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IMPLANT -ABUTMENT CONNECTIONS: A REVIEW ON MARGINAL BONE LOSS

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Abstract:

Dental implants have been used for replacement of missing teeth. Various factors are considered to determine the success rate of dental implants. One of the important factors determining the success rate is peri-implant bone loss that occurs subsequently after implant placement. A variety of etiological factors have been listed responsible for peri-implant bone loss. One among the etiological factors for bone loss pertaining to implant geometry is implant-abutment connection type. Implant abutment connection type should be designed to minimize the bone loss around implants. Hence it is important to analyze and compare the bone changes that occur around implants with different connection types to choose an appropriate type for achieving maximum success rates.

Key words:- Peri-implant bone loss, implant-abutment connection, internal hex, external hex, platform switching, morse taper.

Introduction

Dental implant restoration is currently widely practiced treatment modality for replacement of missing teeth and to restore human masticatory function. Long term success of dental implants depends on successful osseointegration, bone level stability and maintenance of soft tissue health[1]. Albrektsson et al proposed that a dental implant is considered successful if peri-implant crestal bone loss is less than 1.5 mm during the first year after implant placement and less than 0.2mm annually thereafter[2].

Peri-implant bone remodeling occurs after the implant is exposed to oral environment during second stage surgery or when abutment is placed immediately following implant placement. Remodeling process causes marginal bone resorption which is affected by variety of factors such as traumatic surgical technique, excessive loading, implant -abutment micro gap ad its microbial contamination, biologic width reestablishment, peri-implant inflammatory infiltrate, micromovements, repeated screwing and unscrewing and implant neck geometry[3].

The type of implant -abutment connection (IAC) is one of the major factors which affects the crestal bone level changes. Implant abutment interface should be designed to reduce stress on prosthetic component and on bone-implant interface by incorporating features of anti-rotation and should

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be able to resist bacterial penetration[4]. The IAC can be of external connection which has standard geometric projection on the implant platform or internal connection where mating components are recessed into implant body[5] (Fig 1 – a&b). IAC can be further characterized as a slip fit joint where slight space exists between the mating parts e.g. external or internal hex, or a friction fit joint where mating components are literally forced together e.g. Morse taper (Fig 2) and cone screw connection[4]. One potential way to reduce marginal bone loss is to physically move the implant-abutment interface horizontally using smaller diameter abutments to connect to implants. The manufacturers changed the configuration from butt-joint to an internal cone connection combined with non-matching implant and smaller diameter abutment. These types of connections have been termed as Platform switched connections[6] (fig 3).

The objective of the present study is to review the predictable marginal bone loss around dental implants with different implant-abutment interfaces using the available evidence.

External Hex Connection

Initial 0.7mm tall external hex connection with a butt joint was introduced by Branemark. It was found to have reversibility and compatibility with different systems[4]. It was designed to provide a rotational torque transferring mechanism for implant placement and later evolved by necessity into a prosthetic indexing and anti-rotational mechanism[6]. But in external hexagon there is existence of a microgap in the implant-abutment interface[7]. Major drawback was screw loosening and fatigue fracture due to short hex height and limited engagement which lead to micromovements and joint instability[4]. Placing an abutment on submerged implant with external hexagon created a butt-joint interface between the implant and abutment. Many experimental and clinical studies documented that marginal bone loss occurred around these implants[6].

In a study by Herman et al, tissue-level (nonsubmerged implant) was used as control and experimental group included models with presence of an interface (microgap) at the implant-abutment interface. This study was able to demonstrate 1.5-2.0 mm bone loss around bone level, external hexagon butt joint implants when there was an interface created (at 2nd stage surgery) or immediately if the abutment was placed on the implants. When no interface existed as in tissue level implants (control group), no or minimal bone loss was observed. Further if the interface was moved apically, more bone loss occurred and if the interface was moved coronally, less bone loss was observed[6]. According to study by Hartman and Cochran amount of bone loss was related to location of interface, relative to the crest of the bone. The closer the interface to original bone level, the more bone loss was observed[8]. This was common finding around butt-joint connections and approved by many others[6]. The hypothesis for the bone loss around these implants was related to the presence of bacteria in the interface between implant and abutment connection. As in external-hexagon butt joint implant systems, a contaminated micro-gap exists in the interface, prevention of microbial leakage has been challenging for restoration of two staged implants to minimize inflammatory reaction and maximize the bone stability around implants[6].

Internal Connection

This interface was developed to overcome clinical complications of external connection. Initial internal connection introduced by Niznick had 1.7mm deep hex below 0.5mm wide, 45 degree bevel[4]. The mating components are deep within implant body which shifts the implant abutment fulcrum to the middle of the implant resulting in better stress distribution and prosthetic screw stability. Main advantage is the long internal wall engagement body, resisting micromovements at the implant abutment interface. Levin noted screw loosening incidence as low as 3.5 %. Weaker link in internal connection is bone rather than prosthetic screw as most of the stress concentrates in the bone around implants[4].

Through the years, internal connections have evolved into numerous designs in an attempt to achieve better microbial seal and joint stability. Internal slip fit connections having an internal geometrical anti rotational feature like hexagon, octagon, spline or trichannel are marketed now[4]. Internal conical connection /Morse taper (cone within cone) has conical projection from the abutment tightly fitting into conical recess in the implant body. Mechanical friction between external conical wall of abutment and internal wall of implant locks them into cold welded stability eliminating rotation and subsequent screw loosening and also allows for even distribution of stress with the implant, abutment and screws[9,10]. Screwing torque required is less compared to external and internal hexes and also provides adequate biological sea[14].

According to systematic review by Riccardo et al peri-implant bone loss in implants having an internal or conical connection was less compared to implants with external hexagons. The internal and especially conical connection was found to be maintaining stable crestal bone levels in the short – medium period. The reason for better results observed for conical connections is because of reduction in micro-gap and reduced micromovements during loading1. Few studies revealed there was significant difference in peri-implant bone loss between external and conical connections. However, it was less evident for internal and conical ones[5].

Platform Switched Connections

Rodrigo et al stated that osseo integrated implants with internal connections showed less marginal bone loss as compared to external connection implants. This is mainly due to presence of platform switching present in internal connection implants. This is because in platform switching, the

implant abutment connection is far away from the margin, which causes decreased load concentration, decreased micro movements and bacterial colonization takes place at a farther region of bone[11].

One theory stated step created between abutment and implant allows the biologic width to be established horizontally and less vertical bone resorption is required to compensate for biologic seal. Significant decrease in crestal bone loss was found if implant abutment diameter difference was greater or equal to 0.4mm[4].

Ericsson et al depicted the role of inflammatory cell infiltrate for reduced bone loss. The physical repositioning of implant-abutment connection from external outer edge of the implant and bone may

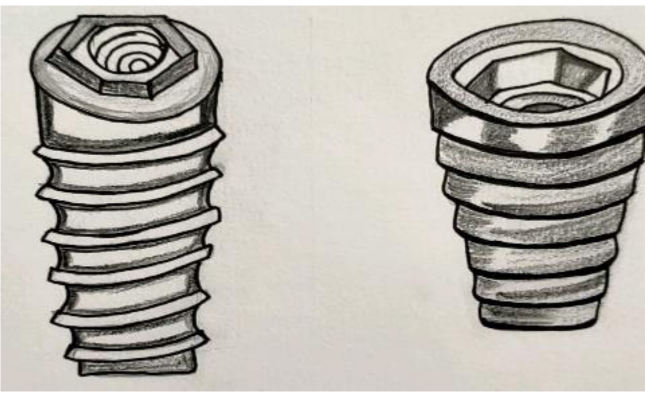

Fig1 A-Internal hex B- External hex

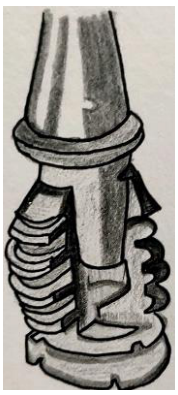

Fig 2 Morse taper connection

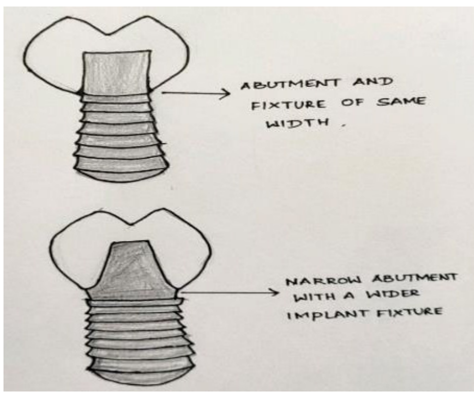

Fig 3- Platform switching

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limit bone resorption by containing the inflammatory cell infiltrate within the angle formed at the interface away from adjacent crestal bone[6]. According to results obtained from the systematic review and Meta analysis by Momen et al inward shifting of implant-abutment interface, by platform switching can be considered desirable morphologic feature that prevents horizontal saucerization and preserve the vertical crestal bone levels. Additional improvement in bone levels around dental implants may be obtained with greater degree of shifting[3].

According to canullo et al the marginal bone around single platform switched implant placed immediately and restored immediately showed less resorption than non-platform switched implants. They also concluded that platform switched implants placed and loaded immediately can help in preservation of papilla by providing peri-implant hard tissue stability[12]. Clinical relevance of platform switching is more important in situations where anatomic structures like sinus floor or alveolar nerve limit the residual bone height, the platform switching approach minimizes bone resorption and increases biomechanical support.

Conclusion

This review is to study the influence of the implant-abutment connection types on the marginal bone level changes. With available evidence based on various systematic reviews and meta- analysis it can be concluded that 1.5 to 2mm bone loss invariably occurred around bone level external -hexagon butt joint implants where the interface is contaminated with bacteria. Many studies have shown that peri-implant bone loss is generally lower when internal type of interface was adopted especially conical connections seem to be more advantageous. Platform switched implants have shown less resorption compared to platform matched implants which is particularly suitable when residual bone height is a limiting factor for implant placement.

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