REVIEW ARTICLE

Clinical Success of Screw-retained Dental Implants: A Systematic Review

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Abstract

Objective: The objective of the research was to review the literature on clinical evaluation and success of screw-retained dental implants by assessing the marginal bone loss (MBL).

Methods: Online electronic databases such as PubMed/MEDLINE, Google Scholar, and Cochrane Library were searched using appropriate keywords for the last 20 years, dated from January 1, 2000, till August 1, 2021, with a restriction on language. Additional sources like major journals, unpublished studies, conference proceedings, and cross-references were explored. Information curated for data extraction included methodology, population, type of implants used, and duration of follow-up.

Results: The PubMed/MEDLINE, Google Scholar, Cochrane Library, and additional sources identified a huge number, out of which 637 search results were screened, out of which 322 were duplicates. The remaining 315 unique studies were screened for the titles and abstracts, and 23 articles were selected for full-text screening. A total of six articles that matched the eligibility criteria were processed for qualitative analysis.

Conclusion: Despite the uncertain retrievability of screw-retained implant-supported fixed restorations, this treatment option in fixed implant prosthodontics is a reliable and effective choice, especially for implant-supported long-span fixed partial dentures (FPDs), full-arch FPDs, and cantilever FPDs.

Keywords: Fixed partial dentures, Implant-supported dentures, Marginal bone loss, Screw-retained implants.

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Introduction

Clinical research in implant dentistry has mostly focused on implant survival, with only a small amount of attention paid to the occurrence of technical difficulties with implant components or restorations. It is crucial to think about the mechanical stability of implant-supported permanent restorations if you want to increase long-term stability and avoid issues. Indeed, technical issues may lead to a rise in the number of repairs and remakes, which are both time-consuming and costly.[1] For partially or completely edentulous patients, fixed implant-supported restorations have become the standard therapy, enhancing mastication and aesthetics.[2] Through a cemented prosthesis with lingual or palatal fastening screws, restorations can be screw- or cement-retained to the implant, or both.[3] Determining a retention system is usually done at the planning stage, when the benefits and drawbacks of each system are weighed against the intended treatment.[4] In this context, the clinician's personal preference may influence the choice of retention system.[5] Screw-retained systems are usually indicated for prostheses with multiple abutments to allow the prostheses to be removed for cleaning and possible repairs.[6] Furthermore, compared with cement-retained prostheses, screw-retained prostheses tend to show less marginal misfit at the crown–implant interface.[7] However, screw-retained prostheses have higher rates of complication, mainly as a result of screws loosening or fracturing and esthetic considerations when the implants are improperly positioned.[8]

Scientific data should be used to evaluate prosthetic alternatives to replace lost teeth. The information available in the literature on the success/survival rates and the prevalence of biological and technical issues of different designs of the tooth and implant-supported fixed prosthesis were summarized in a series of recent systematic reviews.[9–15] The incidence of technical difficulties was much higher for implant-supported prostheses than for tooth-supported prostheses, according to these studies. Technical problems were reported to be more common in cantilever prostheses than in end-abutment prostheses for tooth-supported prostheses. However, these reviews did not explore how cantilevers affect the survival and complication rates of implant-supported fixed dental prostheses (FDPs). To the best of our knowledge, this is the first consensus on the screw-retained type of retention system for fixed implant-supported restorations,[16] as the aim of this systematic review was to determine the clinical success of screw-retained implant-supported fixed prostheses in terms of marginal bone loss (MBL).

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Methods

Search Strategy

An exhaustive literature search was conducted to identify studies pertaining to the assessment of marginal bone level with respect to screw-retained implant-supported fixed prostheses. Online electronic databases such as PubMed/MEDLINE, Google Scholar, and Cochrane Library databases for English articles in dental journals were searched using appropriate keywords for the last 20 years, dated from January 1, 2000, till August 1, 2021. The search strategy applied was a combination of Medical Subject Headings (MeSH) terms and free-text words, including the following keywords: implants, implant-supported fixed dental prostheses, bridges, implant-supported single crowns screw-retained, screw fixation, screw, screw failure, retention, retention system and loss of retention, technical complications, mechanical complications, retrievability, and maintenance. The option of "related articles" was also used. Review articles, as well as references from different studies, were also used to identify relevant articles. Additional sources like major journals, unpublished studies, conference proceedings, and cross-references were explored. Information curated for data extraction included methodology, population, type of implants used, and duration of follow-up. Contact with authors was made to retrieve any unpublished studies.

Eligibility Criteria

- All clinical studies conducted on human subjects for the placement of screw-retained implant-supported fixed prostheses were included.
- Randomized controlled clinical trials, controlled clinical trials, retrospective studies, and prospective studies.
- Case reports, letters, and reviews were not included in the search.
- Follow-up period of at least 1 year after delivery of final restorations.
- Assessments in regard to marginal bone level and bone loss.

PICO

P—Population: Partially edentulous patients
I—Intervention: Screw-retained implant placement
C—None
O—Outcomes: Assessment of MBL
S—Study design: Randomized clinical trials

Focused Question

What is the clinical success of placement of screw-retained implant-supported fixed prostheses with regard to MBL?

Screening and Selection

The papers were independently scanned by two reviewers, first by the title and abstract. Reviews, commentary, or clinical trials were not included in the search. If the search keywords were present in the title and/or the abstract, the papers were selected for full-text reading. Papers without abstracts but with titles suggesting that they were related to the objectives of this review were also selected to screen the full text for eligibility. After selection, full-text papers were read in detail by two reviewers. Those papers that fulfilled all of the selection criteria were processed for data extraction. Two reviewers hand-searched the reference lists of all selected studies for additional relevant articles. Disagreements between the two reviewers were resolved by discussion. If a disagreement persisted, the judgment of a third reviewer was considered decisive.

Data Extraction

Two authors independently extracted data using specially designed data extraction forms, utilizing Microsoft Excel software. Any disagreement was resolved by discussion between the authors. For each selected study, information curated for data extraction included author and year of publication, number of patients, number of implants, implant system, arch design, follow-up period, assessment of MBL, success rate, and the reason of failure. For those articles that had inadequate data to be included in quantitative synthesis, the corresponding authors were contacted to procure additional data.

Risk of Bias

The methodological quality of the studies was evaluated using the "A Cochrane Risk of Bias Assessment Tool: for nonrandomized Studies of Interventions" (ACROBAT-NRSI).[17] Studies were appraised to be at serious, moderate, or low risk of bias (RoB) independently by two reviewers with a third reviewer available in the event of any nonagreement.

Results

The systematic review was conducted according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement guidelines.

Search Selection and Results

The PubMed/MEDLINE, Google Scholar, Cochrane Library, and additional sources identified a huge number, out of which 637 search results were screened, out of which 322 were duplicates (Flowchart 1). The remaining 315 unique studies were screened for the titles and abstracts, and 23 articles were selected for full-text screening. A total of six articles[18–23] that matched the eligibility criteria were processed for qualitative analysis (Table 1). Kappa score of 0.9 was calculated for two independent reviewers for search strategy and RoB.

Quality Assessment

The RoB for six studies[20–25] is summarized in Table 2.

Study Characteristics

A total of 751 implants were placed in 180 participants, with a mean age of 55.44 years old; one study was developed in a private clinic in Spain,[23] and five in universities.[18–23] Two trials were conducted in Sweden,[18,19] one in Switzerland,[20] Austria[21] and Spain[23] each. The mean follow-up was 44 months (range: 12–120 months). ITI Straumann was the most commonly used implant system,[18,19] followed by soft tissue level active (SLActive),[20,22] XiVE® S plus and XiVE® TG,[20] Biomet 3i, and Nobel Biocare systems.[23] Most of the cases were edentulous,[18,19,21] two were partially edentulous,[20,23] and one study was on single crowns.[22] The mandibular arch was the most prevalent for implant placement; most implants were placed for partially edentulous cases in the posterior regions of the mouth. MBL was evaluated in all six studies. MBL was significantly less with a range of 0.67 mm for screw-retained prostheses, the highest recorded being 1.8 mm over 10 years[21] and lowest being 0.1 mm in 1 year.[18] The assessed studies reported that 64 implants failed (8.5%). Three studies showed no failures during

Flowchart 1: Literature search flow

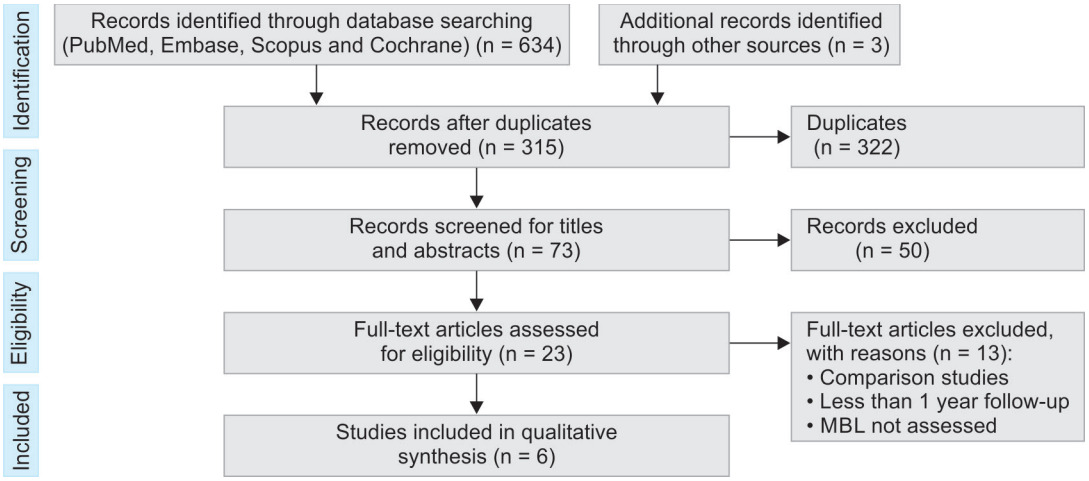

Table 1: Characteristics of the included studies

Study	*No. of patients/ cases*	*No. of implants*	*Implant system*	*Arch design*	*Follow-up period*	*Assessment of MBL*	*Success rate*	*No. of implants failed*	*Reason for failure*
Åstrand et al., 2000	28	167, Straumann	ITI	Edentulous upper jaw	1 year	0.1 mm	92.80%	12	Smoking, peri-implantitis, trauma
Arvidson et al., 2008	62	244, Straumann	ITI	Edentulous lower jaw	3 years	<1 mm	79.03%	50	Death of 8 patients, 5 dropouts
Bornstein et al., 2010	39	56, Straumann	Titanium with modified sand blasted and acid-etched surface	Partially edentulous lower jaw	3 years	0.12 mm	100%	0	NA
Heschl et al., 2011	30	120, Xi VE S plus	XiVE® S plus and XiVE® TG	Edentulous mandible	10 years	1.80 mm	98.30%	2	Postoperative complications
Sahrmann et al., 2016	NA	94, Straumann	SLActive standard plus soft tissue-level implants	Posterior single-tooth gap	3 years	0.5 mm	100%	0	NA
Casar-Espinosa et al., 2017	21	70	Biomet 3i, Nobel Biocare	Partially edentulous patients	2 years	0.33–0.72 mm	100%	0	NA

their follow-up periods. Smoking and peri-implantitis were the reasons for failure.[18,21] However, death and dropout of cases were also seen in large numbers.[19]

Discussion

Implant placement for screw-retained restorations is unquestionably more difficult, since the trajectory of the implant is constrained by a narrow area to locate the screw-access hole. Although this is not always attainable, if it is a goal of implant surgery and care is taken in planning, the result of allowing screw retention is frequently obtained. The first prerequisites are to plan with the restoration in mind and to have well-built and solid surgical guides.[24–26]

The goal of this systematic review was to aid clinicians to determine the clinical success rate of implant-supported fixed restorations that were screw-retained. Unfortunately, a meta-analysis of the data was not possible due to the heterogeneity of the studies identified. Instead, the success rates of screw-retained implant-supported fixed restorations were summarized in the current article. The authors began their search from 2000 because they intended to assemble fresh data following numerous systematic evaluations that had previously been presented as distinct retention techniques alone or in relation to the cement-retained prosthesis. All articles secured were restricted to English. Although short-term studies are unreliable for providing valid evidence for a therapy modality, the follow-up period was set to at least 1 year. This was done to provide more accurate information regarding when screw-retained implant-supported fixed restorations started to develop technical problems. In terms of the type of retention system or type of screw, the current review found about six randomized clinical trials. In terms of objectives, methods, sample size, assessment of treatment results,

Table 2: Illustration of different RoB judgments for different outcomes

Domain	*Åstrand et al., 2000*	*Arvidson et al., 2008*	*Bornstein et al., 2010*	*Heschl et al., 2011*	*Sahrmann et al., 2016*	*Casar-Espinosa et al., 2017*
Bias due to confounding	Serious risk	Moderate risk	Serious risk	Serious risk	Moderate risk	Serious risk
Bias in selection of participants into the study	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Bias in measurement of interventions	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Bias due to departures from intended interventions	Moderate risk	Moderate risk	Moderate risk	Moderate risk	Moderate risk	Moderate risk
Bias due to missing data	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Bias in measurement of outcomes	Low risk	Low risk	Serious risk	Low risk	Low risk	Serious risk
Bias in selection of the reported result	Low risk	Low risk	Serious risk	Moderate risk	Moderate risk	Serious risk
Overall	Serious risk	Moderate risk	Serious risk	Serious risk	Moderate risk	Serious risk

and observation durations, the prospective and retrospective studies found were extremely diverse. The range of implant systems and components employed, as well as the implantation site and implant restorative techniques and designs, added to the heterogeneity. As a result, it was impossible to draw a clear conclusion from the researches that were discovered. This emphasizes the importance of randomized clinical trials in this discipline. For all of the investigations, the clinical success rate ranged from 79 to 100%. Longer follow-up studies are related to more technical problems than shorter follow-up studies, indicating that the incidence of technical complications increases with time. Nonetheless, the majority of the issues observed were small and easily reversible, such as loss of retention, screw loosening, or slight peri-implantitis. If an implant was found to be a failure in these experiments, it was reimplanted after a brief recovery period. Factors such as the treatment jaw (maxilla or mandible) and smoking behaviors, on the contrary, appeared to be significant for peri-implant MBL. Peri-implantitis is a serious biological consequence that causes bone loss; however, it was not included as an outcome in this study due to the lack of a biological link between the presence or absence of prostheses' extension. In clinical research involving dental implants, data on the state of the peri-implant tissues are sparse.[27] The incidence of peri-implantitis was reported in one study included in the current review;[28] 5.1% of the prostheses were affected. The cumulative incidence of peri-implantitis and soft tissue complications for FPDs after 5 years was estimated to be 8.6% in a previous systematic review.[11,12] Disconcertingly higher figures were reported in a more recent systematic review. They obtained data from two study samples, and peri-implantitis was discovered in 28 and 56% of the participants in both investigations, respectively.[29]

Reviewing the data obtained, it can be observed in the more recent studies that there is a trend of a reduction in the incidence of abutment screw loosening.[1,28,30–39] This could be explained by the learning curve over time, as well as improvements in implant component fabrication and mechanical features, as well as the use of torque-controlling instruments for abutment screw retention. Furthermore, incorrectly fitting prostheses and implant components contributed to an increase in technical problems, especially abutment screw loosening.[40] The present review did not elaborate complications in terms of abutment screw loosening related to the type of the implant–abutment retention system.

Because each study used different prostheses, protocols, implants, and component systems, the results of the current analysis indicated no standardized retention guidelines. Taking the findings of this study into account, implant-supported prostheses, particularly long-span and full-arch FDPs, as well as cantilever FDPs, may be effectively screw-retained, as the challenges of these restorations are more common. Additionally, compared to cemented restorations, the retrievability of these reconstructions is less traumatic, more cost-effective, and more predictable.

Conclusion

Despite the uncertain retrievability of screw-retained implant-supported fixed restorations, this treatment option in fixed implant prosthodontics is a reliable and effective choice, especially for implant-supported long-span FPDs, full-arch FPDs, and cantilever FPDs. The literature lacks precise information on the clinical outcomes of screw-retained implant-supported fixed restorations, as well as the ideal types of clinical conditions that promote stability and retrievability. Randomized control trial (RCTs) that are standardized will provide useful information on this topic.

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