The effect of osteoporosis on dental treatments

Dr. Elena Calciolari looks at the ramifications of osteoporosis on patients undertaking dental treatments.

Osteoporosis is a common systemic skeletal disease characterized by a decrease in bone mass and micro-architectural changes in bone structure, which dramatically increase the risk of fractures. It is diagnosed as a level of bone mineral density (BMD), calculated with a DEXA (dual-energy X-ray absorptiometry) scan, 2.5 standard deviations (SD) or more below the average mean value for young healthy women (T-score ≤ -2.5) (Kanis, et al., 2013).

The prevalence of osteoporosis in Europe was estimated to be of 27.6 million people (22 million women and 5.6 million men) in 2010, but due to the population growth and the increase in life expectancy, this number is likely to rise in the future, as shown by Hernlund and colleagues (2013). Projections for the United Kingdom hypothesize that the number of fragility fractures will increase from 536,000, as recorded in 2010, to 682,000 by 2025 (+27%) (Svedborn, et al., 2013).

Women after menopause and men after 70 years old are the most affected demographic due to the detrimental effect a lack of estrogen/androgen has on bone metabolism. Considering the increase in life expectancy, the number of osteoporotic patients requiring dental care is expected to significantly rise in the coming years, and therefore, it is important for dentists to be well aware of any possible effect of osteoporosis (and its medications) on the success of dental treatments and on the incidence of possible complications.

This article will try to answer the following questions:
- Does osteoporosis affect also the jawbones?
- Can we place implants in patients with osteoporosis?
- What is the effect of osteoporosis medications on the success/survival of dental implants?
- What is the risk of developing an osteonecrosis of the jaw after a dental implant?

Where possible, this article will try to give practical tips to the clinician.

Does osteoporosis also affect the jawbones?
Before taking into consideration how to relate with osteoporotic patients, it is of primary importance to understand if osteoporosis does exist in the jawbones, or if it is a disease strictly confined to long bones and vertebrae.

It is, of course, plausible to hypothesize that osteoporosis-induced systemic bone loss may include also bone loss at the jaws, as bones of the skeleton. As a proof of that, some clinical studies reported that there is an increased alveolar bone resorption in osteoporotic versus non-osteoporotic edentulous patients (Hira, et al., 1993; Singhal, et al., 2012), and that medications affecting systemic bone density (like hormone replacement therapy and bisphosphonates) are associated with a slower loss of alveolar bone (Graziani, et al., 2008).

However, the evidence is not so clear. Although several animal and clinical studies have reported a positive correlation between bone density at the jaws and bone density at several other skeletal sites (such as the femur neck, the lumbar spine, the calcaneus, and the forearm), other studies did not confirm these findings. As highlighted by a recent systematic review (Calciolari, et al., 2015a), one of the biggest limits we face today is the lack of a standardized and accurate technique to measure jawbone density, since a DEXA software for jawbones does not exist.

Despite these controversial results, in the past 20 years, many studies have claimed a role of the dentist in the early diagnosis of osteoporosis by measuring specific quantitative/qualitative indices on dental panoramic radiographs (OPGs). A meta-analysis of the accuracy of these indices has reported that, for example, 80% of people with erosions of the mandibular cortex, as assessed by a qualitative evaluation on the OPG, are at least osteopenic and therefore would benefit to be referred to a specialist (Calciolari, et al., 2015b).

Can we place implants in patients with osteoporosis?

It is biologically plausible that the alterations in bone metabolism associated to osteoporosis can also impair bone healing around dental implants and affect their osseointegration. Some animal studies have confirmed a reduced bone-to-implant contact, reduced mechanical properties, and a delay in bone healing in osteoporotic-like conditions, and a few prospective and retrospective clinical studies indicated that osteoporosis could jeopardize implant...
success, especially in case implants are placed in augmented bone. Nevertheless, a systematic and a literary review on this topic failed to identify osteoporosis as an absolute contraindication for implant therapy (Slagter, Raghoebard, and Vissink, 2008; Tsolaki, Madianos, and Vrotsos, 2009).

From the available evidence, we can conclude that dental implants can be successfully placed in osteoporotic patients, but it is advisable to follow a few recommendations to guarantee a more predictable outcome.

In particular, clinicians should carefully assess and try to control for concomitant risk factors that can affect bone metabolism and bone density (such as deficiencies of vitamin D and calcium, smoking, and alcohol abuse), as well as for the presence of systemic diseases (such as diabetes mellitus) with a recognized impact on bone tissue. It is also advisable to consider osteoporotic bone as equivalent to type IV according to Lekholm and Zarb classification, thus porous and on average of poor quality. Hence, the clinician should take into consideration under preparation of the site longer healing periods before siting the prosthesis and a careful implant/bone loading distribution.

It has been argued that bone density is not uniformly distributed in the jaws. In particular, the lowest values of BMD have been recorded in the anterior maxilla and premolar region by Gulsahi and colleagues (2010). Therefore, especially in these areas, it is recommended that the clinician should avoid immediate loading and allow a longer period for the osseointegration of the implants (up to 50% more than normal).

The best way to pre-surgically assess jaw bone mineral density remains quantitative computed tomography, and recently Chai and colleagues suggested Hounsfield units (HU) cutoffs for identifying osteoporotic patients in the dental practice (460 HU for spine T-score) (2014).

A rapidly growing research field is now related to the use of implant surfaces that can be bioactivated, drug loaded, or chemically modified to improve osseointegration and bone formation in challenging conditions (such as osteoporosis). Animal studies have tested, for instance, the use of phosphate ceramic-coated implants, hydroxyapatite-coated implants, bisphosphonate-coated implants, and hydrophilic titanium surfaces (Mardas, et al., 2011; Alghamdi and Jansen, 2013) to promote better bone healing when the host bone is osteoporotic, but these data, though encouraging, still have to be thoroughly investigated in clinical trials.

**What is the effect of osteoporosis medications on the success/survival of dental implants?**

Several medications have been used to treat osteoporotic patients. In general, we distinguish between antiresorptive treatments that slow bone loss and bone anabolic agents that stimulate bone formation. Bisphosphonates (BPs), and in particular alendronate, are still the most commonly prescribed antiresorptive medications for osteoporosis and represent the gold standard in fracture prophylaxis. They can be administered either orally (more frequently) or intravenously, and they are stored in the bone for decades due to their strong affinity for hydroxyapatite. Contrasting results have been reported in relation to the influence of BPs on dental implant osseointegration and success.

Considering that these medications inhibit the formation and activation of osteoclasts and induce their apoptosis, thus reducing bone turnover, they may potentially reduce the regenerative capacity of bone around dental implants, thus impairing osseointegration. At the same time, the slower osseous remodeling allows more time for secondary mineralization, so that there is an increase in bone density and stiffness, together with an increase in microdamage of bone.

Although the available clinical evidence comes mainly from retrospective and case series studies, it seems that systemic BPs do not have a huge impact on the success and survival of dental implants (OR = 1.43, P = 0.156) (Ata-Ali, et al., 2014). The number of dental implants that must be exposed to BPs in order to cause a single implant failure, which otherwise would not have occurred (“number needed to harm”), was reported to be 509 dental implants.

This, however, does not mean that patients taking bisphosphonates are to be considered as complication-free, as described in the next paragraph.

**What is the risk of developing an osteonecrosis of the jaws (ONJ) after a dental implant?**

One of the most serious complications that have been related to the use of bisphosphonates is the development of osteonecrosis of the jaws (ONJ). This rare albeit serious event was first reported in 2003, and since then, the interest and the number of related publications have rapidly increased.

ONJ usually presents as an area of exposed bone that does not heal spontaneously within 8 weeks, and it is usually, but not always, associated with pain (Ruggiero, et al., 2014).

There is general consensus on considering intravenous bisphosphonate treatment in cancer patients as an absolute contraindication for implant placement. This has to do mainly with the serious medical condition affecting these patients, which could not only jeopardize the success of dental implants, but could also put at risk their general health (Donos and Calciolari, 2014). Conversely, osteoporosis treatment with oral

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(or less frequently intravenous) bisphosphonates is not considered an absolute contra-indication for dental implants. Only limited clinical studies have tried to address the risk of ONJ subsequent to implant placement, but it is recommended to consider it comparable to the one associated to a tooth extraction.

ONJs tend to occur more frequently in patients taking nitrogen-containing BPs (such as zoledronic acid and pamidronate) and intravenous bisphosphonates. The incidence of BPs-associated ONJ described in the literature ranges from 0.001% to 0.01%, with highest levels for long-term treatments, up to 0.2% in patients with greater than 4 years of exposure (Lo, et al., 2010). Taking into consideration the aspect of treatment duration, the American Association of Oral and Maxillofacial Surgeons suggested that, for patients taking BPs for more than 4 years, a drug holiday might be considered for at least 2 months before an oral surgery procedure (Ruggiero, et al., 2014).

In order to reduce the incidence of ONJs before an implant surgery, the clinician should first identify and address comorbidities and risk factors that may increase the possibility of developing this serious complications, such as smoking, oral mucosal irritation associated to denture wearing, periodontitis, treatment with corticosteroids, and diabetes mellitus. Furthermore, it is important to reduce the surgical trauma as much as possible, to use abundant irrigation when drilling the bone, and to suture in order to promote primary intention closure of the wound.

The Association of Dental Implantology stresses the importance of ensuring a high level of hygiene to reduce the need of surgical procedures in these patients, but whenever these are needed, it recommends the use of topical antiseptics (e.g., chlorhexidine) and systemic antibiotics (2012).

The reader should note that, though traditionally osteonecrosis of the jaw has been related to the use of bisphosphonates (mainly intravenous), it can be caused also by other antiresorptive medications, such as RANK ligand inhibitor (denosumab), and antiangiogenic medications. This is why the American Association of Oral and Maxillofacial Surgeons now prefers the term medication-related osteonecrosis of the jaw (MRONJ) instead of bisphosphonate-related osteonecrosis of the jaws (BRONJ) (Ruggiero, et al., 2014).

Conclusive recommendations
The available evidence on the risks associated with the treatment of osteoporotic patients is still poor and warrants further investigation. However, both the pathogenesis and the medications of osteoporosis can plausibly interfere with the success of dental treatments involving osseous healing of the jawbones (such as rehabilitation with dental implants or bone regenerative therapies). Before starting any of these procedures, the clinician needs to inform the patient about the possible complications and the risk of failures.

There is no absolute contraindication in placing dental implants in osteoporotic patients, but a longer osseointegration healing period should be taken into consideration. A correct patient selection is also crucial, and the dentist needs, in particular, to address possible concomitant risk factors that may increase the chances of implant failures, such as smoking, corticosteroid treatment, or diabetes mellitus.

Though rare, the association between BP use and osteonecrosis of the jaw can’t be overlooked. Clinicians should be well aware of the risks of dental implant placement in patients under BP treatment (especially intravenous infusion or oral BP therapy greater than 4 years), and should inform the patients accordingly.

Whenever a traumatic procedure such as an extraction or the positioning of an implant is performed in a patient taking BP, extra attention should be paid to ensure an atraumatic surgical technique, an adequate postoperative control, and an adequate occlusal adjustment of the prosthesis.

The dentist should discuss with the GP or the rheumatologist the possibility of a drug holiday in patients taking BPs for more than 4 years.

Patient education and motivation regarding dental care and tight recall programs have to be seen as a priority when dealing with osteoporotic patients in order to reduce the need for surgical procedures.

Last, but no less important, the clinician needs to balance the advantages and disadvantages related to a surgical procedure in patients with combined risk factors and to take into consideration that on some occasions nonsurgical options can be equally well tolerated/accepted with fewer chances of complications.

REFERENCES