REVISTA DE ODONTOLOGIA DA UNESP

ORIGINAL ARTICLE

Rev Odontol UNESP. 2016 May-June; 45(3): 146-148
Doi: http://dx.doi.org/10.1590/1807-2577.23515



# Tightening techniques for the retaining screws of universal abutment

*Técnicas de aperto para parafusos de retenção do pilar universal*

Alexandre Wittcinski REGALIN[a], Rodrigo ALESSANDRETTI[b], Leonardo FEDERIZZI[a], Érica Alves GOMES[a], Ataís BACCHI[a], Aloísio Oro SPAZZIN[a*]

[a]IMED – Faculdade Meridional, Passo Fundo, RS, Brasil
[b]UPF – Universidade de Passo Fundo, Passo Fundo, RS, Brasil

## Resumo

**Objetivo:** Este estudo avaliou a manutenção do torque de parafusos de retenção do pilar universal utilizando diferentes técnicas de aperto e parafusos com ou sem revestimento. **Material e método:** Os parafusos foram apertados nos implantes da seguinte forma: Controle – 32 Ncm de torque; H20 – segurando os 32 Ncm de torque por 20 s; R – 32 Ncm de torque, repetido após 10 min (retorque); e H20+R – combinando as duas técnicas de aperto. Foram também avaliados parafusos de titânio com e sem revestimento da rosca. **Resultado:** A análise estatística mostrou maior manutenção do torque de parafusos de titânio (p<0,001). A técnica H20+R apresentou a maior manutenção do torque (p=0,003), semelhante a manutenção do torque da técnica H20. **Conclusão:** Parafusos de titânio combinando as duas técnicas de aperto pode melhorar a manutenção do torque.

**Descritores:** Prótese dentária fixada por implante; conexão implante dentário; torque.

## Abstract

**Purpose:** This study evaluated the torque maintenance of universal abutment retaining screws using different tightening techniques, and coated or uncoated screws. **Material and method:** The screws were tightened to implants as following: Control – 32 Ncm torque; H20 – holding 32 Ncm torque for 20 s; R – 32 Ncm torque, repeated after 10 min (retorque); and H20+R – combining the two tightening techniques. Titanium and coated screws were also evaluated. **Result:** Statistical analysis showed higher maintained torque for titanium screws (p<0.001). The H20+R technique showed the highest maintained torque (p=0.003), but the H20 technique's maintained torque was similar. **Conclusion:** Titanium screws associating the two tightening techniques can improve maintained torque.

**Descriptors:** Implant-supported dental prosthesis; dental implant-abutment design; torque.

## INTRODUCTION

The clinical success of cemented implant-supported crowns is dependent on the joint stability of the abutment retaining screw, and common clinical complications in implant prostheses include screw loosening[1]. Loosened screws occur through three major mechanisms: lack of a passive fit among components, overload on screw joints and embedment relaxation[2]. This last phenomenon is also known as "settling" and this occurs because the internal threads of the implant and the threads of the retaining screw of the abutment cannot be machined to be perfectly smooth, resulting in high spots on both surfaces. These spots contact only when the initial tightening torque is applied on the screw when developing the preload. Settling then occurs when the rough spots of the screw threads are smoothed under loading, causing loss of part of the initial torque[3].

The clinical procedure suggested to overcome settling effects is a second torque application (retorque) on the retaining screw of the abutment 10 minutes after the initial tightening torque[4]. Investigators have recommended this procedure as a routine clinical technique[3,5,6]. In addition, holding the torque meter for a longer time period during the tightening torque application on the retaining screw could also decrease the settling effect. Moreover, manufacturers of abutment retaining screws have used dry lubricants, such as diamond-like carbon (DLC), to reduce friction during tightening and to allow more screw-turning for a given torque[7,8].

The aim of the study was to evaluate the effect of the tightening technique and the screw coating on the maintained torque of retaining screws of the universal abutments for cemented implant-supported crowns. The hypotheses tested were as follows: 1) a tightening technique other than that provided by the manufacturer improves the torque maintenance of retaining screws in a universal abutment; and 2) coated screws improve the torque maintenance of retaining screws in a universal abutment.

## MATERIAL AND METHOD

Forty implants with external hexagon joints (13.0 mm length × 3.75 mm diameter; Titamax Ti Cortical 4.1, Neodent, Curitiba, PR, Brazil) were submerged in acrylic resin (JET; Clássico, São Paulo, SP, Brazil) in stainless steel cylinders (Figure 1a). A delineator (Delineador B2, Bio-Art, São Paulo, SP, Brazil) was used to standardize the place of the implants. Universal abutments (4.5 mm wide × 6 mm in length × 2 mm trans-mucosal neck; Universal Abutment SF, Neodent, Curitiba, PR, Brazil) were screwed on the implant platform using different tightening techniques (Figure 1b): Control – 32 Ncm torque (manufacturer's instructions); H20 – holding 32 Ncm torque for 20 s; R – 32 Ncm torque, repeated after 10 min (retorque); and H20+R – holding 32 Ncm torque for 20 s and retorque after 10 min (again holding for 20 s). Additionally, two subgroups were evaluated for based on the screw coating: Ti – conventional titanium screw (Hexagonal Screw; Neodent, Curitiba, PR, Brazil and DLC – screw coated with diamond-like-carbon (Neotorque; Neodent, Curitiba, PR, Brazil). A digital torque meter with a precision of 0.1 Ncm (TQ-8800; Lutron Electronic Enterprise CO., Ltd, Taipei, Taiwan) was used to vertically tighten the screws and evaluate the torque maintenance 24 h after tightening (Figure 1c)[5]. During the torque application, the values of torque ranged ±0.5 Ncm during the 20 s. The same operator accomplished all procedures. Data were recorded and analyzed using a two-way analysis of variance (ANOVA) followed by Tukey's test (α=0.05).

## RESULT

The statistical analysis showed that both the tightening technique and the screw coating significantly affected the maintained torque (p=0.003 and p<0.001, respectively). However, the interaction between the two factors was not significant (p=0.869). The combination of tightening techniques applied in the H20+R group presented the highest overall maintained torque values, though the values for the H20 group were similar, regardless of the screw used. Moreover, the conventional screws in the Ti subgroup presented higher maintained torque values than those in the DLC subgroup, regardless of the tightening technique used (Table 1).

## DISCUSSION

The current study showed the maintained torque was lower than the tightening torque for the screws in all groups, which is in agreement with previous studies[3,5,6-8]. This likely occurs due to the phenomenon known as "settling" or "embedment relaxation"[3]. The matching of the techniques used in the H20+R group showed the highest torque maintenance, however the difference between those values and the intermediate values found for the H20 group was not statistically significant. Therefore, the first hypothesis of the study was accepted, as the tightening technique influenced torque maintenance. The higher torque maintenance found for the two holding techniques may be because a longer torque application decreases the irregularities in the threads of the implant and retaining screw, increasing the contact between them during the preload and consequently, decreasing the settling effect. The retorque application

**Table 1.** Mean values (standard deviation) of the maintained torque (Ncm) grouped in blocks (tightening technique and screw)

| Tightening Technique | Maintained Torque* | Screw | Maintained Torque* |
|---|---|---|---|
| Control | 27.0 (3.1) B | Ti | 30.1 (2.0) A |
| H20 | 28.4 (2.8) AB | | |
| R | 26.6 (3.3) B | DLC | 25.6 (2.4) B |
| H20+R | 29.0 (3.6) A | | |

*Mean followed by different letter are statistical significant (P<0.05).

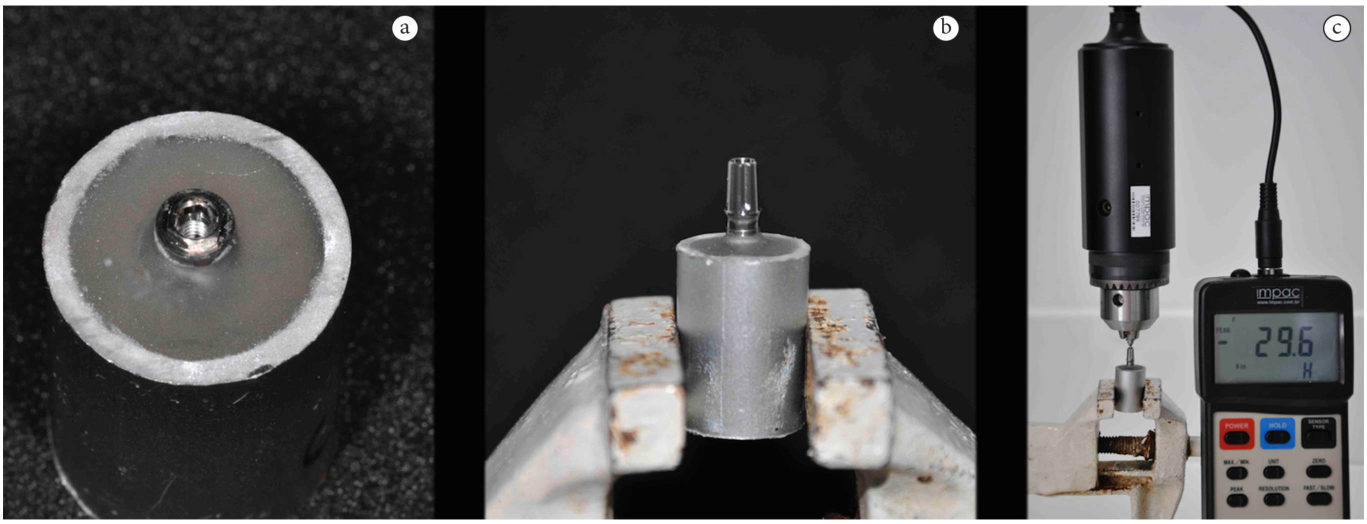


**Figure 1.** Experimental design: (a) implant submerged in acrylic resin; (b) universal abutments screwed on the implant; and (c) tighten and maintained torque using the digital torque meter.

after the settling effect may act to regain preload and increase the contact area between the threads; for this reason, several researchers have advocated that retorque application 10 min after the initial application should be performed routinely during abutment-implant connections[3,5,6]. The current study showed that this technique was most effective when associated with holding the torque for 20 s.

The second hypothesis tested in this study was rejected, as the uncoated titanium screws presented greater torque maintenance than the DLC-coated screws. This result is in agreement with a previous study[8]. The lower maintained torque found for the coated screws could be due to the reduced friction during tightening, which could also reduce the screw's friction resistance during loosening. Coated screws may decrease torque loss after mechanical cyclic loading due to friction reduction during tightening, helping the screw turn farther for a given torque and increasing the contact between the threads of the screw joint, resulting in less screw vibration and fewer micromovements during mechanical cyclic loading[7-9]; however, this effect was not evaluated in the current study. Tightening techniques can decrease the loosening of the abutment retaining screws, but there is no consensus in the literature concerning the benefits of coated retaining screws for abutment fixation[7-11], so clinical studies are needed to confirm the results found in the current study and clarify the hypotheses reported.

## CONCLUSION

Within the limitations of this laboratory study, it was possible to conclude that conventional titanium screws and tightening techniques holding the tightening torque for 20 s and matching the holding and repeated torque applications (retorque) present higher maintaining torque of the retaining screws of the abutment used for cemented implant-supported crowns.


## ACKNOWLEDGEMENTS

The authors would like to thank Neodent for donating the implants, abutments and screws.


## REFERENCES


1. Ma S, Fenton A. Screw- versus cement-retained implant prostheses: a systematic review of prosthodontic maintenance and complications. Int J Prosthodont. 2015 Mar-Apr;28(2):127-45. http://dx.doi.org/10.11607/ijp.3947. PMid:25822297.
2. Kim SG, Chung CH, Son MK. Effect of cement washout on loosening of abutment screws and vice versa in screw- and cement- retained implant-supported dental prosthesis. J Adv Prosthodont. 2015 Jun;7(3):207-13. http://dx.doi.org/10.4047/jap.2015.7.3.207. PMid:26140172.
3. Siamos G, Winkler S, Boberick KG. Relationship between implant preload and screw loosening on implant-supported prostheses. J Oral Implantol. 2002;28(2):67-73. http://dx.doi.org/10.1563/1548-1336(2002)028<0067:TRBIPA>2.3.CO;2. PMid:12498448.
4. Bakaeen LG, Winkler S, Neff PA. The effect of implant diameter, res- toration design, and occlusal table variations on screw loosening of posterior single-tooth implant restorations. J Oral Implantol. 2001;27(2):63-72. http://dx.doi.org/10.1563/1548-1336(2001)027<0063:TEOIDR>2.3.CO;2. PMid:12498429.
5. Spazzin AO, Henriques GE, Nóbilo MA, Consani RL, Correr-Sobrinho L, Mesquita M. Effect of retorque on loosening torque of prosthetic screws under two levels of fit of implant-supported dentures. Braz Dent J. 2010 Jan;21(1):12-7. http://dx.doi.org/10.1590/S0103-64402010000100002. PMid:20464315.
6. Farina AP, Spazzin AO, Consani RLX, Mesquita MF. Screw joint stability after the application of retorque in implant-supported dentures under simulated masticatory conditions. J Prosthet Dent. 2014 Jun;111(6):499-504. http://dx.doi.org/10.1016/j.prosdent.2013.07.024. PMid:24423456.
7. Kim SK, Lee JB, Koak JY, Heo SJ, Lee KR, Cho LR, et al. An abutment screw loosening study of a Diamond Like Carbon-coated CP titanium implant. J Oral Rehabil. 2005 May;32(5):346-50. http://dx.doi.org/10.1111/j.1365-2842.2004.01475.x. PMid:15842243.
8. Assunção WG, Delben JA, Tabata LF, Barão VA, Gomes EA, Garcia IR Jr. Preload evaluation of different screws in external hexagon joint. Implant Dent. 2012 Feb;21(1):46-50. http://dx.doi.org/10.1097/ID.0b013e31823fcbce. PMid:22228458.
9. Basílio MA, Butignon LE, Arioli J Fo. Effectiveness of screw surfasse coating on the stability of zirconia abutments after cyclic loading. Int J Oral Maxillofac Implants. 2012 Sep-Oct;27(5):1061-7. PMid:23057018.
10. Park JK, Choi JU, Jeon YC, Choi KS, Jeong CM. Effects of abutment screw coating on implant preload. J Prosthodont. 2010 Aug;19(6):458-64. http://dx.doi.org/10.1111/j.1532-849X.2010.00595.x. PMid:20456024.
11. Hirata R, Machado LS, Bonfante EA, Yamaguchi S, Imazato S, Coelho PG. Effect of diamondlike carbon coating on reliability of implant-supported crowns. Int J Oral Maxillofac Implants. 2015 Jul-Aug;30(4):806-13. http://dx.doi.org/10.11607/jomi.3750. PMid:26252032.


## CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.


## *CORRESPONDING AUTHOR

Aloísio Oro Spazzin, IMED – Faculdade Meridional, Rua Senador Pinheiro, 304, Bairro Rodrigues, 99070-220 Passo Fundo - RS, Brasil, e-mail: aloisio.spazzin@imed.edu.br



Received: October 5, 2015
Accepted: March 1, 2016