

## Case Report

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# *Staphylococcus epidermidis* And *Staphylococcus xylosus* In A Secondary Root Canal Infection With Persistent Symptoms: A Case Report

## Abstract

The aim of this case report is to highlight the importance of maintaining the aseptic chain during endodontic treatment. This paper describes a clinical situation in which persistent symptoms had developed after the first appointment to treat a vital pulp case. Microbiological analysis of the case indicated that symptoms were probably due to a secondary root canal infection by two species of coagulase-negative staphylococci – *Staphylococcus epidermidis* and *Staphylococcus xylosus*. Symptoms had persisted in spite of using various intracanal antimicrobial agents and systemic antibiotic therapy.

## Introduction

Staphylococci are non-motile, non-spore-forming, catalase-positive, facultatively anaerobic cocci that can occur singly, in pairs, or in irregular clumps (1). Staphylococci have been associated with several human infections and some species can even be implicated in life-threatening infections especially in compromised individuals. Their major habitats appear to be the skin and mucous membranes of humans and other animals.

Although staphylococci are not usually considered to be normal inhabitants of the oral cavity, some species, particularly *Staphylococcus epidermidis*, have been found in saliva samples from healthy individuals (2, 3). In addition to *S. epidermidis*, other *Staphylococcus* species have also been isolated from oral samples, including *Staphylococcus aureus*, *Staphylococcus haemolyticus*, *Staphylococcus hominis*, *Staphylococcus warneri*, *Staphylococcus saprophyticus*, *Staphylococcus simulans* and *Staphylococcus xylosus* (3). Species of staphylococci have also been isolated from oral infectious diseases including osteomyelitis of the jaw, parotitis, peri-implantitis, root surface caries, severe marginal periodontitis, refractory marginal periodontitis, and root canal infections (2, 3). A wide range of potential virulence factors have been reported for staphylococci,

including cell surface adhesins, extracellular material, haemolysins, lipases, proteases, hyaluronidase, nucleases and enterotoxins (1, 3). In addition, there are reports of the emergence of multidrug-resistant staphylococcal species, especially causing nosocomial infections (1, 3, 4).

This paper reports a clinical case in which two coagulase-negative staphylococcal species were found associated with a secondary root canal infection causing persistent symptoms. The possible pathways of such secondary infection are also discussed.

## Case Report

A 31-year-old healthy woman had undergone a total of four appointments for root canal treatment of a mandibular first molar. Information obtained from the endodontist indicated that the pulp was vital and exposed to the oral cavity by caries. The patient reported that the tooth was asymptomatic at the initial visit with the endodontist. After the first visit, she complained of persistent mild pain and tenderness to mastication, which persisted during the following appointments. According to the information from the practitioner, symptoms persisted even after use of several intracanal antimicrobial agents, including sodium hypochlorite, chlorhexidine digluconate and calcium hydroxide. Rubber dam was always used during intracanal procedures and the tooth was never left open. It was also reported that there was empirical use of systemic antibiotic therapy with ampicillin and further with cephalexin (both recommended by a second practitioner who had not examined the patient). However, these drugs were ineffective in relieving symptoms.

At the fourth visit with the first endodontist, symptoms were absent and the practitioner proceeded with the filling of the root canals (Fig. 1). However, afterwards, symptoms recurred and the patient was then referred to the authors to obtain microbiological samples of the root canals. Samples were collected using strict asepsis.

Briefly, teeth were cleansed with pumice, isolated with rubber dam, and the surrounding field cleansed with 3% hydrogen peroxide and then decontaminated with iodine, which was further inactivated with sterile 5% sodium thiosulfate. According to the



Figure 1: Radiograph of the mandibular first molar with persistent symptoms during endodontic therapy. Note that one of the mesial canals was not filled. This radiograph was obtained before removal of the root canal filling for sample collection.

endodontist's information, although the three root canals had been instrumented, only two were obturated and the other was medicated with a calcium hydroxide paste. The root canal fillings in the two canals and the medication in the other canal were mechanically removed using files and sterile saline solution. The root canals were then filled with sterile saline solution and a K-type file (Dentsply/Maillefer, Ballaigues, Switzerland) was introduced to a level approximately 1 mm short of the tooth apex, based on diagnostic radiographs, and a discrete filing motion was applied in each canal. Three sequential paper points were then placed to the same level and used to soak up the fluid in each of the three root canals. Each paper point was retained in position for 1 minute. Paper points were then transferred to a tube containing pre-reduced anaerobically sterilised brain heart infusion broth and immediately sent to the laboratory.

The samples were inoculated onto rich, non-selective blood agar plates. Plates were observed daily for growth except anaerobic plates, which were assessed after seven days of culture. Identification was based on oxygen tolerance, Gram-staining and microscope features, colony morphology, and biochemical characterisation, including the catalase test, coagulase test, hydrolysis reactions and fermentation patterns. Susceptibility to novobiocin was also checked.

The two bacterial species identified from the root canal samples were *S. epidermidis* and *S. xylosus*. Identification of these species was according to Baron et al (5). Antibiotic susceptibility testing was also performed for the identified bacterial species, using the disk diffusion method and the findings are shown in Table 1.

During the microbiological identification procedures, the patient sought a second practitioner who revealed that the patient was asymptomatic after re-instrumentation and intracanal medication with calcium hydroxide/chlorhexidine gluconate paste. Therefore, he proceeded with the root canal filling. According to the dentist's information, the tooth was slightly symptomatic for the first week after completion of the treatment and then it became asymptomatic. The patient was then referred for the permanent coronal restoration.

## Discussion

Secondary intraradicular infections are caused by microorganisms that were not present in the primary infection and have penetrated the root canal system during treatment, between appointments, or after the conclusion of the endodontic treatment (6). The main

**Table 1: Profiles of antibiotic susceptibility of the two coagulase-negative staphylococci isolated from a secondary root canal infection.**

Antibiotic	<i>Staphylococcus epidermidis</i>	<i>Staphylococcus xylosus</i>
Amoxycillin/potassium clavulanate	S	S
Ampicillin	S	S
Cefazolin	S	S
Cefotaxime	S	S
Cephalothin	S	S
Ciprofloxacin	S	S
Clindamycin	S	I
Erythromycin	R	S
Gentamycin	S	S
Imipenem	S	S
Oxacillin	S	S
Penicillin	S	S
Rifampin	S	S
Tetracycline	S	S
Vancomycin	S	S

S = susceptible; R = resistant; I = intermediate.

sources of contamination of the root canal system during treatment include remnants of dental plaque, calculus or caries on the tooth crown, leaking rubber dam, contamination of the endodontic instruments (as for instance, after touching the instrument cutting edges with fingers), and contamination of irrigant solutions or other solutions for intracanal use (such as saline solution, distilled water, citric acid, etc) (6).

In the present case, the patient had reported that the first endodontist used to wrap cotton wool around the files to dry the root canals. This may have been the likely cause of contamination of the root canal system with microorganisms from the skin. However, other causes as indicated above, might have been responsible for the secondary root canal infection during treatment. Moreover, the possibility exists that microorganisms could have entered the root canal system between the appointments or even after the first root canal filling. This may occur due to leakage through the temporary/permanent restorative material, breakdown, fracture or displacement of the temporary/permanent restoration, or fracture of the tooth structure (6).

Regardless of the pathway, if the penetrating microorganisms are successful in surviving and colonising the root canal system, a secondary infection may ensue. Secondary infection can become persistent if microorganisms in some way resist the intracanal procedures of disinfection. If microorganisms persist in the root canal at the time of root filling, there is a higher risk that the treatment will result in failure (7).

For the patient in this report, empirical antibiotic therapy was recommended by practitioners after persistence of symptoms despite successive interventions. However, the antibiotics were not effective in relieving symptoms. This procedure merits some consideration. Firstly, this is not a reasonable indication for antibiotic

usage in endodontics because bacterial species within the root canal are usually unaffected by systemically administered antibiotics. Secondly, another practitioner had recommended antibiotic therapy without even examining the patient, which is an unacceptable procedure. Finally, if the root canal was secondarily infected with other species, antibiotic therapy might have selected resistant staphylococci within the root canal system. This last consideration is highly unlikely because both staphylococcal species isolated were susceptible to both clinically-used antibiotics in laboratory tests, though discrepancies can occur between laboratory and clinical efficacy of antibiotics.

Staphylococci have been occasionally isolated from primarily infected root canals (8). In the present case of secondary infection, the associated microbiota was composed only of two species of coagulase-negative staphylococci – *S. epidermidis* and *S. xylosus*. There have been few reports concerning the isolation of *S. epidermidis* from endodontic infections (9, 10). Isolation of *S. xylosus* is a more rare occurrence.

Coagulase-negative staphylococci, particularly *S. epidermidis*, are an increasingly important cause of nosocomial infection. *S. epidermidis* usually occurs as an opportunistic pathogen in a wide range of infections, including those related to indwelling medical devices, postoperative infections, bacterial keratitis, infections of patients undergoing immunosuppressive therapy and some oral infections, such as gingivitis, periodontitis, periradicular abscesses and root canal infections (1, 11–13). Its virulence factors may include proteases, lipases, hyaluronidase, lipoteichoic acid, haemolysins, slime production and multi-drug resistance (1, 3, 4, 11–14). Although *S. xylosus* has not been long considered an important pathogenic bacterial species, it has been isolated in elevated proportions in actively destructive periodontal disease, which was non-responsive to conventional surgical treatment and systemic tetracycline therapy (15). Moreover, *S. xylosus* has also been found in cases of endocarditis, acute pyelonephritis, and other opportunistic infections in immunocompromised individuals (16–18).

Staphylococci have generally a commensal relationship with the host. However, under certain situations, as reported in this paper, they can gain entry into the host tissue and may develop the life-style of a pathogen. Success in the new life-style will depend on whether microorganisms adapt to the new environment, obtain nutrients, multiply and induce tissue damage.

While the pulp remains vital, it has been long recognised that infection is restricted to the coronal portion that is exposed to caries and/or saliva. If an infection establishes itself after the initial appointment in vital cases, it appears obvious that microorganisms were introduced into the root canal system during treatment, between appointments or after treatment. The case reported herein was a vital pulp case that clearly became infected after endodontic intervention probably as a result of a break in the aseptic chain.

## Conclusions

Maintenance of the aseptic chain during treatment is paramount in endodontic therapy to prevent infection in vital cases, and to prevent the introduction of new microbial species other than the members of the primary infection in cases of infected necrotic pulps. This case report further stresses the need to perform endodontic treatment under strict aseptic conditions, because some cases of secondary infection may be even more difficult to treat than the primary infection and may result in persistent symptoms and/or failure of the root canal treatment.

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