MINI REVIEW

CRESTAL BONE LOSS AROUND IMPLANTS

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ABSTRACT
Crestal bone loss around an implant is seen as a manifestation of lack of osseointegration around an implant. It is said to be of multi factorial origin leading ultimately to the loss of the implant prosthesis with other severe consequences. This bone loss can be seen either early or late in the life of the implant. The early bone loss is impacted more by foreign body reactions and also patient related factors whereas the late CBL is due to microflora. The most important reason for CBL is overloading followed by a concept called brain-bone axis. The bone and immune system reacting to a foreign body is also seen to be an influencer of bone loss as a result of chronic inflammation becoming an immunological response. Due to osseoseparation becoming an alarming issue; methods to measure crestal bone loss are important. Standardised Intraoral Radiography[SIR] and Cone Beam Computed Tomography[CBCT] are the most appropriate ways of assessment available. This literature review has been done to highlight the importance of crestal bone loss as it is important for future success.

KEYWORDS
Crestal bone loss, osseointegration, brain-bone axis, radiographic techniques.

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Introduction

With the commercially pure titanium implants with a machined surface launched by Branemark, crestal bone loss [CBL] was relatively infrequent and non-progressing. In the late 1980s and 1990s, it was widely understood that 1 mm of CBL might be expected in the first year after implant placement, with 0.2 mm of CBL occurring on average after that. In fact, an adage developed that CBL between the first and second threads is common with these implants, after which time bone levels remained surprisingly steady for years. As a result of the initial wave of implants' success, the number of clinical scenarios that can benefit from dental implant therapy has grown. Following that, the number of healthcare providers qualified to put and restore implants was increased. Finally, "innovations" to dental implant systems were made with the purpose of expanding clinical scenarios and the pool of providers. Unfortunately, despite the best intentions, and some less-than-best intentions, the number of dental implant-related issues reported today is substantial. Indeed, it is significantly higher than necessary, putting patients at unacceptable risk of inferior clinical outcomes such as implant failure, biological tissue loss, financial loss, and psychological anguish.

The term osseosufficiency was coined by Koka and Zarb to characterize the function of the clinician-patient-implant system interaction in promoting and maintaining osseointegration[1]. A condition of osseosufficiency is achieved in this concept if the mix So components provided by the clinician [skill, knowledge, experience], the patient [genetic, environmental, behavioural], and the implant system [design, material] is "enough" to promote and sustain osseointegration. Osseoinsufficiency is the result of a mixture of elements that is "not enough." Peri-implant CBL is a clinical manifestation of osseoinsufficiency that can result in implant retrieval, osseous deformation, soft tissue deformation, aesthetic compromise, and a dissatisfied/upset patient who loses faith in their healthcare provider. Crestal bone loss is thought to have a multi-factorial origin and can occur early or late in a dental implant's lifetime. Early here refers to the first year after implantation, and CBL is a result of bone remodeling following surgical and restorative therapies, as well as early loading problems posed by an implant and its accompanying prosthesis [2]. Early CBL is not always impacted by oral microbiota infection. The cumulative effect of chronic etiological factors that are immunological [foreign body reaction], environmental, including patient factors such as motivation, smoking, bruxism, and

infection/inflammation, and clinician [surgeon/prosthodontist] influence may influence late CBL [3]

Discussion

The factors that affect the amount of crestal bone loss are given below. Overloading is assessed to be the first major reason. Esposito et al. reported that after an implant body osseointegrated and is exposed to functional loads, the implant prosthesis may be overloaded, resulting in implant loss. According to the findings, overload is a primary factor of late implant failure and contributes to peri-implantitis.[4] Overloading is a tough concept to define, however it might be thought of as a relationship between overloading and CBL. The clinical relevance of overloading in the peri-implant force level and/or kind of force application that exceeds the allowed or tolerated range CBL is discussed below. In terms of notation, 0.1 percent volume deformation equals 1000. [microstrain]. Frost et al. split bone's reaction to strain into four phases or "windows" based on the amount of deformation between bone and implant. Disuse atrophy window [50–100% of the amount of bone and implant deformation]. In this phase, where the overall effect of bone production and resorption is negative, bone resorption may occur. Second is the Steady state window [100–1500 με]. In this case, the net volume of the bone remains steady. Third is the mild overload window and last is the fatigue failure window where the destruction and bone resorption occurs[4]. In monkeys, Isidor et al. studied the crestal bone reaction to high occlusal load or plaque formation[5] A fixed partial prosthesis was placed 6 months after the implants were inserted in this study, and there were two experimental groups: excessive occlusal over load and plaque accumulation. From 4.5 to 15.5 months after overloading began, there was a loss of osseointegration and/or CBL. CBL did not occur in any of the implants that had plaque accumulation. In a canine model, Esaki et al. found a link between the degree of initial loading and peri-implant osteogenesis. Immediate load [0 N, 10 N, 50 N] was administered to implants put in healed sites utilizing a cyclic loading mechanism in this study. In the 10 N group, freshly produced bone was observed over a wide area from the implant neck toward the tip. In the 50 N group, on the other hand, newly produced bone was rarely seen[6]. Excessive occlusal load after implant installation in a dog was studied by Heitz-Mayfield et al[7]. Supra-occlusal crowns were implanted after six months dental recovery following implant placement. At eight months, all implants had osseointegrated, with no statistically significant difference in osseous response between test and control implants.

The second factor that is noted involves the 'Brain-Bone Axis'. It states how osseointegration is determined by modulating factors from the brain. According to new data, the brain and nervous system in general play critical roles in long-bone healing and remodeling processes [8]. Long bones are innervated by sympathetic, parasympathetic, and somatic nerve fibers, which form complex neural networks between the central nervous system and the bones [9] Recent research has also revealed major functional linkages between the central nervous system and the immune system, which, as previously mentioned, plays an important role in peri-implant bone repair. Sympathetic and parasympathetic nerve fibres of the autonomic nervous system innervate immune organs such as lymphoid organs [e.g., lymph nodes, spleen], which can affect bone remodelling [10]. Studies on the impact of mental and physical stress on general health and immunity support the idea that the brain can influence the immune response[11]. Furthermore, central nervous system medicines [e.g., opioids, antidepressants, anticonvulsants] and depression are linked to low bone mass and a higher risk of osteoporosis and fractures.

The bone and immune system foreign body reaction is another factor that causes crestal bone loss. Any foreign-body implant that comes into contact with vital tissues can trigger the immune/inflammatory response, in which defense cells such as neutrophils, lymphocytes, reactive pro-inflammatory macrophages [i.e., M1 and OsteoMac], and osteoclasts are activated and engulf and digest the foreign body under normal circumstances. Repair cells including fibroblasts, osteoblasts, and macrophages [M2 and OsteoMacs] are also activated, assisting in tissue repair and remodelling as well as tissue protection from further harm. When the immune response is overly powerful or prolonged, or its function is impaired, another possible immunological reaction to a foreign body arises. The defense/repair balance may shift towards chronic inflammation and chronic tissue damage in such settings [12]. Donath et al.[13] were the first to propose that the reaction of bone-tissue engulfing a dental implant is consistent with a protective foreign body immune response in which the implant is isolated and so protects the surrounding bone marrow tissue [Figure 2]. The Wennerberg and Albrektsson group and others have further suggested that once new bone has formed around the implant, maintaining a balance between bone resorption and bone formation [i.e., 'foreign-body equilibrium'] can maintain osseointegration and marginal bone height around the implants [14].

Measuring crestal bone loss

The occurrence of osseoseparation and peri-implantitis has necessitated the measurement of CBL. Osseosufficiency, or the harmonious relationship between the host, the implant, and the clinician [2], is required for a "lifetime" treatment for a patient. It was suggested that alterations in the bone anchoring be monitored on a regular basis[1]. In this situation, X-ray imaging techniques have naturally evolved as a useful tool for determining the extent of marginal bone loss. Standardized Intraoral Radiography [SIR] and CBCT appear to be the most appropriate procedures for assessing crestal bone levels in living patients nowadays.

Standardized intraoral radiography

Standardized intraoral [or periapical] radiographs have been and continue to be the most widely used approach for assessing peri-implant bone loss over time. The intraoral bisecting angle technique is preferable over the long cone paralleling technique for reducing distortion[15]. This periodontology technique involves holding the radiographic film parallel to the implant's long axis and aiming the X-ray beam perpendicularly towards the receptor. Periapical radiographs were previously taken using traditional films; however, digital radiography is becoming more widely employed in dental practice. A magnifying lens can be used to do regular measurements on conventional films. Most research techniques nowadays, however, include high-resolution digitization of a conventionally produced radiological film. The digital subtraction technique has been developed for research purposes to directly evaluate bone loss by superimposing two serial radiography pictures before removing them to isolate/quantify bone changes using specially-designed software [16].

Cone beam computed tomography

The use of CBCT, also known as digital volume tomography, to assess peri-implant bone level is very new, having only been introduced to dentistry 20 years ago. The lower irradiation dosage and less severe metallic artifacts compared to standard CT opened the door to new dental uses. In comparison to SIRs, CBCT image quality is mostly determined by the material's technological performance. The voxel size and field of vision are two of the most influential characteristics. Image resolution is linked to the size of volume elements, or voxels, which are typically cubes [with edges ranging from 0.08–0.3 mm in peri-implant defect research]. Small voxels, on the other hand, add to the noise [17].

Conclusion

Traditional etiologies are being combined with novel mechanisms in order to better reconcile what was supposed to be happening during osseointegration with real long-term clinical consequences. Today, the ability to examine osseointegration outcomes at the implant, prosthesis, patient, and clinician levels allows us to recognise that osseointegration is most likely a form of foreign body reaction, and it focuses our attention on factors that influence the immune response or the outcome of a patient's immune response. In this way, established etiologies like infection-induced inflammation and overloading can be considered as immune response modulators, and the influence of immune response via neuroimmunomodulation opens up new and fascinating research possibilities. In clinical practice, measuring crystal bone loss is limited by the limitations of radiographic imaging. New approaches and digital technologies, on the other hand, point to the advent of non-invasive ways for measuring crestal bone position and changes over time that may be more sensitive and specific. Imaging advances will also help us better assess the impact of new techniques, products, processes, and materials.

Author contribution

Dr.Joshua Narde: Data curation, Investigation, Original draft preparation, Software.
Dr.Sahil Singh: Conceptualization, Reviewing, Supervision.

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Conflict of interest

The authors have nothing to disclose or any conflicts of interest.

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