

Effect of Double Screw on Abutment Screw Loosening in Single-Implant Prostheses

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Purpose: This study was conducted to assess the effect of using a double screw on the prevention of abutment screw loosening. **Materials and Methods:** Internal connected abutment with a single screw (IS), internal connected abutment with a double screw (ID), external connected abutment with a single screw (ES), and external connected abutment with a double screw (ED) groups were prepared (n = 10 in each group). After 50,000 loading cycles, postload removal torque loss (RTL) percentage was measured. **Results:** Postload RTL of ID and ED were smaller than those of IS and ES ($P = .000$ and $P = .039$, respectively). **Conclusion:** This study showed that a double screw was more effective in prevention of screw loosening. *Int J Prosthodont* 2016;29:445–447. doi: 10.11607/ijp.4791

Screw loosening is the most frequently occurring mechanical complication in implant restoration.¹ Prevention of screw loosening depends on implant-abutment joint stability and the preload determined by torque. Efforts have been made to increase preload and prevent screw loosening.² In a previous study, double nut tightening was found to be effective for preventing screw loosening.³ The present study was conducted to examine the validity of a double-screw abutment developed in view of a double nut-tightening method on prevention of screw loosening compared with the existing single-screw abutment.

Materials and Methods

Implant fixtures used in this study were internal and external connection (Cowellmedi), and double-screw abutments with upper screw (HK Dental) were chosen (Fig 1). Fixtures were divided into four groups (n = 10

per group): internal connection abutment with a single screw (IS), internal connection abutment with a double screw (ID), external connection abutment with a single screw (ES), and external connection abutment with a double screw (ED) (Table 1, Fig 2). For the IS and ES groups, an initial loading of 30 Ncm was applied. After 10 minutes, the same amount of torque was applied, compensating for preload loss as a result of surface sinking, and 5 minutes later the removal torque value was measured. For the ED and ID groups, the initial loading of 30 Ncm was applied and the same amount of tightening torque was applied 10 minutes later. Following the manufacturer's instructions, the upper screws were loaded under 20 Ncm tightening torque and applied again with the same amount of tightening torque 10 minutes later, and after 5 more minutes removal torque was measured. This procedure was repeated five times. A metal cap with a disc shape was fixed on the abutment with Premier Implant Cement (Premier Dental Products). The metal cap was loaded under 50N, 2Hz, and 50,000 loading cycles (the estimate for occlusion over 4 weeks) using a dental chewing simulator (R&B) as shown in Fig 3.⁴ After cyclic loading, removal torque values were measured using a torque gauge (Model BTG60CN, Tohnichi) and postload RTL was calculated. Paired t test was used to compare the removal torque values of each abutment before and after cyclic loading. Independent t test ($\alpha = .05$) was performed to compare single-screw with double-screw abutments.

Results

No significant difference in initial removal torque values among different abutment types was observed ($P = .478$ between IS and ID groups and $P = .427$

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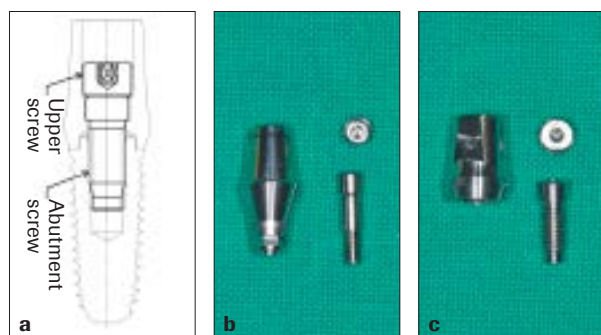


Fig 1 (a) Schematic view of double-screw abutment. (b) Internal-type double-screw abutment. (c) External-type double-screw abutment.

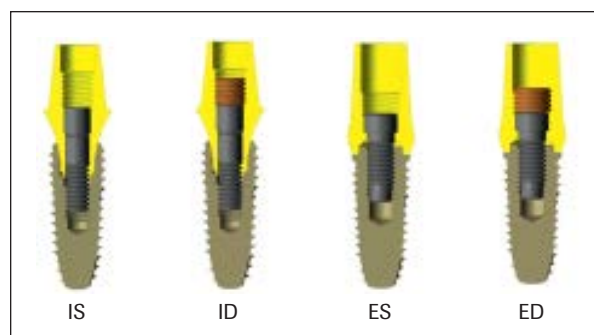


Fig 2 Sectional view of the implant fixture, abutment, and abutment screw assemblies in each group. IS = internal connection abutment with a single screw; ID = internal connection abutment with a double screw; ES = external connection abutment with a single screw; ED = external connection abutment with a double screw.

Table 1 Specifications of Experimental Materials

Group	Fixture size (mm)	Material	Abutment size (mm)	Material	Abutment screw size (mm)	Material	Connection type	n
IS	5.0 × 12	Titanium, grade 4	Cuff: 2.5; length: 5.5	Ti-6Al-4V	U: 2.4 × 2; A: 2 × 9.2	Ti-6Al-4V	Internal hex, 11°	10
ID								10
ES	5.0 × 12	Titanium, grade 4	Cuff: 2; length: 6	Ti-6Al-4V	U: 3.4 × 2.2; A: 2.5 × 8	Ti-6Al-4V	External hex	10
ED								10

IS = internal connection abutment with a single screw; ID = internal connection abutment with a double screw; ES = external connection abutment with a single screw; ED = external connection abutment with a double screw; U = upper screw; A = abutment screw.

Table 2 Mean ± SD of Initial and Postload Removal Torque (Ncm) and Removal Torque Loss (RTL, %)

Group	Initial (Ncm)	Postload (Ncm)	Postload RTL (%)
IS	26.7 ± 0.50	16.0 ± 1.7	40.1 ± 6.9 ^{a,c}
ID	26.5 ± 0.87	20.6 ± 2.6	22.4 ± 8.6 ^{a,d}
ES	24.0 ± 0.99	19.9 ± 1.4	17.2 ± 4.5 ^{b,c}
ED	24.5 ± 1.68	22.6 ± 1.8	7.7 ± 4.2 ^{b,d}

IS = internal connection abutment with a single screw; ID = internal connection abutment with a double screw; ES = external connection abutment with a single screw; ED = external connection abutment with a double screw.

Values with the same superscript letter are significantly different from one another ($P_a = .000$, $P_b = .039$, $P_c = .000$, $P_d = .006$).

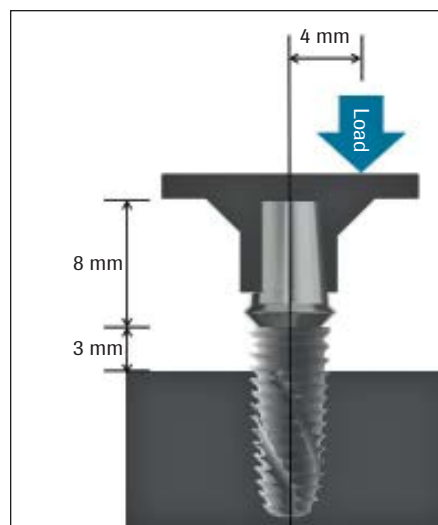


Fig 3 Schematic diagram of testing conditions. A spot 4 mm away from implant's central axis and that corresponded with the site of the molar cusp was loaded under 50 N (the mean value of implant occlusal force), 2 Hz (common occlusal frequency of an individual), and 50,000 loading cycles (estimated occlusion over 4 weeks) using a dental chewing simulator.

between ES and ED groups). Compared with initial removal torque value, postload removal torque value showed a significant decrease in all groups ($P = .000$). When comparing different types of abutment, the ID and ED groups, which used double-screw abutments, showed lower postload removal torque loss than the

IS and ES groups ($P = .000$ and $P = .039$, respectively). In comparing different types of connection, the ES and ED groups showed lower postload removal torque losses than the IS and ID groups ($P = .000$ and $P = .006$, respectively) (Table 2).

Discussion

There was no difference in initial removal torque value according to type of abutment. This observation demonstrates that use of a double-screw abutment with an upper screw does not affect the amount of preload. Postload removal torque values were observed to decrease significantly from initial removal torque values in all groups. The ID and ED groups showed greater postload removal torque values and lower postload RTL percentage than the IS and DS groups. This result suggests that a double-screw abutment is more successful at preventing screw loosening. In this study, the external connection implant groups (ES and ED) exhibited a lower postload RTL percentage than the internal connection implant groups (IS and ID). These observations contradicted the results of previous studies.⁵ With internal hexagon implants, settle-down can result from cyclic loading⁵ and can decrease elongation of the abutment screw and, ultimately, preload. Long-term studies and clinical studies are necessary to validate the effects of double-screw abutments on prevention of screw loosening.

Conclusions

Within the limitations of this study, double-screw abutments in external and internal connection implants exhibited a lower postload RTL percentage after cyclic loading than single-screw abutments. These observations suggest that use of a double-screw abutment is a valid approach for preventing screw loosening.

Acknowledgments

The authors reported no conflicts of interest related to this study.

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Literature Abstract

Effect of Toothbrushing Frequency on Incidence and Increment of Dental Caries: A Systematic Review and Meta-Analysis

Toothbrushing is considered fundamental self-care behavior for maintenance of oral health, and brushing twice a day has become a social norm, but the evidence base for this frequency is weak. This systematic review and meta-analysis aims to assess the effect of toothbrushing frequency on the incidence and increment of caries lesions. Medline, Embase, Cinahl, and Cochrane databases were searched. Screening and quality assessment were performed by 2 independent reviewers. Three different meta-analyses were conducted: 2 based on the caries outcome reported in the studies (incidence and increment) with subgroup analyses of categories of toothbrushing frequency; another included all studies irrespective of the caries outcome reported with the type of dentition as subgroups. Metaregression was conducted to assess the influence of sample size, follow-up period, diagnosis level for caries lesions, and methodologic quality of the articles on the effect estimate. Searches retrieved 5,494 titles: after removing duplicates, 4,305 remained. Of these, 74 were reviewed in full, but only 33 were eligible for inclusion. Self-reported infrequent brushers demonstrated higher incidence (odds ratio [OR], 1.50; 95% confidence interval [CI], 1.34 to 1.69) and increment (standardized mean difference [SMD], 0.28; 95% CI: 0.13 to 0.44) of caries lesions than frequent brushers. The odds of having caries lesions differed little when subgroup analysis was conducted to compare the incidence between ≥ 2 times/d vs < 2 times/d (OR: 1.45; 95% CI: 1.21 to 1.74) and ≥ 1 time/d vs < 1 time/d brushers (OR: 1.56; 95% CI: 1.37 to 1.78). When meta-analysis was conducted with the type of dentition as subgroups, the effect of infrequent brushing on incidence and increment of caries lesions was higher in deciduous (OR: 1.75; 95% CI: 1.49 to 2.06) than permanent dentition (OR: 1.39; 95% CI: 1.29 to 1.49). This meta-analysis study concluded that individuals who state that they brush their teeth infrequently are at greater risk for the incidence or increment of new caries lesions than those brushing more frequently. The effect is more pronounced in the deciduous than in the permanent dentition. A few studies indicate that this effect is independent of the presence of fluoride in toothpaste. It is also possible that other factors in those claiming a higher frequency of brushing, such as greater health awareness and motivation, higher socioeconomic status, and a healthier diet, are responsible for the observed effects.

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