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Replacement of missing teeth with tooth-implant supported fixed dental prostheses

Summary: The aim of the S3 guideline was to assess the survival and success rates of tooth-implant supported fixed dental prostheses (T-I FDPs). A literature search was conducted in MEDLINE/PubMed, Cochrane Library, and Embase in order to identify qualified studies (randomized controlled trials [RCTs] or prospective studies, observation period > 3 years, > 10 participants). In the qualitative and quantitative analyses, 8 and 7 studies were included, respectively. The survival rates for the T-I FDPs were 90.8 % (95%-CI: 86.4–93.8 %) after 5 years and 82.5 % (95%-CI: 74.7–88.0 %) after 10 years. The implant survival rates were 94.8 % (90.9–97.0 %) and 89.8 % (82.7–99.4 %) after 5 and 10 years, respectively. From 185 T-I FDPs, 21 (11.4 %) minor and 23 (12.4 %) major biological complications as well as 23 (12.4 %) minor and 3 (1.6 %) major technical complications were reported. Based on current data, rigidly fixed 3- and 4-unit T-I FDPs show acceptable survival rates after 5 and 10 years.

Keywords: fixed dental prosthesis; implant prosthetics; tooth-implant supported; S3 guideline

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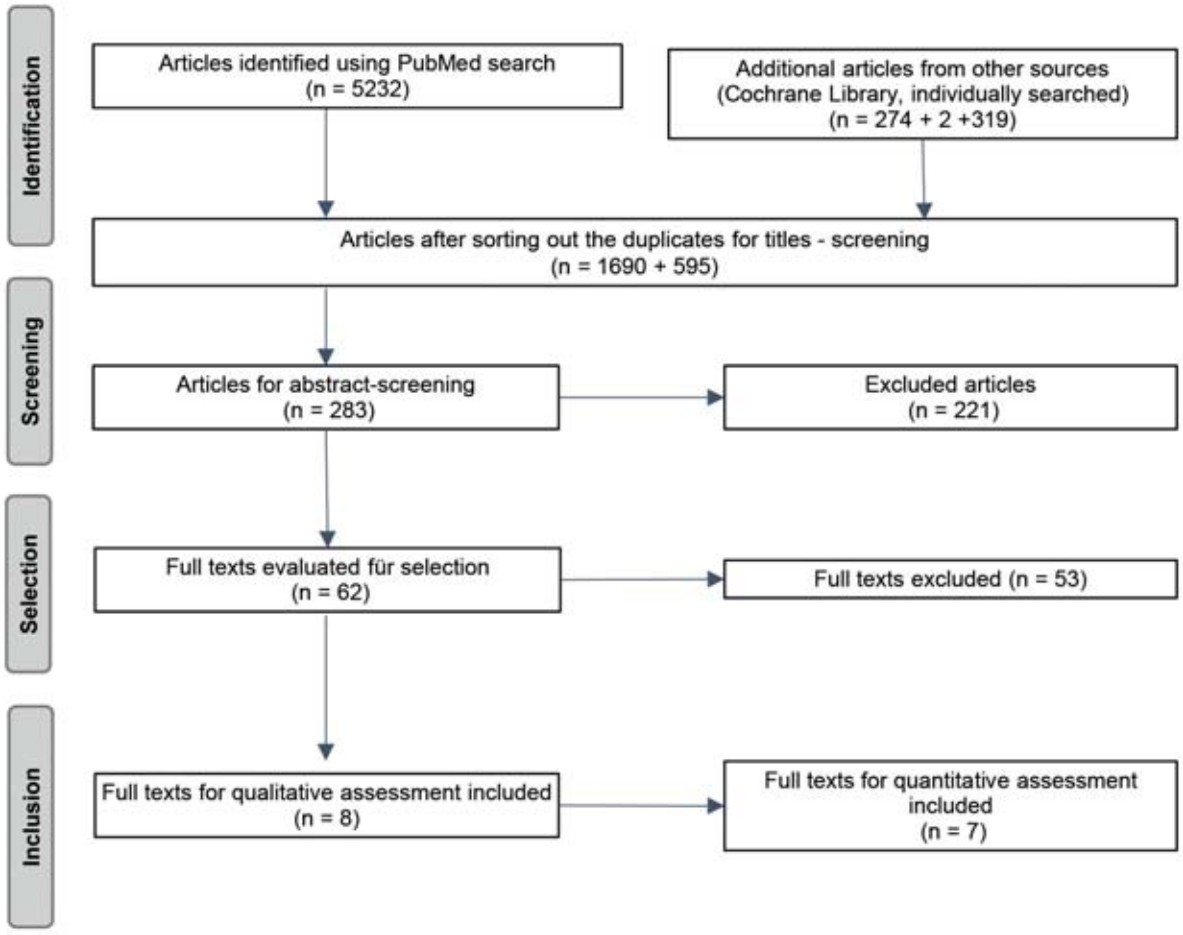

Figure 1 Overview of the screened and included articles in the systematic review.

Introduction

Tooth-implant supported fixed dental prostheses (T-I FDPs) represent a therapy option for the rehabilitation of the partially edentulous dental arch after partial tooth loss. This treatment approach aims to rehabilitate the functions of the stomatognathic by using a fixed restoration concept together with the simultaneous preservation of occlusal support zones when rehabilitating both partially edentulous jaws. T-I FDPs offer the possibility of treating patients using fixed restorations with less surgical effort, especially when there are general anamnestic and/or local constraints, financial motives, or the patient wishes to keep surgical interventions to a minimum.

Systematic review and meta-analysis

At the beginning of the search, the key question was formulated using the PICO scheme to define inclusion and exclusion criteria and search terms: "How is the replacement of missing teeth with T-I FDPs to be assessed in terms of their survival probability and complication rates?"

The databases PubMed, Cochrane Library and the databases of the German Institute for Medical Documentation and Information (DIMIDI) were used for the search. The following inclusion criteria were defined for the selection of literature in relation to the key question:

- randomized controlled trial
- prospective clinical trial
- Meta-analyses based on randomized controlled, prospective studies
- fixed FDP restorations
- observation period of at least 3 years and longer
- clinical follow-up examinations
- languages German and English
- data on the number of patients, FDPs, teeth, implants, and implant system used.

The following criteria were explicitly excluded:

- retrospective studies
- case reports
- in vitro studies
- observation period less than 3 years
- studies including less than 10 patients
- studies with removable implant-supported dental prostheses.

The results of the search are shown schematically in Figure 1. The assessment of the results was carried out using the checklists from "SIGN 50-A A guideline developer's handbook" using the levels of evidence 1++ to 3 [1].

Therapeutic requirements and indications

Generally, the same indications and contraindications apply for implant-prosthetic rehabilitation with FDPs as for dental implants. Likewise, the natural abutment teeth for T-I FDPs

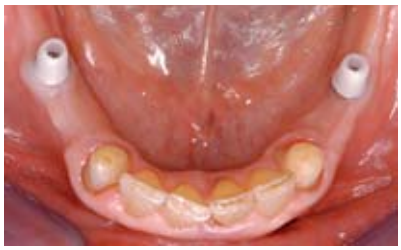

Figure 2 Clinical photo of 2 zirconia abutments on implants in area 35 and 45.

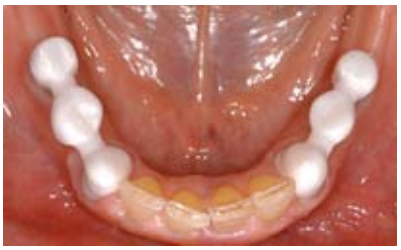

Figure 3 Clinical photo of 2 T-I FDP zirconia frameworks during try-in.

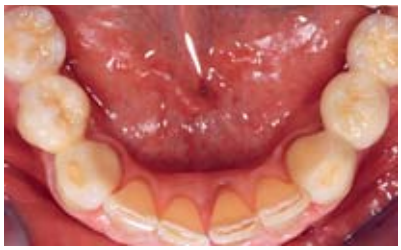

Figure 4 Clinical photo after cementation of 2 T-I FDPs.

(Fig. 1–4: F. Beuer)

must fulfill the same requirements as abutment teeth for fixed, purely tooth-supported restorations. Natural teeth which necessitate crowns can also be used as abutments for T-I FDPs. Rehabilitation with T-I FDPs should be considered as a treatment option when additional implants are to be avoided, bone augmentation is not possible or desired, a removable denture is not an option and the condition of the partially edentulous dental arch is favorable. Endodontically treated teeth can also be used for T-I FDPs provided that the root fillings are satisfactory, a definite 2 mm high dentin margin is present, and the periapical conditions are inflammation-free.

T-I FDP restorations

T-I FDPs should always be designed without cantilever, whereby the dental implant can represent either the mesial or distal abutment. The data is best for three-unit T-I FDPs, thus offering the most predictable prognosis. For more than 4-unit T-I FDPs, the available data is insufficient. In literature, studies on T-I FDPs in the posterior region are preponderant, but this type of therapy can also be applied for the anterior region given that the treatment recommendations are followed.

The rigid connection between the tooth and implant plays a decisive role for the success of the T-I FDP [2, 3, 5–7]. According to one study, if the T-I FDPs were not rigidly constructed, they would have shown significantly more complications [9]. The rigid connection can be either a continuous, definitely cemented bridge framework or a screw-retained attachment [7]. The semi-permanent cementation of rigid frameworks on permanently cemented primary copings on natural abutment teeth has been reported in spite of the fact that intrusions of the abutment teeth have occurred in some cases [9]. Thus, the current recommendation is to permanently cement 1-piece T-I FDP restorations on both abutments [2, 5]. If a separate T-I FDP restoration with a screw-retained attachment is chosen, it should be permanently cemented in the area of the tooth, while it should be screw-retained or provisionally cemented in the area of the implant. Presently, sufficient data is only available for T-I FDPs with metal frameworks. One study reports promising results for ceramic veneered zirconia frameworks after a 3-year observation period [2]. No data is available for modern monolithic zirconia systems. Therefore, metal frameworks are recommended for T-I FDP restorations.

Survival rates and complications

For the rehabilitation of shortened dental arches in posterior regions, T-I FDPs made of veneered zirconia frameworks show a survival probability of 93.9 % after 3 years (Figures 2–4). Various studies have reported survival rates of T-I FDPs with metal frameworks ranging between 91.6 % and 97.6 % [7, 9, 11] after 5 years and 81.7 % [8] and 87.8 % [10] after 10 years. Retrospective studies, which were explicitly excluded from the data analysis based on the guideline used, reported survival rates of up to 100 % after 6 years [13].

The meta-analysis showed survival rates of T-I FDPs of 90.8 % after 5 years and 82.5 % after 10 years [4].

One of the major biological complications associated with the abutment teeth were fractures of endodontically treated teeth. In comparison, implant loss (4.5 % after 10 years) [3, 9] or marginal bone loss of more than 2 mm occurred relatively rare [9].

Among the reported technical complications were loss of retention on the natural abutment teeth, which in some cases led to secondary caries. Occasionally, the loosening and loss of screws occurred for screw-retained attachments which were used to create rigid connections. Abutment fractures of the implants occurred more frequently when the abutment teeth and implants were not rigidly connected [7].

The comparatively low percentage of technical complications of T-I FDPs relative to purely implant-supported bridges could potentially be explained by the preserved tactile sensitivity [12]. However, to date, this apparent advantage has not been sufficiently proven in the clinical setting.

Future prospects

In conclusion, clinical data with respect to T-I FDPs is rather limited. There is a great need for research on all-ceramic T-I FDPs, as well as the analysis of complications with regard to existing tactile sensitivity. Lastly, future studies should also consider patient-related outcomes, especially in comparison to alternative treatment options.

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(Photo: F. Beuer)

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