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Original Research

Abutment screw loosening in dental implants: Systematic review

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ABSTRACT:
Aim: To assess the abutment screw loosening in dental implants survival with especially screw coating in literature. **Methodology:** A database search yielded a total of 14 articles out of which 8 were excluded based on the title and abstracts not relevant to the topic of our interest and 6 were included based on the core data. The six articles were reviewed, and four articles were consolidated to perform the meta-analysis. Three- year survival rates were also taken into consideration for screw loosening in case of implants. **Results:** All the four studies showed a similar expression of outcome measure; the detorque values were expressed in Ncm. The $\chi 2 = 144.71$, $df = 3$, $p < 0.00001$, and $I2 = 98\%$. Hence, a Random Effect model with 95% confidence interval was chosen for meta-analysis. The overall effect observed in the meta-analysis was $Z = 0.36$, $p = 0.72$, and no statistically significant differences were observed between the coated and noncoated screws with respect to detorque values. Complication free survival rate of implants was 97.3%**. Conclusion:** This meta-analysis inferred that there is no difference between the coated and noncoated screws with respect to screw loosening and loosened screw which was rare event in our studies did not affect the survivability of implant in general provided proper anti-rotational features are employed.
Keywords: implant geometry, screw loosening, Coated abutment screws, Surface modification.

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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."[1] The reported rates of screw loosening may vary in various studies. Gunne J et al., reported that over a 3-year follow-up of patients, loosening of gold prosthetic screws was the most common mechanical failure, along with fracture of occlusal material.[2] In a similar study performed on patients with implant-retained prostheses for at least 5 years of follow up, 40% of gold slotted screws failed at the recall appointment.[3] In addition, a systematic review of the literature reported that incidence of screw loosening to be 12.7% over 5 years.[4] Ricciardi Coppedê A et al., also reported that 5.4% of abutment screws became unstable over the first year of

function.[5] This difference may be due to different etiologic factors including mechanical or biological cause, implant components design and material. The implant–abutment joint is a dynamic system that exhibits changes continuously. The internal surface of the implant undergoes a series of changes with fabrication of restoration. With insertion of the healing abutment, impression components, and definitive abutments, the surface morphology of the internal portion of the implant starts showing deterioration even before the definitive restoration is even placed. With clinical procedures that mandate the insertion and removal of abutment screw, a microstructural deterioration of the abutment screw surface morphology may be observed. As deterioration progresses, the detorque values were found to decrease when compared with the torque values and once it reaches its threshold, the threads of the abutment screw disengage from the grooves of the internal surface of the implant and the abutment starts revolving around its own axis posing a clinical problem. It is, therefore, necessary to address this issue to ensure long-term success of dental implants. Studies show that with surface modification of abutment screws, there was a significant difference in the tightening and reverse torque values and surface morphology of the abutment screws under scanning electron microscopy (SEM).

AIM OF THE PRESENT STUDY

The aim of the systematic review was to analyze scientific evidence in the past and present comparing the rate of wear of coated abutment screw surfaces that have been subjected to loading with that of noncoated abutment screw surfaces through torque–detorque values and SEM

METHODOLOGY

A review of literature of studies on resistance to screw loosening in coated *vs* noncoated abutment screws as well as implant survivability that have been published was carried out without a filter on publication dates and all articles of the past were retrieved. For identification of studies included or considered for this review, detailed search strategies were developed for the database searched (PUBMED and MEDLINE). Search was initiated with the combination of controlled vocabulary-free text terms. The keywords employed in this search were broadly classified into five categories describing population, intervention, comparison, outcome, and the type of study. Keywords within each group were combined using operator (odds ratio) OR and the searches of individual groups were combined using operator and, to retrieve articles electronically.

INCLUSION CRITERIA

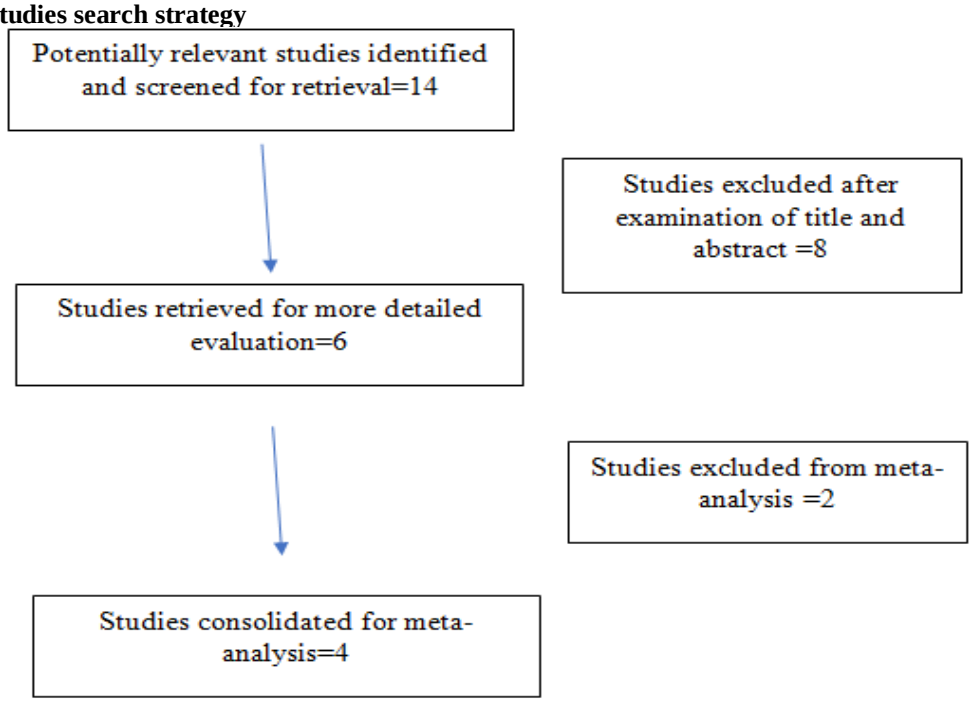
In vitro study, *in vivo* study, clinical trial, randomized controlled trial, lab study, dental material study, or SEM study dealing with abutment screw loosening.

EXCLUSION CRITERIA

Studies dealing with ceramic and other polymer screw Loosening, Studies dealing with screw loosening due to screw fracture.

Out of the 14 articles obtained from electronic search, 8 were excluded based on the title and abstract compared with the topic of our interest and 6 were included based on the core data. The six articles were reviewed, and four articles were consolidated to perform meta-analysis. (Table 1)

Table 1- Studies search strategy



RESULTS

Four studies were consolidated for meta-analysis. All the studies showed a similar expression of outcome measure; the detorque values were expressed in Ncm. The mean detorque values for coated and noncoated screws, respectively, were 20.89 ± 8 and 19.96 ± 7.1 Ncm. The treatment effect measured in this analysis was the difference between the means of coated and noncoated abutment screws, respectively. Random effect model with 95% confidence interval was chosen for meta-analysis. The $\chi 2 = 144.71$, df = 3, $p < 0.00001$, and $I^2 = 98\%$ and the overall effect size observed in the meta-analysis was Z = 0.36, p = 0.72. Hence, it could be inferred that there is no statistically significant difference between the coated and noncoated screws with respect to screw loosening based on detorque values. (Table 2)

Table 2- Meta-analysis—detorque values

Study or subgroup	Coated screws			Noncoated screws				Mean difference IV, random, 95% CI
	Mean	SD	Total	Mean	SD	Total	Weight	
Bacchi A 2015	22.4	1.14	20	26.4	1.16	20	25.9%	–4.00 (–4.71, –3.29)
Juliana 2012	13.62	1.68	9	11.25	4.71	9	23.2%	2.37 (–0.90, 5.64)
Kim HJ 2007	16.05	1.23	7	14.69	2.03	7	25.2%	1.36 (–0.40, 3.12)
Nigro F 2010	31.5	1.2	10	27.5	1.5	10	25.7%	4.00 (2.81, 5.19)
Total (95% CI)	46			46			100.0%	

Heterogeneity: Tau2 = 22.50; $\chi 2 = 144.71$, df = 3 ($p < 0.00001$); I2 = 98%; Test for overall effect Z = 0.36 (p = 72)

DISCUSSION

With increasing dental awareness, the scope of implant therapy has increased manifold. This most advocated therapy for replacement of teeth, however, holds many prosthetic complications such as crown loosening because of short abutments, esthetic failures, ceramic fracture, and inappropriate proximal contacts leading to food accumulation, and associated peri-implant diseases. The prosthetic component failures of the dental implant have also been frequently associated with screw loosening or fracture.[6-8] Nigro et al [9] had mentioned in their article on screw loosening that among the types of mechanical failures, abutment screw loosening is still the most frequently reported in literature. Kano et al [10] stated that factors related to screw loosening are various, including inadequate preload torquing, inaccurate fit of framework, poor component fit, flexure of framework, settling, debris trapped in screw receptor, screw design, and bone elasticity. Jemt et al [11] in their study found abutment screw loosening to be as high as 45% with implant single crowns. Jung et al6 calculated the cumulative incidence of connection-related complications (screw loosening, 12.7%; screw fracture, 0.35%) during 5 years of clinical service. The abutment screw loosening or fracture is also associated with frequent insertion and removal of the abutment screws during the various clinical and laboratory procedures; the abutment screw undergoes wear at microscopic level with each episode. With an increase in this wear, there is a subsequent decrease in the detorque values, and during further prosthetic loading, the screw loses its threshold limit to engage into the grooves, and it either starts revolving around its own axis or tends to fracture.[12-14] Factors related to screw loosening are various, including poor tightening (inadequate preload), inaccurate fit of framework, poor component fit, flexure of framework, settling, debris trapped in screw receptor, screw design, and bone elasticity.[15] Various methods to combat this potential problem of screw loosening would include ensuring an adequate preload which supersedes the masticatory force, proper fit of the component, a considerably rigid framework, care taken to prevent entrapment of debris at the screw receptor site, choosing an appropriate screw design based on the nature of the bone, and coating of abutment screws. Of the several factors influencing abutment screw loosening, coating the screws with various methods was assumed as a potential remedial measure to combat screw loosening. The difficulties with screw loosening include utilization of advanced technology to coat the screws, which will reflect in additional time consumption and escalated costs. However, this present meta-analysis has observed a similar behavior between coated and noncoated abutment screws with respect to screw loosening. Nevertheless, additional methods of powder coating and different choice of materials for abutment screws, which might influence screw loosening, need to be explored by further research.

CONCLUSION

This meta-analysis inferred that there is no statistical difference between the coated and noncoated screws with respect to dental abutment screw loosening and with proper anti-rotation features implant failures can be minimized even with loosening of abutment screws. Hence, both can be used in suitable clinical situations.

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