The Conometric Concept: a five-year follow-up of fixed partial monolithic zirconia restorations supported by cone in cone abutments.

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Background and Aim

The Conometric Concept involves the use of a cone within a cone Morse taper connection between the abutment and the prosthesis to retain an implant-supported fixed dental prosthesis¹⁻³. The reported advantages of this approach are the absence of cements or screws, simple maintenance, a favorable deep emergence profile and cost-effective components. The use of cone in cone abutments to support definitive hybrid acrylic-composite and partial temporary prostheses gave excellent prosthetic results in the short term and no fractures or chips of the resin and composite structure occurred in any case. Those results, achieved in 2010, prompted the authors to test the same cone in cone abutment approach to retain prostheses made of lithium disilicate and monolithic zirconia. The aim of this study was to evaluate the performance of definitive monolithic zirconia implant-supported fixed dental prostheses placed in the posterior region and supported by integrated implants and cone in cone connection abutments.

Methods and Materials

This prospective cohort study comprised of partially edentulous patients in the premolar and molar areas aged 18 or more. All patients received a fixed monolithic zirconia restoration attached using cone in cone abutment connection to two 3.5 or 4.5 mm diameter square threaded, grit-blasted and acid-etched integrated implants with a Morse-tapered connection (Ankylos, Dentsply Implants, Mannheim, Germany). The implants were placed in both healed sites and fresh extraction sockets. The preoperative analysis of the anatomy was performed using panoramic radiographs. A full-thickness flap was elevated and any compromised teeth extracted using an atraumatic approach in order to preserve socket wall architecture. All implants were placed 2.0mm subcrestal in healed sites and 2.0mm under the buccal bone peak level in post-extraction sites. The gap between the inner aspect of the extraction site bone wall and implant surface were always filled using a grafting material (Bio-Oss Collagen, Geistlich Biomaterials Italia, Thiene, Italy). After a healing period of three months the appropriate non-indexed prosthetic abutment (Standard A®/ Standard B®, Dentsply Implants, Mannheim, Germany) was connected and torqued at 15N/cm2 into the implant. The conometric caps were placed over the abutment analogues on the master cast and digitized (3D Scanner, Open Technologies, Brescia, Italy). The zirconia framework was digitally designed (Dental CAD, Exocad GmbH, Darmstadt, Germany) and milled (G5, Dental Machine, Bobbio, Italy) using an appropriate mass (Zirkonzahn Prettau, Zirkonzahn, Gais, Italy). The milled framework was then finished and colored and sintered (Zyrkomat, Vita Zahnfabrik, Bad Säckingen, Germany). The external surface of the caps was prepared with retention grooves using a 0.3mm separator (Dynex 0.3Ø22mm, Renfert GmbH, Hilzingen, Germany). The caps were then sand-blasted, placed over the distal abutment in the master cast and over the mesial abutment in the mouth of the patient. The inner surface of the zirconia structure was also prepared with retention grooves using an inverted cone diamond bur (5805.FG.016, Komet, Rock Hill, SC, USA). The zirconia structure was then cemented using Permaceem, (DMG Chemisch-Pharmazeutische Fabrik GmbH, Hamburg, Germany) to the coping placed in the master cast. This structure was then placed in the mouth of the patient and cemented intra-orally to the coping of the mesial abutment in order to ensure a passive and precise fit. The restoration was then removed from the oral cavity with a spring bridge remover and excess cement carefully removed. The FPD was polished and reinserted. Proper occlusal contacts were checked with 8µm aluminum foil (Hanel Shimstock. Coltène/Whaledent AG, Altstätten, Switzerland). The conical connection was activated using a calibrated striker (Abutment striker cod.156-1008-03, Leone, Firenze, Italy). The following data-set was recorded for each patient:

- Biological or technical complications or any other adverse event recorded for the FDPs and the opposing dentition. Complications were classified as either minor or severe
- Pocket probing depth measured at the mesial, buccal, distal and lingual/palatal sites using a periodontal pressure-calibrated (0.25 N) plastic probe (TPS probe; Vivadent, Schaan, Liechtenstein). Measurements were rounded to the nearest millimeter.
- Dimensional changes of the bone at the mesial and distal sites of the integrated implants performed using periapical radiographs and a customized positioning jig taken at each follow-up. The baseline for probing and radiographic measurements was set immediately after placement of the definitive restoration (T3), three months after implant placement.
- Categorization of the opposing dentition by type of restoration and supporting structure at the time of placement of the definitive zirconia partial restoration and at the five-year follow-up.

Esthetic, functional and biologic United States Public Health Services (USPHS) parameters modified by the FDI World Dental Federation study design were collected at the last appointment five-years after placement of the restoration.

Results

A total of 78 patients were included in the period between September 2010 and June 2011. The mean age of the patients at the time of surgery (T1) was 45.3 years (SD=12.9; n=78; min=25; max=71). None of the 156 implants placed failed to integrate. None of the treated patients reported prolonged sensorial disturbances. 76 patients (with 152 implants) were available for the definitive impression three months after surgery (T2). Each patient received a three-unit zirconia FDP.

4 patients (5.1%) dropped out of the study because they were unavailable or unwilling to attend the planned follow-up appointments. One of the 76 FDPs (0.8%) fractured 41 months after placement. The fracture point was located at the connection between an implant-supported element located in the first molar area and its mesial pontic. A total of 71 FDPs (93.4%) supported by 142 implants reached the five-year follow-up.

The treatment achieved a 88.2% success rate and a 97.4% survival rate at the five-year follow-up. The intra-observer reliability test using the Pearson correlation coefficient scored a value of 0.891 for the radiological measurements and 0.849 for the probing measurements. No cases of inflammation or infection of the mucosal cuff around the neck of the implants were recorded.

Conclusions

The results of this research indicate that abutment-prostheses using cone in cone connections were successful within the five-year period of this study. None of the zirconia FDPs assessed during this five-year study became detached.

References

1. Degidi M, Nardi D, Sighinolfi G, Piattelli A. Immediate rehabilitation of the edentulous mandible using Ankylos SynCone telescopic copings and intraoral welding: a pilot study. Int J Periodontics Restorative Dent. 2012 Dec;32:e189-94.
2. Degidi M, Nardi D, Piattelli A. The Conometric Concept: Coupling Connection for Immediately Loaded Titanium-Reinforced Provisional Fixed Partial Dentures: A Case Series. Int J Periodontics Restorative Dent 2016; 36:347-354.
3. Degidi M, Nardi D, Sighinolfi G, Piattelli A. The Conometric Concept: Definitive Fixed Lithium Disilicate Restorations Supported by Conical Abutments. J Prosthodont. 2016 Oct 10. doi: 10.1111/jopr.12548. [Epub ahead of print].