



Treatment of Cuboid Bone Osteomyelitis in Diabetic Patient with Bioactive Glass S53P4 – Case Report

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Abstract

Osteomyelitis in diabetic patients requires a very challenging treatment and often leads to limb amputation. Due to increasing incidence of diabetes it has become a worldwide health problem. There have been few cases in the literature described as successful treatment of cuboid osteomyelitis with a new bone substitute as Bioactive Glass S53P4. We present a clinical case of diabetic patient with an osteomyelitis of cuboid bone due to chronic foot ulcer where a two-stage surgical treatment was indicated with a suitable antibiotic treatment. Firstly, a resection of infected bone was done with a temporary antibiotic spacer and arthrodesis was made and a second part with a Bioactive Glass substitute and treating the ulcer with a half thickness skin graft. In our clinical case treatment with Bioactive Glass in diabetic osteomyelitis showed successful results with a promising treatment outcome.

Keywords: Diabetic Foot; Osteomyelitis; Cuboid Bone; Bioactive Glass; Surgical Treatment

Abbreviations

BAG: Bioactive Glass; MRI: Magnetic Resonance Imaging

Introduction

Foot ulcer is one of the most common health problems and is one of the major cause of amputations in diabetic patients [1].

Foot ulceration can be caused by altered biomechanics of the foot due to diabetes and other conditions or it develops as a complication of the diabetic peripheral neuropathy.

The majority of foot ulcers are chronic with a normal constant bacterial colonisation that leads to infection. Infection of soft tissue in diabetic patient is threatening condition for progression of the infection to adjacent structures such as bones and joints causing osteomyelitis [2]. It may lead to lower extremity amputation due to infection control [2]. Signs and symptoms of diabetic foot infections could sometimes be concealed by affiliated peripheral neuropathy, peripheral arterial disease or immune dysfunction [2].

Osteomyelitis in diabetic patients is still a difficult clinical problem with a challenging treatment and high risk of major amputation [3,4]. Conservative therapy with antibiotics or surgical treatment are still debated about timing and consequences [3]. Resection of the infected bone with simultaneous antibiotic therapy for several weeks is the method of limb sparing treatment.

There are now new biomaterial options of bone substitutes used to fill the bone defects after resection [4]. One of them is Bioactive Glass which has bacteriostatic characteristics and stimulates bone growth. Its use in cases of osteomyelitis treatment has shown good results with no later complications so far [4]. We present a clinical case of osteomyelitis of cuboid bone successfully treated with Bioactive Glass bone substitute.

Cuboid bone plays an important role in biomechanics of the foot. It articulates posteriorly with calcaneus and anteriorly with bases of fourth and fifth metatarsals. It has a poor blood supply and is reported a rare site of osteomyelitis.

Clinical Case

A 78-year-old Caucasian female patient with hypercholesterolemia, arterial hypertension, diabetes mellitus and subdecompensated heart failure and a history of corrective arthrodesis of the left foot 30 years ago, presented with plantar chronic ulcer on the left foot with signs of infection. Magnetic resonance imaging was done for further diagnostics that showed plantar angulation of the cuboid bone as cause of the ulcer with chronic osteomyelitis.

Angiographical status of the limb was examined and found a sufficient macrocirculation. On the day of admission her laboratory levels of CRP was 19 mg/L and leucocytes $7,3 \times 10^9/L$. She was already treated with antibiotics for several days. Based on all diagnostic



Figure 1: X-ray of the left foot before admission. Altered biomechanics of the foot is seen.

examinations that were done, a two-stage surgical treatment was indicated. During an operation a necrectomy of soft tissue and a segmental resection of cuboid bone and resection of basis of 4th and 5th metatarsal bones was done. In the bone defect a temporary antibiotic spacer was applied and an external Orthofix ring fixator was installed for the arthrodesis. Ulcer was treated with a necrectomy and a negative pressure therapy. Microbiology confirmed infection of cuboid bone with *Clostridium perfringens*. Histologically an additional infectious osteomyelitis of both basis of metatarsal bones was proven.

A negative pressure therapy was changed several times until there was sufficient granulation of the chronic wound. The second stage surgery was done with temporary antibiotic spacer removal

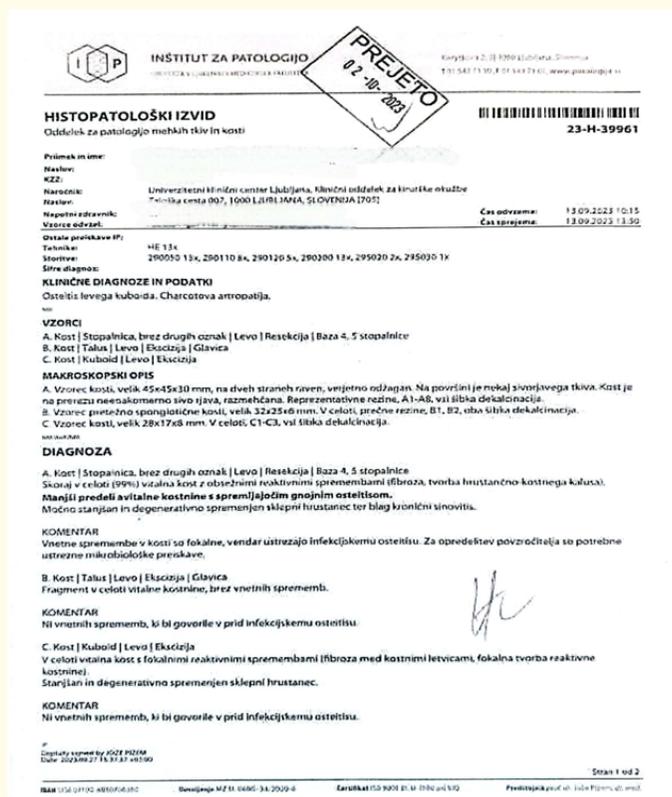


Figure 2: Pathological report confirming osteomyelitis of basis of 4th and 5th metatarsal bones.

and replacement with a Bioactive Glass putty and granules on the site of cuboid and metatarsal bone defect.

Further a chronic wound was covered with a half thickness skin graft and negative pressure therapy for a few more days. The patient was further treated with antibiotic therapy based on micro-

biological findings for 3 months. After 3 months the external fixator was removed, meanwhile the patient did not burden the foot.

On the follow up X-ray showed suitable position and appropriate healing of the affected bones with no signs of osteomyelitis. In addition, chronic ulcer wound healed properly with no later complications.



Figure 3: Removal of antibiotic spacer.

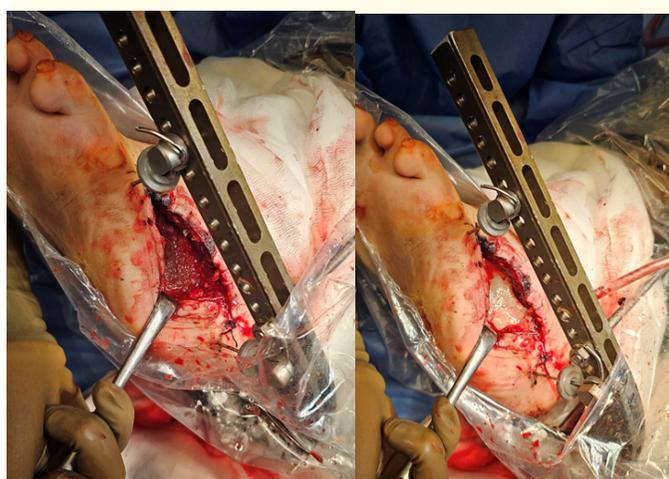


Figure 4: Application of Bioactive Glass S53P4 granules and putty.

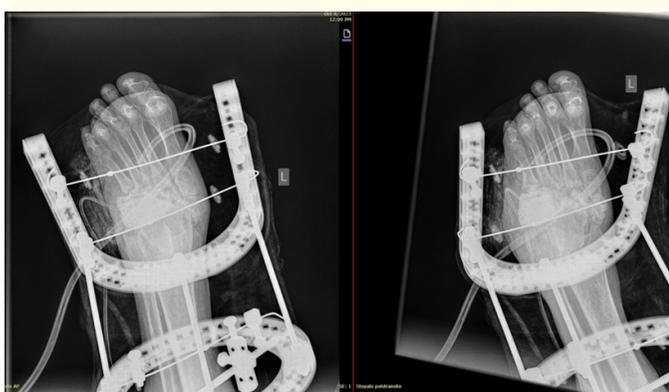


Figure 5: After second-stage of the surgery, external fixator Orthofix and Bioactive Glass is seen.



Figure 6: 8 weeks follow up after Orthofix installation.



Figure 7: Two weeks follow up after Orthofix removal and 2 months follow up after the second stage surgery. Healed wounds.

After finished treatment the patient participated in physiotherapy.

Discussion

In the presented clinical case report the patient developed a chronic foot ulcer due to altered biomechanics of the foot with a plantar angulation of the cuboid bone as a causative factor and osteomyelitis of the underlying bone structures. The IWGDF/IDSA



Figure 8: X-ray after 3 months follow up. Bioactive Glass position is seen with a bone calus.

Guidelines for diabetic foot infections recommends the diagnosis for osteomyelitis in diabetic foot is based on laboratory findings and X-ray imaging or in doubt additionally MRI performing [2]. In our case, MRI revealed osteomyelitis of cuboid bone which was later histologically and microbiologically proven. Treatment of osteomyelitis of the foot could be very challenging in diabetic patients with many associated negative factors. Such an infection presents high possibility for foot amputation, that is why the treatment goal is limb integrity and function preservation that is very important for the patient's functional status and social actualization. Treatment can be more conservative with antibiotic treatment or surgical with removal of infected bone in different levels as only part of the bone or an amputation. By the IWGDF/IDSA Guidelines of diabetic foot infections recommendation is to consider up to 3 weeks of antibiotic treatment after minor amputation of the foot with positive bone margin cultures and 6 weeks of diabetic therapy without bone resection or amputation [2]. In our case infectiousologists recommend antibiotic treatment of osteomyelitis for 3 months according to microbiology findings.

Surgical treatment is based on resection of infected bone. In our case we decided for limb sparing surgery with a resection of an infected part of cuboid bone and bases of 5th and 4th metatarsal bones. We performed a two-stage surgical treatment where we used a temporary antibiotic spacer in the first stage to locally reduce the possible remaining infection of remained resected bones

while applying external fixator for arthrodesis. To fill the resulting bone defects after removing the spacer in the second stage we used biomaterial S53P4 Bioactive Glass. There was also a case report described in the literature as option two-stage surgical treatment of cuboid osteomyelitis by Elias S., *et al.* yet not included Bioactive Glass [6]. It is a third-generation biomaterial that is used as a bone substitute and has antimicrobial effect, ability to fill bone defects and stimulates bone growth all of that required for optimal healing. There is an increasing number of clinical reports available in the literature describing and concerning the use of the third-generation biomaterials. Roberto De Giglio, *et al.* described finding of their observational retrospective study involving 44 patients affected by osteomyelitis of the diabetic foot. Their findings were that BG was shown to be more effective than traditional treatment, it was linked with a lower probability of need of antibiotic treatment after the follow up period further BG was shown to be a safe biomaterial to use in diabetic foot [4]. There has also been good results of preservation surgery reported by our clinical group in treating septic osteoarthritis and osteomyelitis in diabetic foot [5,7]. Our previously published retrospective study including diabetic patients with complication of septic osteoarthritis treated with BG S53P4 presented a wide array of potential applications for use of above mentioned biomaterial with a promising results [5,7]. Andrea Panunzi, *et al.* described positive outcome of treatment with Bioactive Glass in a clinical case of digital osteomyelitis caused by multidrug resistant bacteria [3].

According to our experiences and reports of other clinical cases treatment with Bioactive Glass currently seems to be a favourable method of treatment of osteomyelitis in diabetic foot.

Conclusion

The clinical case report presents positive results of treatment with Bioactive Glass S53P4 of osteomyelitis in diabetic foot. It is the new third-generation biomaterial used as bone substitute with all the required properties needed for suitable treatment of infected bone. Its use in osteomyelitis treatment is increasing in the literature which contributes to more clinical data about its efficacy and safety. So far there has been no complications about the use of Bioactive Glass reported and it seems to show promising results.

Conflict of Interest

The authors declare no conflict of interest.

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