Case Report

ANNALS OF MEDICINE & SURGERY

OPEN

Can jaw bone healed from chronic sclerosing osteomyelitis be considered healthy when planning dental implants? Case report with 20-year follow-up

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Introduction and importance: Extraction of mandibular third molars can lead to complications such as chronic sclerosing osteomyelitis (CSO), an inflammatory bone marrow disease that tends to progress. CSO involves the cortical plates and often the periosteal tissues and is caused by a variety of microorganisms, including *Corynebacterium* spp. The treatment of chronic osteomyelitis (CO) and CSO remains challenging, as there is no universal treatment protocol. This case report investigated whether jaw bone that has healed from chronic sclerosing osteomyelitis can be considered healthy bone when planning dental implants.
Case presentation: A 21-year-old Caucasian woman developed CO and CSO after third molar surgery.
Clinical discussion: A combination of alveolar ridge bone resection, extraction of teeth 47–32, and long-term specific antibiotic therapy against *Corynebacterium* spp. was administered. An attempt at preprosthetic alveolar ridge reconstruction with an anterior superior iliac crest bone graft resulted in graft failure and the patient refused further harvesting procedures. Implantation in the intraforaminal zone also resulted in the loss of two implants after loading. Finally, inferior alveolar nerve transposition resulted in the successful reimplantation of two implants, which were fully functional almost 11 years later.
Conclusion: This case report presents the treatment history of this patient. With a longitudinal observation period of greater than 20 years, the results of this case demonstrate the successful treatment of bone with CO, CSO, and *Corynebacterium* spp. infection. Following the removal of infected bone, radical debridement, and long-term antibiotic therapy, bone health was restored.

Keywords: Case Report, corynebacterium, dental implants, osteomyelitis sicca, osteomyelitis

Introduction

Surgical extraction of the mandibular third molars is one of the most commonly performed procedures in oral and maxillofacial surgery[1,2]. Surgery can result in complications such as trigeminal nerve injuries and alveolar osteomyelitis[3]. Osteomyelitis is a progressive bone marrow inflammation that involves the cortical plates and periosteal tissues[4] and occurs more often in the mandible than the maxilla in alveolar osteomyelitis[5]. Osteomyelitis occurs as a result of trauma[6], bone surgery[7], vascular insufficiency[8], or tooth extraction in general[9] and is often associated with dental implants[10]. Odontogenic causes are usually infections arising from a pulpal infection of a tooth or an infected gingival pocket as well as secondary infections after dental surgery[11].

Numerous classification systems have been proposed to categorize osteomyelitis, including suppurative or non-suppurative, hematogenous, or resulting from a contiguous focus of infection[8]. Additionally, acute and chronic osteomyelitis are identified using unique International Classification of Diseases codes[12]. The symptoms of acute osteomyelitis include pain, fever, swelling, purulent discharge, intraoral and extraoral fistulas, unhealed soft tissue in the oral cavity, neuropalsy in the involved area, pathological fracture, and trismus; moreover, patients typically present without bone necrosis in days to weeks following the initial infection. Chronic osteomyelitis (CO) develops after months to years of persistent infection and may be characterized by the presence of necrotic bone and fistulous tracts from skin to bone[13].

HIGHLIGHTS

- A 21-year-old Caucasian female patient developed chronic osteomyelitis (CO) and chronic sclerosing osteomyelitis (CSO) following third molar surgery.
- An inferior alveolar nerve transposition led to successful reimplantation of two implants for prosthetic restoration.
- Over an observation period of more than 20 years, the successful treatment of bones with CO, CSO and *Corynebacterium* spp. infections can be demonstrated.

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Annals of Medicine & Surgery (2024) 86:2266–2276

Received 17 December 2023; Accepted 2 February 2024

Published online 15 February 2024

http://dx.doi.org/10.1097/MS9.0000000000001826

CO can be classified into several subtypes, including suppurative CO[14], jaw osteonecrosis[15], bisphosphonate-related osteonecrosis of the jaw[16], chronic juvenile osteomyelitis[17], chronic recurrent multifocal osteomyelitis[18], osteomyelitis occulta, and chronic sclerosing osteomyelitis (CSO; osteomyelitis sicca; pseudo-Paget)[19].

CSO was first described by Garré in 1893[20]. Although rarely reported, recent experiences indicate that CO and CSO are more common than previously thought[21,22]. Since mandibular CO has symptoms similar to other diseases such as osteonecrosis and chronic recurrent multifocal osteomyelitis, its true incidence is difficult to determine[21].

The microbiological causes leading to mandibular osteomyelitis have a polymicrobial nature and involve a broad spectrum of microorganisms from the *Streptococcus* or *Actinomyces* genera, including *Corynebacterium*[21–24]. The precise pathophysiology of microbiological infections of the jaw is not fully understood; however, inflammation may occur when the typical microbial flora is disrupted[25]. Usually, this is a secondary process as the bacteria spread through adjacent soft tissues, extraction sites, or fracture sites to affect bone[26]. Therefore, infections without soft tissue involvement are particularly rare[8].

The treatment of CO and CSO remains challenging, as no universal treatment protocol has yet been established[27,28]. Treatment of osteomyelitis of the jaws includes elimination of the cause, incision and drainage, sequestrectomy, saucerization, decortication, jaw resection, antibiotics, and hyperbaric oxygen[29]. Additionally, managing mandibular osteomyelitis may be challenging given its anatomic location and polymicrobial nature[30] and can lead to severe tooth and bone loss[8,30]. Alveolar bone resection and the resulting bone defects should be reconstructed since the presence of sufficient mandible bone is essential for successful dental rehabilitation[8,31]. Several methods of reconstruction are available for cases with continuity resection of the mandible owing to osteomyelitis of the jaws, including fibula free flap (FFF)[32,33] or deep circumflex iliac artery (DCIA) flap[34]. In general, the reconstructive goals for segmental defects of the mandible include achieving mandibular continuity, restoration of height and contour with an appropriate aesthetic, reconstruction of any soft tissue deficits, and restoration of mastication with adequate interincisal opening[35].

Long-term survival and success of dental implants depend on sufficient bone amount and quality[36]. Thus, reconstruction of the alveolar ridge in combination with the placement of dental implants is crucial for achieving a sustainable functional outcome for prosthetic restorations in patients who have undergone alveolar bone resection for CO or CSO[37]. Clinicians must clarify the method of choice for successful dental implant placement in mandibular bone after osteomyelitis. Several additive methods are currently available for reconstructing alveolar ridges. In these additive methods, the height and width of the bony defect are reconstructed using an onlay of the augmentation material. These methods include bone block grafts[38], guided bone-regeneration techniques[39], and reconstruction using titanium meshes[40]. Although promising, only a few methods have been successfully used in patients with CO or CSO[41].

We report this case to demonstrate the successes and failures of several methods used to rehabilitate the mandible after alveolar ridge/tooth extraction due to combined CO and CSO in a patient who was followed for more than 20 years. We present this case report in accordance with SCARE 2020 criteria[42].

Case presentation

We present the case of a 21-year-old Caucasian woman whose right (48) and left lower third molars (38) were removed in February 2003 by a board-certified oral and maxillofacial surgeon (Figs. 1, 2A). The patient had no medical history and was not taking any medication. The patient's genetic and psychological information was unremarkable. She was a smoker but had an inconspicuous drug history. Regarding family history, her grandmothers and cousins had diabetes. The patient's father was diagnosed with laryngeal cancer and her uncle was diagnosed with blood and colon cancer. The patient underwent a one-year

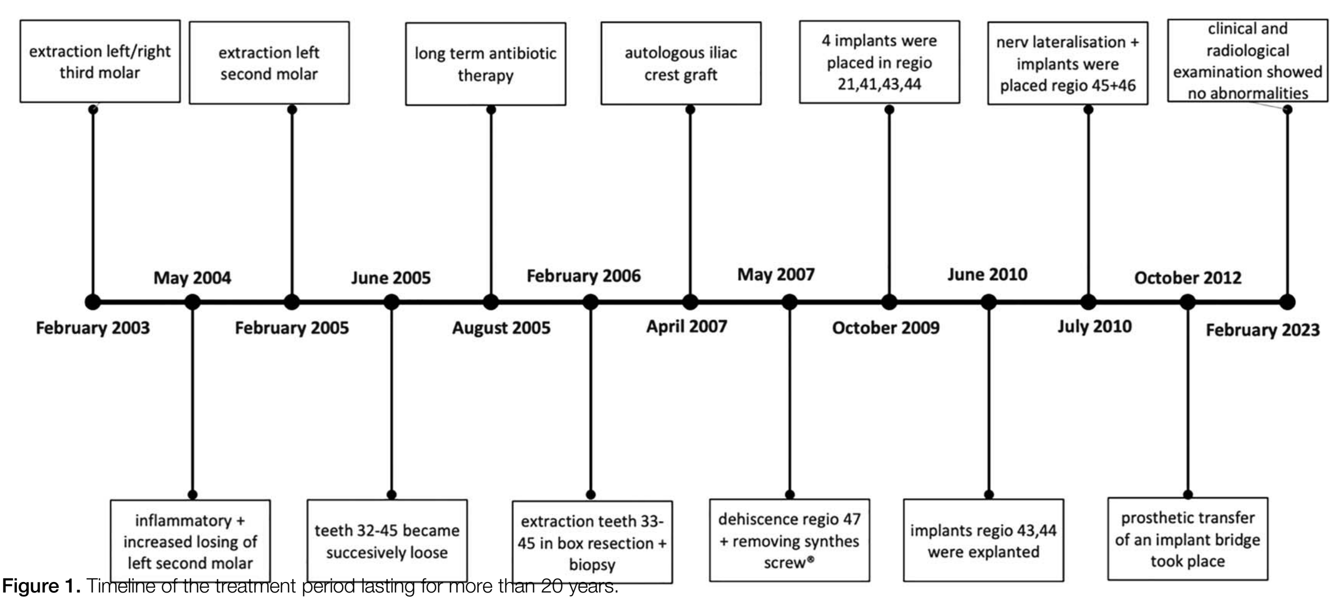

Figure 1. Timeline of the treatment period lasting for more than 20 years.

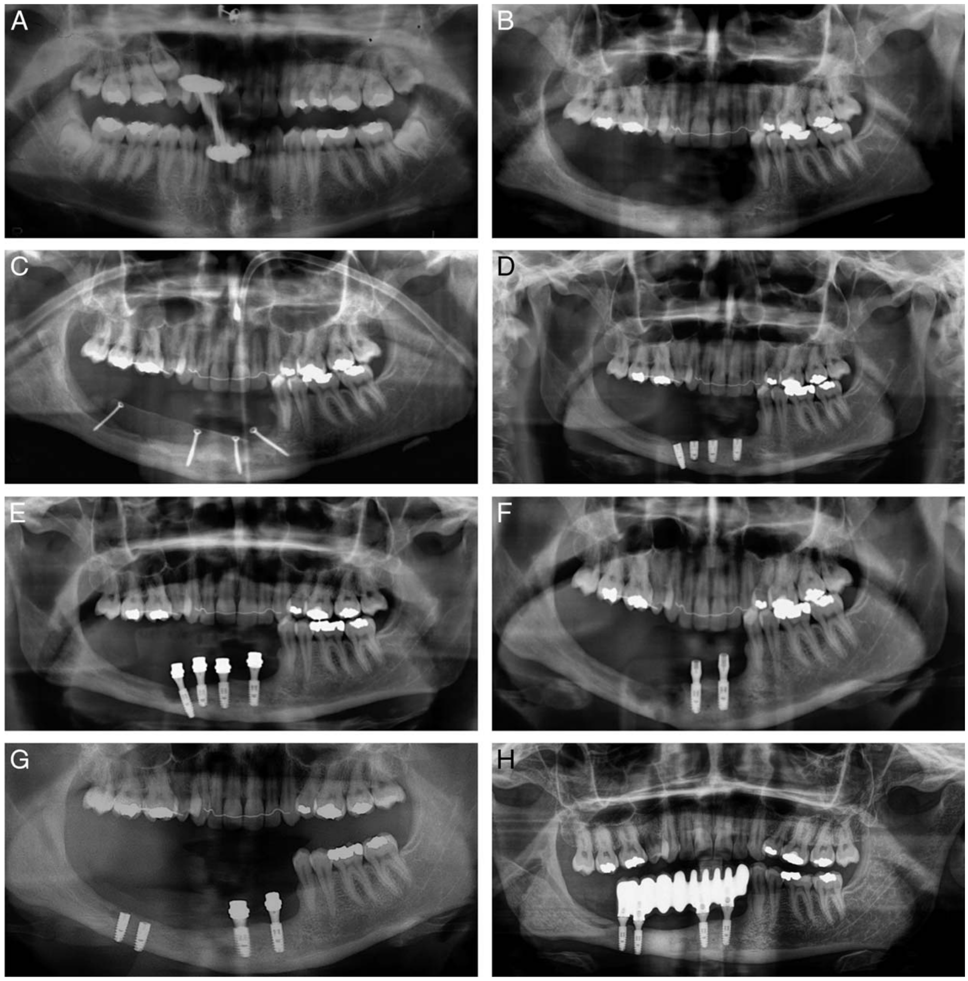

Figure 2. (A) Orthopantomogram (OPT) before surgical removal of teeth 38 and 48 in February 2003. (B) OPT after removal of teeth 33–45 during alveolar ridge bone resection in February 2006. (C) OPT after augmentation with autologous iliac crest graft to create an implant site in April 2007. (D) OPT after placing four dental implants in the mandibular anterior region in October 2009. (E) Despite the lack of implant loading, bone loss appeared in OPT regio 44 in June 2010. (F) OPT after explantation of two dental implants in regio 43 and 44 in June 2010. (G) OPT after lateralization of inferior alveolar nerve and insertion of implants in regio 45 and 46 in July 2010. (H) OPT with radiological findings in February 2023, 13 years after dental implant insertion.

orthodontic treatment (2003–2004) with a multi-bracket appliance (GC Orthodontics Europe GmbH) due to a lack of space. She received regular checkups and oral hygiene appointments, which revealed no abnormalities. After completion of the orthodontic therapy, extraction of the third molars and fixation of maxillary retainer from 13 to 23 was indicated. For this reason, she went to a private surgical practice in Vienna, Austria, and started tooth extraction (48). During extraction under local anaesthesia, no intraoperative peculiarities were observed. The postoperative course was uneventful, although inflammatory swelling on the right side was noted and was treated using local antibiotics. Fifteen months after the procedure (May 2004), the patient returned with an inflammatory swelling on the right side and increased mobility of tooth 47 (Fig. 3A). The patient never experienced any pain or elicited tenderness. The wound was cleaned by flaring and reaming, and the mobile tooth 47 was fixed to tooth 46 by wire ligation (Fig. 3B). Notably, the patient developed pneumonia at that time. Despite constant monitoring and local antibiotic administration, the wire splint stabilization failed to improve the patient's condition, and the lower right second molar was extracted in November 2004. Three months later, the lower right first molar was no longer worth preserving. The tooth was extracted, and the wound was excised.

Owing to the continuous progression of the inflammatory process, teeth 32–45 became successively mobile (Fig. 3C, D) and the patient was referred to Vienna General Hospital (June 2005). Computed tomography (CT), MRI, and three-phase scintigraphy were performed during the extended diagnostic workup.

Long-term antibiotic therapy oral with clindamycin (300 mg Dalacin; Pfizer) was initiated in August 2005. However, the progressive course of the disease resulted in the removal of teeth 33–45 during alveolar ridge bone resection performed in February 2006 (Figs. 2B, 4A). The teeth showed grade IV mobility. The resection started from approximately tooth 45, 1 mm above the exit of the mental nerve, and extended widely to the opposite regio 33, ~3–4 mm below the chronically altered bone (Fig. 4B). The bone segment with overlying teeth 45–33 was removed and sent for histological examination. The wound was sutured tightly, and the patient was administered 600 mg clindamycin (Dalacin; Pfizer) intravenously and 500 mg prednisolone (Solu-Dacortin; Merck).

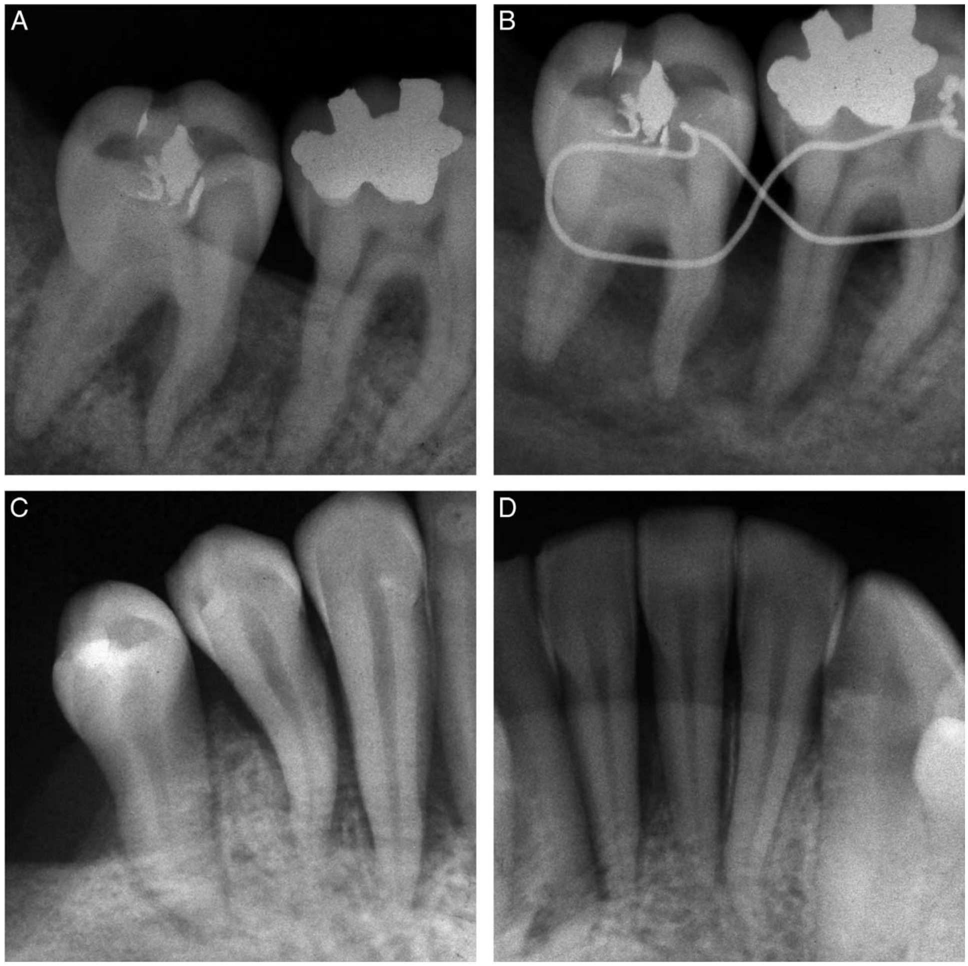

Figure 3. (A) Orthopantomogram (OPT) section of tooth 47 with inflammatory swelling on the right side and increased mobility (May 2004). (B) OPT section of tooth 47 after fixation to tooth 46 by wire ligation (May 2004). (C) OPT section of teeth 43–41, which became successively mobile (November 2004). (D) OPT section of teeth 43–32, which became successively mobile (November 2004).

As a domestic therapy suggestion, clindamycin (300 mg 3 × 2; Dalacin; Pfizer), thiamine disulfide (3 × 2; Neubrion forte; Procter & Gamble), and diclofenac (Voltaren; Novartis) were recommended for pain. The procedure was performed without complications; however, the infectious disease department suggested the long-term continuation of the antibiotics for three months. Histological examination of the biopsy specimen confirmed a tentative diagnosis of CO combined with CSO and no evidence of acute inflammation. Microbiological examination of the specimen showed increased growth of *Corynebacterium* spp. After an uncomplicated postoperative course, augmentation with an autologous iliac crest graft was performed in April 2007 to create an implant site (Fig. 2C).

During this augmentation procedure, a mucosal incision was made vertically over the remaining alveolar process in the median. The tunnelling preparation was then performed to the left to tooth 33 and to the right (Fig. 5A, B). There, the mental nerve was exposed (Fig. 5C) and the preparation was continued, tunnelling to the retromolar trigonum. Simultaneously, the iliac crest was removed; the crista reached ~2 cm posterior to the anterior superior iliac spine after layer-by-layer preparation. This was followed by careful subperiosteal dissection medially and laterally to ~8 cm. A monocortical block of the inner corticalis was removed with a saw. Finally, a second monocortical block was excised from the outer cortical bone. After smoothing the bone edges with a rose bur and applying bone wax to the cancellous bone, cancellous bone sponges were applied, a Redon drain was inserted, and layer-by-layer wound closure was performed.

The iliac crest bone was handed over and an L-shaped piece was adapted from the monocortical block, which was supported from regio 33 to the right jaw angle (Fig. 5D). This piece was placed in the prepared tunnel and a recess was made in the area of the exit point of the mental nerve using a rose drill to avoid nerve compression. The bone piece was then fixed with two 16-mm synthes screws (AXS; Stryker) intraforaminally and at the right jaw angle. In regio 33, a monocortical block measuring ~0.5 × 1 cm was inserted and fixed with a screw (Fig. 5E). Bone chips were placed in the area of the retromolar trigonum and the wound was closed with 4-0 suture (Supramid; Braun) (Fig. 5F).

One month later (May 2007), dehiscence was observed in regio 47. The osseous margins of both the graft and the mandible were slightly more irregular, with a more obvious gap. The region was surrounded by marked inflammatory soft tissue enhancement and no evidence of osseous buildup was observed.

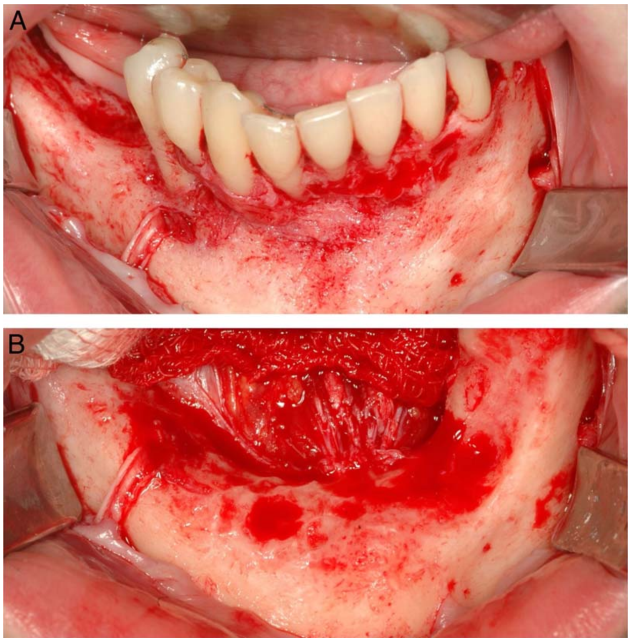

Figure 4. (A) Clinical photo of mandibular bone infected with chronic osteomyelitis (CO) and chronic sclerosing osteomyelitis (CSO) in regio 45–32 in August 2005. (B) Clinical photo after mandibular alveolar ridge bone resection in August 2005.

Surgical recutting of the dehiscent site and visualization of the distal end of the iliac crest graft were performed. The synthetic screw in regio 47 was removed, and the distal edge of the iliac crest graft was reduced using a rose drill. The wound was carefully curetted and irrigated (Betaisadona; Mundipharma).

At the same time, a smear was taken to determine microbial antibiotic resistance using the agar diffusion test. The results showed resistance to clindamycin, erythromycin, and josamycin. After a complication-free postoperative course, the remaining screws were exposed and removed on November 2007. Intraoperatively, the iliac crest graft showed little remaining cancellous but significant cortical bone.

CT of the facial skull performed in February 2009 revealed no evidence of recent osteomyelitis.

In July 2009, the patient was followed up before implantation. CT of the mandible showed that the bone was diffusely compacted in the mandibular region on the right side, with the compaction extending to the midline and discretely extending beyond the left side. The bone contour was smooth and the cortical bone was intact. However, no recent osteolysis was observed. A markedly reduced height of the mandible on the right side (~9 mm) was observed. In addition, MRI of the facial skull revealed no evidence of CSO. Therefore, four implants (Ankylos; Dentsply Sirona) were placed in the mandibular anterior region with bone substitute material (Bio-Oss; Geistlich) under general anaesthesia in October 2009 (Fig. 2D). This procedure was followed by gingival margin incision at regio 33–47. Mucoperiosteal flap preparation proved to be very difficult because of previous surgeries. The bone appeared clinically unremarkable. The nerves were visualized and spared. The implantation of the four implants followed, with two implants in regio 41 and 42 (3.5×9 mm) and one each in regio 43 (3.5×8 mm) and 44 (3.5×11 mm). All implants exhibited primary stability. The wound was closed with a 5.0 suture (Prolene; Johnson & Johnson). The operation was performed without complications and the patient was discharged with the therapy recommendations of amoxicillin/clavulanic acid (1 g Augmentin; GlaxoSmithKline; 2×1) and 400 mg dexibuprofen (Seractil; Gebro Pharma; 3×1).

Five months later (March 2010), the implants were exposed under local anaesthesia, the cover screws were removed, and the healing abutments were inserted. In June 2010, bone loss was observed in regio 44 (Fig. 2E) and was treated with laser, antibiotic, and analgesic therapies. Amoxicillin/clavulanic acid (Augmentin, GlaxoSmithKline), dexibuprofen (Seractil, Gebro Pharma), and proton-pump inhibitors (pantoprazole) were recommended as medications. However, this did not prevent the explantation of two distal implants in regio 43 and 44 (June 2010) (Fig. 2F). We planned to perform reimplantation in a more distal area. At the bone level, nerve lateralization was required before insertion.

In July 2010, the position of the inferior alveolar nerve (IAN) and adjacent anatomical structures was assessed radiographically, and the distance between the IAN and the alveolar ridge was measured at relevant points to perform the osteotomies. The surgical procedure was performed under local anaesthesia using inferior alveolar, lingual, and buccal nerve-blocking techniques. A linear incision was made on the crest of the alveolar ridge with a releasing incision anterior to the mental foramen, approximately in the mesial region of the canine to guarantee coverage of the bone defect. A mucoperiosteal flap was then raised and the surgeon directly visualized the mental foramen, which was carefully released from the periosteum. To preserve the anatomic characteristics of the mental foramen area, circular marks were made around this structure only on the cortical bone with a spherical diamond bur using a low-speed handpiece. Subsequently, these markings were united and deepened with a piezo until the medullary bone tissue was observed, creating a ring around the mental nerve. Centripetal osteotomy was then performed, and the bone tissue was removed, leaving the nerve tissue free in the region of the foramen. The incisor nerve was then transected and lateral osteotomy was started from the buccal direction toward the trajectory of the IAN using a spherical diamond bur and handpiece. A Nabers probe with a rhomboid tip was introduced into the mandibular canal adjacent to the buccal wall through the prepared mental foramen. This penetration was used to guide the lateral osteotomy and as a preparation for the spherical burr to minimize the possibility of lesions in the inferior alveolar vascular-nervous bundle.

IAN transposition was performed using a delicate spatula to manipulate the vascular-nervous bundle. A bone collector adapted to a surgical suction appliance was used during the osteotomy and bone cutting. After placing two Ankylos implants (Dentsply Sirona) in regio 45 and 46 (Fig. 2G), bone tissue collected during the osteotomies and bone-cutting procedures was inserted adjacent to the implants, preventing the IAN from contacting the implants.

The patient was prescribed a β-lactam antibiotic (500 mg amoxicillin; Ratiopharm) every 8 h for 7 days as well as an anti-inflammatory drug (500 mg mefenamic acid; Parkemed, Pfizer). Sensory alterations and radiographic findings were monitored periodically.

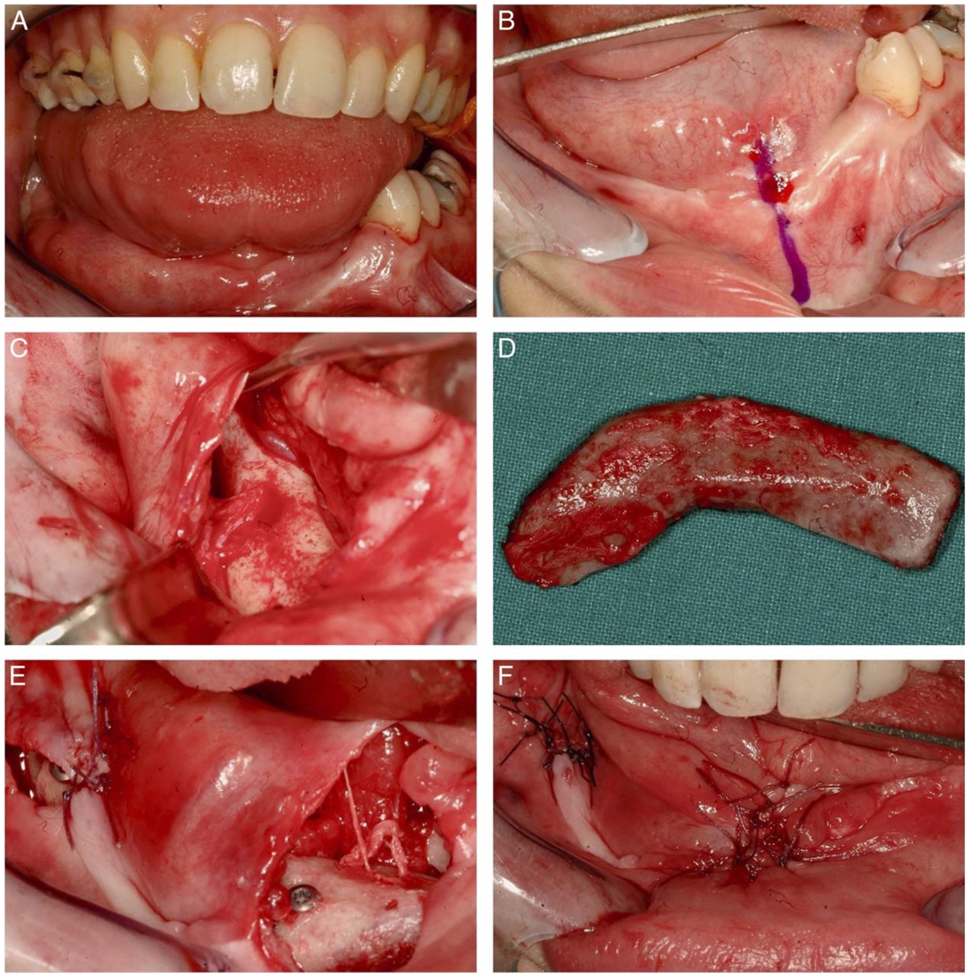

Figure 5. (A) Clinical situation before performing the iliac crest graft in April 2007. (B) A mucosal incision was made vertically over the remaining alveolar process in the median. (C) A tunnelling preparation was performed to the left. The inferior alveolar nerve is shown. (D) The iliac crest bone was handed over and an L-shaped piece was adapted. (E) A monocortical block measuring ~0.5 × 1 cm was inserted and fixed with a screw. (F) Bone chips were inserted in the area around the retromolar trigone and the wound was closed tightly.

The surgical protocol for IAN transposition followed by implant placement presented excellent results, with complete recovery of sensitivity observed seven months after the surgical procedure. Almost 2 years after the implant insertion, an implant bridge with the special feature of a lingual prosthetic screw connection was prosthetically transferred from regio 33 to 46 (October 2012). In February 2023, 11 years after the prosthesis handover, the patient presented at our university clinic (Figs. 2H, 6A). She had moved abroad and only returned to her original practitioner 11 years later.

During this period, she only occasionally underwent professional tooth cleaning and dental checkups. Furthermore, the patient underwent annual CT scans, which revealed evidence of osteomyelitis.

The prosthetic restoration was removed with lingual screws to assess the clinical situation and to perform professional tooth cleaning (Fig. 6B, D). No radiological (Fig. 7A–E) or clinical abnormalities were observed. In addition, no mucosal changes or radiological evidence of detectable bone loss were visible.

A digital periodontal examination performed using the pa-on system (orangedental) revealed an average pocket depth of 1.57 mm and recession of 0.00. The attachment loss was 1.57 mm and the bleeding on probing rate was 69%. A maximum probing depth of 4 mm on the dental implants was only found in two places in the implant region: 47 lingual + implant regions and 32 vestibular regions. Despite the history of no smoking and no systemic factors, her periodontal risk was high owing to the 69% bleeding on probing, two probing depths ≥5 mm (teeth 15 and 28 buccal), a bone loss index of 0.49 mm, and 11 missing teeth (excluding wisdom teeth) (Fig. 8A, B).

The implants and remaining dentition were professionally cleaned sub and supragingivally using an Airflow device (EMS Dental). The prosthetic fit was then reclothed and the patient was scheduled for regular recall appointments at short intervals (Fig. 6C). After this treatment, the patient was again reminded of the urgency of regular follow-ups, and we look forward to her presenting for follow-up within a few years.

Discussion

This case report aimed to demonstrate different methods of mandibular rehabilitation after alveolar ridge and tooth

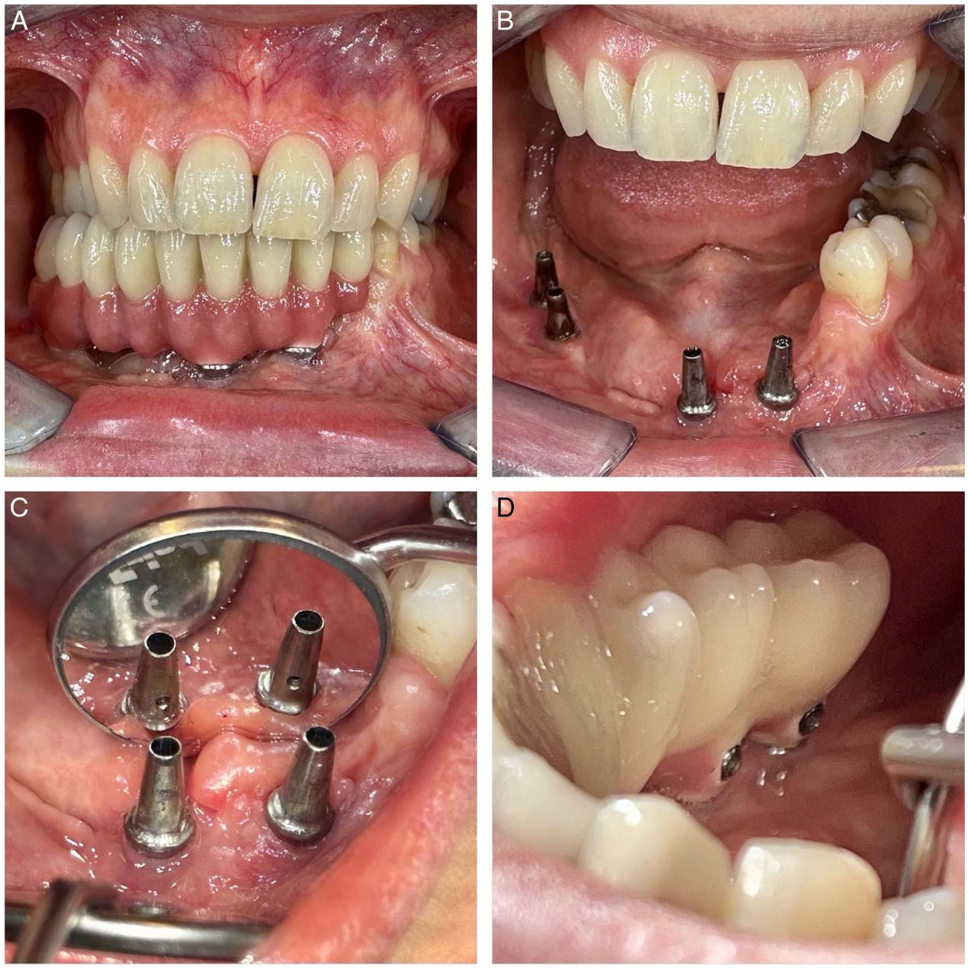

Figure 6. (A) Images taken in February 2023, 11 years after the prosthesis handover. (B) Removal of the prosthetic restoration with its lingual screw prosthetic screws to assess the clinical situation and for professional teeth cleaning. (C) Lingual prosthetic screws. (D) Re-clothing of the prosthetic fitting.

extraction due to combined CO and CSO in a patient after wisdom tooth surgery. A combination of alveolar ridge bone resection, tooth extraction from 47 to 32, and long-term specific antibiotic therapy against *Corynebacterium* spp. was performed.

The question arises as to whether bone infected by *Corynebacterium* spp. and successfully treated with antibiotics and surgical intervention can regenerate into healthy bone. In the present case, which we have followed for more than 20 years, we present the consequences of a complication after wisdom tooth surgery, including the particular combination of CO and CSO, which resulted in the loss of nine teeth and the alveolar ridge. To the best of our knowledge, mandibular rehabilitation after alveolar ridge loss or tooth extraction in the form of an iliac crest transplant, nerve lateralization, and implant insertion has not been previously described in the literature.

Osteomyelitis is more common in the mandible than in the maxilla because of the dense and poorly vascularized cortical plates of the mandible and the vasculature originating from the inferior alveolar neurovascular bundle. Mandibular osteomyelitis was common before the discovery of antibiotics[8]. Host defenses, along with systemic diseases, such as diabetes mellitus, autoimmune disorders, malignancy, malnutrition, and acquired immunodeficiency syndrome (AIDS), can contribute to the progression of osteomyelitis[43]. The patient in the present case had an unremarkable medical history, although her immediate family members had diabetes mellitus.

Corynebacterium spp. are often present with other Gram-positive bacteria, such as *Staphylococcus aureus*, *Corynebacterium diphtheriae*, and streptococci[44]. In vitro studies have shown that *Arcanobacterium haemolyticum*, similar to *Corynebacterium* spp., is sensitive to most classes of antibiotics used to treat respiratory tract infections, except for trimethoprim/sulfamethazine[45]. Higher penicillin concentrations may be required for tolerance.

Effective interprofessional communication among clinicians, clinical laboratory microbiologists, and pharmacists is crucial for managing patients with corynebacterial infections. Clinicians should communicate with the laboratory to ensure proper handling of pharyngeal culture specimens when considering this diagnosis. Consultations with infectious disease specialists may also be helpful[46].

In the present case, the Clinical Institute for Medical and Chemical Laboratory Diagnostics, Institute for Pathology, and the infectiologist collaborated closely to determine the best therapeuting approach. The patient underwent long-term antibiotic therapy with 300 mg Dalacin (Pfizer) for 1.5 years to treat the combined CO and CSO. Surgical debridement of the infected

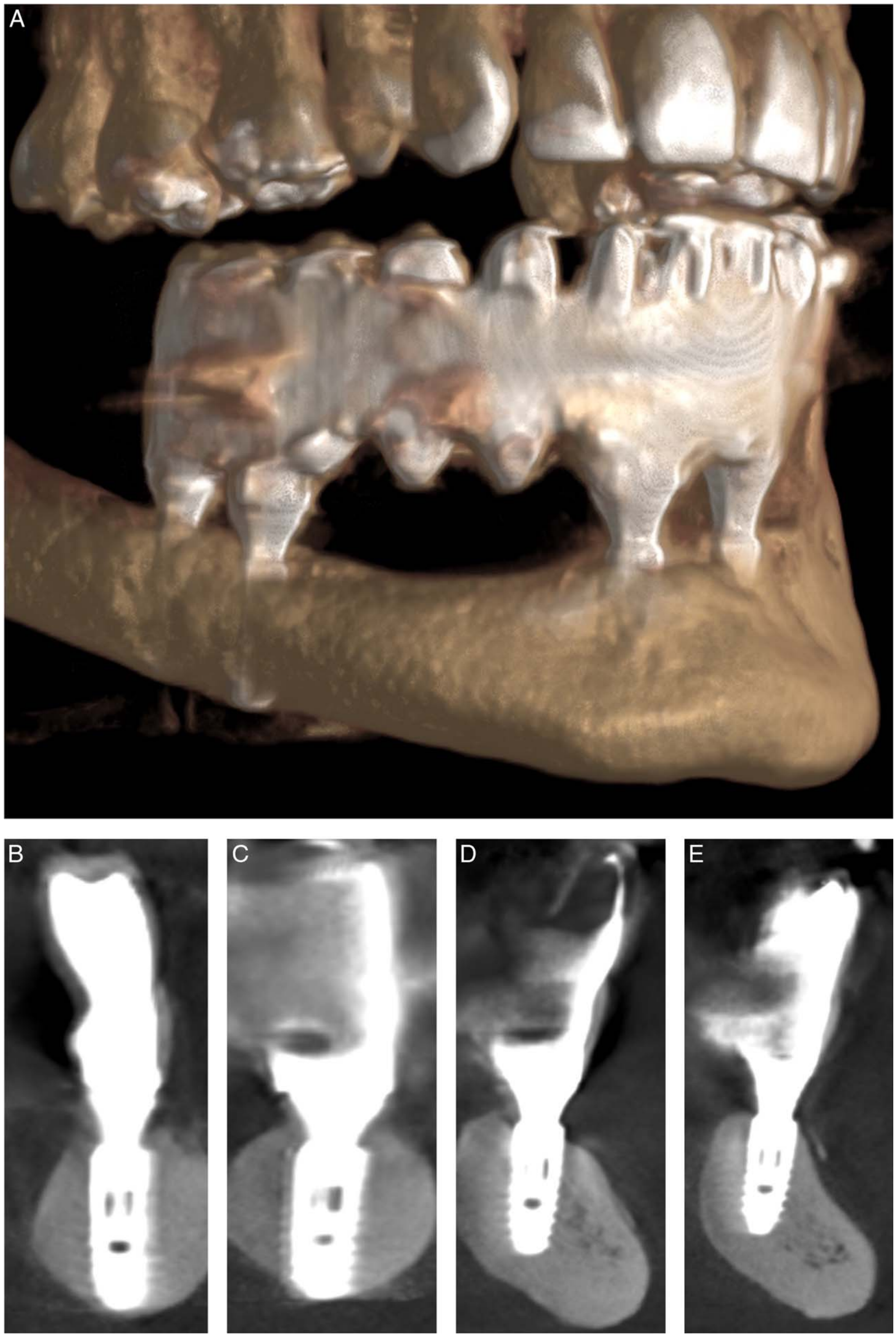

Figure 7. (A) Three-dimensional view of the right mandibular arch. Cone-beam computed tomography section showing no radiological abnormalities 11 years after prosthesis handover of the implant in regio 47 (B), 46 (C), 41 (D), and 32 (E).

bone was performed, suggesting removal of the infected site. In cases where the bone level is too low to accommodate sufficiently long implant attachments without injuring the IAN, bone grafting is recommended to elevate the alveolar ridge and facilitate implant placement.

Autologous bone is considered the gold standard graft for compromised bone, owing to its osteoconductive, osteoinductive, and osteogenic properties[47]. Additionally, autologous bone is histocompatible and non-immunogenic. An iliac cancellous bone graft (ICBG) harvested from the anterior iliac crest is commonly

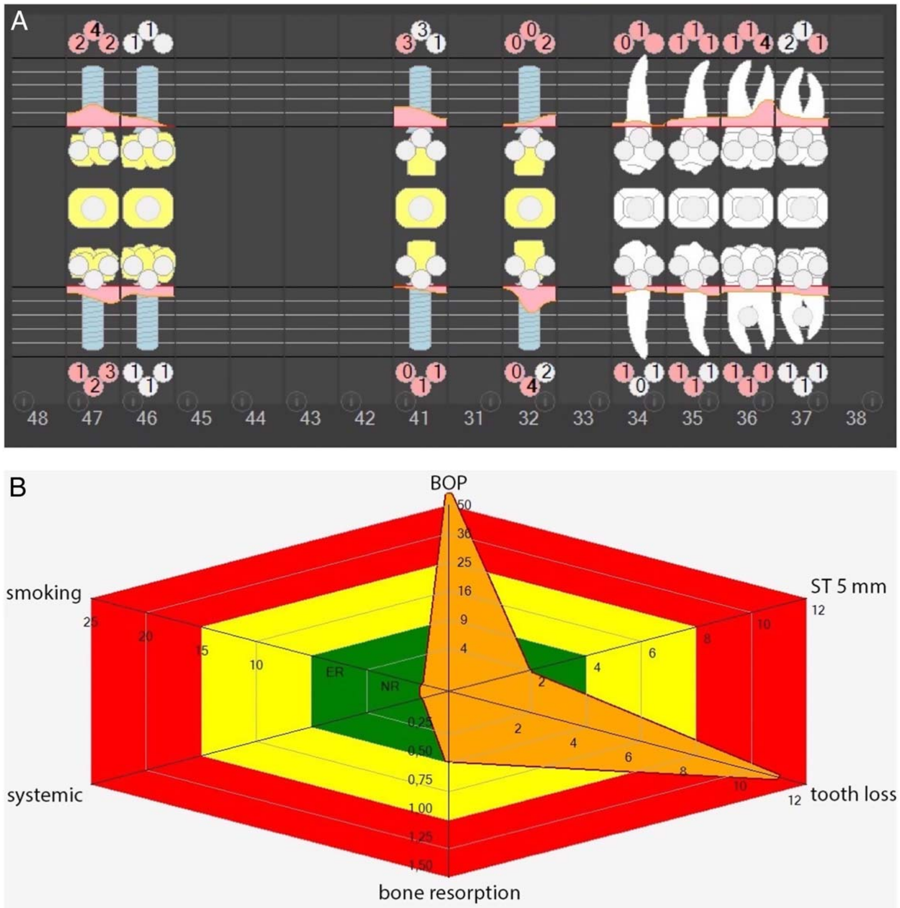

Figure 8. (A) Digital periodontal examination performed in February 2023. (B) Assessment finding indicating the patient's high risk of periodontal diagnosis. BOP, bleeding on probing; ST, probing depth.

used because of its abundance, ease of harvesting, and simultaneous availability during alveolar ridge preparation[48]. However, the drawbacks of ICBGs include significant donor site morbidity such as postoperative pain, sensory disturbance, and claudication, leading to extended hospital stays[49]. ICBGs are also subject to unavoidable bone absorption, with reported absorption rates exceeding 40% after 1 year, potentially necessitating reoperation[50].

Although osseointegrated dental implants have become reliable and effective for replacing missing teeth, they are associated with clinical complications[51,52]. These complications can be categorized as biological, technical, mechanical, aesthetic, or phonetic and may compromise the outcomes of dental implants[53]. Pathological lesions around dental implants are typically inflammatory and result from bacterial accumulation on the implant surface, leading to an escalating inflammatory response[54,55].

The relationships between bacterial osteomyelitis, peri-implantitis, and implant failure in the mandible or maxilla are not well understood, and no treatment protocol has yet been established for the management of osteomyelitis and peri-implantitis in these cases[56].

Minimizing the incidence of biomechanical complications in single-implant restorations (SIRs) and partial fixed implant-supported prostheses (PFISPs) requires reducing the resistance to adverse leverage forces during function. Placing implants as vertically as possible and ensuring shallow incisal guidance can help minimize these forces on anterior SIRs and PFISPs[57].

Additionally, every 10-degree increase in implant inclination may lead to a 5% increase in the torque applied to the restoration during function. Biomechanically, the functional loads on implant restorations primarily affect the crestal bone surrounding the implant body[58]. Thus, caution is needed in cases with multiple factors such as heavy occlusal forces, laterally positioned implants, and steep cuspal inclination, as these factors can concentrate stress at the abutment-implant connection, potentially leading to complications[57].

In our case, the loss of osseointegrated implants can be attributed to incorrect loading of the prosthetic restoration, as the distally inclined Ankylos implant (Dentsply Sirona) in regio 44 could not be properly compensated owing to the unavailability of appropriately angled intermediate parts. The consequent unfavourable leverage forces on the implant resulted in its failure.

In addition to ICBGs, another option for rehabilitating edentulous atrophic posterior mandibles is IAN lateralization (IANL) or IAN transposition (IAT). These techniques, which have been used for more than 40 years, have shown good survival rates[59]. The advantages of IANT include the ability to place longer fixtures and the engagement of two cortices for initial stability[60]. Insufficient bone superior to the mental foramen is often a limitation for the ideal fixture length, and the existing superior bone is typically of poorer quality than the cortical bone.

A major clinical concern with IANT is temporary or permanent nerve dysfunction, which leads to altered sensation in the lower lip and chin[60]. In our case, IANT allowed for the placement of a 10-mm Ankylos implant (Dentsply Sirona) without complications during both implantation and nerve transplantation.

Although the patient and practitioner were satisfied with the progress, even 11 years after prosthetic treatment, it is important to note that the patient carries a high periodontal risk and requires regular checkups at short intervals to ensure long-term success.

In light of 20 years of experience with this patient, a free iliac crest graft and infraforaminal implantation with such a large prosthetic span with leverage effects must be viewed critically, and a different therapy may be selected today.

Furthermore, to our knowledge, no comparable cases have been reported in the literature and no reports have described implantation after nerve transposition. Therefore, no general conclusions can be drawn from this case.

Conclusion

With a longitudinal observation period of more than 20 years, this case demonstrates the favourable prognosis for implant rehabilitation in a case with combined CO and CSO associated with *Corynebacterium* spp. infection following successful treatment including the removal of infected bone, radical debridement, and long-term administration of antibiotics.

However, the treatment of this case was also characterized by failures such as the loss of the iliac crest graft and implants. Finally, clinical and radiological evaluations revealed no unusual abnormalities compared with non-infected, osteomyelitis-free bone. These results provide compelling evidence for restored bone heath following successful treatment for the combination of CO and CSO associated with *Corynebacterium* spp. infection.

Ethical approval

This study was approved by the relevant ethics committee.

Consent

The patient received a thorough explanation of this report and gave oral and written informed consent to be included in this report as well as for publication of this case, anonymous data, and pictures. A copy of the written consent is available for review on request.

Source of funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author contribution

All authors approved the version submitted for publication. All authors read and approved the final manuscript. P.G. and F.P.-M.: study concept and design, writing the paper. B.S., M.M., D.B., P.B.: data collection, analysis, and discussion of data. D.T.: final approval of the version to be published.

Conflicts of interest disclosure

The authors declare that there is no conflicts of interest.

Research registration unique identifying number (UIN)

Not applicable.

Guarantor

Dritan Turhani.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Acknowledgements

The authors are grateful to the patient for permission to use her clinical data. The authors thank Editage (www.editage.com) for English language editing.

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