REVIEW ARTICAL

Unveiling The Mystery of Screw Loosening: A Review

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Abstract:
The use of osseointegrated implants has greatly expanded dentists' choices for restoring Edentulous spaces. The primary goal for clinicians has always been to treat patients with the best chance of success. Two common issues with implants are screw loosening and fracture at the implant abutment junction. It' s believed that the main cause of screw loosening might be the & quot; loss of preload.& quot; Many factors can impact the relationship between torque and preload. This review article aimed to examine the various factors that influence abutment screw loosening and how they impact the success of dental implants.
Keywords: Abutment screw, Preload, Screw fracture, Screw loosening.

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INTRODUCTION

Dental implants are a dependable and effective option for restoring the lost teeth, for reviving the oral function, and enhancing quality of life. With the inventions of new technology and techniques, dental implants have become a popular way for patients seeking a long-term tooth replacement solution. Prosthesis which are retained by implants have become an easily available and widespread option for missing teeth. Although implants have become the popular option for replacing lost teeth, the risk of complications such as mechanical, biological, and esthetic cannot be overlooked.[1,2]

Commonly observed complications which are mechanical in nature, related with implant-supported fixed prostheses consists of loosening of screws, fracture of screws, fracture of veneering material or framework, loss of retention, and implant fractures.[3,4]

Implant screws have a critical role in the dental implant treatment success, providing stability, retention, and longevity to the restored teeth or prostheses. Proper care, maintenance, and follow-up are indispensable to ensure the functionality and durability of implant-supported restorations. The abutment screw is a critical component of almost all implant systems, serving to connect the implant and abutment. When tightened, the screw undergoes elastic deformation and elongation, creating a tensile force known as preload..[5,6]

One of the most commonly encountered mechanical implant complications includes screw loosening and screw fracture.[7]

MECHANISM OF SCREW LOOSENING:

The abutment screw plays a crucial role in connecting the implant and abutment in major implant systems. Preload can be defined as tension created in a screw due to elastic deformation when the threading are tightened.[8,9] Preload can also be defined as "the axial force generated between the threads of the abutment screw and the inner part of the implant along the direction of the long axis of the implant." The screw can be compared to a stretched spring. The implant and the abutment are held together by the clamping force, which is determined

mainly by the preload and is crucial for maintaining stability in the implant and abutment connection.
Bickford[10] has described the screw loosening process into two phases. In first phase, the screw's initial tensile deformation decreases under external force impact, which leads to a decreased clamping force. In the second phase, as the clamping force decreases, micromotion between the implant and abutment interface increases, leading to connection instability and eventual screw loosening. This progression from preload loss to abutment screw loosening underscores the importance of maintaining clamping force for long-term stability.[5]

FACTORS AFFECTING SCREW LOOSENING

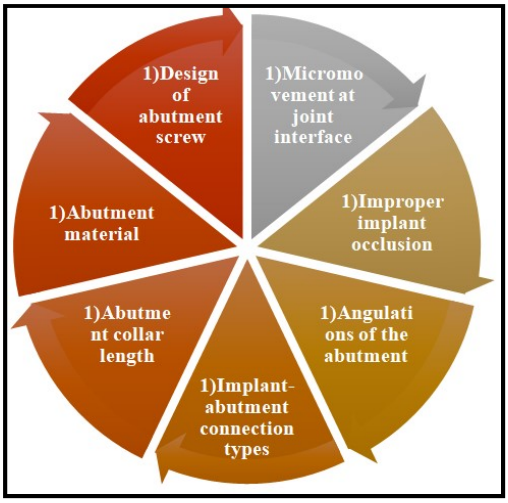

Fig 1. Factors Affecting Screw Loosening

1. Micromovement at the joint interface

Screw loosening routinely result from micromovement at joint interface. This may be correlated with an initial torque which is inadequate, frameworks that are ill-fitting and changes in occlusal overload, screw design, materials used for screw manufacturing, and surface coatings of screw in co-occurence with a movement in direction of implants with internal connections have decreased the incidence remarkably. Correct torque should be used to place screws and should be re-applied with caution because their mechanical properties might have changed.[6]

2. Improper implant occlusion

Improper implant occlusion might be one of the reasons related with screw loosening. More tendency to occlusal overloading can be found in dental implants compared to natural teeth because periodontal ligament loss. Misch[11] reported that adjustments of occlusion are fundamental to prevent differences in mobility between implants and teeth during heavy occlusal forces. Regular follow-ups and periodic adjustments of occlusion were essential for prevention of overload that might occur with the positional changes of natural teeth.[12,13]

3. Angulations of the abutment

Hotinski et al. found that angulation-correcting implants were more effective at preventing screw loosening compared to straight implants. In another study comparing the removal torque values of internal hex abutments and external hex abutments, a significant difference was observed in the external hex abutments.[14] On the contrary, El-Sheikh et al. found by increasing abutment angulation and collar height, significantly affected removal torque value following dynamic cyclic loading, leading to increase in screw loosening .[15]

4. Types of implant-abutment connection

The connection type present between abutment and implant (e.g., external hex, internal hex) can impact implant system stability and the screw loosening tendency.[16] The advantage of an external connection is the anti-rotation and proper orientation of the abutment. However, the contact parts of the joint have limitations in diameter and height, which means that external forces, especially lateral forces, can cause micro-motion at the implant-abutment interface, leading to joint instability. In a study by Binon et al., it was found that external forces can directly transmit to the abutment screw and the top of the implant near the joint, potentially causing loosening or even fracture of the abutment screw in the external connection.[17] The internal connection is more advantageous than the external connection for maintaining stability of the implant and abutment connection. It resists torque loss and screw loosening to a greater extent than the external connection. A recent systematic review by Vetromilla et al concluded that abutment screw loosening and abutment fracture occur more frequently in external

hexagon connections compared to internal hexagon or morse taper connections.[18]

5. Abutment collar length

Abutment collar height should be selected depending on gingival thickness to achieve a more esthetic appearance. Siadat et al[19] studied different collar heights of the abutments and their influence on loss of torque. There was no significant difference in torque loss observed among the various collar heights of abutments before applying cyclic loading. However, the abutment with a greater collar height was found to be more susceptible to torque loss after cyclic loading. This could be due to the increased collar height of the abutment, leading to a longer axial cantilever length.

6. Abutment material

The material of abutment could also influence the implant-abutment connection stability. Jo et al[20] conducted a study in which he found that abutments made of titanium alloy (Ti-6Al-4V) had higher compressive strength values and preload in comparison to the commercially pure grade 3 titanium (group T3), and commercially pure grade 4 titanium (group T4). Zirconia and alumina abutments had greater brittleness and higher modulus of elasticity compared with the conventional titanium abutments, thus affecting the torque loss and preload. Dhingra et al[21] concluded that zirconia abutment had higher torque loss than titanium abutment after cyclic loading. Debris lodged between the zirconia abutment and screw, and between the abutment and implant, may also impede further torque loss and maintain joint stability. Therefore, the zirconia abutment may still be a suitable choice for various clinical scenarios.

7. Design of abutment screw

Lee et al[22] did a study in which the screw surface was contaminated with nanoparticles of titanium to make surface if screw more rough with a larger coefficient of friction. After repeated insertion and removal, it was discovered that the contaminated screws experienced a greater torque loss compared to the non-contaminated ones. This was due to an increase in the coefficient of friction on the screw surface, making it more susceptible to the settling effect and resulting in a greater loss of preload.

CONCLUSION

Screw loosening or the loss of torque presents to be the most common mechanical problem seen in day to day practice by clinicians. Various factors influence the decrease or increase in the progression of this complication which involves micromovement, implant-abutment angulation, improper implant occlusion, implant-abutment connection, abutment collar length, abutment screw design, and abutment material. An attempt has been made to include all the major factors that may contribute to abutment screw loosening. Dentists who practice implant placement or restore them prosthetically must be aware of these complications. Screw loosening and fractures can be prevented by increasing frequency of follow-ups, retightening any loose screws or replacing with new ones whenever indicated.

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