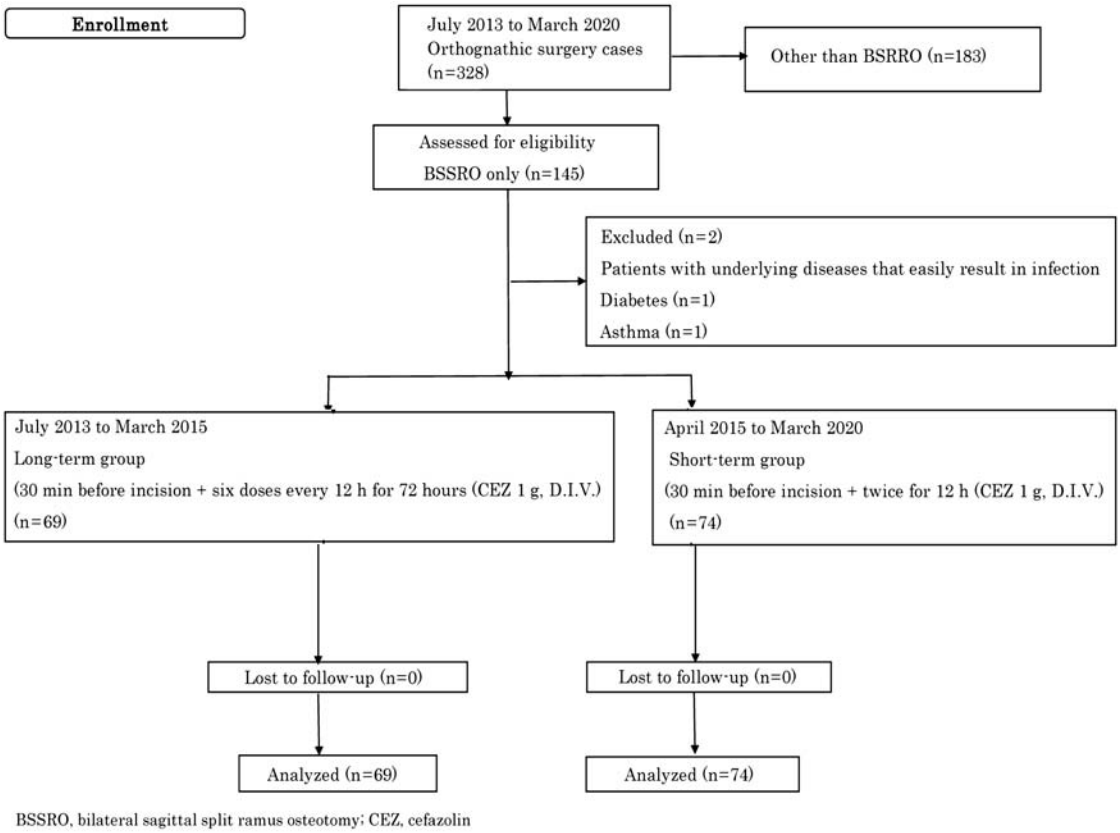
Sex, age, body mass index (BMI), operative time, total movement of the left and right mandibles, total blood loss, drainage period, and SSI occurrence were evaluated in the study. Total blood loss was defined as the sum of the intraoperative blood loss and drain effluent.

Operative procedures and diagnoses

All patients received 1 g of cefazolin sodium (CEZ) intravenously 30 min before the surgical incision. Bilateral SSRO was performed according to the Obweggeser-Dal Pont method, and all procedures were performed by five oral surgeons. Titanium miniplates and screws were used for mandibular fixation. All wounds were closed using absorbable polyglycolic acid sutures. Continuous suction drains were placed at the mandibular angle on both sides.

For postoperative antimicrobial therapy, from July 2013 to March 2015, 70 patients received six doses of 1 g CEZ every 12 h over the 72-h postoperative period (long-term treatment group), and from April 2015 to March 2020, 75 patients received 1 g CEZ twice over the 12-h postoperative period (short-term treatment group). The two groups showed no differences in surgical technique and all patients were operated on by the same surgeon.

The diagnosis of SSIs was determined according to the criteria of the US CDC[14] (Table 1). All patients provided written informed consent for participation in the study (Aichi Gakuin University Ethics Committee, Approval No. 379).



BSSRO, bilateral sagittal split ramus osteotomy; CEZ, cefazolin

Figure 1. Patient selection process

Table 1. Criteria for defining SSI/superficial incisional SSI [14]

Infection occurs within 30 days after the operation and infection involves only skin or subcutaneous tissue of the incision and at least one of the following:
1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative.
4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

SSI, surgical site infection

Statistical analysis

At the beginning of the study, the statistically necessary number of eligible patients was estimated: the incidence of SSI was set at 5% in the long-term group and 15% in the short-term group, based on previously published studies[1-9]. The minimum number of patients required for each group was calculated at 76, based on a one-sided significance level of 5% and a detection rate of 80%[15]. All parameters were analyzed using the Shapiro–Wilk test and were confirmed to be normally distributed. In the analysis of factors affecting SSIs, the independent variable was defined as the presence or absence of SSIs, and the dependent variables were defined as the factors that may affect SSIs (sex, age, BMI, operative time, and total movement of the left and right mandibles). Fractional analysis was performed. A Student's t-test was used to compare the differences between the long-term and short-term groups for the six study items.

In addition, a simple regression analysis was performed to investigate the relationship between SSIs and the duration of postoperative antibiotic administration to determine the presence of potential factors. The difference in the incidence of SSIs between the long-term and short-term treatment groups was compared using Fisher's exact test. The statistical analysis software used was JMP software (version 16; SAS Institute, NC, USA).

Results

Of the 145 patients, two patients with type II diabetes mellitus and asthma were excluded, and 143 patients (61 men and 82 women; age range, 16–59 years; mean, 27.1 years) were included in the study.

The long-term treatment group comprised 69 patients (31 males and 38 females; mean [SD] age, 27.9 years [9.6 years]; range, 16–52 years). Their mean BMI was 21.4 kg/m^2 (range, 7.3–32.7 kg/m^2). Bilateral SSRO was performed in 62 patients (89.9%) with mandibular protrusion (including combined open bite and asymmetry), three patients (4.3%) with mandibular retrusion, and four patients (5.8%) with asymmetry. The mean (SD) operative time was 115.4 min (25.7 min); the mean (SD) total movement of the right and left mandible was 11.2 mm (4.5 mm); and the mean total blood loss was 224.3 mL (range, 95–905 mL).

The short-term group included 74 patients (30 men and 44 women; mean [SD] age, 26.5 years [9.9 years]; range, 16–59 years). Their mean BMI was 21.3 kg/m^2 (range, 7.3–32.7 kg/m^2). Bilateral SSRO was performed in 67 patients (90.5%) with mandibular protrusion (including combined open bite and asymmetry), one patient (1.4%) with mandibular retrusion, three patients (4.1%) with asymmetry, and three patients (4.1%) with open bite. The mean (SD) operative time was 118.5 min (28.0 min); the mean (SD) total movement of the right and left mandibles was 10.9 mm (5.0 mm); and the mean total blood loss was 233.6 mL (range, 65–441 mL). No abnormal intraoperative bleeding was observed and no blood transfusion was administered in either group, and the two groups showed no differences in any of the parameters (Table 2).

Comparison of the incidence of SSIs

The incidence of SSIs did not differ significantly between the two groups ($p = 1.0$) (Table 3), and the

duration of prophylactic administration of antibiotics showed no association with the presence of infection. The results of this analysis are presented in Table 4, which also shows the details of the cases diagnosed with SSIs. All three cases of postoperative infection were resolved by antimicrobial administration, wound drainage, and lavage.

Analysis of factors influencing the occurrence of SSIs

The factors that were potentially associated with SSIs are included in Table 3. Simple regression analysis showed that none of these factors was associated with SSIs.

Discussion

In this study, we conducted a single-center, retrospective, observational study to verify the validity of shortening the postoperative antimicrobial administration period. In our department, until March 2015, we administered antimicrobial agents for 72 h after surgery in all patients, but after April 2015, we shortened the administration time to 12 h after surgery, in accordance with the findings of previous studies

Table 2. Differences in the clinical factors between the SSI (+) and SSI (−) patients

Clinical factor		Total (n=143)	Long-term group (n=69)	Short-term group (n=74)	P-value
Sex	Male	61 (42.7%)	31 (44.9%)	30 (40.5%)	0.5961
	Female	82 (57.3%)	38 (55.1%)	44 (59.5%)	
Age (years)		27.1±9.7	27.9±9.6	26.5±9.9	0.3711
BMI (kg/m^2)		21.3±3.3	21.7±3.6	20.9±2.9	0.1492
Surgery time (min)		117±26.9	115.4±25.7	118.5±28.0	0.4972
Total movement of the right and left jaws (mm)		11.1±4.7	11.2±4.5	10.9±5.0	0.7716
Total bleeding volume (mL)		229±105.8	224.3±119.3	233.6±92.0	0.6005
SSI (+)		3 (2.1%)	1 (33%)	2 (67%)	1.0000
SSI (–)		140 (97.9%)	68 (49%)	72 (51%)	

Data are presented as mean ± standard deviation or number (percentage).
SSI, surgical site infection; BMI, body mass index

Table 3. Differences in the clinical factors between the long- and short-term groups

Clinical factor		SSI (n=3)	not SSI (n=140)	P-value
Sex	Male	0 (0%)	61 (43.6%)	0.1311
	Female	3 (100%)	79 (56.4%)	
Age (years)		36.0±15.6	27.0±9.6	0.1399
BMI (kg/m^2)		22.9±0.95	21.3±3.3	0.3875
Surgery time (min)		134.7±73.0	116.6±25.6	0.2648
Total movement of the right and left jaws (mm)		5.8±7.3	11.2±4.7	0.0721
Total bleeding volume (mL)		134.7±21.5	231.2±106.0	0.0833
Long-term group		1 (1.4%)	68 (98.6%)	1.0000
Short-term group		2 (2.7%)	72 (97.3%)	

Data are presented as mean ± standard deviation or number (percentage).
SSI, surgical site infection; BMI, body mass index

Table 4. SSI cases

	Group	Age (years)	Sex	Time	Location	Symptoms	Treatment
Case 1	Long-term group	26	Female	POD6	Right side mandible	Fever (37.3°C), pain, swelling, redness, and tenderness	Drainage and oral antimicrobial administration
Case 2	Short-term group	54	Female	POD30	Right side mandible	Spontaneous pain, swelling, redness, and pus drainage	Drainage and intravenous antimicrobial administration
Case 3	Short-term group	28	Female	POD7	Right side mandible	Fever (37.5°C), pain, swelling, redness, and tenderness	Drainage and intravenous antimicrobial administration

SSI, surgical site infection; POD, postoperative day

and guidelines[16,17]. The results showed that the incidence of SSIs in patients treated with SSRO alone was 1.4% (1/69) in the long-term group and 2.7% (2/74) in the short-term group, with no significant difference related to the duration of prophylactic antimicrobial therapy. None of the clinical factors involved in SSIs were associated with statistically significant differences, and in patients undergoing SSRO, two doses of 1 g CEZ administered 12 h after surgery could prevent the occurrence of SSIs. However, the small number of SSIs was one of the reasons for the lack of statistical significance in this study.

The premise of our study was based on the findings of a systematic review of long-term and short-term prophylactic antimicrobial regimens after orthognathic surgery, which reported SSIs in 11.2% of the patients in the short-term group, which received antimicrobials within 3 days after surgery, and 3.8% of the patients in the long-term group, which received antimicrobials for more than 4 days after surgery[16]. However, the incidence of SSIs in our hospital was generally low (1.4% in the long-term group and 2.7% in the short-term group). The low incidence of SSIs in this study could be attributed to the fact that the study was conducted at a single institution, and there were few clinical factors that could cause SSIs. In addition, negative-pressure continuous suction drains were placed at the lateral mandibular angles for 1 or 2 days after surgery, and the hospitalization period was 8 days after surgery, which was longer than that in other reports. Moreover, although this study was performed only for patients undergoing bilateral SSRO, the short operative time of 69–218 min (mean, 117 min) in comparison with that reported in the study by Jansisyanont et al.[18] (range, 75–507 minutes) may have been a factor. Based on the incidence of SSIs, the number of patients in each group required for statistical strength was approximately 1800, and it would be difficult to complete the recruitment of such a large number of patients for a study at a single institution. In addition, because the subjects formed a retrospective cohort, there was a temporal gap between the long- and short-term treatment groups. Thus, the findings of this study alone are insufficient to conclude that shortening the duration of postoperative antimicrobial therapy results in non-inferiority of SSIs incidence. In the future, a randomized controlled trial with a larger number of patients in a multicenter setting should be conducted for more definitive verification.

SSRO can be performed for various jaw deformities such as mandibular protrusion, mandibular retrusion, open bite, and mandibular asymmetry. In addition, SSRO is the most frequently performed orthognathic surgery because it allows rapid functional recovery after surgery[19]. However, SSRO is associated with a high incidence of SSIs because it is a semi-clean surgery, and long-term postoperative administration of antimicrobial agents has been recommended to prevent SSIs in SSRO[20]. Nevertheless, antimicrobial resistance (AMR) due to the increased use of antimicrobial agents has been recognized as a problem, and a global action plan on AMR was adopted by the WHO General Assembly in 2015[21]. Thus, the momentum for establishing universal guidelines for the appropriate use of postoperative antimicrobial agents is increasing. However, application

of guidelines from other countries to reduce the incidence of SSIs is complicated by the disparities in medical environments among institutions and countries.

As a general rule for the prevention of perioperative infections, the tissue concentrations of antimicrobial agents must be sufficiently high before performing all surgical procedures[22,23]. Preoperative administration of antimicrobial agents is used to reduce the number of bacteria caused by intraoperative contamination to a level that can be controlled by host defense mechanisms. Efficient and appropriate use of prophylactic antimicrobial agents by clinicians can reduce SSIs, prevent the development of resistant organisms, prevent adverse events caused by antimicrobial agents, shorten hospital stays, and reduce costs, thereby providing higher-quality medical care to patients and significantly affecting treatment outcomes and quality of life[24,25]. Both the WHO and CDC strongly recommend that prophylactic antimicrobial agents should not be administered after wound closure, and further shortening the period of SSI prophylaxis will facilitate the establishment of appropriate use that minimizes the emergence of resistant bacteria and side effects.

Conclusion

In this study, we retrospectively investigated the differences in the incidence of SSIs after SSRO between patients undergoing postoperative antimicrobial therapy for long- and short-term periods at a single institution. In SSROs, two doses of 1 g of CEZ at 12 hours postoperatively can prevent the occurrence of SSI.

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