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Short Communication

Assessment of implant stability- A short communication

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ABSTRACT

Knowledge of stability is essential to the achievement of successful outcomes in dental and orthopaedic implantology. Assessment of this interface is fundamental to the investigation of implant stability, since poor integration at this region may result in complications such as loss-of-implant-failures. There are several methods to assessing this stability from traditional histological analysis, which is invasive in nature and targets tissue at a specific time point during or after healing, but also clinical assessments and imaging modalities .Furthermore, these methodologies are clearly useful in predicting implant survival time as well as provide information to clinicians of an optimal excipient period for loading. This article will provide an in depth review of currently available tools to assess implant stability.

1. Introduction

Being one of the fundament contributors to the overall result of implant treatments, stability of the implants is crucial not only in dentistry, but also in orthopaedy courses as well. There is primary stability that is achieved as soon as the implant is placed, and thus it is essential if the integration and prolonged good stability are to be achieved. Comparing various thread profiles based on recent studies further revealed that aggressive thread designs in implants can has a positive effect on the values of primary stability.[1] This correlation between implant success and patient health and, thus, the potential of dental implants to enhance densities and promote healing in the bone tissue and other neighboring tissues, confirms the relationship between implants' stability and the overall optimization of the rehabilitation process.[2]

Moreover, assessment of implant stability does not only entail attaining mechanical lock; additional factors that pertain to surface compatibility and patient factors that may influence osseointegration and/or healing must also be as well considered. Thus, understanding and evaluating the implant stability gives valuable data for increasing the efficiencies of orthopaedic and dental therapies.

1.1. Techniques of mechanical evaluation

Osseointegration stability throughout different phases is in correlation with a number of mechanical assessment methods. Two of these are Resonant Frequency Analysis, (RFA) and Insertion Torque (IT). The significance of these approaches in the clinical work aiming at predicting implant success is evidenced by studies revealing a direct correlation between the MM and, in particular, secondary BBIS.[3]

While higher primary stability may lead to early bone union, there are risks for long term stability according to the current literature available. Therefore, the implant location has to be adapted in order to consider the short-term and long-term stability results.[4] Hence, several nonmechanical assessment techniques should be used in coordination to increase the effectiveness of the implant.

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1.2. Use of RFA (Resonance Frequency Analysis) for implant stability Evaluation

An essential method for assessing implant stability is resonance frequency analysis (RFA) which informs about the primary stability of dental implants after the implantation of the implant. This technique, which is non-invasive, gives an appropriate approach to assessing implant integration, based on the Implant Stability Quotient (ISQ), which has a high correlation with insertion torque values (ITV). Research has established that ISQ as follows in figure, tend to improve steadily with time even when they are initially associated with lower torques thus indicating existence of a wisdom anchor implant that has a potential of being stable in the long term.[5] Further, studies addressing the different components of implant stability have established that Hounsfield Units, which denote densities of bone, are more attributable to stabilization levels than the width of the alveolar crest.[6](Fig 1,2)

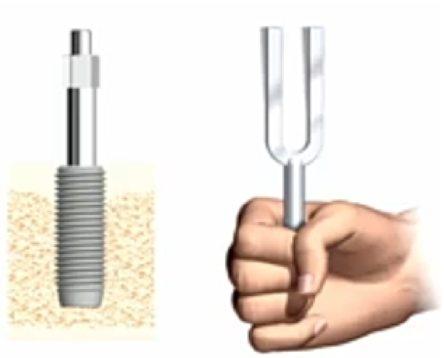

Figure 1: Credit- ossell

Figure 2: Credit-Lee, Jungwon Pyo, Se-Wook Comparison of implant stability measurements between a resonance frequency analysis device and a modified damping capacity analysis device: An in vitro study Journal of Periodontal & Implant Science/jpis.2020.50.1.56)

1.3. Biological Assessment

In as much as assessing implant stability may seem easy, with the existence of biological assessment techniques is key souring to the area of the structure being assessed as evidence the oral and maxillofacial regions. Resonance frequency analysis (RFA) is one of these techniques, which assesses the stability and the ossointegration of the dental implants by measuring its resonant frequency. For instance, it was observed that jaw fractures are sites of medically prolonged Implant Patients Stability Quotient (ISQ) values.[7]Furthermore, biological evaluations provide physicians about the biological reactions surrounding the implant site in addition to the mechanical stability of implants. A retrospective analysis of maxillary incisor replacements, for instance, demonstrated the significance of maintaining marginal bone level and soft tissue stability throughout time.[8]

1.4. Bone density and quality and the evaluation of implant stability

Bone density and quality become an essential part of implant stability evaluation since it influences osseointegration and correspondingly long-time success rates. High-density, robust bone significantly provides a solid environment to the implant by improving mechanical interlocking and reducing the possibility of failure under functional loads. On the other hand, low-density poor-quality bone can affect the primary stability of an implant, which leads to several problems such as micromovement or even long-time loosening of the implant. So far, several imaging techniques including computed tomography and dual-energy X-ray absorptiometry have been utilized to visualize microstructure of bone tissue and for the quantitative assessment of bone density, providing information on suitability of implant site.[9,10]

2. Discussion

Objective measurement of implant stability supports the correct unloading decisions. According to Sennerby and Meredith, in the case of immediate loading for a temporary prosthesis that has been replaced by a permanent one, "low (secondary) values may be indicative of overload and ongoing failure." To avoid failure, they suggest that surgeons consider unloading, possibly placing additional implants, and wait until the stability values increase before loading the permanent prosthesis. Methods to assess implant stability can be grouped into invasive/ destructive methods and non-invasive nondestructive methods. The destructive methods included histomorphologic analysis, tensional test, push-out / pull-out test, and removal torque analysis.[11,12] Noninvasive/ nondestructive methods for assessing the stability of an implant include the surgeon's perception, radiographical analysis/ imaging techniques, cutting torque resistance (for primary stability), insertion torque measurement, percussion test, periotest, resonance frequency analysis (RFA).[13,14]

3. Conclusion

More specifically, with interbody fusion devices, like cages, the entire stability and associated results from PLIF are improved drastically. From a comparison of clinical outcomes, patients who received cages in their procedures had higher rates of fusion with lower complication profiles. Where the studies indicate that, while bone group presented fusion rates of 0%, 30%, and 90% at 3, 6 months, and 1 year, respectively, the cage group achieved 0%, 50%, and 100% over the same intervals, cages even appear peculiarly essential to solid fusion, which does relate directly to functional outcome and patient satisfaction. The evidence indicates that the addition of an interbody cage brings not only an increase in surgical success but also a reduction in the risk of complications arising due to instrumentation failure, thereby further solidifying its potential benefit clinically.[15]

4. Summary of Key Findings and Future Directions

As implant dentistry evolves, various methods for evaluating implant stability have been introduced; therefore, several pieces of information have been learnt in relation to the function of these methodologies. Key findings: Advanced methods of RFA and torque measurement remain cornerstones, but these have increasingly been complemented by the more modern imaging methods like CBCT and FEA, which further detail osseointegration and the implant load-bearing capacity and enable a more discriminate evaluation of stability over time. Although these new technologies are being developed, there are still problems to be encountered with some of them, such as variability in the interpretation of measurements, and hence the establishment of uniform protocols is very essential. Future directions in implant stability assessment should focus on the integration of multimodal approaches that include clinical assessments in combination with emerging technologies for an enhanced implant stability evaluation. Such an integrated framework may potentially lead to superior treatment protocols and improved patient outcomes in the growing domain of implant dentistry.

5. Conflicts of Interest

There are no conflicts of interest.

6. Source of Funding

None.

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Author's biography

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