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Efficacy of tooth-supported fixed prostheses among periodontitis and non-periodontitis patients: A systematic review and meta-analysis

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***Abstract*---**Background and aim: The purpose of this study is to investigate the efficacy of tooth-supported fixed prostheses among periodontitis and non-periodontitis patients. Method: Databases of PubMed, Scopus, Web of Science, EBSCO, ISI Web of knowledge and Embase were searched for systematic literature between 2011 to 30 November 2022. Data analysis was performed using STATA/MP V17 software. 95% confidence interval for effect size with fixed effect model and Inverse-variance method were calculated. Result: In the initial review, duplicate studies were eliminated and abstracts of 203 studies were reviewed, the full text of 54 studies was reviewed by two authors, finally, 7 studies were selected. Failure rate of tooth-supported fixed prostheses was 8% (ES, 8% 95% CI -0.80, 0.96), biological complications were 4% (ES, 4% 95% CI -0.93 1.02) and technical complications were 22% (ES, 22% 95% CI -0.76 1.20). Conclusion: Based on the current meta-analysis, the failure rate of tooth-supported fixed prostheses was low, and this therapeutic approach

can be used to restore chewing function in patients with advanced periodontitis.

***Keywords*---**Tooth-Supported Fixed Prostheses, Periodontitis, complications.

Introduction

Periodontitis is a severe gum infection that can lead to tooth loss and other serious health complications and is a serious gum infection that damages the soft tissue and, without treatment, can destroy the bone that supports teeth(1). Also, this disease is known as a multifactorial chronic inflammatory disease(2). Stage IV periodontitis is an advanced case of the disease that causes extensive bone loss and eventually leads to the loss of several teeth, which can affect the chewing process(3). Therefore, the treatment of stage IV periodontitis is very important, a comprehensive multidisciplinary approach is used for treatment (orthodontics, removable prostheses, fixed prostheses, dental implants and tooth support)(4). During the past years, the use of dental implants has been very popular because it has been considered a suitable method for replacing teeth(5). Studies show that the use of dental implants can have mechanical and biological complications that should be taken into account. On the other hand, patients with a history of periodontitis are at a higher risk of developing peri-implantitis, which doubles the importance of investigating complications(6, 7). In patients with stage IV periodontitis, biological complications may occur around the implant, which cause treatment failure(8, 9). Therefore, in the present study, an attempt has been made to investigate the mechanical and biological complications of dental implants in patients with stage IV periodontitis and to evaluate the survival rate of the used teeth. The purpose of this study is to investigate the efficacy of tooth-supported fixed prostheses among periodontitis and non-periodontitis patients.

Method

Search strategy

Present study is a systematic review and meta-analysis based on PRISMA 2020 Checklist(10), All international databases, PubMed, Scopus, Science Direct, ISI, Web of Knowledge, and Embase using keywords related to the objectives of the study between 2011 to 30 November 2022 were reviewed. Google Scholar search engine was also used to find related articles. PICO strategy to answer the research questions showed in Table1.

MeSH key words:
((((((("Prostheses and Implants"[Mesh]) OR (“Prostheses and Implants/statistics and numerical data"[Mesh] OR "Prostheses and Implants/therapy"[Mesh])) OR "Dental Implants"[Mesh]) AND ("Periodontitis"[Mesh] OR "Chronic Periodontitis"[Mesh])) AND ("Mouth, Edentulous"[Mesh] OR "Jaw, Edentulous, Partially"[Mesh] OR "Jaw, Edentulous"[Mesh])) AND "Survival Rate"[Mesh]) AND "complications" [Subheading].

Table1. PICO strategy

PICO strategy	Description
P	Population: partially edentulous patient with periodontitis
I	intervention: tooth-supported fixed prostheses
C	Comparison: patients without periodontitis
O	Outcome: clinical outcome and biological and technical complications

Selection criteria

Inclusion criteria: Clinical controlled trials studies, randomized controlled trials studies, cohort studies, Case series studies, adult age group, articles published in Englis and studies that assessed the tooth-supported fixed prostheses.
Exclusion criteria: Case studies, case reports, reviews, letter to editor and studies without full text.

Data items, Data collection and Selection process

Using a checklist that included the author's name, year of publication, sample size, study design, sex, mean of age, number and type of prostheses, Number of abutments and follow-up period was extracted and reported in Table 2; Also, the data required for meta-analysis including clinical outcome, biological and technical complications were extracted from the studies. All articles were selected based on the inclusion criteria, two reviewers independently screened each record, and each report was retrieved.

Quality assessment

Newcastle-Ottawa Scale (NOS) (11) used to assessed quality of the cohort and cross-sectional studies, case-control and case series studies, This scale measures three dimensions (selection, comparability of cohorts and outcome) with a total of 9 items. In the analysis, any studies with NOS scores of 1-3, 4-6 and 7-9 were defined as low, medium and high quality, respectively.
the quality of randomized control clinical trial studies was evaluated using the Cochrane Collaboration's tool(12). The scores of this tool are between 0 and 6, and higher score showed higher quality of study; the scoring of each item is 1 for low risk and 0 for high and unclear risk.

Data analysis

Data analysis was performed using STATA/MP. V17 software. 95% confidence interval for effect size with fixed effect model and Inverse-variance method were calculated. To deal with potential heterogeneity, random effects were used and I^2 showed heterogeneity. I^2 values less than 50% indicate low heterogeneity and above 50% indicate moderate to high heterogeneity.

Result

Study selection

In the initial search, 228 articles related to the keywords were found. Of these, 10 studies were Duplicate records, 8 articles were removed due to Records marked as ineligible by automation tools, and 7 articles were records removed for other reasons. In the next step, abstracts of 203varticles were reviewed and finally 149 articles were excluded from the research according to the exclusion criteria. The full text of 54 articles was reviewed and according to the inclusion criteria, 47 studies were excluded and finally seven studies were selected (Fig 1).

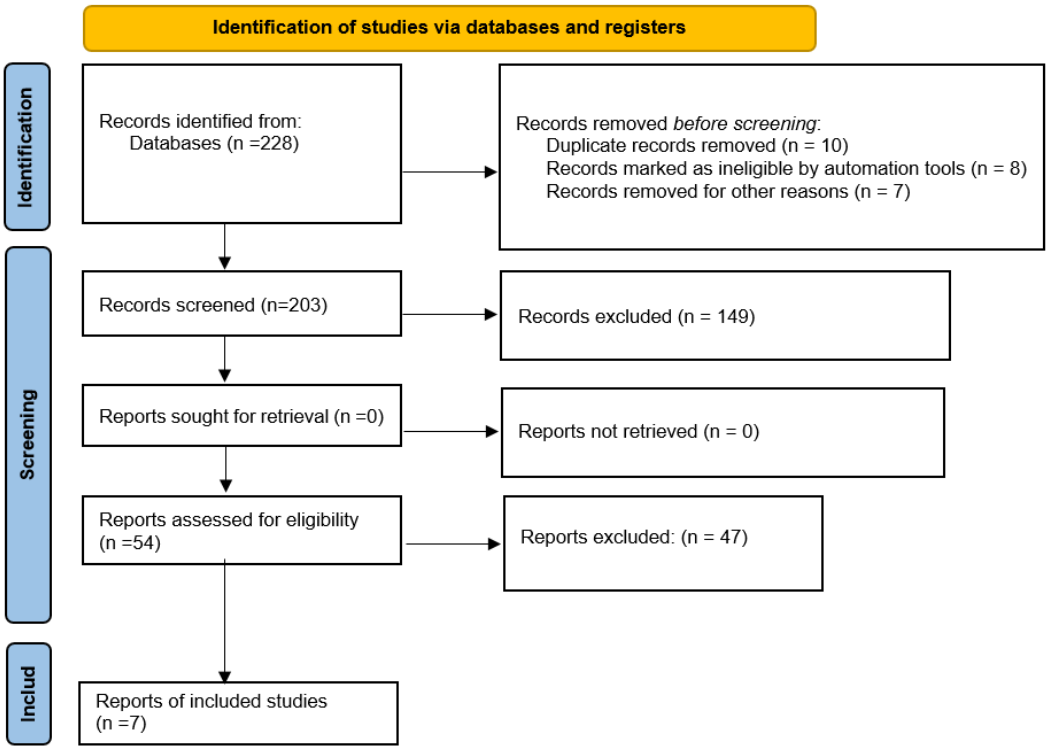

Figure 1. PRISMA 2020 Checklist

Study characteristics

Seven case series studies were selected and included in the study. A total of 387 patients between the ages of 31 years and 62 years were examined. Table 2 shows a summary of Data extracted.

Table 2. Data extracted from studies selected for systematic review and meta-analysis

Study. Years	Study design	Number of patients	sex		Mean of age	prostheses		Number of abutments	Follow-up (months)
			male	Female		Number	type		
Bäumer et al., 2020 (13)	CS	42	16	26	35	NA	Fixed partial dentures, including crossarch prostheses	173	290
Guarnieri and Ippoliti., 2019 (14)	CS	17	9	8	50	27	Cross-arch fixed partial dentures, combining teeth with advanced attachment loss and implants	128	180
Li et al., 2016 (15)	CS	39	23	16	45	39	Fixed partial dentures	NA	48
Graetz et al., 2013 (16)	CS	38	NA	NA	NA	81	Fixed partial dentures, including cross arch prostheses	198	166.2
Heschl et al., 2013 (17)	CS	28	9	19	50	27	Cross-arch fixed partial dentures, with or without cantilevers	231	75.7
Brägger et al., 2011 (18)	CS	139	55	84	62	139	Fixed partial dentures, including cross arch prostheses	323	135.72
Bäumer et al., 2011 (19)	CS	84	16	68	31	NA	Fixed partial dentures, including cross arch prostheses	54	126

CS: Case series; NA: not available

Risk assessment

According NOS tool, four studies had a total score of 6/9 (moderate quality), three studies had a total score of 5/9 (low quality). This result showed moderate to high risk of bias in included studies (Table 3).

Table3. Risk of bias assessment (NOS tool)

Study. Years	Selection (5 score)				Comparability (2 score)	Outcome (2 score)		Total score
	representative sample	Sample size	Non respondents	Ascertainment of the exposure	Based on design and analysis	Assessment of outcome	Statistical test	
Bäumer et al., 2020 (13)	1	1	1	0	1	1	1	6
Guarnieri and Ippoliti., 2019 (14)	1	1	1	0	1	0	1	5
Li et al., 2016 (15)	1	1	1	0	1	0	1	5
Graetz et al., 2013 (16)	1	1	0	0	1	1	1	5
Heschl et al., 2013 (17)	1	1	1	1	1	1	0	6
Brägger et al., 2011 (18)	1	1	1	0	1	1	1	6
Bäumer et al., 2011 (19)	1	1	1	1	1	0	1	6

Tooth loss

Overall tooth loss of 12% (ES, 12% 95% CI -0.68, 0.93) with low heterogeneity (I^2=0%; P =1.00) (Fig.2).

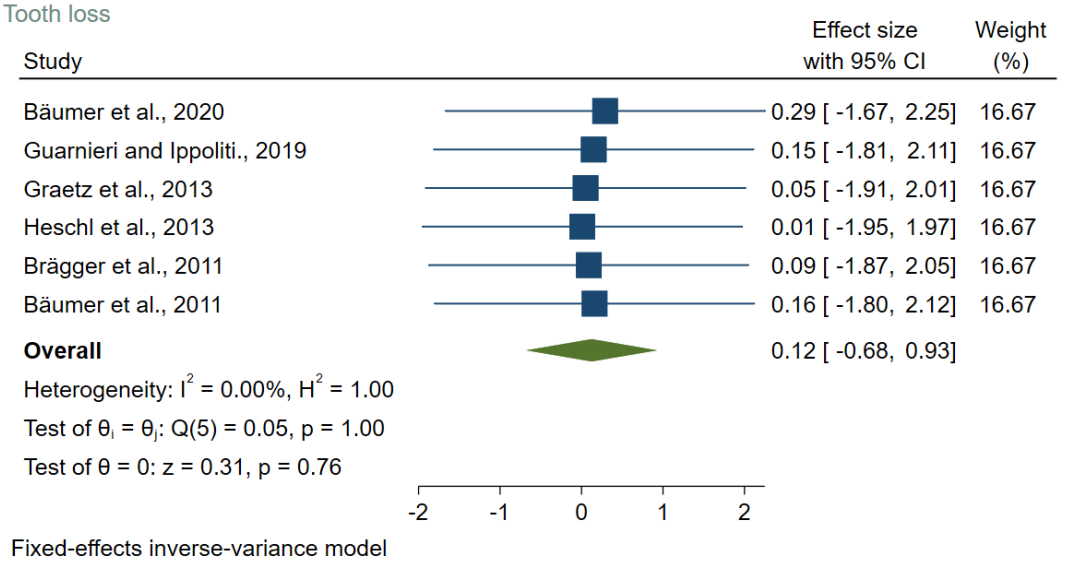

Figure 2. Forest plot showed overall tooth loss

Failure rate of tooth-supported fixed prostheses

Failure rate of tooth-supported fixed prostheses was 8% (ES, 8% 95% CI -0.80, 0.96) with low heterogeneity (I^2=0%; P =1.00) (Fig.3).

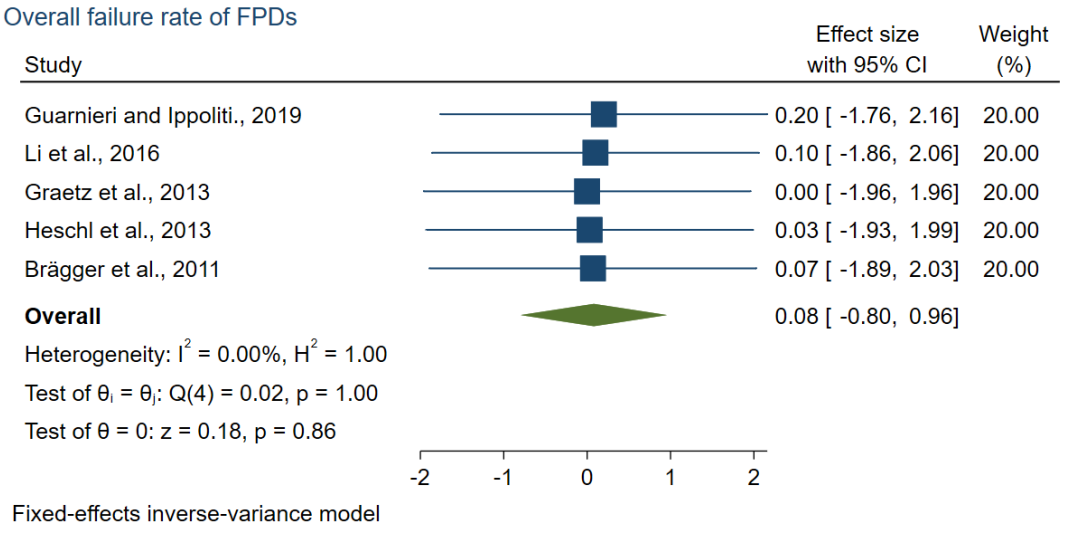

Figure 3. Forest plot showed failure rate of tooth-supported fixed prostheses

Failure rate of Prosthesis

Failure rate of prosthesis was 27% (ES, 27% 95% CI -0.61 1.15) with low heterogeneity (I^2=0%; P =0.95) (Fig.4).

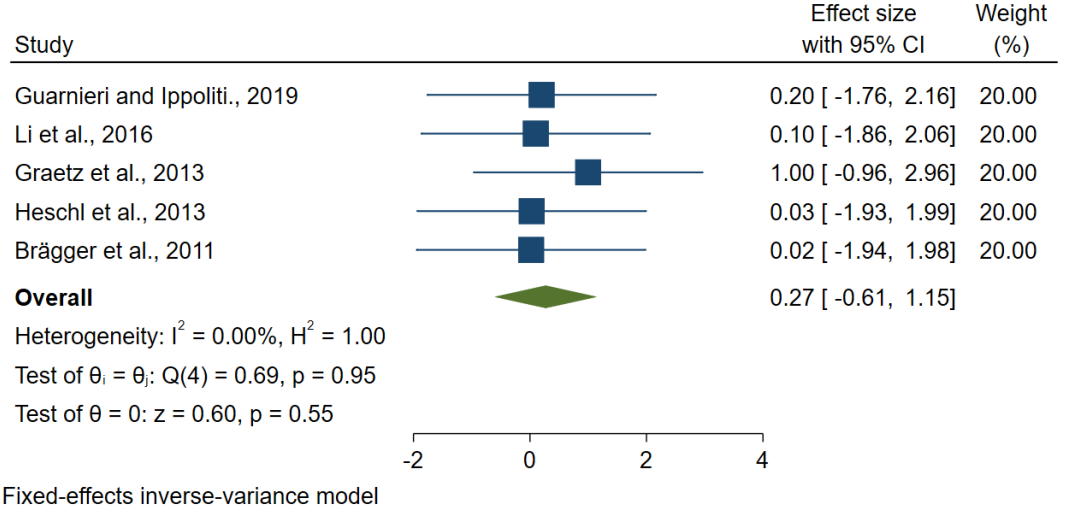

Figure 4. Forest plot showed Failure rate of prosthesis

Failure rate of abutments

Failure rate of abutments was 25% (ES, 25% 95% CI -0.55 1.05) with low heterogeneity (I^2=0%; P =0.99) (Fig.5).

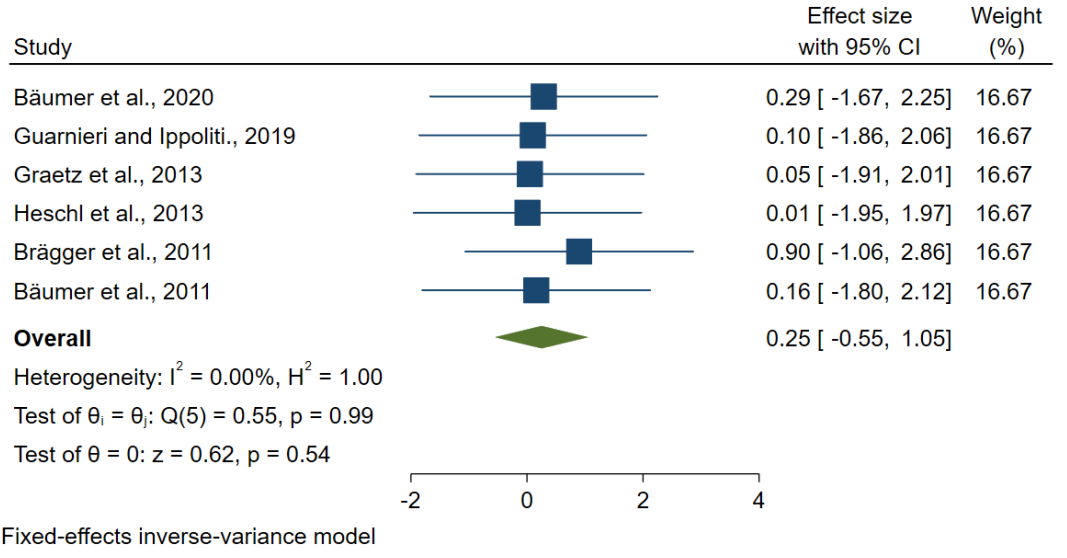

Figure 5. Forest plot showed Failure rate of abutments

Biological complications

Biological complications were 4% (ES, 4% 95% CI -0.93 1.02) with low heterogeneity (I^2=0%; P =1.00) (Fig.6).

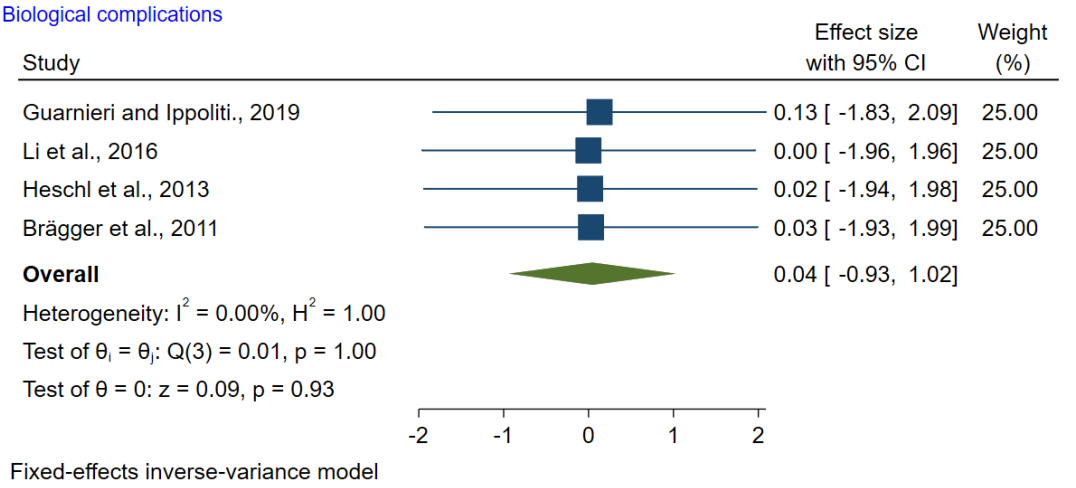

Figure 6. Forest plot showed biological complications

Technical complications

Technical complications were 22% (ES, 22% 95% CI -0.76 1.20) with low heterogeneity (I^2=0%; P =1.00) (Fig.7).

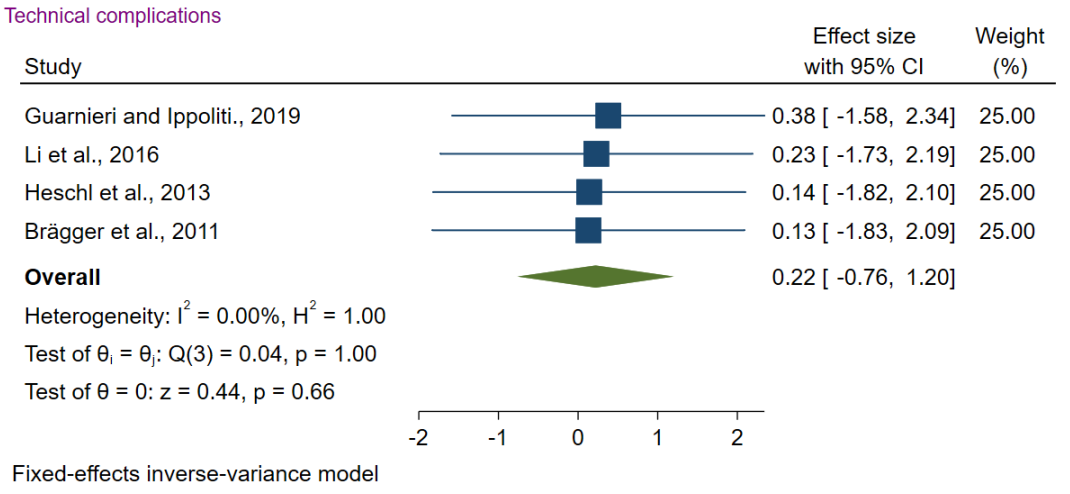

Figure 7. Forest plot showed technical complications

Discussion

In the present study, a low heterogeneity between the studies was observed, which can be used from the findings of the present study, however, it should be noted that the cognitive methodology of the studies was the same and different prostheses were used in the treatment, or the progress of periodontitis was not considered. On the other hand, the variety of interventions can also affect the results. The present meta-analysis showed that tooth loss during the follow-up period of 48 to 290 months was 12%. The failure rate of prostheses was 8% and 27%, respectively, and the failure rate of tooth-supported fixed prostheses was significantly low, which is consistent with the findings of previous studies(20). The use of periodontal disease teeth as abutments can be considered as an important predictor of tooth loss, although tooth-supporting FPDs are a suitable treatment alternative in stage IV periodontitis patients. Meta-analysis showed that the failure rate of abutments during the mentioned follow-up period was 25%. Studies have shown that periodontal disease teeth increase the risk of disease progression and can lead to tooth loss. To confirm the present evidence, more studies on tooth loss in patients with aggressive periodontitis are needed. It is important to note that the type of restoration provided cannot affect the survival of the teeth. Studies have shown that the survival rate for adhesive restorations to replace mandibular anterior teeth is low. Few studies have examined all the complications affecting primary teeth in detail, to confirm the findings, more studies need to be conducted and to investigate biological complications and technical complications. According to the present meta-analysis, the incidence rate of technical complications (22%) was higher than the incidence of biological complications (4%). Today, most partially edentulous patients with or without periodontitis are treated with dental implants to replace missing teeth. Therefore, it is worthwhile to compare the survival rate of abutment teeth or implants that support tooth-supported fixed prostheses. In the present study, the selected studies were case series, and RCT studies need to be done. The present study had limitations, firstly, RCT studies were not found in the search period and the sample size of the studies was small; More studies with

a larger sample size are needed. Another limitation of the classification of periodontal status in the studies was that the definition of stage IV periodontitis was different, however, all the selected studies were conducted in patients with a history of "severe" periodontitis, it is better to conduct future studies with a more precise definition of periodontal status. On the other hand, the follow-up period was different from the limitations of the present study, which can affect the results of the reported complications, and finally, the data of tooth loss and biological complications or prosthesis failure and technical complications were analyzed and analyzed at the patient level. It was not possible due to the lack of information provided. According to the mentioned limitations, more RCT studies with a higher sample size and a long follow-up period are needed to provide stronger evidence and report complete data in the studies.

Conclusion

Based on the current meta-analysis, the failure rate of tooth-supported fixed prostheses was low, and this therapeutic approach can be used to restore chewing function in patients with advanced periodontitis. However, clinical trial studies are needed to confirm these findings.

References

1. Slots J. Periodontitis: facts, fallacies and the future. Periodontology 2000. 2017;75(1):7-23.
2. Flemmig TF. Periodontitis. Annals of periodontology. 1999;4(1):32-7.
3. Gasner NS, Schure RS. Periodontal disease. StatPearls [Internet]: StatPearls Publishing; 2022.
4. Herrera D, Sanz M, Kebschull M, Jepsen S, Sculean A, Berglundh T, et al. Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline. Journal of clinical periodontology. 2022;49:4-71.
5. Bohner L, Hanisch M, Kleinheinz J, Jung S. Dental implants in growing patients: a systematic review. British Journal of Oral and Maxillofacial Surgery. 2019;57(5):397-406.
6. Vetromilla BM, Brondani LP, Pereira-Cenci T, Bergoli CD. Influence of different implant-abutment connection designs on the mechanical and biological behavior of single-tooth implants in the maxillary esthetic zone: A systematic review. The Journal of prosthetic dentistry. 2019;121(3):398-403. e3.
7. Stavropoulos A, Bertl K, Eren S, Gotfredsen K. Mechanical and biological complications after implantoplasty—A systematic review. Clinical Oral Implants Research. 2019;30(9):833-48.
8. Apatzidou DA. The role of cigarette smoking in periodontal disease and treatment outcomes of dental implant therapy. Periodontology 2000. 2022;90(1):45-61.
9. Montero E, Molina A, Palombo D, Morón B, Pradíes G, Sanz-Sánchez I. Efficacy and risks of tooth-supported prostheses in the treatment of partially edentulous patients with stage IV periodontitis. A systematic review and meta-analysis. Journal of Clinical Periodontology. 2022;49:182-207.
10. Tugwell P, Tovey D. PRISMA 2020. Journal of Clinical Epidemiology. 2021;134:A5-A6.

11. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. European journal of epidemiology. 2010;25(9):603-5.
12. Higgins J, Altman D, Gøtzsche P, Jüni P, Moher D, Oxman A, et al. Cochrane bias methods group; cochrane statistical methods group. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials BMJ. 2011;343(7829):d5928.
13. Bäumer A, Weber D, Staufer S, Pretzl B, Körner G, Wang Y. Tooth loss in aggressive periodontitis: Results 25 years after active periodontal therapy in a private practice. Journal of Clinical Periodontology. 2020;47(2):223-32.
14. Guarnieri R, Ippoliti S. Long-term outcomes of tooth-implant-supported rehabilitation of periodontally compromised and treated patients refusing bone grafting surgical therapies. Implant Dentistry. 2019;28(6):528-36.
15. Li J, Jiang T, Lv P, Fang X, Xiao Z, Jia L. Four-Year Clinical Evaluation of GFRC-RBFPDs as Periodontal Splints to Replace Lost Anterior Teeth. The International journal of prosthodontics. 2016;29(5):522-7.
16. Graetz C, Schwendicke F, Kahl M, Dörfer CE, Sälzer S, Springer C, et al. Prosthetic rehabilitation of patients with history of moderate to severe periodontitis: A long-term evaluation. Journal of Clinical Periodontology. 2013;40(8):799-806.
17. Heschl A, Haas M, Haas J, Payer M, Wegscheider W, Polansky R. Maxillary rehabilitation of periodontally compromised patients with extensive one-piece fixed prostheses supported by natural teeth: a retrospective longitudinal study. Clinical oral investigations. 2013;17(1):45-53.
18. Brägger U, Hirt-Steiner S, Schnell N, Schmidlin K, Salvi GE, Pjetursson B, et al. Complication and failure rates of fixed dental prostheses in patients treated for periodontal disease. Clinical oral implants research. 2011;22(1):70-7.
19. Bäumer A, Pretzl B, Cosgarea R, Kim TS, Reitmeir P, Eickholz P, et al. Tooth loss in aggressive periodontitis after active periodontal therapy: patient-related and tooth-related prognostic factors. Journal of clinical periodontology. 2011;38(7):644-51.
20. Lulic M, Brägger U, Lang NP, Zwahlen M, Salvi GE. Ante's (1926) law revisited: a systematic review on survival rates and complications of fixed dental prostheses (FDPs) on severely reduced periodontal tissue support. Clinical Oral Implants Research. 2007;18:63-72.