**Journal of Neonatal Surgery**
***ISSN(Online): 2226-0439***
***Vol.14, Issue 33s (2025)***
*https://www.jneonatalsurg.com*

OPEN ACCESS

# Evaluating the Survival Rate of Implant-Supported Fixed Prostheses in Partially Edentulous Patients.

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Cite this paper as: Baher Tarik, Rahmah Kashif, Tallal Ejaz, Hina Naz Naseem, Ayousha Iqbal, Fahmeed Akhtar6, Nabiha Naeem (2025) Evaluating the Survival Rate of Implant-Supported Fixed Prostheses in Partially Edentulous Patients...Journal of Neonatal Surgery, 14, (33s) 508-514

## ABSTRACT

**Background**: Implant-supported fixed prostheses have gained popularity as a modality of treatment in the rehabilitation of partially edentulous patients in terms of their good functional and esthetic results. Nevertheless, they have to be evaluated regularly in order to facilitate evidence-based clinical decisions.

**Objective**: To evaluate the survival rate of implant-supported fixed prostheses in partially edentulous patients.

**Methods**: The study was a prospective cohort study that took place in a tertiary care dental teaching hospital and lasted 24 months. A total of 80 patients with partially edentulous patients who were rehabilitated with implant-supported fixed prostheses through consecutive sampling were enrolled. The data were evaluated with the SPSS software. Kaplan-Meier survival analysis was done and compared by the use of the log-rank test, p-value ≤ was taken to be statistically significant.

**Results**: The total 24-month survival of the implant-supported fixed prosthesis was 95%. Four prostheses failed in the follow-up. The Kaplan-Meier analysis established high chances of survival during the follow-up. Statistical significance was not found in terms of survival depending on the location of implant, type of prosthesis, or even smoking status ($p > 0.05$).

**Conclusion**: Implant-supported fixed prostheses showed good clinical results and high survival rates in partially edentulous patients in the medium term. The findings back the claim that they should be used as a reliable and predictable form of treatment, provided that proper clinical guidelines are adhered to.

**Keywords:** *Fixed and removable dental implants; Prosthesis survival; Implant-supported fixed prostheses*.

## INTRODUCTION

Partial edentulism is a prevalent oral health issue on a global scale, and it has been linked to functional, esthetic, and psychosocial implications.[1] The World Health Organization found that a considerable percentage of the adult population may suffer tooth loss, where partial edentulism was more common than complete edentulism, especially in middle-aged and elderly population groups.[2] It is estimated that almost 30%-50% of adults above 35 years of age have lost at least one permanent tooth, with a rise in prevalence as a result of dental caries, periodontal disease, trauma, and failed restorations.[3] Oral rehabilitation is therefore an important process of restoring missing teeth so as to enhance mastication, phonetics, facial esthetics, and quality of life.[4]

Conventionally, removable partial dentures or tooth-supported fixed dental prostheses have been used as a means of rehabilitating partially edentulous patients.[5] Nonetheless, these traditional treatment modalities tend to be linked with constraints of impaired retention, augmented plaque formation, abutment tooth development, and progressive bone

resorption.[5] Conversely, the Implant-Supported Fixed Prosthesis (ISFP) has emerged as a predictable and biologically favorable option, which can replace missing teeth without compromising the neighboring natural teeth.[6] Dental implants increase functional load transfer to the alveolar bone and hence, decrease bone resorption and increase long-term prosthetic stability.[7].

However, the development of implant design, surface modification, surgical procedures, and prosthetic materials has led to significant improvements in clinical outcomes over the last few decades.[8] Longitudinal and cohort studies have all indicated a high survival rate in the case of fixed prostheses that are supported by implants, which will be between 90% and 98% within 5 to 10 years of follow-up.[9, 10] The implant survival and success of the prosthetics have been demonstrated to be influenced by factors like bone quality, implant placement, prosthesis design, load protocols, and patient factors such as oral hygiene and overall health.[11] Regardless of these positive results, complications such as peri-implantitis, mechanical failures, and prosthetic loosening remain problematic in long-term maintenance.[12, 13]

Even though the use of an implant-supported fixed prosthesis is becoming more common in partially edentulous patients, differences in the reported survival rates of various populations and clinical scenarios reveal the necessity of additional investigation. The evaluation of the survival rate of implant-supported fixed prostheses is needed in evidence-based treatment planning, patient advice, and the optimization of long-term results. Thus, the justification of the current study is to deliver clinically significant evidence on the survival of an implant-supported fixed prosthesis in the partially edentulous patients as a part of the current literature in the field of implant dentistry. This study is intended to assess the survival rates of partially edentulous patients who receive implant-supported fixed prostheses and to examine what factors affect their clinical survival.

## METHODOLOGY

This was a prospective cohort study conducted in the Department of Prosthodontics and Implant Dentistry for one year.

A sample size was then determined with the help of OpenEpi version 3.01 and taken out of an expected survival rate of 95% of the implant-supported fixed prostheses, as published indicated in past literature.[14] The required minimal sample size was calculated to be 73 patients with a confidence level of 95% and a margin of error of 5%. An extra 10% was considered to account for the possible attrition that might occur during follow-up, making the final sample size 80 patients.

A non-probability consecutive sampling method was utilized, whereby all partially edentulous patients who came to the study setting within the recruitment time period and met the eligibility criteria were recruited up to the required sample size. The study involved patients aged 18 years and above with partial edentulism receiving implant-supported fixed prostheses and who gave written informed consent. Patients were also excluded in case they were totally edentulous, had uncontrolled systemic diseases, were receiving head and neck radiotherapy, were pregnant or lactating, heavy smokers, had poor oral hygiene or active periodontal disease, or were non-compliant to follow-up visits.

The eligible patients were subsequently enrolled after receiving ethical approval by the institutional review board, and baseline demographic and clinical information, which represented the age, gender, medical history, implant site, quantity of implants placed, and the type of prosthesis, were documented on a structured proforma. The implant installation was done in aseptic conditions as required by the manufacturer. After the proper healing process, the fixed prostheses supported by implants were prepared and supplied. The patients were also reminded to undergo a follow-up assessment at 1 month, 6 months, 12 months, and 24 months after delivery of the prosthesis.

Clinical and radiographic assessments were performed at every follow-up visit to determine the survival of the prosthetics. The review of prosthesis survival was determined as the survival of a functional implant-fixed prosthesis that does not require removal or replacement of the prosthesis despite the possibility of minor technical complications. Follow-up recorded any biologic or mechanical complications such as peri-implant inflammation, screw loosening, or fracture of the prosthetic.

The Statistical Package of the Social Sciences (SPSS) version 26 was used to enter and analyze the data. The demographic and clinical characteristics were summarized using descriptive statistics, whereby quantitative variables were presented as means and standard deviations, and qualitative variables were presented as frequencies and percentages. Kaplan Meier survival analysis was used to estimate the survival rate of the implant-supported fixed prostheses, and the log-rank test was used to determine the difference in survival between groups. A p-value of 0.05 or less was regarded as being statistically significant.

## RESULTS

The study included 80 partially edentulous patients. There was a preponderance of males in the study population, and most of the participants were in the middle-aged group. The age of the patients was in the middle of the forties; the percentage of older people was quite minimal. The majority of patients were not smokers, and few of them had a history of smoking (Table 1).

In the aspect of clinical features, implants were commonly placed in the mandible and not the maxilla. A larger proportion of patients got two implants than one implant, and a small proportion got three or more implants to undergo the process of

prosthetic rehabilitation. The most widely provided prosthetic restorations were fixed partial dentures, in contrast to single crowns. Regarding loading protocol, delayed loading was made in most cases, and in a smaller proportion of patients, early loading was made (Table 2).

The dominant outcome of the follow-up period in the case of implant-supported fixed prostheses was their functionality and retention. The overall survival rate at the end of 24 months was high, as only a few prostheses failed. It was shown that the mean survival time was the indicator that showed that the majority of prostheses were stable during the span of almost the entire observation (Table 3).

Peri-implantitis was the most common cause of failure in the failed prostheses, followed by loss of the implants because of poor osseointegration and prosthetic fracture. Such failures explained all the losses of the prostheses observed in the study period (Table 4).

The Kaplan-Meier survival revealed remarkable short and medium-term survival of implant-supported fixed prostheses, and the probabilities of survival did not decrease with time during the follow-up period. Comparisons made in terms of the location of the implants, the type and kind of prosthesis, and the status of smoking did not show any statistically significant differences in terms of survival outcomes. Even though the survival rate of smokers when compared to non-smokers was significantly lower, this was not significantly found to be increased in log rank test (Table 5).

**Table 1. Demographic and Baseline Characteristics of Study Participants (n = 80)**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Gender** | Male | 46 | 57.5 |
| | Female | 34 | 42.5 |
| **Age group (years)** | 18–30 | 12 | 15.0 |
| | 31–45 | 29 | 36.3 |
| | 46–60 | 26 | 32.5 |
| | >60 | 13 | 16.2 |
| **Mean age ± SD (years)** | 44.6 ± 11.8 | | |
| **Smoking status** | Non-smoker | 69 | 86.3 |
| | Smoker | 11 | 13.7 |

**Table 2. Clinical Characteristics of Implant-Supported Fixed Prostheses**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Implant location** | Maxilla | 35 | 43.8 |
| | Mandible | 45 | 56.2 |
| **Number of implants per patient** | Single implant | 28 | 35.0 |
| | Two implants | 34 | 42.5 |
| | Three or more implants | 18 | 22.5 |
| **Type of prosthesis** | Single crown | 31 | 38.8 |
| | Fixed partial denture | 49 | 61.2 |
| **Loading protocol** | Delayed loading | 62 | 77.5 |
| | Early loading | 18 | 22.5 |

**Table 3. Survival Outcome of Implant-Supported Fixed Prostheses during Follow-up**

| Outcome | Number (n) | Percentage (%) |
|---|---|---|
| Prostheses survived | 76 | 95.0 |
| Prostheses failed | 4 | 5.0 |
| **Overall survival rate at 24 months** | | 95.0% |
| **Mean survival time (months ± SD)** | | 23.4 ± 2.1 |

**Table 4. Causes of Failure of Implant-Supported Fixed Prostheses (n = 4)**

| Cause of Failure | Frequency (n) | Percentage (%) |
|---|---|---|
| **Peri-implantitis** | 2 | 50.0 |
| **Implant loss due to poor osseointegration** | 1 | 25.0 |
| **Prosthetic fracture** | 1 | 25.0 |
| **Total** | 4 | 100.0 |

**Table 5. Kaplan–Meier Survival Analysis and Log-Rank Comparison of Prosthesis Survival**

| Variable | Category | Survival Rate (%) | Log-rank p-value |
|---|---|---|---|
| **Time-based survival** | 6 months | 100 | |
| | 12 months | 98.7 | |
| | 24 months | 95.0 | |
| **Implant location** | Maxilla | 94.3 | |
| | Mandible | 95.6 | 0.68 |
| **Type of prosthesis** | Single crown | 96.8 | |
| | Fixed partial denture | 93.9 | 0.61 |
| **Smoking status** | Non-smoker | 96.5 | |
| | Smoker | 90.0 | 0.09 |

## DISCUSSION

In the current prospective cohort trial that addressed the survival rate of implant-supported fixed prostheses (ISFPs) in partially edentulous patients, the overall survival was noted to be high at 95% at 24 months of follow-up. This observation is in line with the remaining literature that shows that implant-supported fixed prostheses have superior medium-term survival rates in diverse clinical conditions.

Similar survival results have been reported in several recent studies. A retrospective cohort study comparing implant survival between elderly patients showed that the cumulative survival rates were 99.0% and 98.1% at 5 and 10 years, respectively, which highlights the long-term outcome of the implant-supported prosthesis against longer follow-up periods, although this study concentrated on implant and not prosthesis survival.[15] Similarly, Roshan et al. have given 93.3% 5-year survival rate of implant-supported fixed partial dentures, with an implication of 93.3% of the ISFP surviving in our cohort.[16] Further, a systematic review identified estimated survival rates of 98.3% at 5 years for both metal-ceramic implant-supported fixed

dental prostheses, but this is slightly higher and generally aligned with long-term reliability found in our cohort.[17]

Regarding short-term results, monolithic zirconia implant-supported full-arch fixed dental prostheses demonstrated survival rates as good as 97.8% after one year, which highlights the high effectiveness of modern workflows and materials in prosthetics despite the inability to provide a direct comparison of the results with those after 24 months.[18] A retrospective cohort study on cross-arch fixed prostheses indicated that the reported survival rate of implants (97.64%) was lower than that of the prosthesis (82.35%) because of framework fractures, indicating that the design and materials of a prosthesis can affect long-term outcomes.[19]

In addition to survival, there are biological and technical complications, which are also significant factors in the prognosis of the implant-prosthesis. Peri-implantitis and prosthetic fracture also led to a percentage of failures of the prosthesis in our study. This is reflected in other recent literature where peri-implant diseases and mechanical problems are reported as frequent adverse events in the context of long-term follow-up. Pera-implantitis and soft tissue complications were common within 5 years in systematic reviews, peri-implantitis and technical complications, including veneer fractures and screw loosening, were also found to add to the overall morbidity, although survival rates were above 90%.[20] Equally, a Japanese cohort observed that the losses in implants within 5 and 10 years of implantation were frequently associated with peri-implantitis, which is in tandem with our clinical trends of failure.[15]

On comparison with the greater scope of comparative studies, implant-supported prostheses have been shown to show greater survival compared to traditional fixed partial dentures and removable ones. A multi-national analysis of the literature demonstrated better survival rates of implant-supported prostheses (93.3%) than removable dentures (66.7%) relative to a comparable period, indicating the existence of biomechanical benefits adjacent to the implantation and implant-supported prostheses.[21]

There are studies that show that it might vary depending on the design of the prosthetics and the patient. To illustrate, a study of the narrow-diameter implant reconstructions demonstrated excellent survival rates of implants with an average of 7 years at the expense of increased complication rates, which indicates that clinical outcomes can be adjusted by the parameters of the prosthetics and of anatomy.[22] Additionally, although the majority of the studies show a high survival rate, there are those studies, such as the Peking University cohort, which highlight the significance of risk factors such as mandible placement in the framework fractures, noting that the clinical context and design detail determine the longevity of the prosthesis.[19]

Collectively, the results of our study are consistent with the findings of other researchers that implant-based fixed prosthesis system offers a reliable and long-lasting rehabilitation strategy to partially edentulous patients and that implant-supported fixed prostheses have a survival of more than 90 percent in a variety of patient groups and different follow-up periods. The little variation in the estimates of survival in the recent studies is likely to be due to the differences in the study design, prosthetic materials, patient cohorts, and the duration of the follow-ups. Notably, the observed incidence and nature of biological and technical complications in this study and other studies underscore the importance of stringent maintenance guidelines, patient education about oral health, and cautious prosthesis design in an attempt to avert risk factors that may undermine long-term results.[17]

The results of the current research hold significant clinical significance in the rehabilitation of partially edentulous patients. The success rate of implant-supported fixed prostheses, which has been reported during the follow-up period, justifies its application as a predictable and reliable treatment modality in normal clinical practice. These findings support the application of implant-supported fixed prostheses in the restoration of function, esthetics, and patient satisfaction, and reduce the biological cost of the surrounding natural teeth. The positive survival results in the various areas of implant placement and the types of prostheses also indicate that with proper case selection and a uniform approach to surgery and prosthesis placement, implant-supported fixed prostheses could be effectively used in a broad spectrum of clinical conditions. Moreover, the fact that the incidence of the prosthesis failure is low also underlines the significance of the careful planning of the treatment, the correct loading regimes, and the frequent visits of the patients to the doctor in order to improve the clinical outcome in the long run.

Although the outcomes are promising, there are some limitations that should be mentioned in this study. To begin with, the follow-up period was restricted to 24 months, and it might not adequately address the issue of late biological/mechanical complications with implant-supported fixed prostheses. Second, the research was carried out in one center, which can narrow down the extrapolation of the results to other population groups and other clinical environments. Third, even though survival analysis was conducted, marginal bone loss, peri-implant soft tissue health, and patient-reported outcome measures, which are parameters of implant success, were not evaluated. Also, possible confounding variables, including parafunctional habits and specific features of the textile composition of prosthetics, had not been evaluated. These findings are expected to be further confirmed, but future multicenter studies with longer follow-up and elaborate success criteria are suggested.

## CONCLUSION

The implant-supported fixed prostheses showed high rates of survival in partially edentulous patients with a 24-month follow-up. Most of the prostheses were functioning and had few biological and mechanical complications. Peri-implantitis was also found to be the most frequent cause of prosthesis failure, which highlights the importance of maintaining oral hygiene measures and adherence to them by patients. In short, the use of implant-supported fixed prostheses as a treatment modality in partially edentulous patients has proven to be a reliable treatment modality, with good medium-term clinical results when good surgery and prosthetic principles are used

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