Review

DENTAL IMPLANT PLACEMENT IN HYPERDENSE BONE AREA OF THE JAW: A NARRATIVE MINIREVIEW

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ABSTRACT

Dental implant placement has become one of the safest surgical procedures in oral surgery; when the jawbone is enough in height and width, dental implant placement is easy, and implant primary stability is predictable. However, one of the most important elements of success in dental implants is primarily bone density. Bone tissue quality can vary depending on patient health, previous tooth extraction, or odontogenic or non-odontogenic lesions in the jaws, which should be removed before dental implant placement into edentulous areas. Among lesions of the jaw bones, the radiopaque ones are less frequent and less studied. This mini literature review aims to evaluate the reliability of dental implant placement in the hyperdense bone area of the jaws, avoiding, when possible, lesion removal. Material and methods: the research was performed manually on PubMed, Google Scholar, and Scopus databases by typing the exact search string; among 114 scientific articles, only 8 matched the eligibility criteria. These studies show how radiopaque lesions should always be investigated to understand their origins: radiological investigation and eventual clinical symptoms reported by the patient should be considered for differential diagnosis; anyway, according to these reported cases, implant placement can be successfully performed also when these types of lesions are present, even if further research is needed to develop new and specific surgical protocols.

KEYWORDS: *hyperdense lesions, dental implants, jawbone, idiopathic osteosclerosis, condensing osteitis, cemento-osseous-dysplasia*

INTRODUCTION

Radiolucent lesions of the jaws, such as periapical cysts or odontogenic tumors, correspond to 80% of bony lesions and are widely described in the literature. Therefore, many clinical protocols have been used from diagnosis to treatment (1). Otherwise, radiopaque lesions are less investigated and outlined in the literature. They are often incidental findings in radiography or computed tomography exams. They can occur in different regions of the jaws, and no treatment is required if they are located in areas of no surgical interest (1, 2).

Literature is poor in guidelines and protocols regarding diagnosing and managing hyperdense lesions. They are usually well-defined unilocular or multilocular masses and represent a benign or inflammatory process. Moreover, dental implant placement in these areas is often problematic, and the scientific literature on intra-operative and post-operative complications is unclear (2, 3).

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Many types of radiopaque lesions described in the literature can be related to benign bone and cartilage tumors and mesenchymal odontogenic tumors (4). Abnormal radiopacities could often be found during CBCT exams accidentally; those could be more often related to remaining endodontic materials, remaining dental roots after a complicated extraction, and fractured bone pieces. Less commonly, these findings could be related to dental elements and other odontogenic tissue, moving the diagnosis to different types of pathological lesions, such as odontogenic and non-odontogenic tumors and benign or malignant tumors (5, 6).

The presence of radiopaque or radiolucent lesions of the bone could make the placement of dental implants challenging. In these cases, it is often needed to wait for the healing of the interested area after their surgical removal: bone regeneration requires time, and it takes at least 3-4 months to have good bone quality to place an implant with an acceptable primary stability (7-9). But is surgical resection always needed when a radiopaque lesion occurs?

First, understanding its nature is the most crucial thing when a radiopaque lesion is found during the radiographical investigation. Radiologists play a vital role in identifying and diagnosing mandibular and maxilla lesions. CBCT is the gold standard imaging modality to detect information about the characteristics of the lesions and their anatomical boundaries in the maxillofacial district (10).

The relationship of densely sclerotic lesions to adjacent teeth and cortical bone and the assessment of lesion margins often allows the clinician to arrive at a single diagnosis. Moreover, a final diagnosis can frequently be made to assess extragnathic bone findings when these lesions occur as a systematic disorder sign (11, 12). Usually, a radiopaque lesion can be described as a densely sclerotic, ground glass, or mixed lytic-sclerotic, with each category representing different lesions that can help in differential diagnosis. This is a general guide to the diagnostic process, as many lesions demonstrate considerable radiologic variability (11).

Similar clinical and radiographical manifestations can be seen when densely sclerotic lesions occur. They are usually benign with a homogeneous radiopaque pattern, and among these, we can find:

- *Idiopathic osteosclerosis (IO)* can be described as a well-defined, more radiopaque area in cancellous bone and can be associated or not to dental elements; when associated with teeth, it can be found in the periapical or interradicular region, especially lower molars. The lesion can present an irregular or rounded shape, measuring from 1 to 3-4 mm. Its etiology is unknown; inflammation or trauma should be considered. Normally, lesions do not grow in size but decrease. Patients do not show symptoms or clinical signs. No biopsy is needed, and the diagnosis is based on radiological presentation (6, 11).
- *Condensing osteitis (CO)* is a radiopaque asymptomatic lesion usually localized in the posterior region of the mandible in the root region of the tooth. Its etiology is linked to a persistent apical infection due to tooth bacterial invasion or bone exposure to necrotic substances such as the material used for root canal treatment. The necrosis of surrounding soft and periodontal tissue near the root can lead to bone remodeling with excess bone matrix deposition, resulting in a more dense bone area (13, 14).
- *Cemento-Osseus-Dysplasia (COD)* describes a spectrum of idiopathic odontogenic fibro-osseous lesions in which a mixture of cementum, bone, and fibrous connective tissue replaces normal bone. There are subtypes based on the affected region and diffusion: periapical, focal, or florid. Periapical COD is usually described adjacent to the roots of vital teeth in the anterior sextant of the mandible. Focal COD occurs away from the periapical region, in the posterior jaw. Florid COD shows multifocal lesions affecting multiple regions of the mouth. COD has a strong female predilection in the 4th and 5th decades of life. A narrow radiolucent halo at imaging distinguishes COD from condensing osteitis and idiopathic osteosclerosis. However, at early stages, COD can be confused for a periapical inflammatory lesion (11, 15, 16).

MATERIALS AND METHODS

Literature research has been performed, including PubMed, Google Scholar, and Scopus databases typing the same research string adapted according to their respective advanced research criteria: "*Radiopaque Lesions OR Hyperdense Jaws Lesions OR Cemento-Osseus Dysplasia OR Idiopathic Osteosclerosis OR Condensing Osteitis AND Dental Implant*". A total of 114 scientific articles were found.

The inclusion criteria were case reports, case series, or RCTs related to human cases of dental implant placement in hyperdense bone areas.

The exclusion criteria were: studies containing keywords but not relevant to the research topic, articles that included radiopaque odontogenic tumors such as odontoma, cementoblastoma, osteoid osteoma, articles that did not include a description of clinical cases of dental implants placement in the lesion area, articles not available in full-text, articles not available in English. According to these criteria, only 8 articles were included in this review.

RESULTS

A total of 114 articles was found published from 1991 to 2021 (30 on PubMed, 67 on Google Scholar, and 17 on Scopus, respectively): doubles, articles that did not include description of clinical cases and articles not written in English were excluded for a total of 94 remanent studies; only 8 articles were electable for this review published from 2018 to 2021. Among these, 6 reported cases of Florid-Cemento-Osseus-Dysplasia (FCOD) and two reported Condensing Osteitis (CO). In 2 articles, dental implant placement was scheduled without involving the radiopaque mass, and the first decided to perform the lesion removal plus Guided Bone Regeneration (GBR) before implant surgery at 6 months with a follow-up of 18 months after function (3, 13). Alqahtani et al. reported a dental basal implant placement in a CO lesion after the tooth extraction; no follow-up is available (17, 18). All the remaining articles reported cases of dental implant placement directly in the radiopaque areas, and only 4 of these (19-22) reported respectively 2, 8, and 16 years of follow-up after surgery and a case of osteomyelitis after surgery. The most recent study reported a case of dental implant placement in the radiopaque lesion describing a new 3-step surgery protocol (23).

DISCUSSION

The management of radiopaque lesions is always confusing and unclear for the clinician. The studies included in this mini-review reported different approaches. Treatment of this kind of lesion is often “wait and see”, avoiding the removal when there are no evident signs or symptoms. The avascular nature of these lesions is often related to a major risk of bone infection, resulting in necrosis and osteomyelitis (20). Implant placement in these areas is rarely performed because the lack of vessels and marrow bone could lead to unsuccessful osseointegration. The exposure of lesion tissue during extraction of the involved tooth or lesion removal or implant bed preparation could lead to a bacterial invasion and, consequently, osteomyelitis (21). According to the articles included in this mini-review, the management could be differentiated into:

- a more conservative approach, which provides the dental implant placement in a safe area near the radiopaque mass without involving it,
- a second option is not removing the lesion and placing the dental implant directly into the radiopaque mass,
- and finally, a more invasive approach that removes the entire lesion and, if necessary, a GBR before implant placement.

Esfahanizadeh et al. (3) describe a case of dental implant placement near a hyperdense bone area of the mandible identified as a Florid-Cemento-Osseus-Dysplasia (FCOD). In this case, Esfahanizadeh et al. decided to perform dental implant insertion without removing the FCOD lesion: two dental implants were placed respectively on the mesial and the distal edge of the lesion. Orthopantomography was taken at 12 and 18 months after surgery. The other studies describe two cases of Condensing Osteitis (CO) associated with erupted teeth. Rass et al. (13) opted for a less conservative surgery: the mandibular left second molar (4.5) was extracted together with the CO lesion, and the wide bone defect was treated with a Guided Bone Regeneration using a bone graft and a resorbable membrane; two dental implants were placed after 6 months, and no follow-up controls were available. Alqahtani et al. (17) reported a case of CO associated with a first mandibular molar in which the involved tooth was extracted to immediately place a basal implant without removing the radiopaque lesion.

In all these studies, clinicians opted not to involve the radiopaque mass during dental implant insertion. This choice can be explained by the results shown by other studies, such as Gerlach et al. (24), in which implant failure is reported following implant placement in patients with FCOD: patients returned with swelling, pain, and implant mobility after only 26 months of function. The FCOD lesion was grown and involved all the surrounding implant bone. The moving implant and lesion were removed, followed by histological exams that confirmed FCOD diagnosis.

Another approach could involve the removal of the lesion before the implantation procedure: the surgical procedure is recommended for those patients with pain, swelling, and deformities; otherwise, no treatment is required since these lesions usually remain non-aggressive (4, 11). Moreover, when surgical removal is performed, the avascular nature of the lesion contributes to susceptibility to severe infection, bone sequestration, and osteomyelitis (25), which do not lead to adequate bone healing. In addition, after the surgical removal, a GBR with bone graft and membrane is often needed to replace the absent bone volume. Alqahtani et al. (13) show how this procedure may lead to a successful implant placement after 6 months, but sadly, there is no further information about follow-up and survival after function.

A more conservative approach includes no treatment for the radiopaque mass and implant placement in the adjacent area, even very close to the lesion (3, 17). Esfahanizadeh et al. (3) show an 18-month follow-up in a patient with FCOD

where two implants were placed mesially and distally to the lesion without invading it. A contralateral edentulous area where the same lesion was spotted was not treated because a similar implant placement could not be performed without involving the radiopaque mass. Alqahtani et al. (17) show even immediate implant placement without removing the lesion, but unfortunately, there is no follow-up.

Other studies show dental implant placement involving the affected bone area: Adnot et al. (19) described a dental implant placement in an affected bone area after ostectomy treatment to adjust crestal edges. The authors showed perfect dental implant integration after 2 years of follow-up. They underlined specific recommendations during surgical and prosthetic procedures, such as drilling under abundant irrigation and delayed implant loading till dental implant osseointegration is obtained. Perez et al. (23) describe how to manage safe dental implant placement in COD lesions instead. The first step includes a drilling sequence under abundant irrigation, rinsing with betadine, hermetic wound closure, and a prescription of antibiotic therapy. The second step includes dental implant placement after 3 weeks. The third and last step includes the insertion of the healing abutment ed during the drilling sequence; this risk is higher in COD lesions made of avascular tissue. Moreover, delaying implant placement helps reduce dental implant surface contamination, placing the implant after 3 weeks during proliferative after 3 months.

The biological rationale of this protocol is to reduce bone necrosis risk due to the high-temperature reach phase with woven bone and fibrous matrix formation. Shadid et al. (20) show a case of dental implant placement in an FCOD lesion with 8 years of follow-up: classic 2-stage surgery was performed by placing implants directly in the hyperdense tissue. The patient underwent radiographic controls immediately after surgery, after one year, and every 2 years; after 8 years, dental implants showed perfect integration without bone problems. The FCOD lesion was not removed because it was asymptomatic, and it would be difficult for the clinician to discern healthy tissue from diseased tissue with the necessity of bone-guided regeneration after removal. Otherwise, FCOD lesions are made of tissue with poor vessel presence, which could lead to poor healing and osteointegration process, risk of infection, and risk of bone fracture, depending on their dimensions.

When the clinician decides to preserve the lesion, it is important to insert the patient in a maintenance protocol of hygiene and radiographic exams to highlight any changes. Park et al. (21) reported the longest follow-up of a dental implant placed into an FCOD lesion. After 16 years, implants were removed due to periimplantitis, and a micro-CT analysis was performed. The histological investigation showed how FCOD tissue is similar to dense bone, with no gap between the implant and FCOD tissue with good direct contact, no soft tissue interposition, and no blood vessels. The conclusions of this study led the clinicians to affirm that dental implant placement in FCOD tissue could be performed after endodontic and periodontal infection resolution and after complete calcification of the FCOD lesion, delaying surgery in the late stages of lesion maturation. On the other hand, Shin et al. (22) showed all the complications of placing dental implants directly into the avascular lesion: a case of osteomyelitis after dental implant placement due to drilling sequence without good cooling plus lack of blood vessels, which led to bone necrosis.

CONCLUSIONS

Implant placement in the jawbone area in which radiopaque masses are spotted can be performed following a conservative surgical procedure without consequences. When the radiopaque mass is not invaded, implant success can be reached normally. For those benign lesions, no treatment is required unless the patient complains symptoms such as pain and swelling or facial deformities. Implant placement directly into the radiopaque area is possible but not risk-free. A good drilling protocol with abundant irrigation is required in order to prevent bone necrosis as well as delaying implant loading when osteointegration is reached totally. Once diagnosis is cleared follow-up with regular radiographic exams is needed to control any possible modifications. Further studies are necessary in order to understand how to manage these cases, how to improve and facilitate differential diagnosis and how to ease implant placement even when radiopaque masses are present.

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