A preclinical study provides evidence about the performance of original and non-original prosthetic components.

Mattheos N, Li X, Zampelis A, Ma L, Janda M. 143 Investigating the micromorphological differences of the implant-abutment junction and their clinical implications: a pilot study. Clin Oral Implants Res. 2016 Nov;27(11):e134-e143

INTRODUCTION:

The implant-abutment junction is the site where occlusal forces are transferred to the implant. Therefore, it represents a critical junction in the entire implant-prosthesis connection, and any deformation or misfit of the implant abutment could potentially lead to technical complications.

At first glance, the design of non-original abutments seems to be equivalent to the corresponding originals. In fact, there are critical differences that can only be perceived by analyzing the cross-section of the implant-abutment junction under high magnification, for example using scanning electron microscopy.

This study aimed to investigate the morphological micro-features of three commercially available implant–abutment connections using compatible and original prosthetic components. Potential correlations between the micromorphology and functional complications were also addressed.

MATERIALS AND METHODS:

The experimental groups consisted of a Straumann Tissue Level implant (Ø 3.3 mm, length 10 mm, Regular Neck (RN)) connected with:

a. the Straumann synOcta gold abutment.

b. the Ostech Pro - Pack RN Eng IL CoCr Str

c. the Medentika GmbH POC abutment, Co/Cr

A torque force of 35 Ncm was applied in each case according to the manufacturer's instructions. After connection, the implant-abutment units were then embedded in an acrylic polymer matrix and sectioned using a cutting/grinding microtome system.

Next, the sliced implant–abutment connections were scanned (Scanning Electron Microscope (SEM)) and digitally photographed. The photographs were analyzed, and the total contact areas (CA) were measured, allowing the actual extent of tight contact to be estimated for each of the implant-abutment junctions. The following areas were analyzed (Fig. 1):

1. the area of the abutment in contact with the external shoulder of the implant neck **(BLUE)**
2. the area of the abutment in contact with the internal connection of the implant **(RED)**
3. the area of the abutment screw in contact with the internal implant threads **(WHITE)**

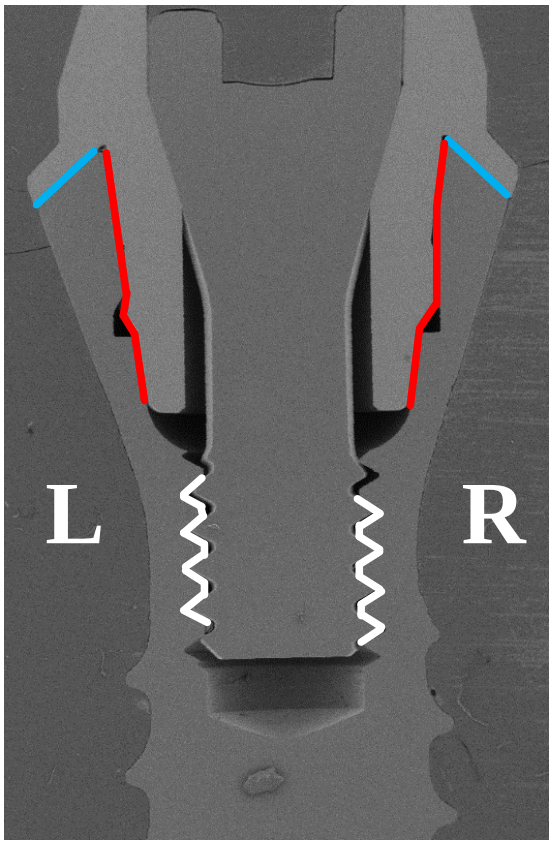

Fig. 1 | Contact areas (CA) of the implant-abutment connection investigated in the study. L-left side, R-right side.
Image: courtesy of Dr. N. Mattheos

KEY RESULTS AND CONCLUSIONS:

1. Only the original Straumann abutment presented consistent and reliable values of tight contact measurements in all critical studied areas on both the left (L) and right (R) sides. Figs. 2-4). Such a performance ensures the long-term success of the prosthesis and prevents complications.
2. Finite element analysis revealed microroughness and microcracks, visible particularly in the abutment – implant shoulder area of the Medentika prosthetic component, both in the areas of tight and non-tight contacts.

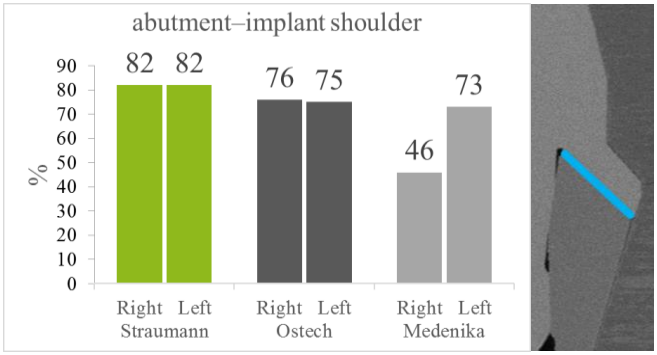

Fig. 2 | The length of total tight contact for the abutment – implant shoulder area (as a percentage of the maximum contact area). *Adapted from Mattheos et al 2016.*

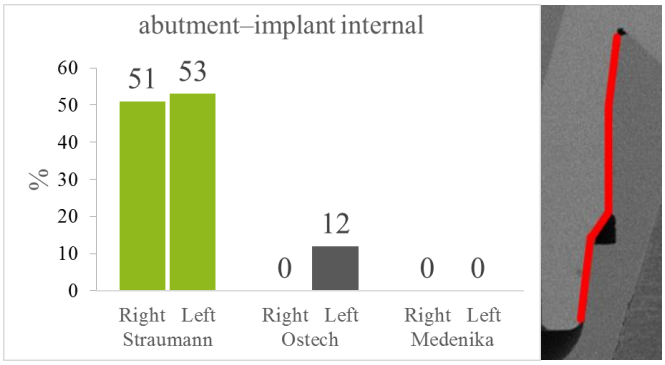

Fig. 3 | The length of total tight contact for the abutment – implant internal area (as a percentage of the maximum contact area). *Adapted from Mattheos et al 2016.*

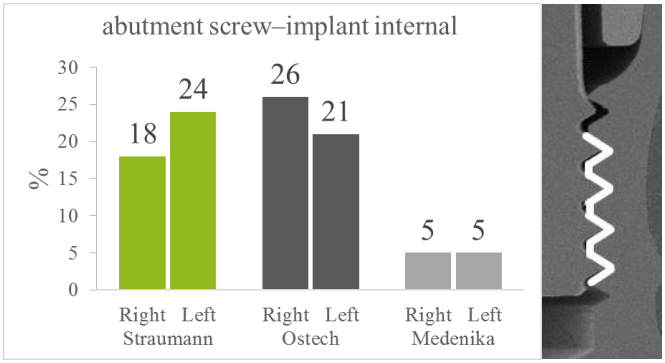

Fig. 4 | The length of total tight contact for the abutment screw – implant area (as a percentage of the maximum contact area). *Adapted from Mattheos et al 2016.*

- A tight contact between the implant and the abutment determines the friction that holds the prosthesis on the implant and prevents micromotion caused by the occlusal forces. Non-original abutments often present a higher rotational misfit. An abutment that does not fit perfectly in the implant can potentially lead to abutment screw loosening and, subsequently, to fracture of the abutment screw or even the implant (Gigandet et al., 2014, Kano et al., 2006).
- Unless the abutment is manufactured with very high precision, contact areas of the implant shoulder and the internal connection can counteract each other, which in turn could cause material wear and the formation of microcracks. The microcracks and roughness between the abutment and implant, observed particularly in the compatible abutments, can increase the risk of settling and possible screw loosening, as previously reported by Kim et al. 2011.
- The engagement of the abutment screw threads is a crucial factor, as the force that leads to preloading of the abutment is applied through these threads (Cardoso et al. 2012). The deficient engagement seen in compatible abutments creates a significant risk of deformation or fracture of the screw.
- "Compatible abutments can present critical morphological differences from the original ones. The differences in the cross-sectional geometry result in large differences in the overall contact areas, both in terms of quality and quantity, which could have serious implications for the long-term stability of the prosthesis." *Source: Mattheos et al. 2016*

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Institut Straumann AG
Peter Merian-Weg 12 CH-4002 Basel, Switzerland
Phone +41 (0)61 965 11 11, Fax +41 (0)61 965 11 01
www.straumann.com

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