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Tooth intrusion in implant-tooth supported dentures.

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Introduction

In combined implant-tooth supported fixed dentures or so-called *hybrid* bridges, the connection between natural and artificial abutments has to be separated for technical and clinical reasons. In this connection, some observations demonstrate tooth intrusion in cases of semi-rigid or rigid connection of the abutments. This phenomenon was discussed using mathematical or physical models, however, no satisfying explanation for the apical migration exists till now. Since a common characteristic of the relevant case reports is the use of precise attachments or copings for the connection between the implant supported part of the denture on the one hand and the tooth supported on the other, the aim of our study was to evaluate the effect of different types of copings on apical migration of the tooth with the help of a realistic in-vitro model.

Materials and Methods

On a realistic model of a so-called free-end situation, a fixed denture was attached to an integrated implant (IMZ Type 51-1122, Friatec, Mannheim, Germany) on the one hand and to a root-form premolar (Frasaco, Tettnang, Germany) on the other, whereby both parts of the bridge were connected with the help of a telescope crown attached to the premolar (see Fig. 1). The fixture was coated by a layer of a mixture of elastic acrylic resin (Plastex, Hager Dental, Duisburg, Germany) and PMMA to simulate physical properties of periimplant bone. The premolar was embedded in a layer of soft acrylic resin (Kerr fitt, Kerr, Karlsruhe, Germany) to simulate realistic tooth movement and physiological tooth mobility.

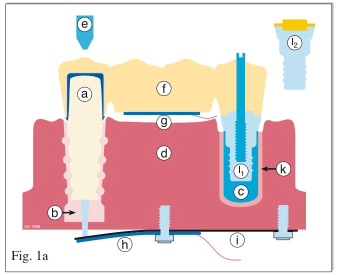

Fig. 1a

- (a) Frasaco® tooth with telescope crown (0°, 2°, 6°, 0° + lateral clearance)
- (b) Kerr Fitt® layer
- (c) IMZ® implant with exchangeable abutments (see I_1, I_2)
- (d) PMMA base
- (e) piston of the loading machine
- (f) metal framework (Degulor M®)
- (g) strain gauge 1 (control)
- (h) strain gauge 2 (measurement of force transmitted into the periodont)
- (i) metal spring (carrier of strain gauge)
- (k) semi-elastic-layer (PMMA+Plastex®)
- (l) abutment without IMC (I_1) abutment with IMC (I_2)

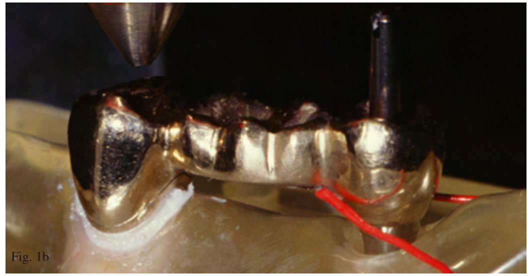

Fig. 1b

The telescope crown was interchanged for different types: (1) semi-rigid coping of 0 degrees (C0); (2) rigid tapered coping of 2 degrees (C2); (3) semi-rigid tapered coping of 6 degrees (C6); and (4) non-rigid coping with lateral clearance (CC). The fixture itself was employed with a rigid titanium connector (I_1) as well as with an intramobile IMC-connector (I_2).
To simulate a masticatory process, the denture was loaded 80 times each at time intervals of 1.2 sec using a force of 50 N. During and up to 60 min after loading, the intrusive stress of the premolar was recorded using apical strain gauges (6/120 ALY 61, Hottinger Baldwin Meßtechnik, Darmstadt, Germany). To obtain control data, the premolar was also loaded without denture. All trials were repeated 5 times, and data were evaluated statistically by non-parametric methods.

Results

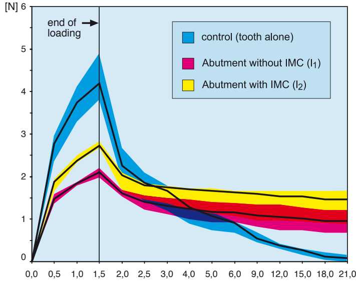

Fig. 2 Medium intrusive forces and quartils for the semi-rigid connection using a 0°-telescope crown (C0) compared to the control during a period of 20 min after loading

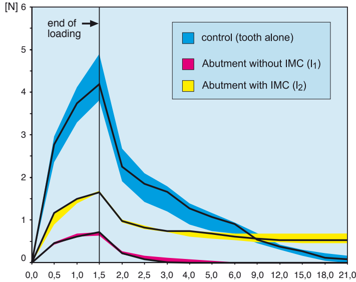

Fig. 3 Medium intrusive forces and quartils for the rigid connection using a 2°-telescope crown (C2) compared to the control during a period of 20 min after loading

Any type of telescope crown revealed typical load reactions of the tooth (see Fig. 2-5):

In case of the rigid implant abutment, the maximum intrusive force towards the tooth amounted to: 2.10 (1.98-2.21) N for C0; 0.72 (0.64-0.72) N for C2; 2.79 (2.59-3.00) N for C6; and 1.66 (1.60-1.72) N for CC.

For all copings, the intrusive forces showed different courses during the period of reposition of the tooth. After 20 min, the values still amounted to: 0.96 (0.69-1.22) N for C0; 0.00 (0.00-0.00) N for C2; 1.39 (0.94-1.84) N for C6; and 0.15 (0.12-0.18) N for CC.

By using the intramobile IMC-connector, the intrusive force towards the tooth was greater at any point of time, whereby no deformation of the bridge itself could be observed. Compared to the use of a rigid titanium abutment, the long-term intrusive force with IMC amounted to: 150% for C0; more than 500% for C2; 130% for C6; and 450% for CC.

In the case of rigid connection (C2), the tooth showed an immediate and total reposition after loading (Fig. 3).

For the semi-rigid connections (C0 and C6), a residual and orthodontically effective intrusive force of more than 0.3 N could be still observed 60 min after conclusion of the loading (Fig. 2 and 4).

By using the telescope crown with lateral clearance (CC), the reposition of the tooth was comparable to the control (Fig. 5).

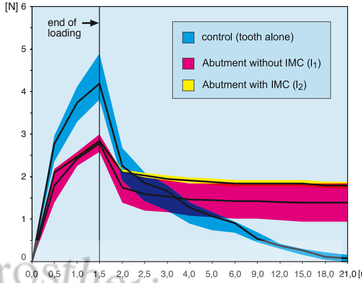

Fig. 4 Medium intrusive forces and quartils for the semi-rigid connection using a 6°-telescope crown (C6) compared to the control during a period of 20 min after loading

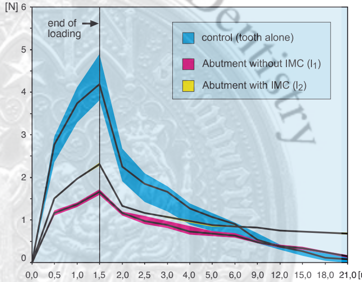

Fig. 5 Medium intrusive forces and quartils for the non-rigid connection using a 0°-telescope crown with lateral clearance (CC) compared to the control during a period of 20 min

Conclusion

In hybrid bridges, the risk of apical migration of the tooth is most pronounced in cases of semi-rigid connection between the natural and the implant abutment.

For any type of coping, an intramobile connection between fixture and abutment causes greater intrusion of the tooth.

Rigid connectors act like cemented or screw retained copings, and provide passive tooth reposition after loading by an elastic reaction of the implant and denture.

Copings with lateral clearance or non-rigid copings enable teeth to creep autonomously into the original position after intrusion.

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