

Dental Implant Placement in Focal Osteoporotic Bone Marrow Defect: a Case Report and Treatment Recommendations

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ABSTRACT

Background: Focal osteoporotic bone marrow defect is asymptomatic radiolucent area usually discovered incidentally during radiographic examination of the jaws. This bone condition can lead to clinical complications during dental implant placement or during osseointegration process.

Methods: A 54-year-old woman was referred to private dental implant centre for a dental implant rehabilitation treatment in May 17, 2016. Oral examination revealed a healthy mucosa with no visible pathology. Adentia of tooth #46 and moderate atrophy of the edentulous alveolar process were found. Panoramic radiography of the jaws showed 2 cm x 2 cm radiolucency with irregular borders located in tooth #46 region. The margins of the bone defect were uneven, single trabeculae were visible, and the cortical layer was not deformed. In the absence of signs of pathology, it was decided to perform a dental implant surgery in the edentulous jaw segment #46.

Results: The osteoporotic focus was filled with natural bovine bone substitute Cerabone[®]. The granules were gently condensed to the sides - to the buccal and lingual walls until they filled the entire cavity. A 10 mm long, 4.1 mm diameter Straumann[®] Tissue Level implant was surgically placed with the shoulder of the implant resting on the margins of the osteotomy. It was proposed six steps protocol for surgical dental implant installation in focal osteoporotic bone marrow defect in mandible.

Conclusions: A six-step protocol for surgical placement of dental implants in focal osteoporotic bone marrow defects may be a useful tool for clinicians in implant dentistry.

Keywords: bone marrow; bone substitutes; dental implants; radiography; mandible.

Accepted for publication: 30 September 2022

To cite this article:

Juodzbalyš G.

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J Oral Maxillofac Res 2022;13(3):e5

URL: <http://www.ejomr.org/JOMR/archives/2022/3/e5/v13n3e5.pdf>

doi: [10.5037/jomr.2022.13305](https://doi.org/10.5037/jomr.2022.13305)

INTRODUCTION

Nowadays, tooth replacement with an implant-supported restoration is a predictable and successful treatment method [1,2]. Long-term success rates are related to the osseointegration phenomenon of dental implants [3,4]. However, the process of implant osseointegration can be affected by factors such as the primary stability of the implant, which depends on implant geometry [5-7], surgical technique [8] and bone condition i.e. bone density and volume [9]. Therefore, insufficient bone condition can lead to clinical complications during dental implant placement or during osseointegration process [9]. One such condition can be focal osteoporotic bone marrow defects (FOBMDs) [10]. FOBMD is asymptomatic radiolucent area usually discovered incidentally during radiographic examination. It can be of various sizes and shapes without expansion of the cortical bone of the jaw. FOBMD consists of hematopoietic red marrow with varying amounts of fatty yellow marrow [11,12].

This condition is usually found in the posterior region of the mandible in an adult woman. Furthermore, FOBMD is mainly located in edentulous areas region where tooth extraction was previously performed [13]. Lack of primary stability due to FOBMD can lead to displacement or even migration of the implant into the jaw [11,13].

This paper describes the case of a successful dental implant placement in a focal osteoporotic bone marrow defect and provides treatment recommendations for this condition.

CASE DESCRIPTION AND RESULTS

A 54-year-old woman was referred to private dental

implant centre, in Kaunas, Lithuania, for a dental implant rehabilitation treatment in May 17, 2016. The physical examination was unremarkable. Oral examination revealed a healthy mucosa with no visible pathology. Adentia of tooth #46 and moderate atrophy of the edentulous alveolar process were found. In anamnesis, tooth #46 was extracted 12 month ago and post-extraction socket healing was uneventful. Panoramic radiography of the jaws showed 2x 2 cm radiolucency with irregular borders located in tooth #46 region (Figure 1). The margins of the radiolucency corresponded to the extraction socket borders of the extracted tooth #46. The margins of the bone defect were uneven, single trabeculae were visible, and the cortical layer was not deformed. In the absence of signs of pathology, it was decided to perform a dental implant surgery in the edentulous jaw segment #46.

Under local anaesthesia Straumann® solid screw implant (Straumann AG; Basel, Switzerland) placement operation was planned according to manufacturer's recommendation. When drilling with a pilot drill (2.2 mm diameter), after penetrating the cortical layer of the jaw, the drill fell down into the bone without resistance. The osteotomy in the cortical layer was widened using second (2.8 mm diameter) and third (3.5 mm diameter) drills. A 3.5 mm diameter depth gauge was used to check the preparation depth. The gauge was inserted into the implant bed without pressure until it rested against the bone. The patient was asked if she felt irritation or pain in the inferior alveolar nerve. The answer was negative. Furthermore, gentle curettage of the bone walls was performed using a curette through the implant bed. There were no signs of any pathology like cyst, bony haematomas and etcetera. A diagnosis of focal osteoporotic bone marrow defect was established.

A 10 mm long, 4.1 mm diameter Straumann® Tissue Level implant was planned to be placed with the shoulder of the implant resting on the margins of



Figure 1. Panoramic radiography demonstrating 2 x 2 cm radiolucency with irregular borders located in tooth #46 region. The margins of the radiolucency correspond to extraction socket borders of the tooth #46.

the osteotomy. Before inserting the implant, the osteoporotic focus was filled with natural bovine bone substitute Cerabone® (Botiss biomaterials GmbH; Zossen, Germany). The diameter of the Cerabone® granules was 0.5 - 1 mm. The granules were gently condensed to the sides - to the buccal and lingual walls until they filled the entire cavity. A 3.5 mm diameter depth gauge then was gently inserted to create a bed for the implant and to avoid pressure on the mandibular canal when screwing in the implant. Finally, the dental implant was inserted with a hand ratchet until the shoulder of the implant rested on the cortical layer of the mandible. The engagement of the implant neck into the bone ensured the minimal primary stability of the implant that was clinically felt. Medications and postoperative recommendations were prescribed after dental implant surgery. The healing was uneventful. The implant was left to heal submerged for 4 months. After 4 months, stage II surgery was done, and soft tissue correction was performed. Cement-retained metal ceramic crown was attached and control panoramic radiograph was performed (Figure 2). The patient was enrolled in an oral hygiene and dental implant care program.

Annual regular follow-up showed no complications. A control panoramic radiograph and CBCT (Figure 3) taken in August 2022 showed no signs of peri-implantitis, marginal bone loss, or failed osseointegration.

DISCUSSION

FOBMD is an uncommon localized bone defect consisting of red bone marrow with varying amounts of fatty yellow marrow. According to Shankland and Bouquet [15] in adult jaws, the yellow bone marrow comprises around 75%, while the red bone marrow is about 25%. Most often, these defects are determined radiologically as an unusual radiolucency often detected accidentally. Its size can vary from a few millimetres to a few centimetres in diameter [14]. The shape and borders are difficult to define, but they do not interrupt the cortical layer [11]. Usually, FOBMD appear in the edentulous area where a tooth was previously extracted [15]. Shankland and Bouquet [15] conducted a study of 100 cases and determined that 3% of FOBMD were bilateral.



Figure 2. Panoramic radiography demonstrating the osteoporotic focus filled with natural bovine bone substitute and a 10 mm long, 4.1 mm diameter Straumann® Tissue Level implant placed with the shoulder of the implant resting on the margins of the osteotomy.



Figure 3. Patient's radiographic examination after 6-year follow-up: A = panoramic radiography; B = CBCT axial plane, demonstrating no signs of peri-implantitis, marginal bone loss, or failed osseointegration.

Most often, FOBMD is found in the distal areas of the mandible of a middle-aged woman [14].

The present case report of a representative patient shows key demographic, clinical and radiographic findings in patients with FOBMD. The diagnosis was stated based mainly on radiological findings. This is in coincident with Makek and Lello [16]. They distinguished three typical radiographic features: (a) the lesion is usually round or oval, (b) the lesion usually has a well-defined anterior wall that sometimes appears sclerotic, (c) the lesion may be seen without internal structures or trabeculations. Furthermore, there were no signs or symptoms of mandibular cyst or other pathology.

Treatment strategy was based on filling the osteoporotic focus with bone substitute and screwing in the tissue level implant, which has a neck and a shoulder. This treatment was chosen to avoid possible complications related with inferior alveolar nerve injury and implant displacement into mandibular bone marrow. Some authors presented data concerning accidental implant displacement into the marrow space of mandibular body in patients with FOBMD [17-19]. Heavy displacement of the implant may primarily cause the inferior alveolar nerve compression or even injury. The situation can be complicated by a further surgical procedure for the removal of implants, during which there may be secondary injuries to the nerve [20]. Most of authors of presented cases were using bone level implants that were not sufficiently fixed in the cortical layer of the mandible [17-20]. In contrast, a tissue-level implant with a prominent shoulder was used in this study.

Iwanaga and co-authors [21] investigated microsurgical anatomy of superior wall of the mandibular canal and a cancellous bone pattern above the mandibular canal. The inferior view of the canal was classified into four groups depending on the surface of the superior wall of the mandibular canal. In the case of class II, the upper wall of the mandibular canal was osteoporotic, and by filling the osteoporotic bone marrow defect too strongly, the bone substitute granules may penetrate into the mandibular canal. It can evoke serious complication - inferior alveolar nerve compression. This is why the filling of the bony defect must be done gently, without pressure, by shaping the implant socket with a depth gauge, before screwing in the implant.

It is important to note that it is necessary to ensure that bone substitute fill the cavity between buccal and lingual walls, to ensure bicortical defect filling.

This will ensure the long-term support and functioning of the implant. In this case, it is not necessary to fill the entire cavity.

For the proper diagnosis of FOBMD, the use of a low-dose scanning system, CBCT, which has been specifically designed to produce three-dimensional images of the jaw skeleton, is recommended. However, CBCT is often recommended for clinical usage, especially in cases there the vital structures are difficult to detect due to its high accuracy and low radiation exposure [22].

Taking into account the morphology of the mandibular osteoporotic defect and the structure of dental implants, the following six steps protocol is recommend for surgical dental implant installation in focal osteoporotic bone marrow defect:

1. Determine if it is not a cyst, bony haemangioma, et cetera. Perform a histological examination if there are suspicions about a possible pathology.
2. Before filling out the defect, make sure that there is no contact with inferior alveolar nerve.
3. Gently curette through the osteotomy to ensure that there is no cyst capsule or other structures.
4. When filling the bony defect, spread the bone granules in directions between buccal and lingual walls, to ensure bicortical defect filling.
5. Do not apply excessive pressure.
6. Use a tissue-level implant with a shoulder to attach to the mandibular cortical bone.

CONCLUSIONS

Patients with a suspected osteoporotic bone marrow defect should undergo a cone-beam computed tomography to accurately determine the size of the defect, its relationship with the mandibular canal, and to avoid possible complications. A six-step protocol for surgical placement of dental implants in focal osteoporotic bone marrow defects may be a useful tool for clinicians in implant dentistry.

ACKNOWLEDGMENTS AND DISCLOSURE STATEMENTS

The authors received no specific grants from funding agencies and no financial support for this work and there is not any conflict of interest among authors.

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To cite this article:

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J Oral Maxillofac Res 2022;13(3):e5

URL: <http://www.ejomr.org/JOMR/archives/2022/3/e5/v13n3e5.pdf>

doi: [10.5037/jomr.2022.13305](https://doi.org/10.5037/jomr.2022.13305)

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