

ORIGINAL ARTICLE

OUTCOMES OF DENTAL IMPLANT THERAPY IN PATIENTS WITH DOWN SYNDROME: A SYSTEMATIC REVIEW



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ABSTRACT

Objectives

Patients with Down syndrome (DS) require an earlier and more frequent tooth replacement than rest of the population. The objective of this systematic review is to critically analyze and summarize studies to ascertain the outcomes and survival of dental implants placed in jaws of DS patients.

Methods

Using the key words “dental implants,” “Down syndrome,” and “prosthodontics,” an electronic search was conducted via PubMed/MEDLINE, ISI Web of Science, Google Scholar, Embase, and Central Register of Controlled Trials (CENTRAL) databases by 2 authors, S.N. and Z.K., independently. Retrieved studies were screened against the predefined exclusion and inclusion criteria. To estimate the risk of bias, quality assessment of included studies was carried using the ‘Case Reports (CARE) guidelines’.

Results

Primary search resulted in 156 studies. Eight studies met the inclusion criteria and reporting a total of 81 dental implants placed in 36 DS patients. The type of implant loading ranged from immediate to a delay of 1 year after placement of the implant. Implant diameter ranged from 3.3 to 4.5 mm, and height ranged from 8.5 to 18 mm. The follow-up ranged from 1 to 6 years. Of 81 implants placed, 21 implants (26%) were reported as failed.

Conclusions

Patients with DS have a higher risk of implant failure. However, the reason for the failure is not very well understood. Although case reports and case series suggest that implant survival is diminished in DS patients, large-scale randomized controlled trials are required to determine the exact mechanism associated with risks of implant failure.

INTRODUCTION

Down syndrome (DS) is caused by the presence of a third copy of chromosome 21 (trisomy 21) and affects approximately 1 in every 700 children. DS is the leading cause of mental disability.¹ Along with intellectual disability, DS also

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gives rise to a number of characteristic physical features, including characteristic facial features, diminished physical growth, and decreased fertility. Moreover, vision and hearing capabilities are also affected in 38% to 80% and 50% to 90%, respectively.² DS may lead to a number of complications in the oral cavity. Although dental caries is less prevalent in DS patients, there is a higher incidence of gingivitis and periodontitis at a young age that is associated with the early loss of teeth.³ In addition, parafunctional habits such as bruxism or clenching may also lead to an excessive wear (attrition) of teeth.⁴ Developmental anomalies of the head and neck such as cleft lips and palate and malocclusions are comparatively more common in patients with DS. Moreover, tooth agenesis (or hypodontia) is 10 times more common in individuals with DS compared with systemically healthy patients.⁵ Missing and lost teeth lead to functional and psychosocial issues in DS patients. Therefore, patients with DS require more frequent and earlier tooth replacement than the rest of the population.

Treatment of periodontitis involves surgical and nonsurgical periodontal therapy. Although nonsurgical periodontal therapy consists primarily of scaling and root planing along with improving oral hygiene of the patient, surgical periodontal therapy involves procedures such as open-flap debridement, bone grafting, and guided tissue regeneration.⁶ If tooth loss occurs, fixed and removable prostheses may be provided to the patient. Dental implants, surgical devices that are in direct contact with the periodontal bone, may be placed in the jaws to support the prostheses.⁷ Dental implants have exhibited a mean 10-year survival rate of 95% in the general population.⁸ Research has documented dental implant therapy in patients with DS.⁹ For example, removable and fixed prostheses supported by dental implants placed in the jaws may be provided to patients with DS for restoring masticatory function and esthetics. However, to date, no systematic review has been published focusing on the outcomes of dental implant therapy in patients with DS. The objective of this systematic review is to critically analyze and summarize studies to ascertain the outcomes and survival of dental implants placed in jaws of DS patients.

METHODS

Search Methodology

A detailed electronic search was conducted using databases including ISI Web of Science, PubMed/MEDLINE, Google Scholar, Embase, and Central Register of Controlled Trials (CENTRAL) by 2 authors (S.N. and Z.K.) independently for the articles published from January 2000 to December 2016. A number of search words such as “dental implants,”

“Down syndrome,” and “prosthodontics” were used in combinations. A secondary manual search was conducted by scanning the reference lists of the articles found in the primary search. The search strategies followed the PRISMA guidelines (Figure 1). Both authors used the same inclusion and exclusion criteria to filter the studies independently, and any disagreements in study selection were resolved by discussion. The interexaminer reliability value was calculated as kappa = 0.83.

Eligibility Criteria

Predefined inclusion and exclusion criteria were applied to screen studies relevant to this review. Any disagreements were resolved by discussion among authors. The following inclusion criteria were used: (1) randomized controlled trials, case series and case reports, and retrospective studies; (2) studies describing implant placement in DS patients; (3) studies reporting survival and/or failure of dental implant at the end of follow-up period; and (4) studies in English. Short communications, reviews, editorials, and letters to the editor were excluded.

Data Collection

The data were extracted from the selected studies (Table 1). The recorded data included the type of study, patient's age range, number of implants used, implant dimensions (diameter and height), type of implant loading, number of failed implants, and follow-up period reported in each study.

Quality Assessment of Studies

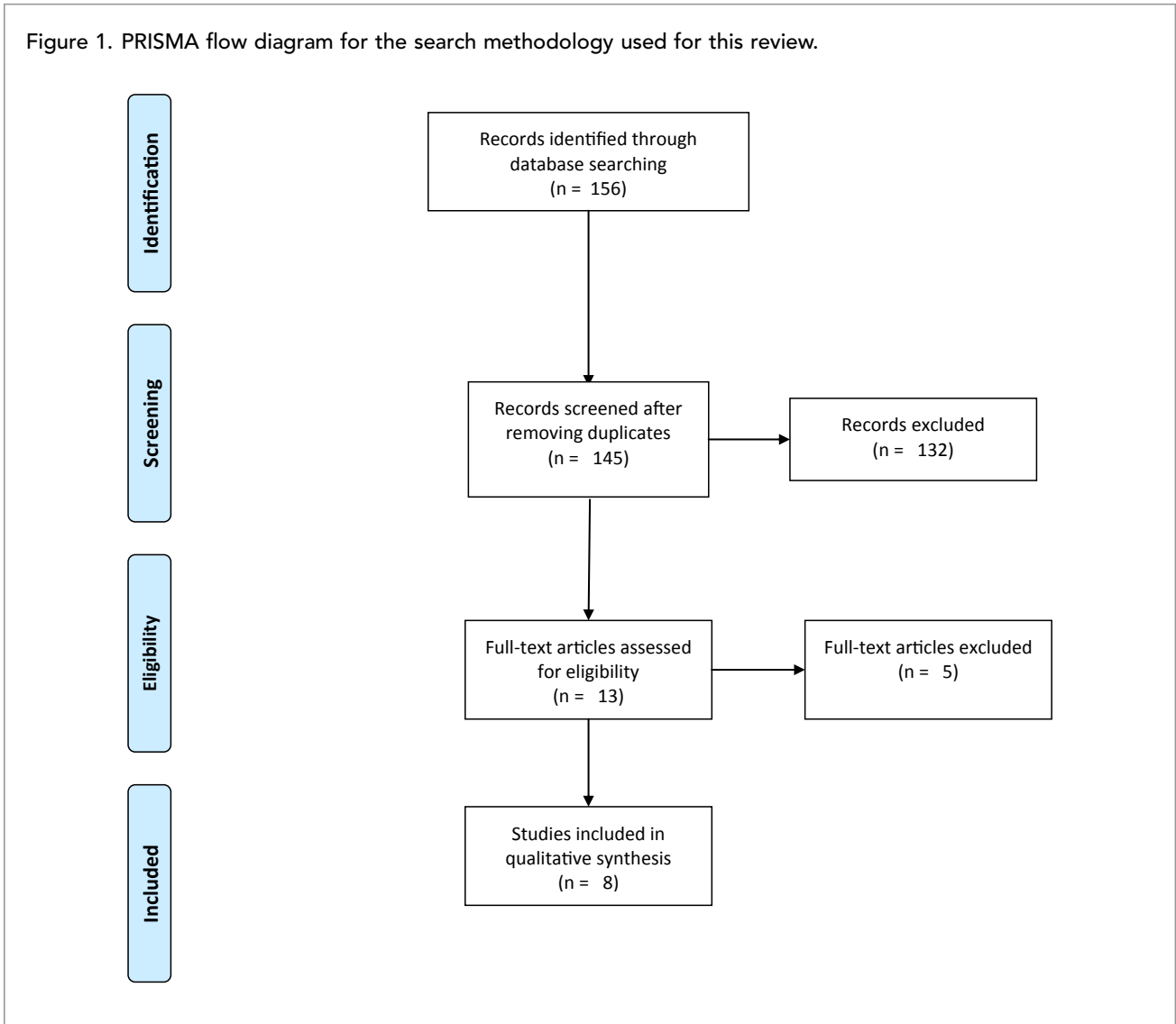
To estimate the risk of bias, quality assessment of each study was carried using the CARE guidelines¹⁷ by authors S.N. and Z.K. Any disagreements were solved by discussion. The quality of titles, key words, abstracts and introduction, presence or absence of a suitable timeline, patient description, description of clinical examination, measurement of peri-implant disease, description of implant therapy in addition to follow-up, outcomes, discussion, patient perspectives, funding information, and informed consent were assessed to estimate the quality of each study (Table 2).

RESULTS

Results of Literature Search

Primary search resulted in 156 studies. After exclusion of duplicates, abstracts and titles of 145 studies were read to include studies relevant to this review. After exclusion of 132 irrelevant studies, full texts of 13 studies were read (Figure 1). After further exclusion of 5 studies (short communications, reviews, and editorials), only 8 studies met the inclusion criteria of this review.⁹⁻¹⁶ No studies were found in the reference lists of the included articles

Figure 1. PRISMA flow diagram for the search methodology used for this review.



during manual search. The included articles consisted of 6 case reports,^{10-14,16} a case series,⁹ and a prospective study.¹⁵

General Characteristics and Outcomes of Studies

In all the studies,⁹⁻¹⁶ a total number of 36 DS patients received 81 dental implants and age of the patients ranged from 16 to 60 years. The type of implant loading ranged from immediate loading to a delay of 1 year after placement of the implant. The range of implant diameter was from 3.3 to 4.5 mm, and the height ranged between 8.5 and 18 mm. Follow-up ranged between 1 and 6 years. Of 81 implants placed, 21 implants (26%) were reported as failed.

Quality of Included Studies

All included studies contained an adequate title, suitable introduction, and discussion and described the patients

appropriately (Table 2). In most of the studies, patients, clinical examination, and implant disease were adequately described. Although the geometry of dental implants and their surgical placement was adequately described in most of the studies, the prosthodontic stage of treatment was described by only 2 studies.^{13,16} Patient perspectives of the dental treatment provided was described only in 5 studies.¹²⁻¹⁶ Funding information was only provided in 1 study.¹⁵ None of the studies stated informed consent of the patients.

DISCUSSION

For dental implants placed in the general population, 10-year survival rate as high as 96% has been reported.¹⁸ In the studies included in this review, a significantly higher number (26%) of dental implants failed within 6 years of placement. These findings suggest that implants placed in

Table 1. General characteristics and outcomes of studies included in this review.

Study	Type of study	No. of patients (n)	Patient's age (years)	Number of implants (n)		Implant dimensions (mm)		Type of implant loading	Follow-up
				Placed	Failed	Diameter	Height		
Lustig et al. ¹⁰	Case report	1	16	2 maxillary; 2 mandibular	1	3.75-4	11.4-13	Delayed (1 y)	2.5 y
Velde et al. ¹¹	Case report	1	NR	5	2	NR	10-18	Immediate	3 y
Oczakir et al. ¹²	Case series	3	39-53	2 maxillary; 6 mandibular	NR	NR	NR	NR	2-11 y
Soares et al. ¹³	Case report	1	22	1 maxillary	0	4	15	Immediate	4 y
Ribeiro et al. ¹⁴	Case report	1	36	5 maxillary; 8 mandibular	1	3.75	13	Delayed (6 mo)	28 mo
Ekfeldt et al. ¹⁵	Prospective study	3	19-46	4 maxillary	0	NR	13-15	NR; 1 implant not loaded	6 y
Posse et al. ⁹	Case series	25	19-60	30 maxillary; 43 mandibular	17	3.3-4.5	8.5-15	Delayed (4.1 ± 1.3 mo)	1 y
Saponaro et al. ¹⁶	Case report	1	27	3 mandibular	0	3.7	13	Delayed (4 mo)	~2 y
Total	—	36	—	81	21	—	—	—	—

NR, not reported.

the jaws of DS patients are more likely to fail compared with implants placed in the jaws of members of the general population.⁹⁻¹⁶ Adequate peri-implant bone density is required for the dental implants to withstand occlusal loads.^{19,20} A recent systematic review suggests that dental implants placed in osteoporotic patients may have a higher chance of failure.²¹ Similarly, studies indicate that patients with DS may have reduced bone density,^{22,23} which may be a cause of the increased dental implant failure observed in the included studies.⁹⁻¹⁶ Osteogenic implant surface coatings improve the osseointegration and outcome of implants²⁴ and hence can be helpful in patients with DS. Furthermore, a majority of the studies reported poor oral hygiene among DS patients, which may have further contributed to the increased failure rate of dental implants.⁹⁻¹⁶ Prior studies have suggested that although there is no significant difference between oral hygiene indices of non-DS patients and DS patients with gum disease, the severity of gingivitis is higher in the latter.²⁵ Hence, a combination of poor oral hygiene, reduced bone density, and a higher susceptibility to periodontal disease may have contributed to the high implant failure rates in DS patients.

Another factor that may have contributed to implant failure in DS patients is the compromised immune response. Studies suggest that due to a reduced number of T- and B-lymphocytes, reduced cellular responses to vaccinations, and compromised phagocytosis and chemotaxis, DS patients have a higher susceptibility to infections.²⁶ When compared with systemically normal patients, raised levels of gingival interleukin-10 in DS patients have been detected, indicating increased gingival and periodontal inflammation.²⁷ In another study, reduced activation of interferons has been suggested in DS patients with periodontitis when systemically compared with patients with periodontitis, furthering the notion that DS patients may have a higher susceptibility to periodontal disease due to an impaired immune system.²⁸ As reported by a recent systematic review by Duarte et al.,²⁹ peri-implant cytokine levels are raised in cases of peri-implant disease. Hence, a compromised peri-implant immune response in DS patients may lead to an increased risk of peri-implant infections. However, to date, no studies have attempted to compare the peri-implant inflammatory cytokine levels of DS and systemically healthy patients with peri-implant infection.

Table 2. The quality assessment of included studies according to CARE guidelines.

Assessment criteria	Lustig et al. ¹⁰	Velde et al. ¹¹	Oczakir et al. ¹²	Soares et al. ¹³	Ribeiro et al. ¹⁴	Ekfeldt et al. ¹⁵	Posse et al. ⁹	Saponaro et al. ¹⁶
Title	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Key words	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Abstract								
Background	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Case summary	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Conclusion	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Adequate introduction	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Timeline	No	No	No	No	No	No	No	No
Patient description	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Adequate clinical examination(s)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adequate measurement of peri-implant disease	Yes	Yes	Yes	No	No	Yes	Yes	No
Adequate description of implant therapy								
Geometry of implants	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Description of surgical stage	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Description of prosthodontic/laboratory stage	No	Yes	No	No	Yes	No	No	Yes
Follow-up/outcomes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Discussion	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Patient perspective	No	No	Yes	Yes	Yes	Yes	No	Yes
Funding information	No	No	No	No	No	Yes	No	No
Informed consent	No	Yes	No	No	No	No	No	No

Individuals with DS often have parafunctional habits such as bruxism and tongue thrusting.³⁰ These factors may have also led to the early implant failures recorded in this review. Indeed, some studies have documented immediate loading of implants in DS patients.^{11,13} Studies suggest that bruxism may contribute to early failures of

immediately loaded dental implants.^{31,32} Hence, because DS patients may already be predisposed to early implant failures due to the aforementioned factors, it may be advisable to avoid immediate loading in DS patients. Nevertheless, the majority of the implant failures recorded by Posse et al.⁹ failed before loading, suggesting that

peri-implant factors, rather than occlusal factors, are the main determinants of implant. Hence, future studies should focus on studying the effect of the type of implant loading on outcomes of dental implant placement in DS patients.

There are a number of limitations regarding the reviewed studies. Because no randomized controlled trials were included, there was no suitable comparison group. None of the studies described any attempt to blind the investigators and/or dental surgeons. Because all the studies included in this review were case reports or case series, CARE guidelines were used to carry out the quality assessment. Many of the studies did not fulfill the criteria described by the guidelines. The limited sample size of case reports and lack of blinding may have led to biased results. Only 1 study followed up the studied patients in excess of 5 years, which warrants long-term studies to assess the viability of dental implants in DS patients.¹⁵ Future studies should focus on improving the study design as well as the sample size and inclusion of a suitable comparison to minimize the chances of bias.

CONCLUSION

Patients with DS have a higher risk of implant failure. However, the reason for the failure is not very well understood. Although case reports and case series suggest that implant survival is diminished in DS patients, large-scale randomized controlled trials are required to determine the exact mechanism associated with the higher risk of implant failure.

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