

## IN BRIEF

- Describes the possibility of cross contamination through the dental operator.
- Describes the possibility of methicillin-resistant *Staphylococcus aureus* (MRSA) contamination on the surfaces of the dental operator.
- Helps to consider adequate infection control (IC) guidelines and effective IC practices on the surfaces of the dental operator.

# Nosocomial transmission of methicillin-resistant *Staphylococcus aureus* via the surfaces of the dental operator

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**Objective** We assess the possibility of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission via the surfaces of the dental operator.

**Methods** A survey of MRSA contamination on the surfaces of the dental operator, and an analysis of MRSA transmission via the dental operator between patients was carried out in the department of special dental care and oral surgery.

**Results** MRSA was observed on the surfaces of dental operator including the air-water syringe and reclining chair. Nosocomial infection or colonisation of MRSA occurred in eight out of 140 consecutive patients who had no evidence of MRSA at admission. Antibigrams of 30 antibiotics revealed that the isolates from the eight patients were of the same strain as those from the surface of dental operator. After treating the patients under a revised infection control (IC) protocol including a single use of barrier covers, MRSA was not detected on the surfaces of the dental operator, and no nosocomial infection or colonisation occurred during hospitalisation (0/117 patients).

**Conclusions** These results suggest that MRSA contaminates the surfaces of the dental operator, and therefore the dental operator should be considered a possible reservoir of MRSA.

## INTRODUCTION

Infection control (IC) is a major problem in dentistry.<sup>1</sup> The contamination of surfaces of the dental operator is of particular concern, as surfaces with viable organisms become potential reservoirs for infection.<sup>2-4</sup> Potentially pathogenic organisms could be transmitted from the patients' mouths or wounds to the fingers of dental staff, and then to any surfaces of the dental operator including switches, hand pieces, light handles, and cabinets.

Many dental professionals have suggested the possibility of cross contamination through the dental operator.<sup>2,5</sup> However, few studies concerning bacterial transmission from one patient to another via the dental operator have been published.

Methicillin-resistant *Staphylococcus aureus* (MRSA) has become endemic in some hospitals.<sup>6,7</sup> Previous studies have demonstrated MRSA contamination on a variety of environmental surfaces in the hospital setting.<sup>6,7</sup> The dental operator may also be contaminated with MRSA and become a potential source of MRSA.

To assess the surfaces of the dental operator as a reservoir of MRSA in the hospital setting, we surveyed MRSA contamination on surfaces of the dental operator in the special dental care and oral surgery ward at our institute. We also examined the possibility of MRSA transmission to patients from the dental operator.

## MATERIALS AND METHODS

This survey was conducted in the ward of the department of Special Dental Care and Oral Surgery at Shinshu University Hospital during the period between January 2001 and November 2002. Patients with oral and maxillofacial diseases are hospitalised, examined and cared for in the treatment room of the ward. There are two dental operatories in this room. On February 8 2002, a surprise survey of environmental contamination with MRSA in the treatment room was carried out. MRSA was detected on the surfaces of several pieces of equipment. To reduce MRSA contamination of the dental operator, we reconsidered our infection control (IC) protocol and added two sentences as stated below:

1. Use single-use barrier covers for the lights, headrest, instrument table, dental vacuum suction and chair control switches for each patient (instead of wiping with alcohol-soaked gauze).
2. Stop the use of air-water syringe.

After the revision of the IC protocol, all doctors, nurses, and related hospital staff were instructed in the new IC protocol and trained on how to implement the barrier technique by the end of March 2002. The treatment room was cleaned using disinfectant (77-81% ethanol) towards the end of March. Patients were completely cared for under the new IC protocol from the beginning of April 2002.

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**Table 1 Results of environmental survey on MRSA contamination in the treatment room**

	Before revision of the IC protocol (February 8 2002)	After revision of the IC protocol (December 6 2002)
Air-water syringe	+ (4 colonies)	—
Dental vacuum suction	—	—
Light handle	—	—
Light switch	—	—
Instrument table	—	—
Reclining chair arm	+ (1 colony)	—
Headrest	—	—
Chair control switch	—	—
Floor	—	—
Cabinet	—	—

**Table 2 Comparison of prevalence of nosocomial MRSA infection or colonisation between the patients hospitalised during periods before (January 2001–January 2002) and after (April 2002–November 2002) the revision of infection control (IC) protocol**

	Nosocomial colonization and infection	
	Positive	Negative
Before revision of the IC protocol (n = 140)	8 patients	132 patients
After revision of the IC protocol (n = 117)	0 patients	117 patients

### Survey of environmental contamination with MRSA (environmental culture)

Environmental culture in the treatment room was carried out before (on February 8 2002) and after the revision of IC protocol (on December 6 2002) using the same schedule and methods. The survey was carried out prior to patient care on Friday morning. Ten portions of the treatment room (Table 1) were checked for bacterial culture. A sterile rayon-tipped cultured swab (swab S1, Toyo Kizai Kagaku, Saitama, Japan) was dampened with 0.15 mol/L saline, and culture samples were obtained by scrubbing the surface of the items with these swabs.

The samples were directly inoculated onto blood agar plates and also cultured in thioglycolate broth. Both sets of samples were incubated for 24 hours at 35 °C. Colonies cultured in the broth were subcultured on blood agar plates for 24 hours at 35 °C.

### Survey of prevalence of patients with MRSA infection or colonisation

All 280 consecutive patients who were hospitalised in the ward during the period between January 2001 and November 2002 were assessed. Surveillance culture of the nasal cavity was performed in all patients just before hospitalisation. Samples from sputum, wound, urine, faeces, blood, etc were also cultured before and during hospitalisation if clinical findings required patient culture. If MRSA appeared in the patients who were without MRSA before hospitalisation, we determined that nosocomial infection or colonisation with MRSA occurred.

The prevalence of MRSA infection or colonisation was compared between the periods before and after the revision of the IC protocol. Twenty-three patients who were treated during the period between February 8 2002 (the day of the first environmental culture) and March 31 2002 (the day before complete implementation of the new IC protocol) were excluded from the study, because the IC protocol was under revision. Consequently, there were 140 patients treated during the period before the revision of the IC protocol (January 2001–January 2002), and 117

patients were treated during the period after that (April 2002–November 2002).

### Identification of MRSA and antimicrobial susceptibility tests

MRSA was identified by using MICroFAST 31J (Dade Behring, West Sacramento, USA). MRSA susceptibilities to 30 antibiotics were also examined by MICroFAST 31J and classified as 'susceptible', 'intermediate', or 'resistant' according to the criteria reported by the National Committee for Clinical Laboratory Standards.<sup>8</sup>

### Statistical analysis

Prevalence of MRSA infection before and after revision of the IC protocol was analysed using Fisher's exact probability test. P values less than 0.05 were considered statistically significant.

### RESULTS

The results of environmental culture of the treatment room are shown in Table 1. Before the revision of the IC protocol, a total of five colonies were isolated, including four from the surface of an air-water syringe and one from a reclining chair arm. After the revision, MRSA contamination was not observed. On the day of the first environmental culture, one patient with MRSA infection (patient I, Table 3) was hospitalised, while on the day of the second sampling, no patients with evident MRSA infection or colonisation were hospitalised.

The results of the surveillance culture of the nasal cavity showed that four patients who were admitted during the period after the revision of IC protocol had MRSA colonisation, while no patients were admitted during the period before it. In addition, there was no evidence of MRSA infection prior to any patient's hospitalisation.

The prevalence of MRSA nosocomial infection or colonisation during the periods before and after the revision of IC protocol is shown in Table 2. MRSA nosocomial infection or colonisation occurred in eight patients (five soft tissue infections, one pneumonia, and two colonisations in sputum) during the period before the revision of the IC protocol, while no nosocomial infection occurred during the period after that. There was a statistically significant difference between incidences of MRSA nosocomial infection before and after the revision of the IC protocol (Fisher's exact probability test,  $P < 0.007$ ).

Antibiograms of isolated MRSA cultures are shown in Tables 3 and 4. During the period before the revision of the IC protocol, 13 MRSA cultures were isolated, and their antibiograms revealed that the isolates from the patients were the same as isolates found on the dental operatory. Antibiograms were similar among the isolates from patients A, C, I, the air-water syringe, and the reclining chair arm; among those from patients B, D, F, and the air-water syringe; and among patients E, G, and the air-water syringe. On the other hand, four MRSA strains isolated after the revision of the IC protocol showed different antibiogram patterns to one another, and did not match those of MRSA cultures isolated before the revision of the IC protocol, except one (which was isolated from the same patient who was hospitalised both before and after the revision of the IC protocol).

### DISCUSSION

From the results of this study, a dental operatory contaminated with MRSA was considered as a possible reservoir of MRSA in the hospital setting. After the revision of the IC protocol, MRSA was not detected on the surfaces of the dental operatory. Sampling selection bias may have occurred and resulted in significant decrease in MRSA in the environment, because environmental culture was carried out at a single point of sampling. Furthermore, one patient with MRSA infection had been hospitalised on the day in which the first environmental culture was carried out. This might have influenced the results

Table 3 Antibigrams of MRSA isolated before revision of the IC protocol

	Patient A Sputum	Patient B Wound	Patient C Wound	Patient D Wound	Patient E Sputum	Patient F Wound	Patient G Sputum	Patient I Wound	A-W syringe A	A-W syringe B	A-W syringe C	A-W syringe D	Chair arm
ABK	S	S	S	S	S	S	S	S	S	S	R	S	S
ABPC	R	R	R	R	R	R	R	R	R	R	R	R	R
AMK	I	S	I	S	R	S	R	I	I	S	R	R	I
CAM	R	R	R	R	R	R	R	R	R	R	R	R	R
CDTR	R	R	R	R	R	R	R	R	R	R	R	R	R
CEZ	R	R	R	R	R	R	R	R	R	R	R	R	R
CFPM	R	R	R	R	R	R	R	R	R	R	R	R	R
CLDM	R	R	R	R	R	R	R	R	R	R	R	R	R
CPDX	R	R	R	R	R	R	R	R	R	R	R	R	R
CPR	R	R	R	R	R	R	R	R	R	R	R	R	R
CPZ/ST	R	R	R	R	R	R	R	R	R	R	R	R	R
CTM	R	R	R	R	R	R	R	R	R	R	R	R	R
CTX	R	R	R	R	R	R	R	R	R	R	R	R	R
CVA/ AMPC	R	R	R	R	R	R	R	R	R	R	R	R	R
CZOP	R	R	R	R	R	R	R	R	R	R	R	R	R
EM	R	R	R	R	R	R	R	R	R	R	R	R	R
FMOX	R	R	R	R	R	R	R	R	R	R	R	R	R
FOM	R	R	R	R	R	R	R	R	R	R	R	R	R
GM	R	R	R	S	R	S	R	R	R	R	R	R	R
IPM	R	R	R	R	R	R	R	R	R	R	R	R	R
LVFX	R	R	R	R	R	R	R	R	R	R	R	R	R
MEPM	R	R	R	R	R	R	R	R	R	R	R	R	R
MINO	I	I	I	I	I	I	I	I	I	I	I	I	I
MCIPC	R	R	R	R	R	R	R	R	R	R	R	R	R
PCG	R	R	R	R	R	R	R	R	R	R	R	R	R
PIPC	R	R	R	R	R	R	R	R	R	R	R	R	R
RFP	S	S	S	S	S	S	S	S	S	S	S	S	S
ST/ ABPC	R	R	R	R	R	R	R	R	R	R	R	R	R
ST	S	S	S	S	S	S	S	S	S	S	S	S	S
VCM	S	S	S	S	S	S	S	S	S	S	S	S	S

ABK, Arbekacin; ABPC, Ampicillin; AMK, Amikacin; CAM, Clarithromycin; CDTR, Cefditoren; CEZ, Cefazolin; CFPM, Cefepime; CLDM, Clindamycin; CPDX, Cefpodoxime; CPR, Cefpirome; CPZ/ST, Cefoperazone/Sulbactam; CTM, Cefotiam; CTX, Cefotaxime; CVA/AMPC, Clavulanic acid/Amoxicillin; CZOP, Cefozopran; EM, Erythromycin; FMOX, Flomoxef; FOM, Fosfomycin; GM, Gentamicin; IPM, Imipenem; LVFX, Levofloxacin; MEPM, Meropenem; MINO, Minocycline; MCIPC, Cloxacillin; PCG, Benzylpenicillin; PIPC, Piperacillin; RFP, Rifampicin; ST/ABPC, Sulbactam/Cefoperazone; ST, Sulfamethoxazole/Trimethoprim; VCM, Vancomycin  
S, Susceptible; I, Intermediate; R, Resistant

of MRSA contamination of the dental operatory. However, the environmental sampling was carried out prior to any patient care and the result of antimicrobial susceptibility tests of isolates from the contaminated dental operatory revealed three different antibiograms other than the isolate from the patient. These results suggested the possibility that the dental operatory was contaminated with MRSA.

Adequate IC protocols and practice are important to prevent MRSA contamination of the surfaces of the dental operatory. Williams *et al.*<sup>2</sup> reported that institution of sound IC practices can reduce surface bacterial contamination. Before the revision of our IC protocol, disinfection was not complete, although the dental operatories were chemically disinfected every morning and between patients. Therefore, we started to use disposable

Table 4 Antibigrams of MRSA isolated after revision of the IC protocol

	Patient J Nasal cavity	Patient B Nasal cavity	Patient K Nasal cavity	Patient L Nasal cavity
ABK	S	S	S	S
ABPC	R	R	R	R
AMK	R	S	S	S
CAM	R	R	R	R
CDTR	R	R	R	R
CEZ	R	R	R	R
CFPM	R	R	R	R
CLDM	R	R	R	R
CPDX	R	R	R	R
CPR	R	R	R	R
CPZ/SBT	R	R	R	R
CTM	R	R	R	R
CTX	R	R	R	R
CVA/AMPC	R	R	R	R
CZOP	R	R	R	R
EM	R	R	R	R
FMOX	R	R	R	R
FOM	S	R	R	R
GM	R	R	S	S
IPM	R	R	R	R
LVFX	S	R	I	I
MEPM	R	R	R	R
MINO	S	I	S	I
MCIPC	R	R	R	R
PCG	R	R	R	R
PIPC	R	R	R	R
RFP	S	S	S	S
SBT/ABPC	R	R	R	R
ST	S	S	S	S
VCM	S	S	S	S

ABK, Arbekacin; ABPC, Ampicillin; AMK, Amikacin; CAM, Clarithromycin; CDTR, Cefditoren; CEZ, Cefazolin; CFPM, Cefepime; CLDM, Clindamycin; CPDX, Cefpodoxime; CPR, Cefpirome; CPZ/SBT, Cefoperazone/Sulbactam; CTM, Cefotiam; CTX, Cefotaxime; CVA/AMPC, Clavulanic acid/Amoxicillin; CZOP, Cefozopran; EM, Erythromycin; FMOX, Flomoxef; FOM, Fosfomicin; GM, Gentamicin; IPM, Imipenem; LVFX, Levofloxacin; MEPM, Meropenem; MINO, Minocycline; MCIPC, Cloxacillin; PCG, Benzylpenicillin; PIPC, Piperacillin; RFP, Rifampicin; SBT/ABPC, Sulbactam/Cefoperazone; ST, Sulfamethoxazole/Trimethoprim; VCM, Vancomycin S, Susceptible; I, Intermediate; R, Resistant

barriers based on the evidence that use of disposable barriers in dental operatories can result in a greater increase of IC effectiveness than chemical surface disinfection.<sup>9</sup> Compliance with and awareness of the revised IC protocol are also important to increase its effectiveness. In our case, all doctors, nurses,

and other related hospital staff participated in the revision of the IC protocol and were trained for the barrier technique over a period of a month. After the revision of the IC protocol, MRSA was not detected on the surfaces of the dental operator and no patients were newly infected or colonised with MRSA during hospitalisation.

The present study suggested the possibility that MRSA was transmitted to patients from the surfaces of the dental operator via the hands or gloves of the medical staff. It may also be a possibility that the patients were already colonised with MRSA before their hospitalisation. In this study, surveillance culture of the nasal cavity showed that nosocomially infected or colonised patients had no MRSA prior to their hospitalisation, although it has been reported that sensitivity of the nasal culture is approximately 85%. In the results of this study, antibiograms showed that the isolates that were obtained from the patients infected or colonised during hospitalisation and from the surfaces of the dental operator were the same strain or closely related strains, although we did not perform genotypic analysis of isolates. In addition, MRSA transmission to the patients was not detected after successful control of MRSA contamination of the dental operator. Although potentially unaccounted-for temporal confounders might have resulted in the observed changes in the before-after study, these findings suggest that surface contamination of the dental operator may be one of the causes of nosocomial infection with MRSA.

Unfortunately, this study lacked data concerning the possibility of other sources of contamination being the cause of the patient infection or colonisation, eg nasal carriage of MRSA among the staff. Additionally, the increased awareness of enhanced infection control measures may have been the main reason for the reduction of environmental contamination and patient infection or colonisation. However, as shown in this study, the dental operator can be contaminated with MRSA and this contamination might become a possible source of nosocomial infection or colonisation in the hospital setting. Our results also suggest that awareness of adequate IC guidelines and effective IC practices can reduce MRSA contamination on the surfaces of dental operatories and nosocomial infection with MRSA.

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