

# Cervicofacial Infections Caused by *Staphylococcus aureus*

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## Abstract

*Staphylococcus aureus* (*S. aureus*) is an opportunistic pathogen that causes a wide range of diseases. Dissemination of perioral infections is a common problem in the field of oral and maxillofacial surgery. The aim of the study was to evaluate *S. aureus* carriage in the oral cavity and its dissemination to different cervicofacial regions. Clinical case 1 is a patient with a systemic history of type I diabetes which led to foot amputation one year previously, who presented alteration of ocular motility and the culture showed Grampositive cocci compatible with *S. aureus*. The patient was discharged after eight days of antibiotic therapy and drainage. Clinical case 2 was a young female without any comorbidities who had never been hospitalized before or even exposed to the hospital environment. The presence of lesions compatible with necrotizing fasciitis (NF) in the lower lip mucosal region, rapid evolution of the infection to deep planes, and evolution of the clinical picture alerted health-care providers to the need for prompt care. Clinical case 3 was an immunosuppressed patient with cellulitis which is a bacterial infection of the skin and soft tissues that occurs when the physical barrier of the skin and soft tissues, the immune system, and/or the circulatory system are affected. *S. aureus* is an opportunistic pathogen which causes a wide range of diseases. It inhabits the oral cavity, from where it can spread to distant cervicofacial regions. This is why it is important for health-care professionals to be aware of this niche in case of dissemination in order to provide prompt diagnosis and appropriate treatment.

**Keywords:** Dissemination, opportunistic microorganisms, *Staphylococcus aureus*

## INTRODUCTION

*Staphylococcus aureus* is an opportunistic pathogen that causes a wide range of diseases. Dissemination of perioral infections is a common problem in the field of oral and maxillofacial surgery. Recent research has established that once phagocytosed by neutrophils and macrophages, a certain percentage of *S. aureus* is able to survive within those phagocytes, which may even contribute to dissemination of the pathogen. *S. aureus* also induces its uptake by nonphagocytic cells, and the ensuing intracellular cytotoxicity is suggested to lead to tissue destruction, while bacterial persistence within cells is thought to lead to evasion from the immune response leading to chronic infections.<sup>[1]</sup>

Infections caused by methicillin-resistant *S. aureus* (MRSA) have been associated to worsened posttreatment outcomes and higher costs for health-care systems than susceptible infections (methicillin-susceptible *S. aureus* [MSSA]). Klein *et al.* found that although MRSA infections had previously been associated with higher hospitalization costs, the costs

associated with MSSA-related infections have caught up or even exceeded them.<sup>[2]</sup>

Among the pathologies that may be caused by MSSA, endophthalmitis is a rare, serious inflammation of intraocular tissues and fluids, which affects the anterior and posterior ocular segments and adjacent sclera. Endophthalmitis of any kind, whether exogenous or endogenous, may lead to a significant reduction in visual acuity and in the worst of cases cause loss of the affected eye. Exogenous endophthalmitis is caused by microbial pathogens entering the eye after surgery or trauma or infiltrating through the surface. Microbial keratitis-induced endophthalmitis is a

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**How to cite this article:** Lazarte C, Paladino L, Mollo L, Katra R, Isabel BM, Puia SA. Cervicofacial infections caused by *Staphylococcus aureus*. Ann Maxillofac Surg 2019;9:459-64.

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disease that puts vision at risk, often presenting the worst possible visual outcome.<sup>[3,4]</sup>

Literature reports a wide range of prevalence rates, probably due to the lack of a common definition for microbial keratitis, which is even more lacking for microbial keratitis-induced endophthalmitis. Inconsistencies in routine smear tests for initially mild cases of keratitis which later turn into endophthalmitis may further obscure the accurate estimation of microbial association and detection rates.<sup>[5]</sup> We present herein three clinical cases to illustrate this.

Jagadish Chandra showed that *Staphylococcus* species are the most common pathogens in orofacial infections originating from odontogenic infections.<sup>[6]</sup> Cuesta *et al.*<sup>[7]</sup> identified MRSA in 7.3% of periodontal pockets and 7.3% of oral cavities.

Community-acquired MRSA (CA-MRSA) infections have also been reported to occur in immunocompetent individuals without risk factors traditionally associated to CA-MRSA HEA-MRSA.<sup>[8]</sup>

Of course, it has also been reported to be increased in immunosuppressed individuals, with *Staphylococcus* being one of the major hospital-acquired pathogens with risk of mortality. It is one of the most common bacteria in the skin and can, therefore, cause dermatitis or disseminate from a wound.<sup>[9]</sup>

*S. aureus* is a colonizer present in approximately 30%–50% of skin and mucosa<sup>[10]</sup> and is capable of incorporating genetic material from other microorganisms, thereby increasing its virulence and resistance to antimicrobial agents.<sup>[11]</sup>

## Aims

The aim of the study was to evaluate *S. aureus* carriage in the oral cavity and its dissemination to different cervicofacial regions.

## CLINICAL CASES

### Clinical case 1

Clinical case 1 is a 29-year-old male patient with a systemic history of type I diabetes which led to foot amputation 1 year previously, who visited the emergency room at Eva Perón Municipal Hospital in Merlo, Buenos Aires Province, Argentina. He presented with a right orbital abscess [Figure 1a].

The patient presented alteration of ocular motility (unable to open). Routine blood tests were performed, finding high blood sugar and ketoacidosis. Medical consultation was requested with clinical medicine, ophthalmology, and maxillofacial surgery. It was decided to hospitalize the patient [Figure 2a].

The maxillofacial surgery service requested a computer tomography (CT) scan of the head and performed drainage from which a sample was taken for culture [Figure 3a]. The Department of Infectious Diseases prescribed a regimen of amoxicillin plus sulbactam 1.5 mg plus clindamycin 600 mg every 6 h. The culture showed Gram-positive cocci compatible with *S. aureus*.

The patient was discharged after eight days. After discharge from the hospital, he was afebrile and hemodynamically stable and therefore continued with follow-up at maxillofacial, clinical medicine, and Infectious Diseases outpatient offices [Figure 4a].

### Clinical case 2

Clinical case 2 is a 31-year-old female patient with no systemic history, who visited the emergency room at Eva Perón Municipal Hospital in Merlo, Buenos Aires Province, Argentina. She presented with fever, edema, erythema and pain in the mandible of five days duration.

Cervicofacial examination showed a diffuse induration in the submental region with increase in volume [Figure 1b]. Lower labial mucosa presented a 2 cm × 1.5 cm ulcerated lesion with erythematous borders, indurated and painful [Figure 2b]. It was decided to hospitalize the patient under diagnosis of presumptive NF.

Craniofacial scan showed a small hypodense area with diffuse contours and the presence of multiple nodal formations in submaxillary and submental regions, with a tendency to being grouped, in nonadenomegaly range [Figures 3b and 4b].

Ultrasound was used to explore left hemiface, submaxillary region and at the level of the mandibular angle. It identified an increase in the thickness of subcutaneous cellular tissue associated with an increase in echogenicity of fatty planes and some enlargement of nodes as well as a small mass 9 mm × 5 mm located at the point of the left mandibular angle.

A sample was taken for culture and the patient was indicated for emergent drainage of the submental region [Figures 5 and 6].

Due to suspected sepsis by *S. aureus* and *Streptococcus* spp., antibiotic coverage was indicated with clindamycin 600 mg and vancomycin 1 g every 12 h.

Soft-tissue culture indicated clindamycin- and erythromycin- sensitive, oxacillin-resistant *S. aureus*. Prognosis for the patient was favorable [Figures 7-9].

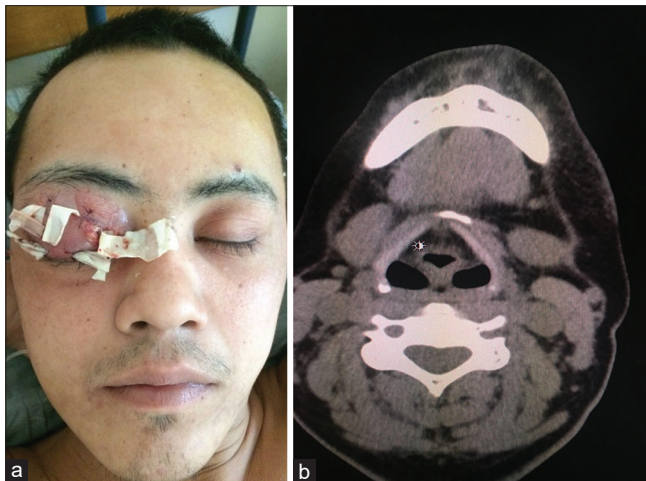
### Clinical case 3

Clinical case 3 is a 69-year-old male patient with a systemic history of tuberculosis, colon cancer, colostomy, and peritonitis [Figure 1c]. He visited the emergency room at Eva Perón Municipal Hospital in Merlo, Buenos Aires Province, Argentina. He presented with cervical cellulitis on the right side of 14 days duration, signs of dehydration, and hypotension. He reported dysphagia and weight loss. Cervicofacial examination showed an increase in volume in the right submaxillary region that was diffusely swollen and painful with seropurulent discharge. The patient also had trismus. Consultation was held with maxillofacial surgery, clinical medicine, and nutrition. CT scan of the head and neck was requested. Drainage was performed after taking a sample for culture. The patient was hospitalized. Amoxicillin plus sulbactam 1.5 every 6 h was indicated. Soft-tissue culture results indicated *S. aureus*. When the patient was discharged, he was afebrile and hemodynamically stable and tolerated





**Figure 1:** (a) Case 1, Right orbital abscess. (b) Case 2, Increase in volume in the labial, submental, and submaxillary regions. Presence of crusts in lower labial half-mucous. (c) Case 3, Volume increase of the right submaxillary region, with purulent secretion



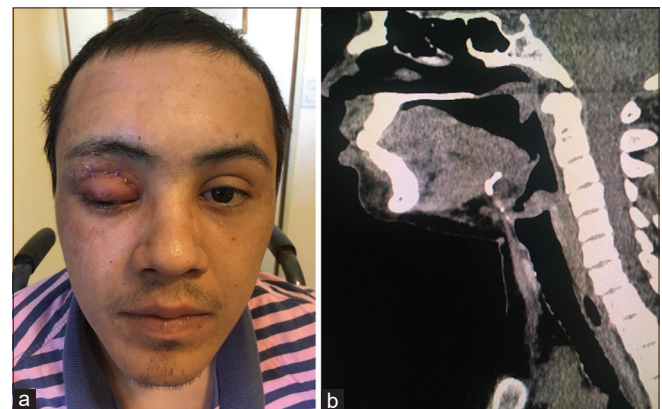
**Figure 3:** (a) Case 1, After the drainage surgery, some laminar drains are placed (b) Case 2, Computed axial tomography of the craniofacial massif. Hypodense image of diffuse contours in the submental and submaxillary regions



**Figure 5:** Case 2, Surgical debridement of necrotizing fasciitis



**Figure 2:** (a) Case 1, Axial computed tomography of the craniofacial massif. Purulent collection is observed. (b) Case 2, Ulcer in mucosa of the lower lip with multiple foci of tissue necrosis. (c) Case 3, Favorable postoperative evolution



**Figure 4:** (a) Case 1, Favorable postoperative evolution. (b) Case 2, Computed axial tomography of the craniofacial massif. Hypodense image of diffuse contours in the submental and submaxillary regions

food by mouth, and colostomy was permeable. Follow-up was performed at maxillofacial, clinical medicine, Infectious Diseases, and nutrition outpatient offices [Figure 2c].

## DISCUSSION

*S. aureus* causes a wide variety of infections ranging from minor skin infections to infections of postoperative wounds. The ability of *S. aureus* to adapt to antibiotics led to the emergence of MRSA in the 1960s. The cause of its resistance to methicillin and all other beta-lactam antibiotics is the *mecA* gene, which is located on a mobile genetic element: the staphylococcal cassette chromosome *mec* (SCC*mec*). There are seven main variants of SCC*mec*: types I to VII. The first MRSA clones





**Figure 6:** Case 2, Laminar drains in the submental region



**Figure 7:** Case 2, Postoperative. 3 days after surgery



**Figure 8:** Case 2, Favorable postoperative evolution of the inferior labial semi-mucosa



**Figure 9:** Case 2, Favorable postoperative evolution of the mucosa inferior labial

were associated with hospital-acquired infections (HA-MRSA). However, as from the late 1990s, CA-MRSA clones emerged worldwide. *S. aureus* compared to HA-MRSA and CA-MRSA is often associated with the presence of the toxin Pantone–Valentine leukocidin. However, in recent years, the distinction between HA-MRSA and CA-MRSA has begun to disappear, and CA-MRSA is now endemic in many hospitals.<sup>[12]</sup> This is a matter of concern to health-care professionals around the world, who endeavor to find new therapeutic strategies for patients who do not respond to the usual medication.<sup>[13,14]</sup>

*S. aureus* is an opportunistic bacterium able to colonize the skin and mucosal membranes in humans and different animal species. Sepsis leads to death in patients with critical diseases. One of the main pathogens responsible for hospital-acquired sepsis is *S. aureus*. The different responses of patients according to their immune status suggest that immune status is an important clinical indicator which should be taken into account in the treatment of septic patients as well as in the development of new immunomodulating therapies.<sup>[13,14]</sup>

*S. aureus* is the most frequent pathogen in serious skin and soft-tissue infections, including toxic shock syndrome,

myonecrosis/gas gangrene, and NF. Intensive care, control of the source of infection, and broad-spectrum antimicrobial agents are required to treat the initial phase of the disease. Increasing attention is being given to the usefulness of rapid diagnostic tests to help in selecting and reducing the antimicrobial agents for these pathologies. In addition, clinical prediction patterns have proven promising to help predict which patients do not require antimicrobial agents against MRSA. Immune status has been shown to be important in clinical outcomes of some, though not all types of serious infections. The debate regarding the benefits of intravenous immunoglobulin continues in recent literature.<sup>[15,16]</sup>

Long-term mortality following bacteremia by *S. aureus* is very high. The risk factors associated to long-term mortality were similar to those found for short-term mortality. To improve long-term survival, patients should undergo screening for comorbidity factors associated with *S. aureus* bacteremia.<sup>[17]</sup>

Community-acquired *S. aureus* bacteremia is a serious infection with harmful clinical effects. Chronic diseases are some of the main risk and prognosis factors for this infection. The

prevalence of diabetes and heart failure is increasing rapidly worldwide; nevertheless, there is little available information to specifically elucidate the influence of these chronic conditions on the risk and outcome of community-acquired *S. aureus* bacteremia.

It is with the aim of increasing current knowledge that we wish to record the clinical cases presented herein.<sup>[18]</sup>

*S. aureus* bacteremia causes 20%–40% mortality within 30 days of acquisition in developed countries. Diabetes mellitus is associated to considerable morbidity–mortality. The mortality rate is, therefore, higher in patients with both pathologies than in patients without diabetes.<sup>[19]</sup> The underlying disease, in turn, favors dissemination, for example, to the ocular zone. *S. aureus* is one of the main pathogenic agents in ocular infections including conjunctivitis, keratitis, and endophthalmitis.<sup>[20,21]</sup> It can infect lachrymal duct, eyelid, conjunctiva, cornea, anterior and posterior chambers, and vitreous chamber. Of these infections, those involving the cornea (keratitis) or internal eye chambers (endophthalmitis) are the most threatening due to their potential for causing loss of visual acuity or even blindness.<sup>[22,23]</sup>

*S. aureus* can also cause NF, a rare infection of the skin and soft tissue involving a rapidly progressive necrosis of surface fascia. If not treated in time, it may cause morbidity and rapid mortality of up to 73%.<sup>[24]</sup> It is usually caused by inoculation of bacteria in the skin by direct attack or hematogenous dissemination. Beta-hemolytic streptococci (*Streptococcus pyogenes*) are usually associated to NF. Although it is considered rare, *S. aureus* is an emerging etiology for NF due to the increasing incidence of CA-MRSA. As in the clinical cases described herein, treatment is usually surgical with exploration and tissue debridement plus antibiotic therapy.<sup>[25]</sup> In clinical case 2, we presented a young female patient without risk factors who had not been hospitalized or had any prior exposure to a hospital environment. The presence of lesions compatible with NF in the lower lip mucosal region, rapid evolution of the infection to deep planes, and evolution of the clinical picture alerted health-care providers to the need for prompt care.

Clinical case 3 was an immunosuppressed patient with cellulitis, which is a bacterial infection of the skin and soft tissues that occurs when the physical barrier of the skin and soft tissues, the immune system, and/or the circulatory system is affected.<sup>[26]</sup> Patients with cancer who receive chemotherapy and/or radiotherapy are prone to many changes such as immunosuppression, imbalance of the microbiome, hyposalivation, and local tissue damage.<sup>[27]</sup>

It should be noted that recent research has established that once phagocytized by neutrophils and macrophages, a certain percentage of *S. aureus* is able to survive within those phagocytes, which may even contribute to dissemination of the pathogen. *S. aureus* induces its uptake by nonphagocytic cells, and the ensuing intracellular toxicity is suggested to

lead to tissue destruction, while bacterial persistence within cells is thought to lead to evasion of the immune response and chronicity of the infections.<sup>[1]</sup>

## CONCLUSION

*S. aureus* is an opportunistic pathogen which causes a wide range of diseases. It inhabits the oral cavity, from which it can spread to distant cervicofacial regions. This is why it is important for health-care professionals to be aware of this niche in case of dissemination in order to provide prompt diagnosis and appropriate treatment.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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