Optimized Placement of Angled Abutments for External-Hex Implant Platforms: A Pilot Study

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A survey demonstrated that angled abutments for external-hex implant platforms are difficult to place because of the handling of the components and screwdriver. The purpose of this study was to evaluate the performance of a device facilitating the placement of prefabricated angled abutments. This new instrument features improved ergonomics and is based on the design of a modified pickup impression coping. Forty experienced professionals tested two methods of placing angled abutments in a typodont on implants replacing a maxillary central incisor and a maxillary first molar. Using the new device, the abutments could be placed with a 43.9% reduction in time compared to the original manufacturer's instrument. *Int J Prosthodont 2011;24:238–240.*

External-hex platform implants are used worldwide. Implants may be placed in suboptimal positions because of anatomical limitations[1] (especially when bone reconstruction is not performed) or operator skill.[2] Angled abutments[3] offer the possibility to restore such difficult cases that would otherwise require removal of the existing implants and may induce other related sequelae.

Prefabricated angled abutments are manufactured for both internal- and external-hex implants. For external-hex systems, angled abutments may be oriented in 12 distinct positions (Fig 1). The seating of such abutments in the proper orientation may be challenging and requires manual skills and attention to detail.[4] Manufacturers provide special abutment holders to simplify placement, but it remains difficult to manipulate both the holder-abutment assembly and screwdriver while focusing on the orientation of the implant's hexagonal platform (Fig 2).[5]

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The aim of this pilot study was to evaluate in vitro the performance of a new device, developed at the Dental Implant Research and Study Center, Federal University of Santa Catarina, Florianópolis, Brazil, for the placement of prefabricated angled abutments on external-hex platform implants.

Materials and Methods

A new holding device for angled abutments was developed based on the design of an open-tray transfer coping for conical abutments (SF Conical Abutment, Neodent). The coping, which adapts to both conical abutments and conical miniabutments (SF Conical Mini Abutment, Neodent), was modified with a triangular opening to permit access to the abutment screw. The prototype holder was completed with an acrylic resin (Dencôr, Clássico) handle to provide adequate gripping (Fig 3). When compared with the abutment holder provided by the manufacturer, the new device features increased contact surface to hold the abutment. Following pilot tests with the prototype, the final device was designed and fabricated using computer-aided design/computer-assisted manufacturing (AutoCAD v 2006, Autodesk).

A typodont was used to simulate two misplaced implants replacing a maxillary left central incisor with excessive labial inclination and a maxillary right first molar with abnormal palatal inclination. Forty clinicians with a minimum experience of 2 years in implant dentistry were identified. A digital chronometer (KENKO) was used to time each abutment placement procedure. The orientation of the abutment was then verified with an explorer and visual inspection

Fig 1 *(above)* Angled abutments with *(left)* dodecagon and *(right)* external-hexagon implant platforms.

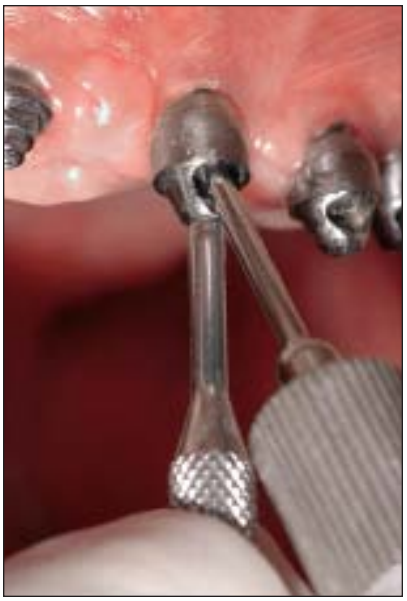

Fig 2 *(right)* Use of the manufacturer's abutment holder and screwdriver during clinical delivery of an angled abutment.

Fig 3 Stages of development of the prototype. **(a)** The modified impression coping attached to the implant was further modified **(b)** with an access window for the screwdriver. **(c)** Acrylic resin was then added to provide better gripping.

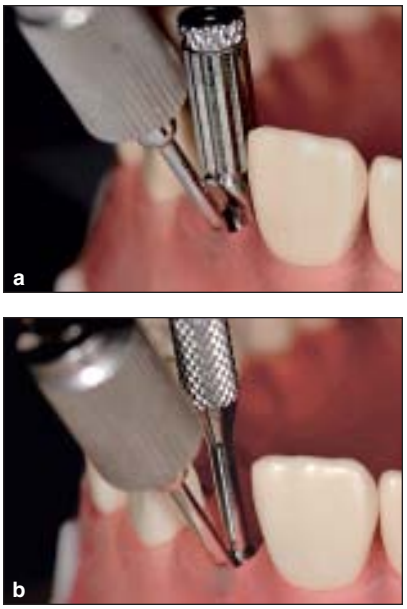

Fig 4 **(a)** Modified and **(b)** standard technique used to fasten angled abutments on the typodont.

after retracting the artificial soft tissues. Each participant had to place an angled abutment (Conical Mini Abutment) on the implants using the manufacturer's abutment holder as well as the new device (Fig 4), resulting in four measurements: standard technique incisor (IS), standard technique molar (MS), modified technique incisor (IMo), and modified technique molar (MMo). To prevent any bias, the placement

Table 1 Two-Way ANOVA Results

Source	*df*	Type III sum of squares	Mean square	F	*P*
Implant site	1	7.661	7.661	0.0315	.859
Abutment placement method	1	15,341.126	15,341.126	63.021	< .001*
Site method	1	30.494	30.494	0.125	.724

*Significant difference.

methods (standard vs modified) and implant site (incisor vs molar) were assigned randomly for the first abutment placement, and the sequence was inverted for the second implant.

Data were analyzed using two-way analysis of variance (ANOVA) (site and placement method). The Tukey HSD post hoc test was used to detect pairwise differences among experimental groups. All statistical testing was performed at a preset alpha of .05. A post hoc power analysis was also carried out and given a significance level of .05, a sample size of 160 with the four groups (n = 40), 3 degrees of freedom in the numerator, and the two covariates. Given an effect size of 0.288 (R^2 of the ANOVA F-test), a power of 86.91% was obtained (G*Power 3.1.2, Axel Buchner).

Results

The two-way ANOVA indicated a significant effect for placement method ($P < .001$) but not for placement site or the interaction term ($P = .86$ and $P = .72$, respectively) (Table 1). The mean insertion times were 44.8, 24.4, 44.4, and 25.7 seconds for IS, IMo, MS, and MMo, respectively. When combining the data of both sites, the abutment could be placed with a 43.9% reduction in time using the experimental design compared to the original manufacturer's instrument.

Discussion

A small survey performed during the experiment revealed that all participants found angled abutments to be the most difficult to place overall. Specific problems were mentioned, such as the difficulty of manipulating the abutment components and the screwdriver, finding the correct position, and stabilizing the abutment while fastening the screw. The majority of participants agreed that the new device facilitated angled abutment placement because it conferred superior tactile perception.

This in vitro pilot study was limited by its lack of some clinical variables, such as soft tissue collapse above the hexagonal platform; saliva, tongue, and oral mucosa movements; and interaction with the cheeks. The size of the operators' hands could be another possible determinant of the ease with which the components could be manipulated. A clinical trial would be necessary to determine the real value of this new device. It was observed, however, that even in a simplified environment, the use of this new device facilitated angled abutment placement.

Conclusion

Angled implant abutments may be difficult to place. The use of a new holder that permits superior tactile perception through increased contact surface with the abutment may improve the efficiency of clinical abutment placement.

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