

Implant Stability in Regenerated Bone

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1. Introduction

Bone regeneration is a surgical therapy that is increasingly being used for implant placement in functional patient rehabilitation. Since the first biological and technical description of the procedure by Dahlin et al. [1], several techniques have been proposed for bone augmentation. The choice of the correct technique varies depending on the specific clinical case, the typology of bone defect, and other variables because therapeutic choices need to be individualized [2–5]. Despite the different techniques proposed in the literature, the aim has always been an increase in hard tissues, which are not enough at baseline, to allow implant placement. Nowadays, this procedure is planned on computer software to have a digital work-flow, with precise and predictable results [6].

2. Implant Stability in Regenerated Bone

After the placement in the bone, the implant requires stability, an essential factor for success [7]. This will be mechanical initially and biological stability later [8]. Primary and secondary stability, respectively, will allow the implant to be in situ at the time of insertion and subsequently loaded with the prosthesis on top of it, which will have a different time of healing in the maxilla and mandibular bone [9,10].

Good primary stability will certainly help the formation of secondary stability of the implant with bone, which will mature in direct contact with the implant surface, thus creating the conditions for osseointegration [11]. The factors that influence the achievement of good primary stability are certainly bone quantity and quality, surgical technique and implant design [12]. In particular, bone quality is the *conditio sine qua non* to achieve good bone-implant mechanical stability [13].

When an implant is placed in a native bone, the preliminary assessment of the bone quality, which will provide primary stability, depends on the anatomical site of insertion [14].

On the other hand, when the amount of bone is inadequate to place the implant, regenerative surgery is needed and the process changes.

A lot of studies have been conducted comparing different bone augmentation methods, in terms of bone substitutes, types of membranes, and accessory materials, all aimed at finding the best result in terms of gain and quality of reconstructed tissue [15,16].

A comparative study by Cucchi et al., for example, did not find statistically significant differences between bone augmentation using a non-resorbable membrane and a titanium mesh associated with resorbable membrane by histological analysis of bone tissue [17].

Different methods were used to assess the implant stability in the surrounding bone. Some of these methods are insertion torque and resonance frequency analysis. The latter, a non-invasive method, has been used both in studies of healed post-extractive bone and in cases of bone augmentation to assess implant stability at different times [18].

According to a study by Vallecillo-Rivas et al., the implant stability found in regenerated bone can be considered acceptable for prosthetic loading at 12 weeks after implant placement [19].



Citation: Caggiano, M.; Acerra, A. Implant Stability in Regenerated Bone. *Appl. Sci.* **2023**, *13*, 12161. <https://doi.org/10.3390/app132212161>

Received: 17 October 2023

Accepted: 3 November 2023

Published: 9 November 2023



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Although considered acceptable, implant stability values in regenerated bone are always lower than those in native bone, even if it is a valuable alternative in patients with bone tissue defects, as long as the waiting time for implant placement in regenerated bone is at least 6 months.

Therefore, more studies are needed to further investigate the quality of the regenerated bone tissue and the degree of stability the implant achieves in the tissue at different evaluation times.

Author Contributions: Conceptualization, M.C. and A.A.; methodology, M.C.; validation, M.C.; investigation, M.C. and A.A.; writing—original draft preparation, A.A.; writing—review and editing, M.C. and A.A.; visualization, M.C.; supervision, M.C. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

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