

# Dental Implant as a Rehabilitative Strategy in Patients with Sjogren's Syndrome: A Systematic Review

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## ABSTRACT

**Background:** Sjögren's Syndrome (SS) is a chronic autoimmune disorder characterized by salivary and lacrimal gland dysfunction, resulting in xerostomia, mucosal sensitivity, and increased risk of dental caries and premature tooth loss. Dental implant therapy offers a promising solution to restore oral function, aesthetics, and quality of life in these patients. This systematic review aimed to evaluate the clinical outcomes of dental implants in patients with SS, focusing on implant survival, marginal bone loss (MBL), biological complications, and functional rehabilitation.

**Materials and Methods:** A systematic literature search was conducted in PubMed, Scopus, Web of Science, and Cochrane Library using terms including "dental implant AND Sjögren's syndrome" and related keywords. Studies published from 2000 to 2023 were included. Clinical trials, cohort studies, and case series reporting implant outcomes in SS patients were selected. Data on implant survival, follow-up duration, prosthetic rehabilitation, and peri-implant complications were extracted and analyzed.

**Results:** Twelve studies, encompassing 405 implants in patients with primary or secondary SS, were included. The mean implant survival rate was 97.9% over a mean follow-up period of 51.9 months. Marginal bone loss was minimal and comparable to healthy populations. The most common biological complication was peri-implant mucositis, reported in up to 94% of patients. Factors influencing implant outcomes included systemic comorbidities, medication use, oral hygiene, and maintenance protocols. Modern techniques, including CAD/CAM prosthetics, CBCT planning, and surgical guides, improved treatment precision and patient outcomes. No significant differences were observed between primary and secondary SS patients regarding implant survival.

**Conclusion:** Dental implants are a reliable and effective rehabilitative strategy for patients with SS, providing functional and aesthetic restoration and improving quality of life. Careful planning, multidisciplinary management, and rigorous follow-up are critical for long-term success.

**Keywords:** Sjögren's Syndrome, dental implants, implant survival, xerostomia, marginal bone loss, oral rehabilitation, CAD/CAM

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## Introduction:

Dental implant therapy has fundamentally transformed the field of restorative and rehabilitative dentistry, providing patients with a reliable means to replace missing teeth and restore oral function, aesthetics, and masticatory efficiency. Unlike conventional removable prostheses, implant-supported restorations offer superior stability, preserve alveolar bone, reduce prosthetic movement, and significantly enhance patient comfort and self-esteem. In addition, implants have been shown to improve nutritional intake and overall health outcomes, particularly in individuals who experience extensive tooth loss or compromised oral function. The long-term success of dental implants, however, is not solely dependent on

surgical technique, implant design, or prosthetic planning; systemic and local factors, including metabolic disorders, immune-mediated diseases, and oral mucosal conditions, play a critical role in determining osseointegration and functional longevity (Almulhim, 2024)<sup>1</sup>.

One autoimmune disorder that poses unique challenges to dental rehabilitation is Sjögren's Syndrome (SS). SS is a chronic systemic autoimmune disease characterized primarily by lymphocytic infiltration of exocrine glands, particularly the salivary and lacrimal glands, leading to progressive glandular dysfunction and symptomatic dryness of the oral and ocular mucosa. The prevalence of SS in the general population ranges between 0.2% and 3%, with a strong female predilection (approximately 9:1) and

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peak incidence in middle-aged adults (40–60 years), though the disease can also manifest in younger individuals and children (Qin et al., 2015; Zehrfeld et al., 2024)<sup>2,3</sup>. Clinically, SS is classified as primary (pSS), occurring in isolation, or secondary (sSS), in association with other autoimmune disorders such as rheumatoid arthritis or systemic lupus erythematosus (Zehrfeld et al., 2024)<sup>2</sup>. While the disease primarily affects exocrine glands, systemic manifestations—including musculoskeletal pain, fatigue, and vasculitis—may also occur, further complicating comprehensive patient management.

The oral manifestations of SS are particularly relevant to dental rehabilitation and implant therapy. Xerostomia and hyposalivation—the hallmark features of SS—lead to a cascade of oral complications, including rampant dental caries, chronic periodontal inflammation, mucosal trauma, oral candidiasis, angular cheilitis, dysgeusia, dysphagia, and general discomfort (Spinato et al., 2010; Invernici et al., 2014)<sup>5,6</sup>. Saliva plays a critical role in maintaining oral homeostasis through its buffering capacity, antimicrobial activity, and facilitation of mastication and deglutition. Reduced salivary flow not only compromises these protective mechanisms but also accelerates the progression of dental disease, resulting in premature tooth loss and diminished quality of life. Consequently, conventional prosthetic approaches such as removable dentures often prove inadequate in SS patients. Poor mucosal lubrication and hypersensitive oral tissues can lead to unstable prostheses, recurrent tissue irritation, and impaired function, necessitating alternative rehabilitative strategies (Mori et al., 2018; Korfage et al., 2016)<sup>7,12</sup>.

Dental implants, as a rehabilitative option, provide a stable, fixed, and durable solution that can overcome the limitations imposed by xerostomia and mucosal fragility. Implant-supported prostheses not only restore occlusal function and aesthetics but also facilitate improved oral hygiene and prosthetic stability, particularly in patients with significant tooth loss. Modern advances in implantology, including surface modifications, immediate loading protocols, and CAD/CAM-fabricated prostheses, have expanded the possibilities for successful implant therapy even in compromised oral environments. Furthermore, the incorporation of multidisciplinary management—coordinating care between prosthodontists, oral surgeons, and rheumatologists—enables optimization of systemic health, mucosal management, and long-term maintenance, which are critical for implant success in SS patients (Azpiazu-Flores et al., 2023; Turkyilmaz & Unsal, 2019)<sup>14,15</sup>.

Despite these advantages, the systemic and local manifestations of SS necessitate careful consideration during treatment planning. Factors such as residual salivary flow, oral mucosal sensitivity, alveolar bone quantity and quality, and coexisting autoimmune

conditions must be thoroughly assessed to minimize complications and enhance osseointegration. Additionally, long-term maintenance protocols, including professional cleaning, antifungal prophylaxis, salivary substitutes, and patient education, are essential to ensure the longevity of implant-supported restorations (Peron et al., 2017; Invernici et al., 2014)<sup>6,9</sup>. Failure to account for these considerations may increase the risk of peri-implant mucositis, implant instability, or prosthetic complications, emphasizing the need for individualized care strategies.

Given the growing prevalence of SS and the increasing demand for implant-based oral rehabilitation, a systematic understanding of clinical outcomes, complications, and prognostic factors is essential for evidence-based management. Several case reports, case series, and cohort studies have documented successful implant placement in SS patients, reporting high survival rates, improved function, and enhanced patient satisfaction. These studies also highlight the role of modern prosthetic materials, advanced implant designs, and rigorous maintenance protocols in optimizing outcomes (Binon, 2005; Spinato et al., 2010; Korfage et al., 2016)<sup>4,5,12</sup>. Nonetheless, variability in study design, follow-up duration, and patient characteristics underscores the need for a comprehensive review of the literature to synthesize existing evidence and provide clinical guidance.

This systematic review aims to critically evaluate the current literature on dental implant therapy in patients with Sjögren's Syndrome. Specifically, it seeks to assess: (1) clinical outcomes and implant survival rates; (2) prosthetic and surgical considerations; (3) peri-implant complications and risk factors; and (4) long-term functional and patient-reported outcomes. By consolidating evidence from case reports, cohort studies, and longitudinal follow-ups, this review provides a framework for clinicians to implement effective, safe, and predictable implant rehabilitation strategies tailored to the unique challenges posed by SS.

### Materials and methods :

#### Study Design

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring transparent and reproducible reporting of literature search, selection, and synthesis. Additionally, the AMSTAR (A Measurement Tool to Assess Systematic Reviews) checklist was employed to enhance methodological rigor and improve the clarity and reliability of the review process. The study was designed to systematically evaluate clinical outcomes of dental implants in patients diagnosed with Sjögren's Syndrome (SS).

#### Objective

Dental implant therapy is increasingly recognized as a preferred rehabilitation strategy for patients with extensive

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tooth loss. In patients with SS, systemic and oral manifestations, particularly xerostomia and hyposalivation, may influence implant survival, osseointegration, and long-term function. The primary objective of this review was to systematically ascertain the clinical outcomes of dental implants in SS patients, with a focus on survival rate, functional outcomes, and peri-implant complications, by critically analyzing current evidence from clinical studies.

### Clinical Relevance

Sjögren's Syndrome is a chronic autoimmune disease that significantly affects oral health through reduced salivary flow, predisposing patients to rampant caries, periodontal disease, mucosal sensitivity, and early tooth loss. Implant-based rehabilitation in SS patients offers the potential for improved masticatory function, aesthetics, and quality of life, but the systemic and local challenges inherent to SS may influence clinical success. This review aims to provide a comprehensive evaluation of both positive and negative impacts of dental implant therapy in SS patients, offering guidance for clinicians and researchers in evidence-based treatment planning.

### Outcome Measures

The primary outcome of interest was dental implant survival rate, defined as the proportion of implants that remained functional and free of mobility, infection, or failure over the follow-up period. Secondary outcomes included:

- Marginal bone loss (MBL): Assessed radiographically to evaluate peri-implant bone stability.
- Masticatory efficiency: Patient-reported improvement in chewing function.
- Periodontal health: Incidence of peri-implant mucositis or peri-implantitis.
- Quality of life (QoL): Improvements in oral comfort, speech, and overall well-being post-rehabilitation.

These outcomes were selected to capture both objective clinical parameters and patient-centered functional and psychosocial benefits.

### Literature Search Strategy

A comprehensive systematic literature search was performed using PubMed, Scopus, Web of Science, and Cochrane Library databases. The search was designed to identify all relevant clinical studies evaluating dental implants in patients with SS, including partial and fully edentulous cases. The following search terms and Boolean operators were used:

- "Dental implant AND Sjögren's syndrome"
- "Dental implant AND diabetes"
- "Maxillary augmentation AND Sjögren's syndrome"
- "Mandibular implant AND Sjögren's syndrome"

- "Peri-implantitis AND Sjögren's syndrome"
- "Dental implant AND rheumatoid arthritis"
- "Implant AND xerostomia"
- "Maxillary augmentation AND xerostomia"
- "Dental implant AND immunocompromised"

To ensure comprehensive coverage, an iterative hand-search of reference lists from all identified articles and relevant reviews was also conducted. The literature search was conducted over a four-month period, from December 2023 to March 2024, yielding a total of 133 articles (115 clinical trials and 18 systematic reviews or aggregated studies). Twenty-five duplicates were removed during the initial screening, leaving 108 articles for further evaluation.

### Inclusion Criteria

Studies were included based on the PICOS (Population, Intervention, Comparison, Outcomes, Study design) framework:

- Population (P): Adult patients ( $\geq 18$  years) diagnosed with primary or secondary Sjögren's Syndrome who had received dental implant therapy.
- Intervention (I): Dental implants used as a rehabilitative measure for partially or fully edentulous patients.
- Comparison (C): Clinical outcomes of dental implants in SS patients, evaluated over a defined follow-up period.
- Outcomes (O): Implant survival rate, marginal bone loss, masticatory function, peri-implant health, and quality of life improvements.
- Study design (S): Prospective or retrospective clinical trials and cohort studies.

### Exclusion Criteria

Studies were excluded based on the following criteria:

- Non-clinical studies: In vitro experiments, animal studies, and laboratory investigations.
- Non-original research: Case reports, narrative reviews, and prior systematic reviews.
- Comorbidity-based exclusions: Studies focusing on patients with systemic conditions other than SS, such as uncontrolled diabetes or immunosuppressive disorders, unless SS was the primary focus.
- Insufficient follow-up: Studies with inadequate reporting of implant survival or clinical outcomes were excluded to maintain reliability.

### Study Selection and Data Extraction

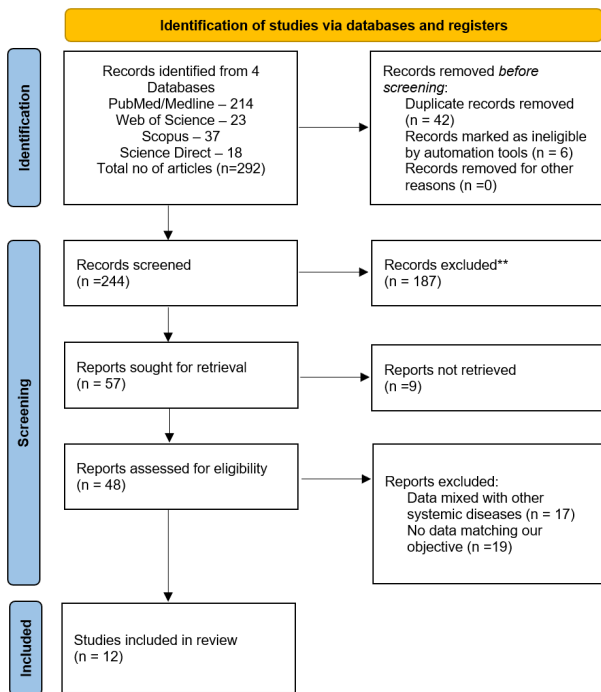
Two independent reviewers screened titles and abstracts for relevance, followed by full-text evaluation for eligibility. Discrepancies were resolved through discussion or consultation with a third reviewer. Data extracted from the included studies included:

- Study characteristics (author, year, country, study design)

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- Patient demographics (age, gender, SS type)
- Implant characteristics (number, location, design, surface treatment)
- Surgical and prosthetic protocols (loading protocol, prosthesis type, material)
- Follow-up duration
- Clinical outcomes (implant survival, marginal bone loss, peri-implant complications, functional outcomes, QoL)

A narrative synthesis was performed due to heterogeneity in study designs, patient populations, and outcome measures. Where feasible, quantitative comparisons of implant survival rates and peri-implant outcomes were conducted.



## Results

### Study Selection

The initial literature search identified a total of 292 articles: 23 from Web of Science, 37 from Scopus, 214 from MEDLINE/PubMed, and 18 from ScienceDirect. Following removal of duplicates and preliminary screening, 12 full-text articles were selected for inclusion in this systematic review based on pre-defined inclusion criteria. Studies were excluded due to failure to meet eligibility requirements, including non-clinical design, inadequate reporting of implant outcomes, or focus on comorbidities other than Sjögren’s Syndrome (SS). Grey literature and unpublished studies were not considered. The included studies were published between 2000 and 2023 and consisted of one case series, four prospective cohort studies, and six retrospective cohort studies.

### Study Characteristics

The selected studies collectively reported on **405 dental implants** placed in patients diagnosed with either primary

or secondary SS. The sample sizes ranged from single-patient case reports to large retrospective cohorts involving up to 104 patients. Prosthetic rehabilitation included single crowns, fixed partial dentures, and full-arch fixed prostheses, although one study did not specify the prosthesis type, only indicating the use of fixed or removable restorations. Only one study analyzed outcomes separately for primary and secondary SS, with no significant differences in periodontal or peri-implant parameters observed between these subgroups (Table 1).

**Table 1: Characteristics and Clinical Outcomes of Included Studies on Dental Implants in Patients with Sjögren’s Syndrome**

Study	Year of Publication	Study Type	No. of Implants	No. of Patients	Follow-up Duration (months)	Study Outcome
Binon	2005	Prospective cohort study	6	1	156	100% Success rate
Oczakir et al.	2005	Retrospective cohort study	12	2	42	100% Success rate
Spinato et al.	2010	Prospective cohort study	6	1	12	100% Success rate
Invercini et al.	2014	Prospective cohort study	2	1	72	100% Success rate
Weinlender et al.	2010	Case series	21	4	57.6	100% Success rate

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<b>Albrecht et al.</b>	2016	Retrospective Cohort study	205	104	36	95.2% success rate
<b>Westoff et al.</b>	2014	Retrospective cohort study	5	3	36	100% Success rate
<b>Chochlidakis et al.</b>	2018	Retrospective cohort study	8	54	48	88% success rate
<b>Korfaage et al.</b>	2016	Retrospective cohort study	140	50	46	97% success rate

### Implant Loading Protocols

The studies demonstrated variability in implant loading protocols. Earlier studies, particularly those conducted prior to 2010, employed conventional delayed loading methods, while more recent investigations increasingly utilized immediate loading protocols, reflecting advances in implant design, surface technology, and surgical techniques.

### Follow-Up Duration and Survival Outcomes

Follow-up periods across the studies ranged from 12 months to 156 months, with a mean follow-up of 51.9 months (SD = 3.2). Implant survival rates were generally high, with an overall average of 97.9%. Failures were reported in only a small number of cases and were predominantly associated with long-term corticosteroid therapy or the presence of additional systemic comorbidities. No studies provided a clear distinction between implant failures in primary versus secondary SS patients, nor were failures correlated with the type of prosthetic rehabilitation.

### Marginal Bone Loss and Peri-Implant Parameters

Marginal bone level (MBL) was assessed radiographically using periapical or panoramic imaging in most studies. Limited studies reported peri-implant soft tissue parameters, such as probing depth, bleeding on probing, mucositis, and peri-implantitis. One study observed increased probing depths and gingival bleeding in SS patients compared to healthy controls, while another reported a higher incidence of peri-implant mucositis and peri-implantitis among SS patients. However, no significant differences were observed between patients with primary and secondary SS. These findings indicate that while SS may influence peri-implant soft tissue health, implant survival remains high when careful surgical and prosthetic protocols are employed.

### Risk of Bias Assessment

Of the 12 studies initially included, 11 studies were retained for critical analysis after thorough scrutiny. The majority were cohort studies, with only one case series included. None of the studies explicitly followed the STROBE guidelines, resulting in limited transparency regarding data synthesis and reporting. Potential sources of bias included:

- Lack of a non-SS control group in many studies, limiting comparative interpretation of implant outcomes.
- Inconsistent reporting of patient-related risk factors, such as smoking status or long-term corticosteroid use, which could influence implant success.
- Variability in follow-up durations and assessment methods across studies.

Despite these limitations, the included studies consistently reported high implant survival rates, indicating that dental implants are a predictable and effective rehabilitation strategy in SS patients when appropriate clinical protocols are followed.

### Discussion:

Patients with Sjögren's Syndrome (SS) face unique challenges in oral health due to reduced salivary flow and altered salivary composition, resulting in a heightened risk of dental caries and premature tooth loss. These oral manifestations compromise not only masticatory function but also aesthetics and overall quality of life. Consequently, dental implant rehabilitation has emerged as a viable treatment modality for SS patients, offering the potential to restore function, comfort, and appearance (Spinato et al., 2010)<sup>5</sup>. This systematic review aimed to evaluate biological complications, marginal bone loss (MBL), and implant survival rates in SS patients undergoing implant therapy (Mori et al., 2018)<sup>7</sup>.

A comprehensive literature search was conducted using electronic databases, manual searches, and grey literature

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to minimize publication bias, without restrictions on language or publication date. Notably, randomized controlled trials (RCTs), considered the least biased form of evidence, were not identified for this topic, highlighting a current gap in high-level evidence (Carr et al., 2016)<sup>16</sup>. Most existing studies are cohort studies or case series, limiting the ability to draw definitive conclusions about implant outcomes in SS.

Saliva is a complex biological fluid containing organic compounds, proteins, glycoproteins, enzymes, and electrolytes that collectively facilitate lubrication, wound healing, and antimicrobial defense. In SS patients, hyposalivation and xerostomia compromise these protective mechanisms, which can negatively affect osseointegration, peri-implant tissue health, and long-term prosthetic stability (Invernici et al., 2014)<sup>6</sup>. Implant failures in this population have been attributed to multiple factors, including MBL, periodontal disease, systemic comorbidities, and inadequate oral hygiene. However, current literature has not established a definitive correlation between these factors and implant failure in SS patients, underscoring the need for future studies examining the microbiological profile, cytokine expression, and biomolecular markers in peri-implant tissues of this population (Albrecht et al., 2016; Korfage et al., 2016; Peron et al., 2017)<sup>12, 13, 9</sup>.

Several studies have proposed factors that may influence implant success. Spinato et al., 2010 suggested that successful implant outcomes in SS patients are associated with well-managed systemic disease and the use of roughened implant surfaces, whereas failures may occur in patients with untreated comorbidities such as rheumatoid arthritis or scleroderma (Spinato et al., 2010)<sup>5</sup>. Similarly, Mori et al., 2018 highlighted the importance of occlusal stability, using the Eichner classification to guide selection of posterior teeth for implant placement while preserving anterior teeth via root canal treatment. The study emphasized the value of short-interval follow-up appointments to monitor and prevent early peri-implantitis, demonstrating that meticulous maintenance is critical for maximizing implant survival (Mori et al., 2018)<sup>7</sup>.

Data on bone remodeling and dental implant outcomes in SS patients remain limited, partly due to the scarcity of long-term follow-up studies. Invernici et al., 2014 stressed the importance of long-term monitoring, two-stage implant protocols, and the current lack of prognostic data for immediate loading in SS patients (Invernici et al., 2014)<sup>6</sup>. More recent approaches incorporating CAD/CAM technology have shown promising results. Flores et al., 2023 reported full-mouth rehabilitation in an SS patient using eight implants with zirconia prostheses, achieving a five-year survival rate of 99%. Success was attributed to precise CBCT-based planning, salivary substitutes (Biotene Dry Mouth), and careful multidisciplinary

management (Azpiazu-Flores et al., 2023)<sup>14</sup>. Similarly, Turkyilmaz et al., 2019 demonstrated stable outcomes for 15 implants placed using flapless surgery and CAD/CAM surgical guides in terminal dentition patients with SS, highlighting the benefits of modern digital workflows in minimizing tissue trauma and optimizing implant placement (Turkyilmaz & Unsal, 2019)<sup>15</sup>.

The influence of systemic medications on implant outcomes remains inconclusive. Two studies suggested potential negative effects of SS-related medications on implant survival, though evidence was limited, whereas Carr et al. reported that corticosteroid use during implant placement did not increase, and may even reduce, the risk of implant failure (Carr et al., 2016)<sup>16</sup>. Across the included studies, the mean implant survival rate was 97.9% over a mean follow-up of 51.9 months, aligning closely with long-term survival in healthy populations, and suggesting that while SS may present challenges, implants can achieve predictable outcomes with careful planning (Albrecht et al., 2016; Korfage et al., 2016)<sup>12, 13</sup>.

Implant surface characteristics may also influence outcomes. Two studies reporting higher failure rates involved machined surface implants, yet insufficient data prevent firm conclusions about the role of surface treatment in SS patients. Systemic and local factors, such as smoking and periodontal disease, appear to exert a more significant influence on long-term implant survival than surface characteristics (Misch et al., 2008; Krennmair et al., 2010)<sup>19, 20</sup>. Smoking was reported in two studies, but no clear correlation between SS and smoking-related implant failure was observed.

Marginal bone loss (MBL), a key indicator of implant success, was reported in only three studies. Despite limited data, bone stability in SS patients appeared comparable to non-SS individuals. Early implant failures likely occur during the osseointegration phase, while long-term MBL remained stable in surviving implants. Peri-implant mucositis emerged as the most frequently reported biological complication, affecting up to 94% of SS patients in one study. These findings underscore the importance of periodontal health, oral hygiene, and vigilant maintenance in ensuring implant success (Almulhim, 2024; Spinato et al., 2010; Invernici et al., 2014)<sup>1, 5, 6</sup>.

No significant differences in implant outcomes were observed between primary and secondary SS patients; however, secondary SS patients with additional autoimmune conditions may require special consideration due to systemic comorbidities or polypharmacy.

### Strengths and Limitations of the Evidence

The included studies provide valuable insights into implant therapy in SS patients, demonstrating consistently high survival rates, feasibility of CAD/CAM-based rehabilitation, and the importance of meticulous follow-up. However, the evidence base has several limitations:

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- Lack of randomized controlled trials (RCTs) limits the strength of conclusions and introduces potential selection bias.
- Most studies had small sample sizes or were single-center investigations, limiting generalizability.
- Inconsistent reporting of systemic comorbidities, medication use, and smoking status complicates the interpretation of risk factors for implant failure.
- Limited long-term data on marginal bone loss, peri-implantitis, and occlusal stability restricts understanding of biological complications.
- Heterogeneity in implant designs, loading protocols, and prosthetic types prevents meta-analytic synthesis.

Despite these limitations, the collective evidence suggests that dental implants are a safe, effective, and predictable rehabilitative strategy for patients with SS, particularly when modern surgical techniques, prosthetic planning, and rigorous maintenance protocols are applied. Future research should focus on long-term, multicenter RCTs examining systemic influences, peri-implant biomarkers, and optimized implant surface technologies in this high-risk population.

### Conclusion

Dental implants have revolutionized restorative dentistry, offering predictable and long-term solutions for patients with complex oral conditions, including those with comorbidities such as Sjögren's Syndrome (SS). This systematic review demonstrated a mean implant survival rate of 97.9%, underscoring the high clinical success of implant therapy in this population, even when conventional radiographic and surgical techniques were used.

The incorporation of modern technologies, including CAD/CAM fabrication, CBCT-based pre-surgical planning, surgical guides, and bone augmentation procedures, has further improved the precision, safety, and predictability of implant placement. In addition, multidisciplinary care, integrating medical management of systemic conditions with dental expertise, enhances implant prognosis and patient satisfaction.

Patients with SS face challenges such as xerostomia, mucosal sensitivity, and premature tooth loss, which can limit conventional prosthetic rehabilitation. Dental implants not only restore oral function but also improve aesthetics, mastication, and overall quality of life. Success is maximized through careful treatment planning, rigorous maintenance protocols, and individualized approaches tailored to the patient's systemic and oral health status.

Overall, this review highlights that dental implants are a reliable and effective rehabilitative option for SS patients, and that leveraging technological and clinical advances is

essential for optimizing outcomes in medically complex populations.

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