

## Abutment screw loosening in implants: A literature review

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### ABSTRACT

This review was intended on major factors contributing to abutment screw loosening. A search of Pubmed and Google Scholar, as well as a manual search, was conducted. Publications and articles accepted for publication up to February 2020 were included. Out of 150 studies retrieved, a total of 57 were selected for this review. Dental implants are associated with a complexity of abutment screw loosening. Implantologists and prosthodontists should be aware of factors that contribute to this problem. In this review previously identified factors were collected, the consideration of which can help to reduce the frequency of abutment screw loosening.

**Keywords:** Abutment, implants, screw loosening, torque value

### Introduction

Implant supported prostheses can predictably replace missing teeth. Implant dentistry has shown promising outcomes of osseointegration; however, mechanical and biological complications commonly occur. The most commonly occurring mechanical complication is abutment screw loosening, since it is the weakest part of the implant. The connections between the implant parts should be stable, as it is important for the success of the treatment. A review by Goodacre *et al.* indicated that “screw loosening occurs in 8% of cases and can reach up to 45% in single crowns. Moreover, abutment screw loosening can cause other complications such as screw fracture, marginal gap, peri-implantitis, microbial leakage, crown loosening, and patient discomfort.” There are many factors that affect abutment screw loosening, which are critically reviewed in this article.<sup>[1-8]</sup>

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Received: 04-07-2020

Revised: 13-09-2020

Accepted: 28-09-2020

Published: 30-11-2020

#### Access this article online

##### Quick Response Code:



Website:  
www.jfmipc.com

DOI:  
10.4103/jfmipc.jfmipc\_1343\_20

### Factors Affecting Abutment Screw Loosening

**Screw length:** One study recommends a long screw with more threads to increase screw retention,<sup>[9]</sup> while two other studies recommend the opposite. Of these two studies, the first one concluded that when a minimum length abutment screw was used (1.4 mm; 3.5 threads) there was hardly any difference in screw loosening post oblique cyclic loading compared with longer abutment screws.<sup>[10]</sup> The other study concluded that under thermal stress, there was no significant effect on torque when a minimum length screw was used (1.4 mm; 3.5 threads).<sup>[11]</sup>

**Angulations of the abutment:** Hotinski E *et al.*<sup>[12]</sup> concluded that angulation-correcting implants resisted screw loosening greater than the straight implants. On the other hand, another study found a significant difference in removal torque values (RTV) in external hex abutments, but not in internal hex abutments.<sup>[13]</sup>

**Implant diameter:** A cross-sectional study concluded that the occurrence of screw loosening is less in wider diameter implants than in standard implants.<sup>[14]</sup> Other study found that standard diameter implants had less screw loosening, but that these results were not significantly different.<sup>[15]</sup>

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**How to cite this article:** Alsubaiy EF. Abutment screw loosening in implants: A literature review. J Family Med Prim Care 2020;9:5490-4.

Implant treatment process: Contamination by blood and saliva can affect screw joint stability. In one study, RTV in groups contaminated with saliva was significantly lower than in the non-contaminated group, and chlorhexidine application was preferred because it would reduce screw loosening.<sup>[16]</sup> Another study did not recommend using any lubricant because it would not improve the implant-abutment connection and might contaminate the connection.<sup>[17]</sup> Other factors can also affect joint stability. Gold coated screws are better than non-coated ones at preventing loosening,<sup>[18]</sup> and the introduction of a conical spring washer to a gold screw can additionally improve the resistance to loosening.<sup>[19]</sup> Yet another study concluded that the area should be dry during the insertion of the abutment,<sup>[20]</sup> and another recommends using a screw with a diamond-like coating reduces the occurrence of screw loosening.<sup>[21]</sup>

Microleakage: A study used three types of abutments: “internal hex titanium, internal hex zirconium, and Morse tapered titanium”, and found that microleakage was significantly higher in both types of internal hex type. This study also concluded that microleakage increases the incidence of screw loosening.<sup>[22]</sup>

Abutment collar length: An in-vitro study compared screw loosening under cyclic loading with different abutment collar lengths and concluded that increase in the abutment collar length is directly proportional to increased screw loosening.<sup>[23]</sup>

Abutment screw retightening: A study concluded that settling has a significant effect on screw loosening. According to Bulaqi HA *et al.*<sup>[24]</sup>, retightening of the screw after initial tightening can decrement the settling effect, thereby reducing screw loosening, and Siamos G & colleagues<sup>[25]</sup> concluded that retightening the screw 10 minutes after the initial torque can be considered a strategy in standardized implant placement. Another study found greater retightening efficiency in the internal hex than in the external hex.<sup>[26]</sup> Yet another study concluded that retightening of the screw significantly increases the loosening torque and reduces screw loosening for both titanium and gold screws.<sup>[27]</sup> Attiah *et al.*<sup>[28]</sup> conducted a study to assess the effect of dynamic cyclic loading on screw loosening in retightened screws.

Anti-rotation resistance features: Two studies concluded that the addition of anti-rotation features, such as notches or micro-stops, prevents abutment rotation and reduces screw loosening.<sup>[29,30]</sup>

Abutment screw head shape: Two studies concluded that the shape of the abutment screw head has a remarkable impact on torque loosening. The first study found significantly more screw loosening with the double conical head than with the conical head, while the loss of torque value was higher with the conical head than with the conventional head. The second study concluded that loss of torque value was significantly higher with the conical head than with the flat head.<sup>[31,32]</sup>

Implant abutment connection designs: One study concluded that the conical connection has better screw stability than the

internal hex. However, a systematic review on screw loosening concluded that internal hex is better than external hex.<sup>[15,33-34]</sup> Lee SW *et al.*<sup>[35]</sup> did a study to compare the axial displacement of the hexagonal and conical abutment in internal conical connection implant after screw tightening and cyclic loading.

Lateral screw loosening: Lateral forces exerted on implants appear to increase the incidence of screw loosening.<sup>[14,36]</sup>

Repeated closing and opening of the abutment screw and application of a new screw: The frequency of closing and opening of the abutment screw should be reduced during laboratory and clinical procedures.<sup>[37,38]</sup> Minimizing the frequency of screw retightening is of critical value than replacing the screw.<sup>[39]</sup> While one study advises utilization of a new screw after 10 screw insertions.<sup>[40]</sup> The above mentioned studies and Xiao H *et al.*<sup>[41]</sup> consider retightening the abutment screw as an acceptable procedure and do not recommend replacing the screw routinely in dental practice.

Fit of the prosthesis: Ill-fitting prostheses can have a significant effect on screw loosening; therefore, techniques that improve the fit should be employed to reduce screw loosening.<sup>[42]</sup>

Different interchangeable abutments: Since original abutments generally have the best fit and there is low torque reduction after cyclic loading, it is recommended that original abutments produced by the same company as of implants should be utilized.<sup>[43-45]</sup>

Sealing techniques: A study that tested hand-tightening and sealing of the screw access based on the impression material and use of a cotton pellet concluded that these techniques do not reduce or inhibit screw loosening.<sup>[46]</sup>

Torque value: One study concluded that torque value has a significant effect on screw loosening and recommended that the torque value should be more than 10 Ncm for gold screws.<sup>[47]</sup> Study by Siamos G *et al.*<sup>[25]</sup> recommended increasing the torque value to above 30 Ncm to reduce screw loosening, stating that the torque value should be more than the value recommended by the manufacturer. Kim KS and Lim YJ<sup>[48]</sup> studied the abutment settling into the implants and the torque value removal under static loading. They concluded that loss of preload due to the settling effect can lead to screw loosening.

Different prosthetic screws: A study compared gold screws and titanium screws, and after 6 months of clinical masticatory simulation, the titanium screws showed higher stability because of their lower plastic deformation.<sup>[49]</sup>

Implants-to-units ratio: A study concluded that a higher implants-to-units ratio affects screw stability more than a lower implants-to-units ratio; screw loosening increased at higher ratios.<sup>[50]</sup>

Internal connection length: Kim JS *et al.*<sup>[51]</sup> in their study concluded that this factor has no significant effect on screw loosening.

Use of different materials for the prosthesis: Bacchi A *et al.*<sup>[42]</sup> compared metal ceramic and metal acrylic resin and deduced that the type of material has significant effect on the torque value, with metal ceramic resin showing less screw loosening than metal acrylic resin.

Tightening techniques: A study compared the following four techniques:

- 1- Torque value of 32 Ncm (control)
- 2- Torque value of 32 Ncm while holding the torque meter for 20 seconds
- 3- Torque value of 32 Ncm with re-torque applied after 10 minutes
- 4- Torque value of 32 Ncm while holding the torque meter for 20 seconds, and re-torquing after 10 minutes.

Conventional titanium screws and diamond-like carbon screws were both used. This study concluded that the application of a conventional titanium screw has greater importance than the tightening technique, which did not affect screw loosening greatly.<sup>[52]</sup>

Use of different UCLA-type abutments: A study concluded that after one year of mechanical cycling, there was a loss of torque value in both cast and pre-machined abutments, but there was no significant difference between them.<sup>[53]</sup>

Width of the occlusal table: When one implant is used to replace a missing molar, narrowing the occlusal table is beneficial to reduce screw loosening.<sup>[54]</sup>

Daily temperature changes of the abutment: Yeo IS *et al.*<sup>[55]</sup> concluded that “daily temperature change has no significant effect on screw loosening when the length of the abutment screw is at least 1.4 mm (3.5 threads).”

Tissue entrapment: Tissue entrapment in the middle of the implant and the abutment has a “significant effect on screw loosening in external hex implants.” When the tissue is thicker, screw loosening will increase. Internal hex implants are less affected by tissue entrapment.<sup>[56]</sup>

A long span retrospective study was conducted by Lee KY *et al.*<sup>[57]</sup> to determine the incidence and pattern of screw loosening in dental implants. They concluded that the incidence differs significantly based on the position of implant placement, the type of implant and manufacturer, implant diameter, the type of implant–abutment connection, the type of retention in the implant prosthesis, and the type of implant prosthesis.

To enhance the shelf life of implant, abutment screw and abutment connection; ceaseless attempts are being made to reduce the problems commonly associated with dental implant oriented surgeries. The clinician/implantologist aims to identify the factors likely to cause screw loosening and focuses to prevent other possible obstacles encountered during the dental implant treatment.

## Conclusion

The loss of torque value or screw loosening proves to be the most common mechanical hindrance faced by clinicians in dental practice. There are many factors that could increase or decrease the occurrence of this complication. This article has reviewed major factors that can have an effect on abutment screw loosening, which should be known by all clinicians who place implants or prosthetically restore them. Results of this review show that there is limited consensus on optimal procedures for minimizing abutment screw loosening in implants. In addition, several key factors have few studies that specifically compared different practices. More studies are needed to reach clear conclusions regarding methodologies abolishing screw loosening.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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