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REVIEW ARTICLE

Dental Implant Abutment Interface: A Comprehensive Review

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ABSTRACT:

The emergence of dental implant therapy continues to increase enabling the rehabilitation of partially and completely edentulous arches with greater success and predictability. Dental implant abutment interface is one of the crucial contact areas which predict the prognosis of dental implants. Hence; we planned the present review to highlight some of the important aspects of dental implant abutment interface.

Key words: Abutment, Dental, Implant.

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INTRODUCTION

From past 35 years implants are considered as most successful treatment option for the restoration of missing teeth. Implant systems commonly consist of an endosteal fixture, which is osseointegrated in the bone and an abutment supporting the prosthesis which is connected with a screw to the fixture. Two staged implant procedure minimizes the early exposure of implant to stress and thus helps in obtaining successful osseointegration. The Implant Abutment Interface (IAI) has external or internal connection. Today implants with internal connection are more commonly manufactured and marketed.[1- 3]

The majority of available dental implant systems consist of 2 main parts: the implant body and the abutment. Micro-gaps at the implant-abutment interface may cause microbial leakage. Microorganisms can penetrate through a gap as small as 10 μm and institute bacterial colonization at the implant-abutment interface, which leads to inflammation in peri-implant soft and hard tissues.[4- 7]This inflammation can cause conditions ranging from peri-implant mucositis to bone loss to, eventually, implant failure. Unfortunately, bone loss that has already occurred is irreversible, and implant failure is still a common complication following therapy. To avoid these problems, a tight seal at the implant-abutment interface to prevent bacterial colonization is recommended.[8- 12]

REVIEW OF LITERATURE

Pieri F et al compared the clinical and radiographic outcomes of single implants immediately placed and restored with two different implant-abutment connections. Forty subjects requiring single maxillary premolar replacement were consecutively included in this study and prospectively followed for 12 months. One implant was placed at the time of tooth extraction and immediately restored in each patient. Subjects were randomly selected to receive either prosthetic abutments with a Morse taper connection and a platform switch (test group) or conventional abutments with an internal connection and a matching diameter (control group). A provisional screw-retained crown was positioned and adjusted for nonfunctional loading within 24 hours. Four months later, the definitive crowns were delivered. No implants were lost in the control group, whereas one implant failed in the test group. At the 12-month examination, no statistically significant differences were seen between the two groups for periodontal parameters, marginal soft tissue level change, or papilla height ($P > .05$), but greater marginal bone loss was observed at the control sites (0.51 ± 0.24 mm) compared to the test sites (0.2 ± 0.17 mm) ($P = .0004$).Although the control group demonstrated a slight increase in marginal bone loss compared to the test group, the peri-implant soft tissues were very stable with both types of implant-abutment connection after 12 months of loading.[11]

Coelho AL et al developed a technique to evaluate the implant-abutment gap of an external hexagon implant system as a function of radius. Six implants of 3.75 mm in diameter (ConexaoSistema de ProteseLtda, Sao Paulo, Brazil) and their respective abutments were screw connected and torqued to 20 N cm(-1). The implants were mounted in epoxy assuring an implant long-axis position perpendicular to the vertical axis. A sixth degree polynomial line fit approach determined radial adaptation patterns for each implant. Micrographs along implant sections showed a approximately 300 mum length implant-abutment engagement region. All implants presented communication between external and internal regions through connection gaps and inaccurate implant-abutment alignment. Average gap distances were not significantly different between implants (P > 0.086). Polynomial lines showed implant-abutment gap values below 10 mum from 0 mum to approximately 250 mum of the implant-abutment engagement region. Gap distances significantly increased from approximately 250 mum to the outer radius of the implant-abutment engagement region. The technique described provided a broader scenario of the implant-abutment gap adaptation compared with previous work concerning implant-abutment gap determination, and should be considered for better understanding mechanical aspects or biological effects of implant-abutment adaptation on peri-implant tissues.[12]

Bishti S et al determined the peri-implant tissue response to different implant abutment materials and designs available and to assess the impact of tissue biotype. Relevant literature published between December 2009 and August 2012 was searched to identify studies dealing with different implant abutment designs and materials, as well as the response of different tissue biotypes.The initial search yielded 2449 titles. After a subsequent filtering process, 23 studies were finally selected. The included studies revealed different factors responsible for the stability of peri-implant tissue and the esthetic outcome. These factors include tissue biotype and architecture, implant abutment material and implant abutment design. Several designs were suggested to prevent marginal bone loss and soft tissue recession. These included scalloped implants, platform-switched implants and gingivally converged or concave implant abutments. Due to the limited number of studies and the heterogeneity in their designs, it was not possible to perform a statistical analysis of the data. The literature provides insufficient evidence about the effectiveness of different implant abutment designs and materials in the stability of peri-implant tissues.[13]

Hansson S conducted a comprehensive review on the conical implant-abutment interface at the level of the marginal bone improves the distribution of stresses in the supporting bone.It has been hypothesized that marginal bone resorption may result from microdamage accumulation in the bone. In light of this, a dental implant should be designed such that the peak stresses arising in the bone are minimized. The load on an implant can be divided into its vertical and horizontal components. In earlier studies, it was found that the peak bone stresses resulting from vertical load components and those resulting from horizontal load components arise at the top of the marginal bone, and that they coincide spatially. These peak stresses added together produce a risk of stress-induced bone resorption. Using axisymmetric finite element analysis it was found that, with a conical implant-abutment interface at the level of the marginal bone, in combination with retention elements at the implant neck, and with suitable values of implant wall thickness and modulus of elasticity, the peak bone stresses resulting from an axial load arose further down in the bone. This meant that they were spatially separated from the peak stresses resulting from horizontal loads. If the same implant-abutment interface was located 2 mm more coronally, these benefits disappeared. This also resulted in substantially increased peak bone stresses.[14]

Imam AY et al compared the ultimate failure resistance of the smallest diameter of the 2-stage type implant provided by 5 commonly used dental implant systems. Thirty implants, Astra OsseoSpeed 3.0 mm and 3.5 mm, Straumann Bone Level 3.3 mm, Zimmer Tapered Screw-Vent 3.7 mm, Full Osseotite Certain 3.25 mm, and NobelSpeedy Replace 3.5 mm, 5 of each type, were tested in this study. A rigid clamp was used to hold the implants at a 30-degree angle to a static load vector. The load continued until the specimen broke or obviously deformed. Peak loads were recorded at that point for all the studied implant systems. The mean fracture/deformation peak load values were 367.20 N ± 98.05 for Astra OsseoSpeed 3.0 mm; 568.80 N ± 85.24 for Astra OsseoSpeed 3.5 mm; 679.00 N ± 81.09 for Full Osseotite Certain 3.25 mm; 553.4 N ± 56.96 for NobelSpeedy Replace 3.5 mm; 802.80 N ± 134.50 for Zimmer Tapered Screw-Vent 3.7 mm; and 576.20 N ± 71.45 for Straumann Bone Level 3.3 mm. Generally, a higher load was required to cause failure in implants with larger diameters than in narrower-diameter implants, and more force was necessary to cause failure in Ti6Al4V alloy implants than in commercially pure titanium implants. With regard to implant diameter and ultimate failure strength, Osseotite Certain 3.25 mm was considered to be more advantageous in comparison with the other implants tested.[15]

CONCLUSION

Dental Implant abutment connection interface (IACI) is a key feature to consider when choosing an implant system. Its clinical abilities are vital to successful outcomes, especially as implant failure is now known to be strongly related to how the restorative phase is managed.

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