

Screw Stability of CAD-CAM Titanium and Zirconia Abutments on Implants with Different Internal Conical Connections

Gulce Çakmak DDS PhD,^a Burcu Batak DDS PhD,^b Burak Yilmaz DDS PhD,^c William M. Johnston MS PhD^d

^aAssociate Professor, Department of Prosthodontics, Istanbul Okan University Faculty of Dentistry, Istanbul, Turkey and ITI Scholar, Division of Postdoctoral and Research, National Autonomous University of Mexico, Mexico City, Mexico.

^bResearch Associate, Department of Prosthodontics, Faculty of Dentistry, Ankara University, Ankara, Turkey.

^cAssociate Professor, Department of Reconstructive Dentistry and Gerodontology, School of Dental Medicine, University of Bern, Bern, Switzerland; Associate Professor, Department of Restorative, Preventive and Pediatric Dentistry, School of Dental Medicine, University of Bern, Bern, Switzerland, and Adjunct Professor, Division of Restorative and Prosthetic Dentistry, The Ohio State University College of Dentistry, Ohio, USA. Associate Professor, Division of Restorative and Prosthetic Dentistry, College of Dentistry, The Ohio State University, Columbus, Ohio.

^dProfessor Emeritus, Division of Restorative and Prosthetic Dentistry, The Ohio State University College of Dentistry, Columbus, Ohio.

Introduction

Limited information is available regarding the removal torque values (RTVs) of screws of different abutment materials when used with different internal conical connections. The purpose of this study was to evaluate the effect of implant type and abutment material (zirconia; Zir and titanium; Ti) on the RTVs of abutment screws after cyclic loading.

Methods

Internal conical connection implants (TX, OsseoSpeed TX, 4.0 S×11 mm) and modified internal conical connection implants (EV, OsseoSpeed EV, 4.2 S×11 mm) (n=10) were clamped in resin dies. Zir and Ti (N=20) custom abutments were hand tightened on implants and then torqued to 20 Ncm for TX and 25 Ncm for EV implants as recommended by the manufacturer. The abutments and implants in resin dies were cyclically loaded at a 30-degree off-axis angulation (Figure 1) by using a sequentially increased loading protocol with a custom chewing simulator; 2-million cycles under 100 N, 3-million cycles under 200 N, and 2-million cycles under 300 N loads with 2 Hz. After 7 million cycles, RTVs (Ncm) were measured by using a torque gauge (6BTG-A, Tochnichi Mfg. Co. Ltd, Tokyo, Japan). The data were analyzed with ANOVA by using restricted maximum likelihood estimation method. Tukey-Kramer adjustment was used for any significant interaction of implant-abutment pairs ($\alpha=.05$).

Results

Two TX implants, 1 with Ti and 1 with Zr abutment, fractured during cyclic loading and discarded for statistical analysis. Only implant type had a significant effect on the RTVs ($P<.001$). Screws of Ti abutments on EV implants had significantly higher RTVs than the screws of Ti ($P=.003$) and Zr ($P=.005$) abutments on TX implants. Means and 95% confidence intervals of RTVs (Ncm) are presented in Figure 2.

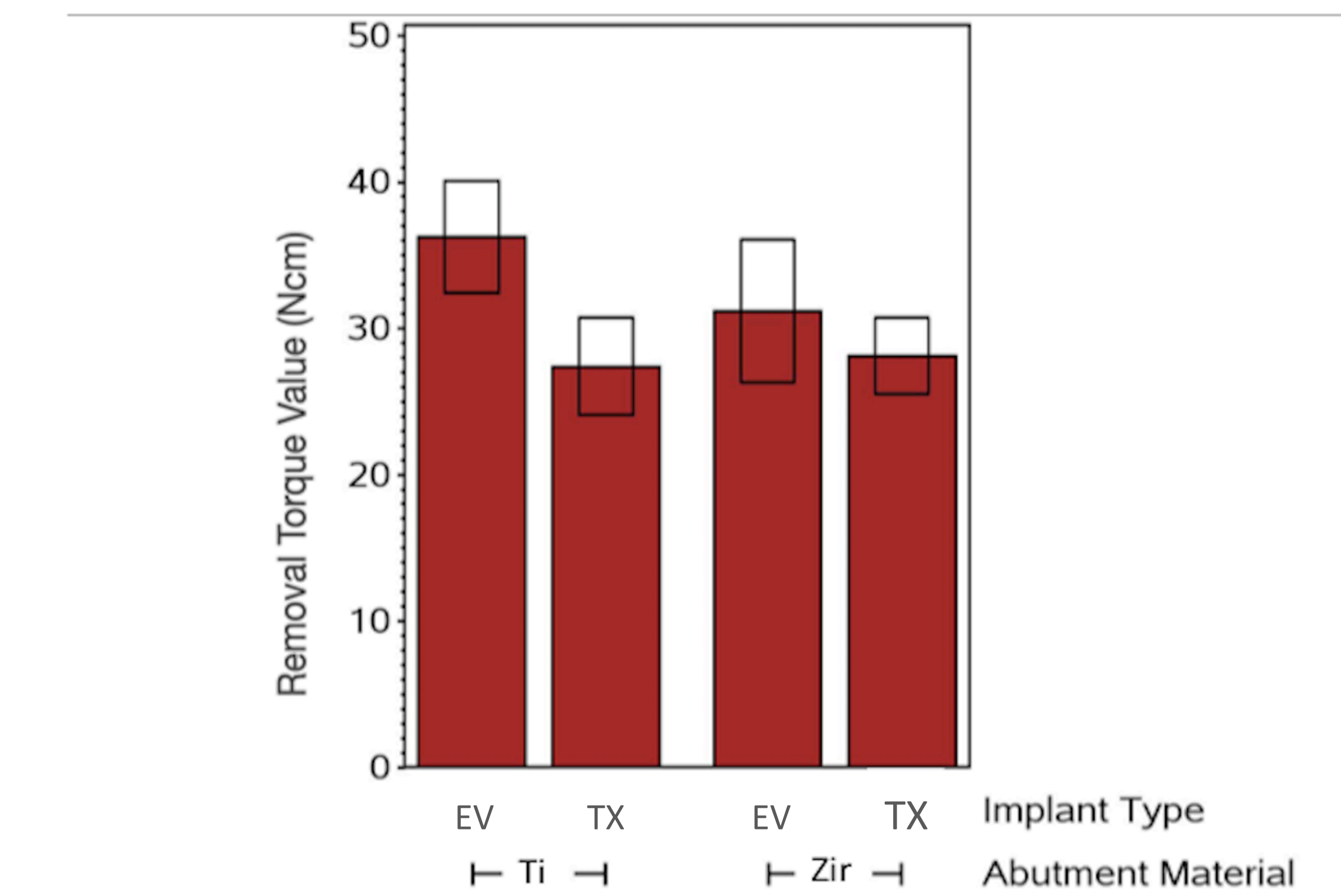
Conclusions

Implant type affected the RTVs, however, the RTVs were higher than the initial torque values for all groups. Screws of Ti abutments on implant, which required greater initial torque values had higher RTVs than the screws of Ti and Zir abutments on the implant that required smaller initial torque values. RTVs were similar for Zir and Ti abutment screws within each implant type.

Figure 1. The abutments and implants in resin dies were fixed to the custom made chewing simulator to load the abutments at a 30-degree off-axis angulation



Figure 2. Means and 95% confidence intervals of removal torque values (Ncm) in different abutment materials and implant systems. TX; a conical dodecagram internal connection design implants, EV; modified conical dodecagram internal connection design, Ti; titanium, Zir; zirconia



Clinical Significance

This study suggests that the performance of tested abutments on both types of internal conical connection implants was promising after long term cyclic loading, because the abutment screws maintained their preload. However, tested modified internal conical connection implants with titanium abutments may be preferred over internal conical connection implants with titanium or zirconia abutments as they had higher removal torque values.