Growing body of evidence on survival rates of implant-supported fixed prostheses

What is the survival rate of implant-supported single crowns at 5 years?

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A systematic review of the 5-year survival and complication rates of implant-supported single crowns. Clin Oral Implant Res 2008; 19:188–195

Data sources Medline and manual searches were made of the bibliographies of all full-text articles and related reviews selected from the electronic search and the following journals: *American Journal of Dentistry, Australian Dental Journal, British Journal of Oral and Maxillofacial Surgery, Clinical Implant Dentistry and Related Research, Clinical Oral Implants Research, Deutsche Zahnärztliche Zeitschrift, European Journal of Oral Sciences, International Dental Journal, International Journal of Oral and Maxillofacial Implants, International Journal of Periodontics and Restorative Dentistry, International Journal of Prosthodontics, Journal de Parodontologie, Journal of Clinical Periodontology, Journal of Dental Research, Journal of Oral Implantology, Journal of Oral Rehabilitation, Journal of Periodontology, Journal of Prosthetic Dentistry, Quintessence International, Swedish Dental Journal and Schweizerische Monatsschrift Zahnmedizin.*

Study selection Prospective or retrospective cohort studies were included if they had a mean follow-up of 5 years or more; were reported in the dental literature in the English or German language; patients had been examined clinically at the follow-up visit; and details of the characteristics of the suprastructures were reported. Publications that combined findings for both implant-supported fixed partial dentures and single-tooth crowns were selected if they allowed for extraction of the data for the single-tooth crowns group. Publications based on patient records only or on questionnaires or interviews were excluded.

Data extraction and synthesis Failure and complication rates are calculated by dividing the number of events (failures or complications; the numerator) by the total exposure time [single crown (SC) time and/or implant time; the denominator]. Event rates for SC and/or implants were calculated by dividing the total number of events by the total SC or implant exposure time in years. The total number of events was considered to be Poisson distributed. To assess heterogeneity of the study-specific event rates, the Spearman goodness-of fit statistics and associated probability value were calculated. Multivariable Poisson regression was used to investigate formally whether event rates varied by crown material (metal–ceramic vs all-ceramic) or crown design (cemented vs screw-retained).

Results Twenty-six studies were included in the meta-analysis. Survival of implants supporting SC was 96.8% [95% confidence interval (CI), 95.9–97.6%] after 5 years. The survival rate of SC supported by implants was 94.5% (95% CI, 92.5–95.9%) after 5 years of function. The survival rate of metal–ceramic crowns, 95.4% (95% CI, 93.6–96.7%), was significantly higher (P 0.005) than the survival rate (91.2%; 95% CI, 86.8–94.2%), of all-ceramic crowns. Peri-implantitis and soft tissue complications occurred adjacent to 9.7% of the SC and 6.3% of the implants had bone loss exceeding 2 mm over the 5-year observation period. The cumulative incidence of implant fractures after 5 years was 0.14%. After 5 years, the cumulative incidence of screw or abutment loosening was 12.7%, and was 0.35% for screw or abutment fracture. For suprastructure-related complications, the cumulative incidence of ceramic or veneer fractures was 4.5%.

Conclusions An observation period of 5 years allows the conclusion that high survival rates of implants and implant-supported SC can be expected, but biological and, particularly, technical complications are frequent.

Commentary

This study was a systematic review examining the 5-year survival and complication rates of implant-supported SC. Systematic reviews provide an excellent vehicle for summarising the evidence on a particular topic. They differ from their narrative counterparts in that they focus on a narrow clinical question and maintain strict study inclusion/exclusion criteria, study quality and methods for data extraction. The authors correctly sought to examine survival rates of both implant fixtures as well as prosthetic reconstructions. The main study results were 5-year implant fixture survival of 96.8% (95% CI, 95.9–97.6%) and implant crown survival of 94.5% (95% CI, 92.5–95.9%). Metal–ceramic crowns fared better than all-ceramic crowns.

There appear to be some weaknesses of the review, however, such as the lack of clarity in its objectives and absence of quality assessment of the included studies. It was originally stated that the purpose of the review was to assess the 5-year survival and complication rate of implant-supported SC. It was stated, though, that there were no trials comparing implant therapy with conventional reconstructive therapy, which addresses a different clinical question. This is relevant, as a systematic review on survival rates of implant crowns could include survival data from observational studies only, whereas comparing implant crowns with conventional fixed bridges would typically include interventional designs (trials). A more focused clinical question would allow for a search of a specific study design. For example, there are many trials comparing implant types, loading time and site development, and these trials may have provided better quality survival data.

The search strategy included terms for both interventional and observational designs, such as cohort and case–control studies. The problem with this is that reviews of observational designs are more

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prone to bias than reviews of trials.¹ Included studies were described as being either prospective or retrospective cohort designs but one study was described as having groups randomised to different implant types. This appears, then, to be a review of interventional and observational studies. Furthermore, comparing implant crowns with conventional fixed bridges may have led to inclusion of fewer trials, but could have provided a higher quality review and addressed areas needing further research.

Systematic reviews usually employ a scoring system from data extraction sheets in an effort to evaluate the quality of studies. Studies that deviate from protocol with respect to populations, intervention or outcomes are commonly excluded from the review. Studies meeting the inclusion criteria are assessed for bias, and the poorer the methodology, the higher the risk for bias. Study quality was not addressed in this review, and systematic reviews of poor quality studies are likely to produce reviews with compromised or distorted results.² Additionally, limiting the included studies to those published in English or German and apparently not searching for unpublished studies or contacting experts for additional material may have overlooked relevant papers.

A Poisson distribution was used to calculate the number of occurrences (failures or complications) during a period of time, and Poisson regression modelling was used to evaluate whether covariates such as material type or cement versus screw-retained crowns affected survival rates. The Poisson distribution can be used when events occur independently and are random. One could question the independence of these events, because one complication could make subsequent events more likely to occur. Life tables or a Kaplan-Meier survival graph may have been helpful in this respect, which would also have accounted for censored observations such as patient attrition. It may have been advisable to perform a subgroup analysis to examine survival differences based on immediate versus delayed implant placement, loading time, site development, or implant type.

Despite the shortcomings in its methods, this systematic review has provided data similar to other reviews and meta-analyses on prosthesis survival. There is now a growing body of evidence on survival rates of both implant-supported and conventional fixed prostheses. Whereas the 5-year survival data are similar for both types, they appear to differ at the 10- and 15-year time periods, with implant-supported prostheses faring better. Nearly a quarter of fixed bridges need recementation, replacement, or experience loss of an abutment at 15 years, but reports of implant-supported prostheses give success rates of about 90% at 15 years, summarised as follows:

- Investigations on conventional fixed bridges are retrospective longitudinal studies that span 15-20 years.
- Investigations on implant-supported prostheses are both retrospective and prospective longitudinal studies that span 5-15 years.
- Longevity on conventional fixed bridges is approx. 90% at 10 years and 75% at 15 years.^{3,4}
- Longevity on implant-supported prostheses is approx. 95% at 7 years⁵ and 89% at 15 years.⁶
- Conventional fixed bridgework has many variables associated with the nature of the prosthetic service, especially the health of the abutment teeth. These factors tend to decrease long-term survival of a bridge.
- Implant studies had smaller CI than articles examining conventional prosthetics.

The protocol for surgical implant placement and prosthesis fabrication has been standardised throughout the world, reducing many treatment variables. Additionally, implants do not decay and rates of peri-implantitis are relatively low. Although trials comparing implant versus conventional prosthetics are rare, survival data continue to show better long-term survival for implant-supported prosthetics. Despite current evidence on treatment of partial edentulism favouring implant therapy, conventional fixed partial dentures have been, and should continue to be the appropriate therapy in many cases.

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