Actinomycosis in radicular cyst: a case report and literature survey

Yan Sun¹, Kayo Kuyama¹, ³, Sisilia Fusi Fifita¹, Toshio Nogami², Kenji Fukui¹, Toshirou Kondoh², Hirotsugu Yamamoto¹

¹Department of Oral Pathology, Nihon University School of Dentistry at Matsudo, Matsudo, Japan
²Department of Maxillofacial Surgery, Nihon University School of Dentistry at Matsudo, Matsudo, Japan
³Department of Forensic Medicine, The Jikei University School of Medicine, Minato-ku, Tokyo, Japan

Abstract: A case of radicular cyst with actinomycosis in a 36-year-old man is described. The cyst, a well-circumscribed radiolucent lesion in the anterior region of the maxilla, was first noticed by the patient's dentist. Computed tomography indicated a cystic area with low density, which included the roots of upper lateral teeth, and revealed a root fracture of the right central incisor. The surgically-removed sample was histopathologically diagnosed as radicular cyst. In addition to usual histological findings of its cyst wall, the cyst was shown to contain actinomycotic flora, which is extremely rare. In the literature, 13 cases of actinomycosis in odontogenic cysts have been documented. Their clinicopathological features, together with those of our case, were reviewed. They involved mainly the maxilla, and the male/female ratios were almost equal. All of the cases were extirpated by conventional surgery. Although their clinical courses were mostly uneventful, bacterial infection occasionally led to aggressive and locally destructive changes.


Key words: actinomycosis, Grocott’s stain, jawbone, odontogenic cyst, radicular cyst

Correspondence: Hirotsugu Yamamoto, Department of Oral Pathology, Nihon University School of Dentistry at Matsudo, 2-870-1 Sakaecho-Nishi, Matsudo 271-8587, Japan Phone & Fax: +81-47-360-9335, E-mail: yamamoto.hirotsugu@nihon-u.ac.jp

Introduction

Actinomyces is one of the natural floras of the oral cavity. More than twenty strains of Actinomyces, which are anaerobic or facultative anaerobic, non acid-fast, Gram-positive and filamentous bacteria, have been so far demonstrated in humans, and new ones are still being found based on advanced molecular technologies (1). Of all the strains causing human actinomycosis infection, Actinomyces israelii is by far the principal agent of human actinomycosis (2).

Clinically, human actinomycosis most commonly involves the cervicofacial area, followed by the thoracic and abdominal areas, such as the lung and esophagus, and the intracranial region (3-4). In addition to periapical actinomycosis, which is rather common among cervicofacial cases, a small number of cases related to odontogenic cysts have been documented in the literature. The normal inhabitant actinomyces of the oral cavity might become pathogenic in association with dental extraction, dental caries, periodontal diseases, or trauma of the mucosa (5), while the pathogenetic details concerning Actinomycotic species remain unknown.

In this report, we describe an unusual presentation of actinomycosis in a radicular cyst. The associated literature was reviewed in order to have a clinicopathological understanding of the disease.

Case report

A 36-year-old man visited a private dental clinic for a carious maxillary left second molar. The patient was asymptomatic except for the carious tooth. However, radiographic examination revealed a round well-circumscribed radiolucency around the anterior teeth of the maxilla at the same time (Fig. 1a), so the patient was referred to Nihon University Matsudo Hospital for further treatment. Grossly, there was soft swelling extending from the labial to palatal gingiva of the right maxillary anterior region. According to the patient’s dental history, endodontic treatment had been previously performed on these anterior teeth. Furthermore, the root of the right central incisor was absorbed and an impacted median retrograding supernumerary tooth was present (Fig. 1b). Computer tomography (CT) indicated a low-density area of 2 × 2 × 3 cm including the root of upper lateral teeth, and revealed a fractured root in the central incisor. The maxillary bone was expanded due to the cystic lesion, and the labial cortical bone showed thinning and a significant loss of palatal cortical bone mass. Imaging indicated a diagnosis of radicular cyst.
To exclude a neoplastic lesion, fine needle aspiration (FNA) diagnosis was done and 10 cc of cystic fluids were collected. The cytological features included inflammatory change with foamy cells accompanied by erythrocytes. A bacterial test was performed; Gram-positive/negative bacteria and obligate anaerobes were not cultured.

Under general anesthesia, the patient underwent surgical removal of the cyst. The procedure was as follows: removal of cyst, extraction of the right upper central incisor and impacted tooth, and root amputation of the right upper lateral tooth. No adhesion between the cyst and surrounding cortical bone was shown, and abruption was easy. No keratin or crystal-like substance was found in the cyst, but it was full of purulent content. The patient made an uneventful recovery over the following two months.

The surgically removed soft tissue was a whitish to brownish soft cyst-like lesion. The specimen was fixed in 10% buffered formalin solution and routinely processed for paraffin embedding. It was stained with hematoxylin and eosin (HE). Serial sections were used for periodic acid Schiff reaction (PAS), methenamine silver-nitrate-Grocott’s variation (Grocott’s stain), Ziehl-Neelsen stain, and MacCallum-Goodpasture method for Gram positive and Gram negative bacteria (Gram stain).

**Histopathological findings**

Microscopically, the cystic wall was composed of granulation tissue lined by non-keratinized stratified squamous epithelia with irregular elongated rete pegs. The granulation tissue contained inflammatory cells including macrophages and those with Russel bodies. Within the cystic lumen, there was a large bacterial mass with sulphur granules surrounded by inflammatory cells (Fig. 2a). Well-defined intertwining filamentous colonies showed numerous club-shaped filaments in their peripheral zones. They were immersed into the soft tissue and surrounded by neutrophils. The filamentous structures were positively stained with PAS (data not shown), Grocott’s (Fig. 2b), and Gram (Fig. 2c) stains. These bacterial colonies were considered to be compatible with actinomycetes druses. The Ziehl-Neelsen stain showed the bacteria were non acid-fast (data not shown). The diagnosis was radicular cyst with actinomycosis.

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**Fig. 1.** Radiographic findings of radicular cyst with actinomycosis arising in the right incisor region of the maxilla of a 36-year-old man. (a) Panaromic and (b) dental radiographs. Panoramic radiography showed a round and well-circumscribed radiolucency including the right lateral incisor root of the maxilla (a, arrow). The central incisor was fractured at its upper part of the root (b, arrow), which might also be a possible causative background inducing actinomycotic infection. In addition, an impacted retrograding supernumerary tooth was observed at the tooth apex of the central incisor (b, arrowheads).

**Fig. 2.** Histopathological findings of radicular cyst with actinomycosis of the maxilla. (a) Hematoxylin and eosin stain; (b) Gram stain; (c) Grocott’s stain. (a) × 20; (b) × 600; (c) × 400. There was a large bacterial mass with sulphur granules within the cystic space (a). Their delicate and tangled meshes of filamentous structures were well delineated by Grocott’s (b) and Gram (c) stains. The peripheral filaments were weakly Gram-positive and showed terminal clubbing. The findings indicated the bacterial colonies were *Actinomyces* druses.
Discussion

Actinomycosis involved in odontogenic cyst is rare according to the literature from 1967 to 2009. All reported cases are shown in Table 1 (6-10). Seven reports including 13 cases were described, and our case has been appended as number 14. Regarding periapical lesions, the incidence of actinomycosis was 1.8% (11). Therefore, the incidence of actinomycosis in odontogenic cyst is rare.

Regarding the cause of actinomycosis, 4 out of 14 patients had received endodontic treatment, 1 had undergone extraction, 1 had a decayed tooth, and 7 were diagnosed as having radicular cysts or residual cysts which were associated with inflammation. Only 1 reported a history with no previous medical condition that might be contributory. The causes of *Actinomyces* invasion to the cystic lesion were relatively clear. In our case, it was suggested that the root fracture of the central incisor was caused because the root canal wall was thin, though endodontic treatment was well performed. For that reason, it was considered that the fractured root, rather than the impacted tooth, accounted for the *Actinomyces* infection. It is hypothesized that there are two possible relationships between *Actinomyces* and odontogenic cyst formation. Inflammatory reaction of the central incisor apical caused by invasion of *Actinomyces* may have stimulated the odontogenic epithelium. As a consequence, the cyst was formed. Or perhaps the cyst already existed, and the *Actinomyces* proliferated in hemorrhagic contents, which filled the cyst cavity. In this case, it was considered that *Actinomyces* may have invaded the fractured point of the root and/or root canal, and then proliferated in the cystic cavity.

Of all the 14 cases, the most common location was the maxilla, accounting for 64%, which was contrary to the literature described in the mandible. However, this finding is compatible with radicular cyst. Consequently, actinomycosis in odontogenic cyst mainly develops in association with radicular cyst in the maxilla. Of the case series, the average age was 37.6 years old. The distribution of males and females was almost equal (F:M = 0.92:1). There were no cases that were severely immunocompromised, such as those with diabetes and HIV. It is proposed that actinomycosis in odontogenic cysts always occurs in adulthood. Gender differences are not unlike those of usual cervicofacial actinomycosis, which occurs more predominantly in men.

Periapical actinomycosis is described as a chronic, purulent and mild infection. In all 14 cases considered in this paper, the patients initially showed no symptoms but gradually felt light pain and swelling as the infection progressed. Sometimes sinus formation was seen. Case 6 in Table 1 had a 4-year history and showed a few fragments of bone in the cyst, which could not have been caused by residual cyst (8). Nair described that actinomycosis could cause persistent apical periodontitis. For the patient in that particular case, the carious tooth was the chief complaint without other infectious symptoms (12). Actinomycosis presents with deterioration when there is bone absorption and tissue disruption, unless it is found during a period of chronic infection.

Actinomycosis is usually a mixed infection combined with other bacteria. If *Actinomyces* is found in a cyst, it can form into a large mass. It is considered that the cystic cavity is suitable for proliferation of *Actinomyces*. That is, the enclosed cyst as an anaerobic environment could easily promote growth of actinomyces. The initial diagnosis depends on histological features of typical branching filaments and sulphur granules. In our case, the fully purulent content gave some indication of *Actinomyces* infection, and FNA detection denied the possibility of a neoplastic lesion. Imaging techniques such as CT and magnetic resonance

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*not available
imaging (MRI) usually yield non-specific findings, contributing only to defining radiological features of the mass and its involvement in adjacent soft tissue (13).

All 14 cases were diagnosed by histopathological characteristics. In addition, only one case was referred for bacteriological test, which was based on anaerobic culture. However, this case was diagnosed firstly by histopathology and later by culture when the clinician had the chance. In another case, anaerobic culture was performed but not successful. Culture is hard to perform because of the extensive requirements of culture media and the time involved. Some advanced molecular technologies such as DNA-DNA hybridization and PCR-based techniques have been introduced for the detection of Actinomyces infection in some studies (14). Fluorescence in-situ hybridization is another method of choice, which is ideal for its specificity. Though these technologies are not widely used today, they could be useful. Histological diagnosis is given to priority (8-9, 11), though the clinical application of molecular analysis is expected. Therefore, it is important to pay attention to all the bacterial colonies observed in the specimens.

Considering the treatment, all cases underwent surgical removal and some were prescribed antibiotic drugs. Case 6 was interesting as the patient received antibiotic drugs but the condition recurred until surgical removal was performed. This suggests that antibiotic treatment is not enough if the bacteria are not eliminated. Therefore, it is important that conventional treatment with/without antibiotics should be performed after early diagnosis. Through actinomycosis involved in odontogenic cyst is described in literature, the route of infection is not clear yet. However, since the dental history for the present case was known, it was considered that actinomycoses had probably invaded the fractured point of the root and then proliferated in the cystic cavity.

References