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THE ROLE OF DIFFERENT IMPLANT DESIGN ON PRIMARY STABILITY AT AN IMMEDIATE EXTRACTION SITE: A LITERATURE REVIEW.

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ABSTRACT The primary stability of dental implant is critical for its clinical success and there are several factors which are responsible for the improvement of the primary implant stability. Some of these include the bone quality and quantity, the surgical technique, clinician experience, and implant design, that is, surface pattern and topography. The primary stability of implants is responsible for successful osseointegration and consequently for its long term clinical success. This article is an attempt to highlight how different implant designs seem to play a relevant role for achieving primary stability at an immediate extraction site.

KEYWORDS : Dental implants, immediate extraction site, Osseointegration, primary stability, implant design.

Introduction:

Dentists have used implants to improve patient's dental aesthetics, health, and function for decades. However, the ridge with compromised bone quality and quantity after tooth extraction always occur which can be prevented by a proper implant treatment. Implants placed in poor quality bone are often related to compromised primary stability and poor Osseo integration. The improved macro- and micro-structure of implants, modified surgical techniques and longer healing period may enhance primary stability and bone quality after implantation.[1]

Immediate loading of dental implants has recently gained popularity due to several factors including reduction in treatment time, aesthetic and patient's benefits. Immediate implant placement in extraction sites has been proposed to preserve both soft and hard tissue architecture. This finding has recently been confirmed by two animal studies showing better bone formation following immediate implant placement.[2]

An acceptable amount of good quality bone as well as sufficient primary stability during implant insertion appear to be the critical factors for success in immediate loading scenarios.[3] During osseous healing implant stability decreases until a secondary biological stability is established.[3,4]This effect has been described to be more pronounced in immediately placed implants.[5]and consequently, extensive extraction sites requiring bone grafting have been treated with submerged healing of implants[6] in order to avoid excessive micro motion at the implant-bone interface.[7]

Specifically, the role of the primary implant stability with surrounding bone seems to be crucial for long term success. Hence, in the present literature review, we aimed to assess and clarify the significance of implant design on primary stability.

Influence of Different parameter on primary stability:

A number of parameters have an influence on primary implant stability. Based on an analysis, implant stability has been shown to be affected by implant diameter, insertion torque, sex, jaw type (bone quality), implantation mode (immediate/delayed), healing stage, and bone grafting**, implant design**, surgical technique.

The role of primary implant stability:

Osseointegration occurs in two levels: primary and secondary. Primary osseointegration is associated with the mechanical engagement of an implant with the surrounding bone after implant insertion; whereas bone regeneration and remodeling offers secondary osseointegration (biological stability) to the implant.[8]

Primary stability defined as contributing factors of mechanical stabilization of dental implant during the healing phase[9]. In other words, primary stability is absence of mobility in the bone after implant placement. The phenomenon behind this is the same as that applied for reduction of fractured long bone; that is there should be utterly no movement between the fragments when the ends of a fractured long bone are reduced to endorse fracture healing.[10] This is because movement even at the micrometer range can induce a stress or stain that may hinder the formation of new cells in the gap. Likewise, during implant healing a micro-motion between 50 and 150 um may negatively influence osseointegration and bone remodeling by forming tissue at the bone-to-implant interface thereby inducing bone resorption.[11]

Several studies have reported different implant design effect primary stability.

Implant design in relation to primary stability:

Implant design, a vital parameter for attaining primary stability, refers to the three-dimensional structure of an implant with all the components and features that characterize it.[12] Implants of varying design reach various degrees of stability, which may determine their future clinical performance.[13] The screw or "threaded" design minimizes the implants micromotion during function thereby maintaining the primary stability.[14] Furthermore, a threaded design also increases the surface area of the implant thereby offering a higher percentage of bone-to-implant contacts, in comparison to implants with a cylindrical design. Vandamme[15] study also showed that threaded implants offer significant bone-to-implant contact during (compared to cylinder-shaped implants) which may also showed enhance the secondary stability.it is accepted that all implants display some extent of bone loss after osseointegration and through time of function. It has been claimed that the introduction of micro threads or "retention grooves "at the neck of the implant may also assist in reducing

distributing stress and reducing the extent of bone loss following the implant installation.[16] Hence cylindrical-type implants seem to be contraindicated for immediate loading regimes due to lowering of primary stability and less resistance to vertical movement and shear stress.[17]

Tapered implants were initially designed mainly to serve for immediate loading after tooth extraction. The theory behind the use of tapered implants is to provide for a degree of compression of the cortical bone in a poor bone implant site.[18] Cylindrical wide body implants increase the risk of labial perforation due to buccal concavities; whereas the decrease in diameter of the tapered implants toward the apical region accommodates for the labial concavity.[19]

Bone density and bone quality:

Variation in bone density can occur in all location in the oral cavity. Bone quality is often referred to as the amount of cortical bone and cancellous bone in which the recipient socket is drilled, for example the densest bone is frequently located in the anterior mandible, followed by premaxilla and the posterior mandible. The least dense bone is usually present in the posterior maxilla as well as mandible. In this context, the clinicians should confirm their assumption regrading bone density at the time of osteotomy development, since bone density at an implant site is a significant feature with respect to surgical protocol and osseointegration.

According to Romanos et al,[20] implant stability in long-term after immediate loading seems to be increase of the peri-implant bone density at the implant-bone interface. A poor bone quantity and quality have been indicated as the main risk factor for implant failure as it associated with excessive bone resorption and impairment in the healing process compared with higher density bone.[20]

Surgical technique on primary stability:

An atraumatic surgical technique is essential to maintain cellular viability thereby preventing the formation of an epithelial connective tissue layer along the bone-implant interface and promote healing.[21] The bone condensing technique has also been suggested to enhance the primary stability of dental implants by increasing the bone density. Experimental studies have shown that bone condensing increase the bone-to –implant contact in early phase of implant placement.[22]

Method of evaluation of the primary stability:

Resonance frequency analysis(RFA):

RFA can be used to monitor the changes in stiffness and stability at the implant-tissue interphase and to discriminate between successful implants and clinical failures[23], which was replaced by the "implant stability quotient (ISQ)" introduced by Ostell.

According to Zix et al[24], the RFL technique appeared to be more precise compared to the Perio test, however there is no clinical stability today which proves the RFL level for implant, which survive in a long term and the necessary minimum RFL threshold we need for the success of primary stability of implant.

Perio Test

The Perio test has been supported as reliable method to gauge primary stability.[25] It is composed of a metallic tapping rod in a handpiece, which is electromagnetically driven and electronically controlled. Signals produced by tapping are converted to unique value called "Perio test values".

Conclusion

There is a significant response by the hard and soft tissues to primary stability. Within the limitations of the present literature review, despite similarities in design or indication, considerable differences in primary implant stability can be present. Further research is required in situations, such as poor bone quality and quantity and multiple implants or augmentation procedures, which may challenge the attainment of primary stability.

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