Jiao Tong University School of Medicine

Clinical Research Protocol

Project Name:	Evaluation of the one-piece zirconia abutments and two-piece zirconia abutments with titanium bases for single implant crowns in esthetic region: a randomized split-mouth clinical trial with 1-year follow-up
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PROTOCOL TITLE:

Evaluation of the one-piece zirconia abutments and two-piece zirconia abutments with titanium bases for single implant crowns in esthetic region: a randomized split-mouth clinical trial with 1-year follow-up

Abstract

Objective: To evaluate the clinical, radiological and immunological outcomes of the one-piece zirconia abutments (OPZAs) and two-piece zirconia abutments (TPZAs) with friction-fitted titanium bases in single implant crowns in aesthetic region.

Materials and methods: The study is a single center, split-mouth and randomized controlled clinical trial. Eligible patients will be randomly assigned into two groups: OPZAs group (OG) and TPZAs group (TG). Survival rates, mechanical complication rates, bleeding on probing (BOP%), probing depth (PD), modified plaque index (mPI), marginal bone loss (MBL), concentrations of pro-inflammatory cytokines (TNF-α, IL-6) in peri-implant crevicular fluid (PICF), and pink esthetics score/white esthetics score (PES/ WES) will be evaluated.

Discussion: Results of the present study will help to evaluate the clinical, radiological and immunological outcomes of OPZAs and TPZAs with friction-fitted titanium bases in single implant crowns in aesthetic region and provide evidence for the effects of two types abutments on the health of peri-implant soft and hard tissue.

Keywords: zirconia abutment, one-piece, two-piece, peri-implant crvicular fluid, inflamatory factors, peri-implant diseases

1. Background

Dental implants have become a well-established contemporary clinical treatment with predictable long-term success in the rehabilitation of partially edentulous patients.[1-5] And in the area of its fixed supra-structure, metal-free materials offer an alternative to titanium-based restorations while ensuring high levels of biocompatibility and esthetics. The range of available materials was significantly expanded with rapidly evolving CAD/CAM technology. And this also provided access to materials classes and their combinations not previously available within conventional manufacturing, such as zirconia ceramics and hybrid ceramics.[6,7]

With the increasing demand for esthetic restorations, attempts of using ceramic abutment had been made over the past 20 years because it can compensate for the unfavorable shade of titanium abutments.[8-10] What's more, a study demonstrated that compared to titanium healing caps, zirconia ones had less bacterial adhesion.[11] Ceramic abutments are available in 2 main designs: one-piece(monolithic) zirconia implant abutment(OPZA） and two-piece hybrid zirconia abutment(TPZA).

The OPZAs has low fracture resistance and caused wear of implant fixtures,[12-14] and TPZAs comprises a sleeve and a titanium insert. The zirconia sleeve, which can be prefabricated by using standardized procedures or customized by using computer-aided design and computer-aided manufacturing (CAD-CAM) methods, is resin bonded or friction fitted to a titanium insert.

The OPZAs were first introduced in 1993,[15,16] intending to replace metal abutments and achieve higher esthetics in the anterior region. Shortly after that, the first experimental monolithic abutments made of partially stabilized zirconia were reported.[17,18] Later, with the development of CAD/CAM technology, it has been possible to design individual abutment shapes. Subsequently,

the TPZAs were also widely used for avoiding direct contact between zirconia abutments and titanium implants.[12,19,20]

To date, reports on the clinical performance of ZAs remain controversial. Different abutment type seems to be associated with different risks, which can arise at any stage of therapy and greatly influence patient's satisfaction and quality of life. Although some clinical investigations affirmed excellent performance of ZAs with survival rate approaching 100%,[21,22] unexpected and early catastrophic fractures of OPZAs and TPZAs with friction-fitted titanium inserts both have been reported.[22,23] OPZAs were considered to be accompanied by higher risks of fracture, screw loosening and permanent damage due to stress concentrations, especially with internal implant connections. While TPZAs with friction-fitted titanium inserts seem to require higher machining accuracy and failure of the connection between the zirconia sleeve and titanium insert is a concern.[21,24-26]

Even though technological progress in the field of metal-free materials has given rise to considerable improvements of these two types of abutment over the decades, there is still lack of clinical evidence for the use of two types ZAs.

Recent studies also showed that pro-inflammatory cytokines in peri-implant crevicular fluid (PICF) were significantly related to peri-implant diseases and further marginal bone loss.[27,28] Tumor necrosis factor alpha (TNF-a) and interleukin-6 (IL-6) are pro-inflammatory cytokines that appear to have an important role in periodontal tissue destruction.[29,30] It's necessary to quantitatively determine the concentrations of cytokines in PICF of OPZAs and TPZAs with friction-fitted titanium inserts as potential biomarkers for peri-implant disease diagnosis.

Thus, the investigators designed this randomized split-mouth clinical trial to evaluate the

clinical, radiological and immunological outcomes of OPZAs and TPZAs with friction-fitted titanium inserts in single implant crowns in aesthetic region. The primary outcome is prespecified as mechanical complication rates at 1-year follow-up.

2. OBJECTIVES AND HYPOTHESIS

The purpose of the present study is to to evaluate the clinical, radiological and immunological outcomes of the OPZAs and TPZAs with friction-fitted titanium bases in single implant crowns in aesthetic region. Survival rates, mechanical complication rates, bleeding on probing (BOP%), probing depth (PD), modified plaque index (mPI), marginal bone loss (MBL), concentrations of pro-inflammatory cytokines (TNF-α, IL-6) in peri-implant crevicular fluid (PICF), and pink esthetics score/white esthetics score (PES/ WES) will be included in the comparison indicators. The null hypothesis is that there is no significant difference regarding mechanical complication rates between two groups.

2. METHOD/DESIGN

Overview

The present study is designed as a prospective, single-center, split-mouth, randomized controlled clinical trial. The investigators plan to recruit several adult patients who have two missing teeth in the maxillary anterior region and plan to be restored with two single implant crowns. The clinical component of the study will be initiated in Feb. 2019 at the Department of Oral and Maxillo-facial Implantology, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University, China.

All patients received oral hygiene instruction and periodontal treatment before implant surgery.

The investigators will record the age, gender, physical health of all participants and they will meet the following inclusion criteria. Peri-apical radiographs with paralleling technique will be performed on the day of final restorations delivery. Clinical radiological and immunological re-evaluations will be performed at 1 year after the final crowns delivery.

Inclusion criteria

1) age≥18; 2) patients with two missing teeth in esthetic region and plan to be restored with two single implant crowns; 3) adjacent to natural teeth; 4) absence of oral mucosal disease and oral infection; 5) implants with conical connection (Nobel Active, Nobel Biocare® or NobelReplace Conical Connection, Nobel Biocare®); 6) patients with the willingness to participate in the present study.

Exclusion criteria

1)Heavy smokers (>10 cigarettes/day); 2) uncontrolled periodontitis (Full mouth plaque score>20%, full mouth bleeding score>25%, residual pocket depth>5mm); 3) with systematic diseases that may affect implant therapy, such as uncontrolled diabetes mellitus (Fasting blood-glucose>7.2mmol/L, Glycosylated hemoglobin >7%), current intake of bisphosphonates (treatment for malignancy), pregnant(or plan to get pregnant), with history of radiation therapy in head and neck region.

Recruitment

Patients who have two missing teeth in the maxillary anterior region and plan to be restored

with two single implant crowns will be recruited at the Department of Oral and Maxillo-facial Implantology, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University, China. Eligible patients will receive the study information and informed consent, and any patients who do not sign the consent will not be included in the study.

Allocation and blinding

Eligible patients have two missing teeth, and they will be randomly assigned into two groups: OPZAs group (OG): restored with the OPZAs; TPZAs group (TG): restored with the TPZAs with friction-fitted titanium bases. The study is an open-label trial without blinding.

Outcomes

All the included patients will be recalled for clinical, radiological and immunological re-evaluations 1-year after the final crowns delivery. Survival rates, mechanical complication rates, bleeding on probing (BOP%), probing depth (PD), modified plaque index (mPI), marginal bone loss (MBL), concentrations of pro-inflammatory cytokines (TNF-α, IL-6) in peri-implant crevicular fluid (PICF), and pink esthetics score/white esthetics score (PES/ WES) will be recorded.

Survival rates.[25] The survival rate was defined as the percentage of success implants and remained crowns which never been replaced.

Mechanical complications rates. Veneer chipping, abutments or implants fracture, screw loosening or fracture and other mechanical complications will be recorded during the 1-year

follow-up.

Peri-implant conditions. The indicators of peri-implant conditions included bleeding on probing% (BOP%), pocket probing depth (PD) and modified plaque index (mPI).

Marginal bone loss (MBL).[26] Peri-apical radiographs with paralleling technique will be performed on the day of final restorations delivery and 1 year later. The implant length is used as calibration reference. The distance between restoration margin and the most coronal level of implant-bone contact will be recorded. The final result calculate as the mean value of mesial and distal sites. The alteration of the distance between baseline and 1-year follow-up is defined as the MBL.

Pro-inflammatory cytokines in peri-implant crevicular fluid (PICF). The investigators will collect the patients' PICF with the paper strip (PerioPaper Strips; Oraflow Inc., Smithtown, NY, USA) at 1-year follow-up to access differences in pro-inflammatory cytokines (IL-6 and TNF-α) between two groups. Enzyme-linked immunosorbent assay (ELISA) will be used to analyzed PICF and evaluated the concentrations of cytokines. The PICF collection method and cytokines determination referred to Christopher A. Barwacz et al (Figure 2).[18]

PES/WES.[27,28] In this study, pink aesthetic score (PES) and white esthetic score (WES) will be applied for the objective esthetic assessment of the final restoration. The investigators will take patients' intraoral photos by the camera (D70, Nikon, Tokyo, Japan) at 1 year follow up. The aesthetic effect will be assessed by two specific dentists independently. They will asked to give scores for variables of PES (Mesial papilla, distal papilla, level of soft-tissue margin, soft-tissue contour, alveolar process and soft-tissue color and texture) and WES (Tooth form, tooth volume/outline, color, surface texture and transparency) with the 0-1-2 scoring system. Final

PES/WES is the sum of the two.

The primary outcome variable is presupposed to be the success rates. And the null hypothesis is that there is no significant difference regarding mechanical complication rates between two groups.

Statistical analysis

All statistical analyses will be performed using SAS software, version 9.4 (SAS Institute). Normal tests will be performed to know the normality of continuous data before appropriate ways of statistical description and analysis were chosen. Means, standard deviations (SD) and student's t test will be used for data in accordance with normal distribution. Medians, inter quartile range (IQR) and Wilcoxon Rank Sum test will be used for non-normally distributed data. Qualitative data will be described and analyzed by percentage and Chi-square Test. A two-sided *P* value of less than 0.05 will be considered to indicate statistical significance.

Missing data

Sample size calculation was performed accounting for possible loss to follow-up. Moreover, the investigators will account for the data not missing at random due to unbalanced loss to follow-up by handling drop-outs as nonsuccess using the intention-to-treat principle.

Ethical considerations

Ethical approval

All eligible patients will receive study information and informed consent, and any patients who do not sign the consent will not be included in the study.

Withdraw

All patients in this study will be informed that they have the right to withdraw at any time during the study, regardless of whether they withdraw or not, the treatment required by the patients will be accepted.

4. Discussion

There are two main types of zirconia abutments: one-piece monolithic abutments and two-piece hybrid abutments. Choosing the most suitable abutment under different circumstances is one of the important clinical decisions in implant treatment. However, reports on the clinical performance of these two types of abutments remain controversial. To our knowledge, no clinical trials are available now comparing the efficacy of one-piece monolithic abutments and two-piece hybrid abutments used in single implant crowns in esthetic region.

As mentioned above, restorations restored with OPZAs were considered to be accompanied by higher risks of fracture, screw loosening and permanent damage due to stress concentrations, especially with internal implant connections. And restorations restored with TPZAs with friction-fitted titanium inserts seem to require higher machining accuracy and failure of the connection between the zirconia sleeve and titanium insert is a concern.[21,24-26]

Angulated screw channel system is a novel choice that provide the option of TPZA with a friction-fitted titanium insert. And CAD/CAM zirconia abutment is a general choice of OPZA.

The investigators designed the present study to help evaluate the efficacy of restorations with OPZAs and TPZAs in esthetic region and give clinicians some advice.

5. References

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