Fracture of internal zirconia abutment connections

A 39-year-old female patient presented seeking an implant-supported restoration to replace her right maxillary central incisor, which had been extracted ten years earlier. Although the healed bone was adequate for implant placement, the horizontal soft tissue was deficient (Figure 1). The treatment plan called for the placement of an implant and a simultaneous tissue graft. A coded healing abutment of the type used for impression taking would be placed initially, followed by a zirconia abutment. The patient provided informed consent and treatment commenced.

A 4mm diameter x 3.4mm platform x 13mm long implant (T3 Tapered Implant, Biomet 3i, Palm Beach, USA) was placed into the healed extraction site (Figure 2). A minimal flap was reflected and a connective tissue graft – harvested from the palate – was placed on the facial aspect of the edentulous site (Figure 3).

An impression of the freshly installed implant was made and a definitive abutment was designed to install early during maturation of the soft tissues (Figure 4). The ideal outline of the abutment and the biocompatible material acted as a scaffold for the soft tissues to heal around. A provisional crown (Figure 5) was cemented to further guide soft tissue architecture before a definitive crown was fitted. Additional soft tissue corrections were performed to increase the soft tissue aesthetics. A final impression was made using an individualised impression coping that matched a duplicate of the zirconia abutment (Figure 6).

Figure 7 shows the final result with definitive crowns on the implant and neighbouring central incisor. Note the excellent soft tissue volume at the buccal side of the implant.

After five months the patient presented to the office complaining about pain in the cervical area of the implant restoration. There were no clinical or radiological signs of inflammation. At a second visit the crown was unscrewed and fractures of the zirconia abutment connection were observed (Figure 9). A temporary crown was provided and impressions were taken so a new zirconia abutment and crown could be constructed. The decision was made to fabricate an anatomically designed zirconia abutment with layered ceramics on the facial aspect. The crown was screw-retained on a titanium interface which was glued into the abutment during one of the final stages of preparation at the dental lab (Figures 10 and 11).

Literature

In implant dentistry, there is often a tendency to set ambitious aesthetic goals when restoring lost dentition, including attempting to correct previous aesthetic deficiencies. With this in mind, numerous techniques have been described to preserve or augment peri-implant tissues. In addition, the design and material characteristics of implant components have been adapted to fulfil the advanced aesthetic requirements of implant restorations.

Customised zirconia abutments can create a more aesthetic transition between the integrated implant and the restoration. In clinical settings, zirconia abutments have been demonstrated to have similar survival rates to titanium abutments, even for posterior restorations. However, the internal connection between a full zirconia abutment and the implant continues to be a mechanical challenge. This is particularly the case for abutments where a zirconia component engages with the internal connection of an implant, where fractures seem to be more likely. The material characteristics of zirconia might not be suitable for an internal tapered connection.

To prevent the zirconia from fracturing at the connection, the use of a titanium connection in bi-component aesthetic abutments has been suggested. An in-vitro study looked at the effect different types of implant-abutment connections had on the fracture load of zirconia abutments. It concluded that the type of connection significantly influences the strength of zirconia abutments. Superior strength was achieved by means of internal connection established via a secondary metallic component.

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