

Survival and Technical Complication Rate of Partial and Full-Arch All-Ceramic Implant-Supported Fixed Dental Prostheses: A Systematic Review and Meta-Analysis

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Survival and Technical Complication Rate of Partial and Full-Arch All-Ceramic Implant-Supported Fixed Dental Prostheses: A Systematic Review and Meta-Analysis

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Abstract

Background and aim: the aim of present study was evaluate Survival and Technical Complication Rate of Partial and Full- Arch All- Ceramic Implant- Supported Fixed Dental Prostheses.

Methods: From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last five years between 2015 and 2021. Effect size with 95% confidence interval, random effect model and REML method were calculated. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

Results: 372 studies (Partial FDPs (n=154) and Full-arch FDPs (n=218)) were selected to review the abstracts, the full text of 97 (Partial FDPs (n=45) and Full-arch FDPs (n=52)) studies was reviewed. Finally, seven studies were selected. Implant survival rate of Partial FDPs and Full-arch FDPs was 98% (ES, 98% 95 % CI 94%, 100%) and 98% (ES, 98% 95 % CI 95%, 100%), respectively. Overall Prosthesis survival rate of Partial FDPs and Full-arch FDPs was 97% (ES, 97% 95 % CI 94%, 100%).

Conclusions: meta-analysis showed survival rate of implants and prostheses in Partial FDPs and Full-arch FDPs is high. The rate of technical complications for Partial FDPs and Full-arch FDPs was about 65%

Keywords: Partial Fixed Dental Prostheses, Full- Arch All- Ceramic Implant- Supported Fixed Dental Prostheses, Implant

Introduction

Fixed implant supported prostheses are an alternative for implant rehabilitation treatment that allow patients to have new fixed teeth. They can be indicated in partial or total edentulous patients, and they can replace single teeth, or teeth and supporting tissues(1). A variety of treatment methods are available in terms of prosthesis preservation, abutment design, framework design, veneering technique and veneering mode(2). There are many studies on conventionally fabricated metal-based prostheses, however technical complications occur during implant-borne reconstructions. Digitally driven processing methods are currently receiving more attention(3, 4). So far, many all-ceramic or ceramic-like materials have been introduced. These reported materials must comply with all

international standards and their mechanical and chemical properties must be investigated. Treatment planning and selection of restorative materials should be evidence-based, however little clinical data is available in this area, especially in relation to newly developed all-ceramic restorative materials. Zirconia is a very strong technical ceramic with excellent properties in hardness, fracture toughness, and corrosion resistance; all without the most common (5). The reduced amounts of alumina with increasing stabilizing content led to the production of new generations of highly transparent zirconia ceramics on the market to be used seamlessly for multiple units. However, with the improvement in aesthetic appearance, the fracture toughness of high-transparency zirconia materials decreased, questioning the long-term clinical outcome. There is insufficient evidence for multi-unit monolithic reconstructions and the need for study in this field is very important. Therefore the aim of current study was evaluate Survival and Technical Complication Rate of Partial and Full- Arch All- Ceramic Implant- Supported Fixed Dental Prostheses.

Methods

Search strategy

From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last five years between 2015 and December 2021. The reason for choosing studies in the last five years is to be able to provide sufficient evidence in this area and use newer studies. Therefore, a software program (Endnote X8) has been utilized for managing the electronic titles.

Searches were performed with mesh terms:

((((((("Mouth, Edentulous"[Mesh] OR "Jaw, Edentulous"[Mesh] OR "Jaw, Edentulous, Partially"[Mesh]) OR ("Denture, Partial, Immediate"[Mesh] OR "Denture, Partial, Temporary"[Mesh] OR "Denture, Partial, Fixed"[Mesh] OR "Denture, Partial"[Mesh])) AND "Omega Dental Ceramic" [Supplementary Concept]) OR "Reconstructive Surgical Procedures"[Mesh]) OR "Ceramics"[Mesh]) OR "Aluminum Oxide"[Mesh]) OR "Dental Porcelain"[Mesh]) AND "Dental Implants, Single-Tooth"[Mesh]) AND "Dental Restoration Repair"[Mesh]) AND "Survival"[Mesh].

This systematic review has been conducted on the basis of the key consideration of the PRISMA Statement–Perfumed Reporting Items for the Systematic Review and Meta-analysis (6), and PICO strategy (Table 1).

Selection criteria

Inclusion criteria: Randomized controlled trials studies, controlled clinical trials; in human; edentulous Patients; Prospective and retrospective cohort studies; in English. In vitro studies, case studies, case reports and reviews; excluded from the study.

Table 1. PICO OR PECO strategy.

PICO strategy	Description
P	Population/ Patient: human participants with mandibular/maxillary edentulous
E	Intervention: all-ceramic implant-supported
C	Comparison: baseline
O	Outcome: Survival and Technical Complication Rate

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Data Extraction and analysis method

The data were extracted from the research included years, study design, Implants, Pontics, sample size and All-ceramic or metal-ceramic tooth-supported fixed dental protheses.

The quality of randomized studies included was assessed using Collaboration's tool (7). The scale scores for low risk was 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality. Newcastle-Ottawa Scale (NOS) (8) used to assess quality of the cohort studies and case-control 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.

For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included. Prior to the screening, kappa statistics was carried out in order to verify the agreement level between the reviewers. The kappa values were higher than 0.80.

Effect size with 95% confidence interval (CI), random effect model and REML method were calculated. Random effects were used to deal with potential heterogeneity and I^2 showed heterogeneity. I^2 values above 50% signified moderate-to-high heterogeneity. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

Results

Partial FDPs: In the review of the existing literature using the studied keywords, 154 studies were found. In the initial review, duplicate studies were eliminated and abstracts of 150 studies were reviewed. At this stage, 105 studies did not meet the inclusion criteria, so they were excluded, and in the second stage, the full text of 45 studies was reviewed by two authors. At this stage, 42 studies were excluded from the study due to incomplete data, inconsistency of results in a study, poor studies, lack of access to full text, inconsistent data with the purpose of the study. Finally, three studies were selected (Figure 1).

Full-arch FDPs: In the review of the existing literature using the studied keywords, 218 studies were found. In the initial review, duplicate studies were eliminated and abstracts of 203 studies were reviewed. At this stage, 151 studies did not meet the inclusion criteria, so they were excluded, and in the second stage, the full text of 52 studies was reviewed by two authors. At this stage, 48 studies were excluded from the study due to incomplete data, inconsistency of results in a study, poor studies, lack of access to full text, inconsistent data with the purpose of the study. Finally, four studies were selected (Figure 1).

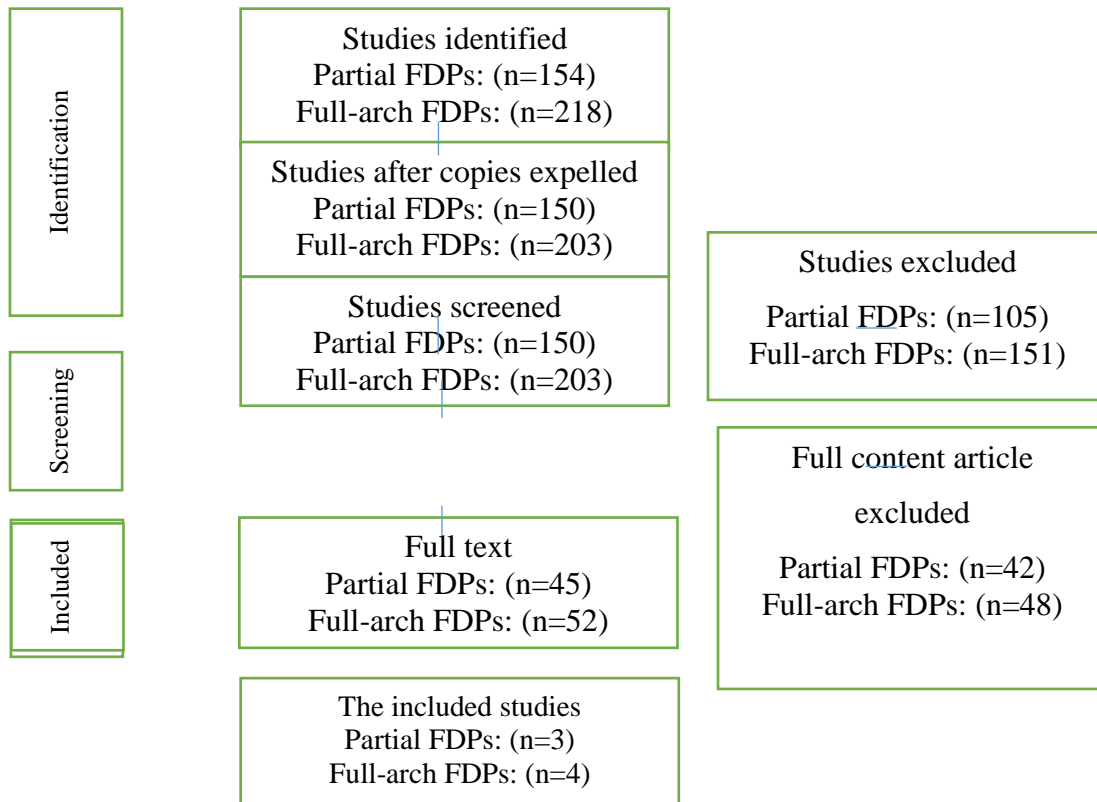


Figure 1. Study Attrition

Characteristics

Three studies (Randomized clinical trials, Prospective and retrospective cohort studies) have been included in Partial FDPs group. The number of patients a total was 145 with 167 fixed dental prostheses and 425 implants. Four studies (one Prospective study and three retrospective studies) have been included in Full-arch FDPs group. The number of patients a total was 141 with 180 fixed dental prostheses and 1006 implants (Table 2).

Bias assessment

According to Collaboration’s tool, one RCT study had a total score of 5/6; and According to NOS tool, three studies had a total score of 8/9 and three studies a total score of 7/9. All studies had low risk of bias or high quality (Table 3 and 4).

Table 2. Studies were selected for systematic review and meta-analysis.

Studies. Years	Group	Study design	Number of patients	fixed dental prostheses	Number pf implants	Number of Pontics
Shi et al.,2017 (9)	Partial FDPs	Retrospective	112	127	310	93
Larsson et al.,2016 (10)	Partial FDPs	RCT	17	24	61	5
Mendez Caramês et al.,2016 (11)	Full-arch FDPs	Retrospective	75	90	528	577
Tartaglia et al.,2016 (12)	Full-arch FDPs	Retrospective	32	46	192	384

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Spies et al.,2015 (13)	Partial FDPs	Prospective	16	16	54	27
Pozzi et al.,2015 (14)	Full-arch FDPs	Prospective	16	18	132	104
Venezia et al.,2015 (15)	Full-arch FDPs	Retrospective	18	26	154	155

Table 3. Risk of bias assessment (Randomized clinical trials).

Study	Random generation of sequences	Concealment of Allocation	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete data on outcomes	Selective reporting	Total score
Larsson et al.,2016 (10)							5

Table4. Risk of bias assessment (NOS tool)

Study. Years	Selection (5 score)				Comparability (2 score)	Outcome (2 score)		Total score
	representative sample	Sample size	Nonrespondents	Ascertainment of the exposure	Based on design and analysis	Assessment of outcome	Statistical test	
Shi et al.,2017 (9)	1	1	1	1	2	1	1	8
Mendez Caramês et al.,2016 (11)	1	1	1	1	1	1	1	7
Tartaglia et al.,2016 (12)	1	1	1	1	2	1	1	8
Spies et al.,2015 (13)	1	1	1	1	1	1	1	7
Pozzi et al.,2015 (14)	1	1	1	1	2	1	1	8
Venezia et al.,2015 (15)	1	1	1	1	1	1	1	7

Implant survival rate

Overall Implant survival rate of Partial FDPs and Full-arch FDPs was 98% (ES, 98% 95 % CI 95%, 100%)with low heterogeneity($I^2 = 0.05\%$; $p=0.65$) (Figure2).

Subgroup meta-analysis showed Implant survival rate of Partial FDPs was 98% (ES, 98% 95 % CI 94%, 100%)with low heterogeneity($I^2 = 0.00\%$; $p=0.46$); Implant survival rate of Full-arch FDPs was 98% (ES, 98% 95 % CI 95%, 100%)with low heterogeneity($I^2 = 13.33\%$; $p=0.45$) (Figure2).

Prosthesis survival

Overall Prosthesis survival rate of Partial FDPs and Full-arch FDPs was 97% (ES, 97% 95 % CI 94%, 100%)with low heterogeneity($I^2 = 0.00\%$; $p=0.94$) (Figure3).

Subgroup meta-analysis showed Prosthesis survival rate of Partial FDPs was 99% (ES, 99% 95 % CI 93%, 100%)with low heterogeneity($I^2 = 0.01\%$; $p=0.78$); Prosthesis survival rate of Full-arch FDPs was 96% (ES, 96% 95 % CI 91%, 100%)with low heterogeneity($I^2 = 0.00\%$; $p=0.85$) (Figure3).

Technical complications

Overall Technical complications rate of Partial FDPs and Full-arch FDPs was 67% (ES, 67% 95 % CI 53%, 81%)with high heterogeneity($I^2 = 87.69\%$; $p=0.00$) (Figure4).

Subgroup meta-analysis showed Technical complications rate of Partial FDPs was 74% (ES, 74% 95 % CI 68%, 81%)with low heterogeneity($I^2 = 0.00\%$; $p=0.44$); Technical complications rate of Full-arch FDPs was 62% (ES, 62% 95 % CI 37%, 87%)with high heterogeneity($I^2 = 89.48\%$; $p=0.00$) (Figure4).

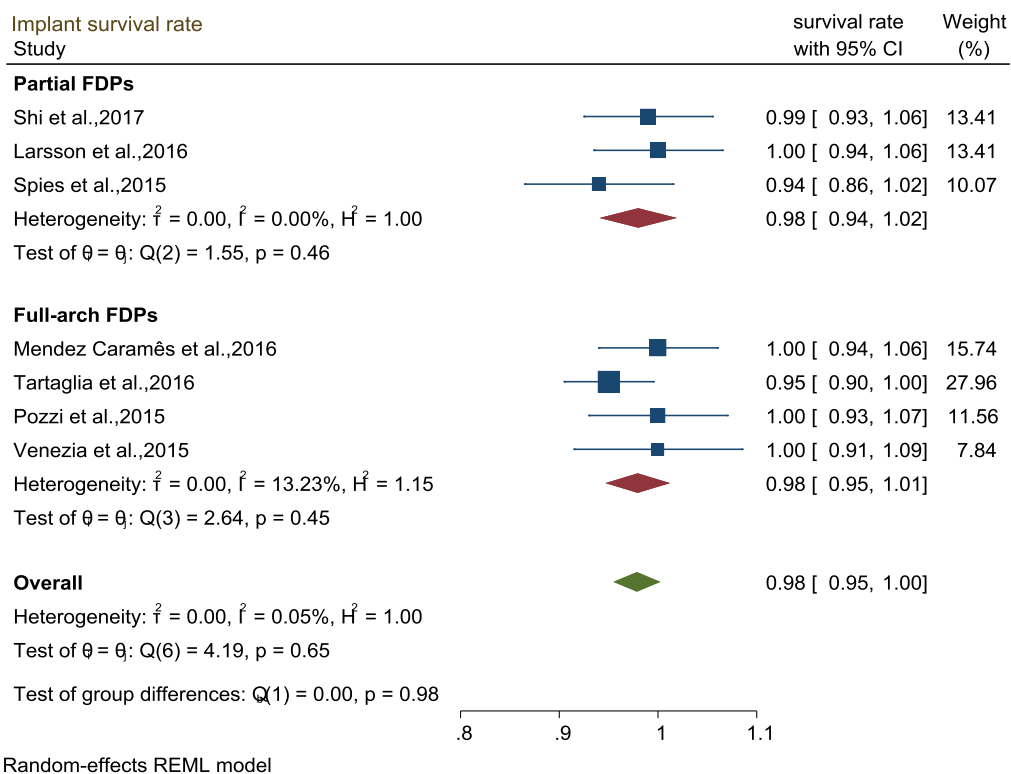


Figure 2. The Forest plot showed Implant survival rate of Partial FDPs and Full-arch FDPs

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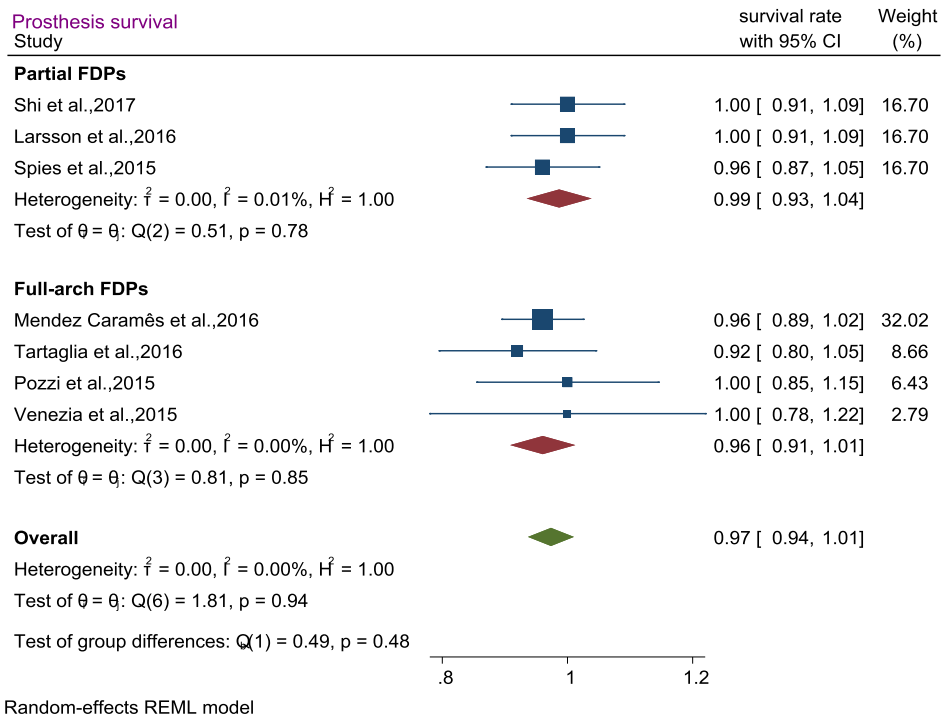


Figure 3. The Forest plot showed Prosthesis survival rate of Partial FDPs and Full-arch FDPs

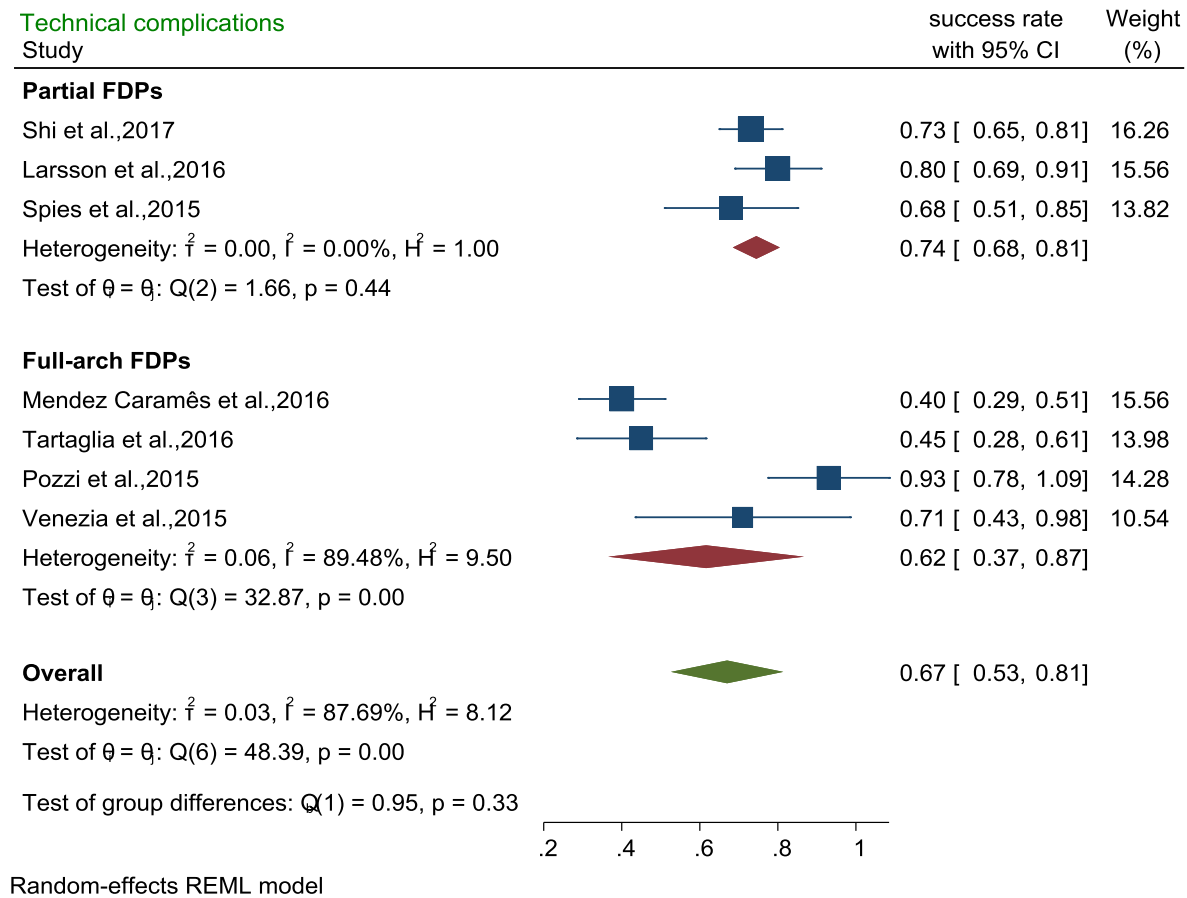


Figure 2. The Forest plot showed Technical complications rate of Partial FDPs and Full-arch FDPs

Discussion

The present study was performed to investigate the Survival rate and Technical Complication rate of Partial and Full - Arch All - Ceramic Implant - Supported Fixed Dental Prostheses by meta-analysis. The meta-analysis reported 98% implant survival after 5 years for Partial FDPs and Full-arch FDPs. Prosthesis survival rates were 99% and 96% for Partial FDPs and Full-arch FDPs, respectively. Also technical complications were 74% and 62% for Partial FDPs and Full-arch FDPs, respectively. In the present study, only one RCT study was found, due to the low heterogeneity between the study results, more RCT studies are needed to confirm the evidence to confirm the results of the present study. A significant amount of research on all-ceramic reconstructions with implants is supported, which requires removal from qualitative analysis. It is important to note that few studies have been included in the meta-analysis, so further studies are suggested in the future. Two studies reported the highest implant failure rate of all studies. Implant failure in both studies was not associated with prosthetic reconstructions (13, 16). In Partial FDPs group, all regenerative failures occurred due to major fractures and clinically incurable ceramic veneers (17). The most common cause of technical complications was chipping of the ceramic veneering (18). The present study had some limitations such as, only one RCT was found in this field, the heterogeneity of the studies in assessing the survival rate of implants and pertussis was low while the heterogeneity between the studies in examining the technical complications was high and considered. The study should be done with caution; further studies will help to find stronger evidence in the future. The sample size should be considered higher. The follow-up period was not the same in all studies, the follow-up period should also be considered in future studies.

Conclusion

The findings of the present study showed that the survival rate of implants and prostheses in Partial FDPs and Full-arch FDPs is high. The rate of technical complications for both groups was about 65%. Clinical advice on alternative all-ceramic systems is not possible due to lack of data, further studies are needed to provide sufficient evidence.

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