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## Original Article

# Factors associated with abutment screw loosening in single implant supported crowns: A cross-sectional study



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## ABSTRACT

**Background:** Implant restorations are considered an ideal treatment option for replacement of missing teeth in partially edentulous patients. Abutment screw loosening is one of the frequently observed technical complications of implant-supported prosthesis. This study aimed to determine the prevalence and factors associated with the abutment screw loosening in cement-retained single-implant crowns.

**Methods:** Enrolment criteria included partially edentulous patients who have been rehabilitated with one or more cement-retained single-implant crowns with minimum post-cementation period of 1 year. They were recalled and evaluated for the presence or absence of screw loosening both clinically and radiographically. They were further evaluated for the presence or absence of factors associated with screw loosening such as parafunctional habits, wider occlusal table, steep cuspal inclines, non-axial loading and cantilevering of the pontic.

**Results:** Twenty-six cement-retained single-implant crowns out of 280 showed screw loosening, making the overall prevalence rate of 10.77%. Among the factors evaluated, parafunctional habits were associated with three cases, wider occlusal table in four, steep cuspal inclines in three, non-axial loading in nine and cantilevering of the pontic in three cases. Exact reasons could not be ascertained in four cases.

**Conclusion:** Abutment screw loosening seems to be a significant prosthetic complication of cement-retained single-implant crowns. Factors evaluated significantly affect the functional durability of the prosthesis. These factors should be considered while restoring to enhance the longevity of such restorations.

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## Introduction

Implant restorations are considered an ideal treatment option for replacement of missing teeth in partially edentulous patients.<sup>1</sup> Abutment screw loosening is one of the commonly occurring prosthetic complications of both screw- and cement-retained implant restorations and is prevalent in single implant-supported crowns.<sup>2</sup> Pjetursson et al. reported the prevalence of 12.7% screw loosening in the implant-supported single crowns.<sup>3</sup> Jemt et al reported 43% loosening of abutment screws in implant single crowns during the first year of the observation period.<sup>4</sup> Becker et al. reported 38% of loosening in implant-supported single crowns of posterior maxilla and mandible.<sup>5</sup> Screw loosening occurs when the separating force acting in the screw joints exceeds the clamping force between the implant and the abutment. The loosened abutment screw can lead to increased microgap between the abutment and the implant, soft tissue infections, ingrowth of the granulation tissue at the junction and fracture of the loose screw under heavy occlusal forces.<sup>6</sup>

The possible factors responsible for the loosening of the abutment screw are parafunctional habits such as bruxism or clenching, wider occlusal table of the crown, steep cuspal inclination and non-axial loading of the implant. These factors can enhance the separating forces on the screw junction leading to the loosening of the abutment screw of the implant prosthesis.<sup>7</sup> The longitudinal study conducted by Cho et al. stated that wider diameter implants had 11% less chances of screw loosening than standard-diameter implants.<sup>8</sup>

This cross-sectional study was aimed to determine the prevalence and the factors associated with the abutment screw loosening in the cement-retained single-implant crowns.

## Materials and methods

This study was conducted on the Armed Forces personnel and their dependents who were rehabilitated with implant restorations in a tertiary care dental centre of armed forces. Patients restored with implant-retained single crowns during June 2015–June 2017 were recalled for the evaluation after obtaining approval from the institutional ethical committee. All the patients restored with cement-retained single-implant crowns and having minimum 1 year of postcementation period were selected for the study.

The final study databases consisted of 182 subjects (102 males and 80 females) with mean age of 48 years (ranged between 27 and 69 years) and were restored with 280 single-implant crowns. All the cases were placed with an implant

of the same make (Alpha-Bio Tec, Israel). The implants were of internal hex and were fabricated from titanium alloy (Ti6Al4VELI) with Nano Tec implant surface. This is achieved by 20- to 40-micron-sized sand blasting followed by acid etching for the creation of 1- to 5-micron micropores. All the successfully osseointegrated dental implants were restored using straight abutment. Closed tray technique was used to make an impression using elastomeric impression material, and the appropriate crowns were fabricated at the departmental laboratory under standard dental laboratory protocols. Out of 280 implant crowns studied, 89 were of wider diameter implants (greater than 4.5 mm diameter) and 191 were of standard-diameter implants (between 3.75 mm and 4.2 mm diameter). Forty-three were located in the anterior region, and 237 were located in the posterior region.

The inclusion criteria for the selection of subjects included patients who were well motivated and willing for follow-up, with similar implant make, had implants placed and restored at our centre, who maintained good oral hygiene and were available after a minimum of 1 year after cementation period. Exclusion criteria included those who were unwilling to participate in the study and those with poor maintenance of oral hygiene.

After completing a minimum of 1-year period of post-restoration, they were evaluated for the presence or absence of screw loosening both clinically and radiographically. Among the cases of screw loosening, they were also evaluated for the presence or absence of bruxism and parafunctional habits, cantilevering of the pontics, wider occlusal table, steep cuspal inclination and non-axial loading.

## Results

Results were analysed using statistical software (MedCalc, version 18.2.1). Among 280 cement-retained implant crowns evaluated after the completion of 1 year of postrestoration period, 26 implants showed screw loosening, making overall prevalence of 10.77%. Six wider diameter implants out of 89 (6.74%) and 20 standard-diameter implants out of 191 (10.47%) showed screw loosening with relative risk (RR) of 0.67 (95% confidence interval [CI] of 0.28–1.60) when compared between them which was not statistically significant with a p value of 0.37 (Table 1). Three out of 43 implants (6.97%) had screw loosening in the anterior region, and 23 out of 237 implants (9.70%) had the loosened screw in the posterior region, with RR of 0.74 (95% CI of 0.23–2.34) when compared between them which was not statistically significant with a p value of 0.60 (Table 2).

**Table 1 – Screw loosening in wider vs standard-diameter implants.**

Type of implants	Total no of implants	No of implants with loosened screws	% of screw loosening	RR	95% CI	p value
Wide-diameter implants (>4.5 mm)	89	6	6.74%	0.6663	0.2765–1.6058	0.3656
Standard-diameter implants (3.75–4.2 mm)	191	20	10.47%			

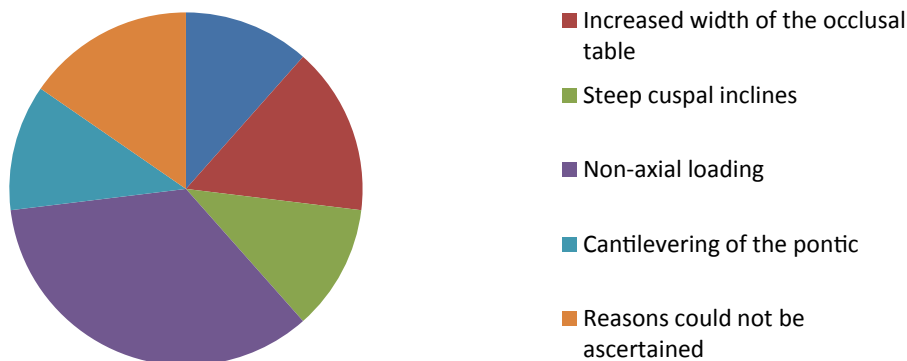
CI, confidence interval.

**Table 2 – Screw loosening in anterior vs posterior implants.**

Type of implants	Total no of implants	No of implants with loosened screws	% of screw loosening	RR	95% CI	p value
Anterior implants	43	3	6.97%	0.7372	0.2307–2.3555	0.6070
Posterior implants	237	23	9.70%			

CI, confidence interval.

### Screw Loosening



**Fig. 1 – Distribution of the factors associated with screw loosening.**

Out of 26 implant crowns with loosened screws, three (11.54%) were associated with parafunctional habits, four (15.38%) with increased width of occlusal table, three (11.54%) with steep cuspal inclines, nine (34.62%) with non-axial loading and three (11.54%) with cantilevering of the pontic. In four (15.38%) implant crowns, reason for the screw loosening could not be ascertained (Fig. 1) and (Table 3).

### Discussion

Abutment screw loosening is the most frequently encountered technical complication in implant-supported prostheses. The main purpose of this study was to assess the prevalence of abutment screw loosening in single cement-retained implant supported restorations over 1-year period of postrestoration and also to establish an association between

prevalence of screw loosening and factors such as parafunctional habits, increased width of occlusal table, steep cuspal inclines, non-axial load on the abutment and cantilevering of the crown. The results of our study are in accordance with the findings of the studies by Graves et al. and Chaar et al. in which the incidence of screw loosening varied between 4.3% and 10% and occurred in a relatively short period after functional loading of implants.<sup>9,10</sup>

Advantages of wider diameter implants over standard-diameter implants have been studied and well documented in the literature. According to the study by Graves et al., when the diameter of an implant was increased from 3.75 mm to 5.0 mm and 6.0 mm, force on a screw decreased to 20% and 33%, respectively. They postulated that increasing the diameter of the implant might indeed reduce the incidence of screw loosening. Clearly, our investigation supports this hypothesis, with only 6.74% of wider diameter implant-supported restorations having loosened screws as compared to 10.47% of standard-diameter implant-supported restorations.

The other significant finding was the difference in the prevalence of loosening between anterior and posterior implants. Posterior implants had approximately 3% more prevalence of loosening than anterior implants. This supports the concept of eliminating unwanted non-axial occlusal forces transmitted to implant-supported restorations. This also signifies that lesser amount of unfavourable masticatory forces act on the anterior implant restorations than on the posterior ones. The factors such as wider occlusal table, steep cuspal inclines and poor or improper tightening of implant abutment screws have significantly less or negligible effect on loosening of the screws in anterior implant restorations.

**Table 3 – Factors associated with the screw loosening.**

Factors associated with screw loosening	No of implants with loosened screws	% of screw loosening
Parafunctional habits	3	11.54
Increased width of the occlusal table	4	15.38
Steep cuspal inclines	3	11.54
Non-axial loading	9	34.62
Cantilevering of the pontic	3	11.54
Reasons could not be ascertained	4	15.38

Owing to repeated static and dynamic forces, parafunctional habits can have a significant impact on the incidence of screw loosening.<sup>11</sup> Non-axial forces created during parafunction can have devastating effect on the integrity of implant abutment junction. The increased loading because of unfavourable forces may cause fatigue and subsequent loosening of abutment screws. This may also lead to fracture of the screw leading to requirement of much complicated prosthodontic retreatment protocols.

The increased cantilevering of the crown because of increased mesiodistal diameter of the crown relative to the diameter of the implant also results in unfavourable forces on the screw. The results of our study have also revealed that a strong correlation exists between increased cantilevering of the crown's marginal ridges and prevalence of screw loosening. This is in concurrence with the study by Feitosa et al. in which any kind of cantilever extension causes rotation and towing forces in the direction non-axial to implant axis, and this increases the chances of loosening of the screws.<sup>12</sup>

In 34.62% of cases, screws loosened because of the non-axial loading of the abutments. This was primarily because of unfavourable axial inclination of the implants obtained while placement and use of angulated abutments. This could be attributed to the multiple operators including specialists and general duty dental surgeons. In 11.54% of the cases, screws loosened due to steep cuspal inclines. Steep cuspal inclines would have caused occlusal prematurity during lateral and protrusive excursive movements causing more towing force on the abutment implant junction.

In 15.38% cases, screws loosened due to increased width of the occlusal table. Wider occlusal table would have induced more lateral forces on the abutment.

Similarly, in 15.38% of cases, reasons for loosening could not be ascertained. It could be because of inadequate torque while tightening the screws before cementing the implant crowns. Further long-term studies with increased sample size are required to ascertain the exact cause.

## Conclusion

Within the limitations of this cross-sectional study, wider diameter implants have less prevalence of screw loosening than standard-diameter implants. In addition, the implant crowns loaded with non-axial occlusal forces exhibited increased chances of screw loosening compared with axial occlusal loading. The study also emphasises the importance

of the various other factors responsible towards screw loosening and supports the requirement of meticulous planning for the success of cement-retained implant crowns with due considerations towards occlusal forces.

## Conflicts of interest

The authors have none to declare.

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