Oral Rehabilitation of Down Syndrome Patients by Dental Implants: A Systematic Review

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ABSTRACT

Objectives: Down Syndrome patients are a particularly vulnerable group to teeth loss and periodontal disease. Therefore, the need for prosthetic rehabilitation is only a matter of time. The aim of this systematic review is to assess and summarize the available literature regarding the outcome of dental implants in patients with Down Syndrome.

Materials and Methods: An electronic search was performed in PubMed, Medline, Lilacs, and Cochrane Library. Search terms used were: “dental implant” OR “implant rehabilitation” AND “down syndrome”. Articles reporting the placement of implants in patients with down syndrome up until 2022 were included.

Results: A total of 15 studies (10 case reports, 4 retrospective studies and 1 prospective study) comprising 234 implants placed in 61 patients were included. Implant failure occurred for 45 implants, leading to a survival rate of 80.7%. 12 studies out of 15 reported their results after a follow up period of 6 months to 4 years.

Conclusion: The limited body of evidence suggests a survival rate of implants in Down Syndrome patients that is lower than among the general population. While several risk factors could explain these failures, there is still much to be answered regarding the mechanisms leading to implant rejection. A careful approach by dental practitioners should be the norm until better designed future studies with longer follow up periods can further shed light on the outcomes of implant therapy in Down Syndrome patients.

Keywords: Dental implant, down syndrome, implant rehabilitation.

I. INTRODUCTION

Down Syndrome (DS) is the most common genetic disorder in the world. Caused by a birth trisomy of a part or the entire chromosome 21, it’s the leading cause of intellectual disability in infants. Individuals affected by this condition have a greater predisposition for an array of systemic diseases (heart defects, neurologic disorders, gastrointestinal tract abnormalities, vision and ENT problems, blood disorders, hypothyroidism, spine and muscle disorders, osteoporosis, ...) as well as specific and recognizable cranio-facial characteristics and a higher prevalence of oral health problems and dental anomalies [1].

Studies centering on the oral health status of patients with DS reveal that they are less prone to dental caries but present a higher incidence of gingivitis and periodontitis that is associated with early teeth loss [2]. The prevalence of dental agenesis, excluding third molars, can range from 30% to 81%, marking a much higher rate compared to the general population [3]. Due to impaired motor development, DS patients are more prone to falls which might lead to fractures or luxations of anterior teeth. These patients also exhibit high prevalence of malocclusion, taurodontism, anodontia, hypodontia, impacted teeth and eruption delay [4].

Therefore, this category of patients finds itself in an earlier need of tooth replacement compared to the rest of the population.

With better understanding of this condition, advances in medical and surgical care have opened the way for long term survival improvement. The large majority of DS patients are now expected to live well into adult life (>55 years of age compared to just 25 years of age in the 1980s). Thus, it’s primordial to offer them up to date mental and physical healthcare to facilitate their social integration [5], [6].

Oral health wise, seeking improved ways to reach better oral and function comfort than the classical go to removable prosthesis, the use of implants has emerged as a viable rehabilitative option to manage teeth loss in syndromic patients [7]-[10].

When it comes to DS, several studies have reported the use of implant supported prosthetic dental restorations. However, multiple risk factors that may potentially hinder osseointegration are present in DS patients which raises concerns regarding a successful implant treatment outcome. These risk factors include reduced bone availability, periodontal disease, unstable occlusion, poor hygiene, parafunctions, altered immune response, genetic factors, macroglossia and cognitive disability [2], [10].

The objective of this systematic review is to critically
analyze the reported studies, and to assess the outcome of
dental implants used for the oral rehabilitation of DS patients.

II. MATERIALS AND METHODS

The present study is a systematic review performed in
accordance with PRISMA declaration (Preferred Reporting
Items for Systematic Review and Meta-Analysis) to gather
available and current evidence of dental implant treatment in
Down Syndrome patients. The search was performed using
“MeSH” keywords based on the elements of the PICO
question:

P (Participants): Down Syndrome patients
I (Intervention): Oral rehabilitation using dental implants
C (Comparison or Control): Not applicable
O (Outcome): Success of dental implant

A. Search Strategy

Comprehensive electronic searches up until August 2022
were performed. The searches were conducted in the
following electronic databases: Pubmed-Medline, Lilacs, and
Cochrane Library. Search terms used were dental implant,
down syndrome, implant rehabilitation. A manual search was
also carried out in the reference list of the retrieved articles to
identify further studies. Full articles were sought for all
potential studies.

B. Eligibility Criteria

Studies were included if they fulfilled the following criteria:
- Human subjects with down syndrome
- Clinical trials and observational studies (retrospective
or prospective)
- Studies reporting on implant placement in patients
with Down Syndrome
- Studies reporting on failure or success of implant
placement in patients with DS
- Studies in the English language

We excluded the studies not in the English language,
review articles, letters to editors, studies that did not report
any results after the follow up period.

C. Data Extraction

The following data were extracted: Authors, type of study,
number of patients, sex and age, general condition, number
and location of implants, type of loading, follow up period,
number of failures.

D. Quality Assessment of Studies

The quality of each study was assessed using the MINORS
index [11]. In general, the quality of the studies included was
low. Most of the articles were case reports and none of the
selected studies was a randomized controlled trial.

In this systematic review, most of the studies were
observational, only two studies provided data from a control
group. Therefore, there was no possibility of carrying out a
meta-analysis. Descriptive statistics, expressed in
percentages, were used to determine the effectiveness of
implants installed in patients with Down syndrome.

III. RESULTS

A. Study Selection

The initial online search yielded a total of 132 publications,
one of which was a duplicate and thus removed. After abstract
screening, 111 studies were removed for being irrelevant. Of
the remaining 20 studies, full texts were assessed for
eligibility and 5 were excluded (Fig. 1).

B. General Characteristics of the Included Studies

The studies consisted in 10 case reports, 4 retrospective
studies and 1 prospective study (Table I).

Only 2 studies reported the use of a control group [20],
[24].

The selected studies evaluated 61 DS patients (24 women,
24 men and 13 unreported) aged between 16 and 60 years old
for those reported.

234 implants were placed (53 in the maxillary, 74 in the
mandible and 107 unspecified) which resulted in 45 failures
or a survival rate of 80.7%. The majority of implant failures
[17] were reported in one study [19].

Regarding the loading protocol, 8 studies reported gradual
or delayed loading, 4 studies reported immediate loading and
4 studies did not mention what type of loading was used. A
total of 150 implants were gradually loaded, 28 of which
ended in a failure (18.6%). Only 7 implants were immediately
loaded and 2 of them failed (28.6%). The type of loading was
not specified for 76 implants, out of which 15 failures
occurred (19.7%).

29 out of 45 implants failed during the osseointegration
period (64.5%). 10 implants were reportedly lost post loading
(22.3%) and 6 implants were not specified (13.2%)

The follow up period ranged from 6 months to 11 years.

Four studies did not report on what type of anesthesia was
used to treat the patients. Six studies used general anesthesia,
one study reported the use of deep sedation, one study used
conscious sedation, and in 7 studies a local anesthesia was

![Fig. 1. Diagram of literature search and selection criteria adapted from PRISMA.](image-url)

### Table I

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of Study</th>
<th>Number of Patients</th>
<th>Gender</th>
<th>Follow Up Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 1</td>
<td>Case Report</td>
<td>10</td>
<td>24 men, 13 unreported</td>
<td>16-60 years</td>
</tr>
<tr>
<td>Study 2</td>
<td>Case Report</td>
<td>15</td>
<td>24 men, 13 unreported</td>
<td>16-60 years</td>
</tr>
<tr>
<td>Study 3</td>
<td>Case Report</td>
<td>10</td>
<td>24 men, 13 unreported</td>
<td>16-60 years</td>
</tr>
<tr>
<td>Study 4</td>
<td>Case Report</td>
<td>5</td>
<td>24 men, 13 unreported</td>
<td>16-60 years</td>
</tr>
<tr>
<td>Study 5</td>
<td>Case Report</td>
<td>5</td>
<td>24 men, 13 unreported</td>
<td>16-60 years</td>
</tr>
<tr>
<td>Study 6</td>
<td>Case Report</td>
<td>5</td>
<td>24 men, 13 unreported</td>
<td>16-60 years</td>
</tr>
</tbody>
</table>

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Most studies reported a difficulty and behavioral challenges in carrying certain oral examinations such as probing and x-rays following implant placement.

The majority of studies treated patients exhibiting a moderate mental impairment, and almost all of them reported poor oral hygiene, ongoing periodontal disease, different stages of tooth mobility or edentulism, in addition to other parafunctions (bruxism, occlusion instability, macroglossia, apnea).

IV. DISCUSSION

The oral rehabilitation of DS patients has always been a challenge due to the myriad of systemic, functional and behavioral obstacles to overcome. Although the conventional removable prosthodontics can provide a relatively simple solution, their low level of comfort, aesthetics and function as well as increased alveolar bone resorption and biomechanical failures make them more of a hindrance to the patient [27]. Therefore, implant supported prosthodontics have made their way to the therapeutic arsenal aimed at providing the best care from modern dentistry to DS patients, on par with non-syndromic patients.

In the present study, the survival rate of implants placed in DS patients is 80.7%. This is below the survival rate of implants in the general population, which is estimated at 96.4% over a 10-year period by [28], and 92.6% over 27 years by [29]. Nevertheless, there is no strict contraindication to placing dental implants in DS patients [30].

The chief complaints of patients, when expressed in the studies, were premature tooth loss, tooth mobility, tooth agenesis and instability or failure of removable prosthesis.

TABLE I: GENERAL CHARACTERISTICS OF THE INCLUDED STUDIES

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of study</th>
<th>Number of patients</th>
<th>Sex &amp; age</th>
<th>General condition of patients</th>
<th>Number &amp; location of implants</th>
<th>Type of implant loading</th>
<th>Follow up period</th>
<th>Number of failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>[12]</td>
<td>Case report</td>
<td>1</td>
<td>16 years old M</td>
<td>Moderate mental impairment Poor hygiene</td>
<td>2 Max 2 Mand</td>
<td>1-year gradual</td>
<td>2.5 years</td>
<td>1</td>
</tr>
<tr>
<td>[13]</td>
<td>Case report</td>
<td>3</td>
<td>39 to 53 years old 1M&amp; 2F</td>
<td>Poor hygiene</td>
<td>2 Max 6 Mand</td>
<td>NR</td>
<td>9, 11, 2 years</td>
<td>0</td>
</tr>
<tr>
<td>[14]</td>
<td>Case report</td>
<td>1</td>
<td>NR</td>
<td>General condition allowed in-chair treatment</td>
<td>5 Mand</td>
<td>Immediate</td>
<td>3 years</td>
<td>2</td>
</tr>
<tr>
<td>[15]</td>
<td>Case report</td>
<td>1</td>
<td>22 years old</td>
<td>Moderate mental impairment Macroglossia</td>
<td>1 Max</td>
<td>Immediate</td>
<td>4 years</td>
<td>0</td>
</tr>
<tr>
<td>[16]</td>
<td>Case report</td>
<td>1</td>
<td>36 years old</td>
<td>Moderate mental impairment Poor hygiene</td>
<td>8 Max 5 Mand</td>
<td>Delayed of 6 months</td>
<td>28 months</td>
<td>1</td>
</tr>
<tr>
<td>[17]</td>
<td>Prospective study</td>
<td>4</td>
<td>19 to 48 years old 3M&amp;1F</td>
<td>NR</td>
<td>4 Max 3 Mand</td>
<td>NR; 1 implant not located</td>
<td>Up to 6 years</td>
<td>1</td>
</tr>
<tr>
<td>[18]</td>
<td>Case report</td>
<td>1</td>
<td>27 years old F</td>
<td>High functioning motor and social skills Macroglossia Tongue thrusting</td>
<td>3 Mand</td>
<td>Delayed of 4 months</td>
<td>21 months</td>
<td>0</td>
</tr>
<tr>
<td>[19]</td>
<td>Retrospective observational study</td>
<td>25</td>
<td>19 to 60 years old 13M&amp;12F NR</td>
<td>Poor oral hygiene</td>
<td>30 Max 43 Mand</td>
<td>Delayed 4 1±1.3 months</td>
<td>1 year</td>
<td>17</td>
</tr>
<tr>
<td>[20]</td>
<td>Retrospective</td>
<td>6</td>
<td>NR</td>
<td>Moderate intellectual disability Type 2 diabetes Periodontitis</td>
<td>31 NR</td>
<td>NR</td>
<td>4 years</td>
<td>9</td>
</tr>
<tr>
<td>[21]</td>
<td>Case report</td>
<td>1</td>
<td>44 years old M</td>
<td>Poor oral hygiene</td>
<td>1 Max</td>
<td>Immediate loading</td>
<td>6 months</td>
<td>0</td>
</tr>
<tr>
<td>[22]</td>
<td>Retrospective</td>
<td>6</td>
<td>23 to 54 years old NR</td>
<td>Mild mental impairment</td>
<td>45 NR</td>
<td>Delayed</td>
<td>5 years</td>
<td>7</td>
</tr>
<tr>
<td>[23]</td>
<td>Case report</td>
<td>1</td>
<td>37 years old F</td>
<td>Cooperative without sedation Periodontitis tooth mobility, macroglossia</td>
<td>2 Max 3 Mand</td>
<td>Delayed 3 months</td>
<td>2 years</td>
<td>1</td>
</tr>
<tr>
<td>[24]</td>
<td>Retrospective</td>
<td>8</td>
<td>NR 2M 6F</td>
<td>Limited cooperation Edentulous Max&amp;Mand Sever bone atrophy</td>
<td>31 NR</td>
<td>NR</td>
<td>2 years</td>
<td>5</td>
</tr>
<tr>
<td>[25]</td>
<td>Case report</td>
<td>1</td>
<td>52 years old</td>
<td>Reduced verbal communication and understanding Periodontitis</td>
<td>2 Mand</td>
<td>Delayed 4 months</td>
<td>2 years</td>
<td>0</td>
</tr>
<tr>
<td>[26]</td>
<td>Case report</td>
<td>1</td>
<td>50 years old M</td>
<td></td>
<td>3 Max 2 Mand</td>
<td>Delayed 12 months for maxillary Delayed 6 days for mandibular</td>
<td>3 years</td>
<td>1</td>
</tr>
</tbody>
</table>


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It should be noted that the selected studies cannot provide conclusive scientific evidence as there were 10 case reports out of 15 studies. Furthermore, only two studies used control groups. The studies were also heterogenous in patients’ age, number of placed implants, implant dimensions, implant types, prosthodontic choices and the duration of the follow up period. This heterogeneity, the limited samples and the design of the studies make it impossible to perform a meta-analysis and limit the ability to draw definite conclusions about dental implant modalities in DS patients. Nevertheless, several remarks can be drawn in this regard to assess the most important variables and explain the low survival rate.

- Bone and peri-implant environment

DS patients present with a higher prevalence of osteoporosis, as well as lower bone mineral density compared to the general population [31]. Several studies have reported a positive correlation between low bone density and implant failure, although it is not a contra-indication of implant placement since conclusive evidence is still unclear [32], [33].

In addition, DS subjects have been reported to be more prone to periodontal diseases that lead to bone loss, with authors agreeing that the prevalence of periodontitis is almost 100% in DS patients under the age of 30 [2]. Bone loss through periodontitis is detrimental to implant stability and osseointegration. A meta-analysis conducted by Wen et al. has concluded that patients with a history of periodontitis, even if treated, experience a higher risk of implant failure [34]. Likewise, [35] observed through a meta-analysis that periodontitis is a risk factor for peri-implantitis and implant loss. Reference [36] also reached the same conclusion.

In the present review, 64.5% of failed implants have occurred in the pre-loading stage. Ekfeldt theorized in both his 2005 and 2013 publications that the repeated failures of implant in a DS patient might be due to his reduced resistance to infections, in combination with oral habits and macroglossia [17], [37].

Corcua-Flores, in one of the few retrospective studies with a control group in this review, found out that DS patients were significantly more prone to marginal bone loss and implant loss than patients with cerebral palsy. Both syndromic groups had parafunctional habits and improper oral hygiene, however DS patients were more prone to periodontal disease [20].

Reference [38] in a systematic review showed that DS patients had significantly more prevalent periodontopathogen bacteria than other mentally syndromic patients. Recent scientific evidence suggests that the presence of pathogen bacteria is necessary but not sufficient to justify the disease. Rather, the paradigm has shifted to studying the mechanisms (genes, proteins, metabolites) involved in the host inflammatory and immune responses as a key driver to the pathological process [39]. It is well known that DS patients have an impaired systemic immune system, with studies suggesting that altered cell functions, oxidative stress alterations and exaggerated inflammatory responses are likely involved in the periodontal destruction seen in individuals with DS [40].

Reference [41] through various genetical studies have attempted to explain osseointegration failure in certain DS patients compared to others suffering from the same syndrome but who were able to stabilize their implants.

Comparing DS patients with periodontal disease and implant failure with DS patients without periodontal disease and without implant failure, they found out that DS patients with periodontitis and failed implants had lower expressions of metallothioneins MT1 and MT2. These molecules seem to have an important role in the early stages of bone healing, an alteration in their expression can lead to a failure of osseointegration or the presence of a bone with little strength to withstand the aggressions of the oral environment [24].

Also, DS patients with periodontitis presented a difference in expression of inflammatory related genes compared to those without periodontitis. Certain patients presented greater individual susceptibility to developing inflammatory symptoms, which may possibly be explained by impairments to metabolic/cell routes/pathways from impairment of the genes involved [41].

Comparing DS patient groups with both periodontal disease and implants, [41] found out that the group that had failed osseointegration exhibited higher expression of genes participating in osteoclastogenesis, signaling that some DS patients are a genetically susceptible group to peri implantitis. Scientific evidence still strongly supports the association between bacterial plaque and peri-implantitis [42]. However, more body of evidence is emerging about the host inflammatory response driving the pathological process. Thus, the focus should expand from antibacterial focused treatments to include the study of immune microenvironment of peri-implantitis, so as to propose more targeted diagnosis and treatments [39], [43].

Also, the varying severity of peri-implantitis among DS subjects with relatively similar environments suggests a genetic aspect and individual susceptibility which need to be further investigated to understand and regulate the pathogenesis of the disease.

The exact mechanism of peri-implantitis is still unclear but is understood to be a complex interplay between the microbiota, the host immuno-inflammatory response and environmental factors [44]. Continuous investigations in this field are needed to provide a wider preventive and therapeutic window, even more so in DS patients that are a highly susceptible group to periodontium destruction.

- Oral hygiene

Most of the studies reported poor hygiene prior to the implant therapy, while insisting on oral health education of both DS patients and parents in implant survival. It is well known that both DS patients and their caregivers face challenges with home and professional oral care as well as difficulties hindering access to professionals willing and able to treat them [45].

Maintenance protocols described in the literature involve home based optimal plaque control and professional mechanical calculus and biofilm removal in every follow up visit. Interestingly, the efficacy of these protocols in DS patients has yielded conflicting results in the literature.

Reference [46] investigated the results of a preventive program involving 34 DS patients who were recalled 7 years after a baseline examination. Despite improved gingival condition, increases in alveolar bone loss and periodontitis prevalence were observed and no conclusion on the efficacy of the program could be drawn since the prophylaxis given to
the patients was not standardized.

Reference [47] reported that close monitoring of DS patients and frequent professional cleaning was decisive in reducing periodontal pathogens present in supragingival plaque at a 6-month time point. The rationale behind this finding is that supragingival plaque acted as a reservoir for re-infection of treated sites, and despite parental compliance with prophylaxis instructions, DS patients were unable to effectively control supragingival plaque.

Reference [48] in evaluated the impact of a 10-year preventive dental health program on the periodontal status of DS patients. The authors concluded that the program failed to prevent the progression of periodontitis and that immunological susceptibility rather than impaired oral hygiene was more at cause of the rapid tissue destruction. However, one major setback of this study is that the control group consisted of healthy individuals with no history of periodontal disease [49].

Conversely, [50] compared two groups of young adult DS patients. One of the groups consisted of subjects that regularly attended follow up maintenance and the second included patients that hadn’t in more a year. They found out that the interrupted group scored higher both in clinical parameters and the benzoyl-DL-arginine-naphthylamide test.

The heterogeneity of these studies in terms of study design, baseline clinical measurements, periodontal indices, radiographic techniques, follow up period, age groups and maintenance protocols, prevents a direct comparison. However, the recurring conclusion seems to be the high risk of periodontal disease progression as individuals with DS respond more aggressively to bacterial challenges, which remains a threat for implant stability. Systematic reviews studying standardized prophylactic approach for periodontal maintenance in DS patients are rare and still have not concluded on a specific method with superior outcome [51].

Therefore, more in-depth and personalized research about plaque control is necessary for this subject population, including studies on the efficacy of chemical agents and host modulating therapy as an adjunctive novel approach to contain periodontitis.

- Occlusion

DS subjects present a higher prevalence of Angle Class III, posterior and anterior crossbite, anterior open bite, bruxism, tongue thrusting, tongue hypotonia and macroglossia [52], [53]. Although the role of occlusion in peri-implant health is still subject to controversy with many differing opinions and there is currently no evidence-based implant-specific concept of occlusion, it is generally accepted that occlusal overload should be avoided to prevent biological and biomechanical failures [54], [55]. Though there is insufficient evidence to support or refute the relationship between parafunctional activities and implant failure, a careful approach is always recommended [56].

Some retrospective studies have suggested higher implant failures post immediate loading in subjects with bruxism [57]. 64.1% of implants in our review were gradually loaded, 3% were immediately loaded and 32.5% were not specified. 28.5% of the immediately loaded implants reported in our studies resulted in failure, against 18.6% of gradually loaded implants.

Reference [22] cautioned against immediate loading of implants in DS patients, given the high risk of failure in the osseointegration phase.

- Behavioral challenges

DS patients present with varying degrees of intellectual disability (low, moderate, severe) as well as a unique behavioral repertoire (challenging behavior, regression, withdrawal, non-compliance, deficits in verbal processing and speech, emotional instability). These challenges negatively impact the level of functioning and ability to acquire new skills within their environment [58]. As a consequence, DS patients experience of oral healthcare is very different from non-DS patients. This experience largely depends on the parents’ willingness and financial ability to seek dental care as easily as possible, access to said care, the dental team’s attitude and skills, the patient’s behavioral cooperation, the extent of unmet dental treatments, and subsequent support and information to caregivers.

With more difficult patients requiring more complex treatment, it’s not uncommon to resort to premedication, sedation or general anesthesia. In this review, 6 studies reported the use of general anesthesia, 6 studies allowed in chair treatment under local anesthesia, 1 study reported the use of conscious sedation for 1 patient, 1 study used intravenous sedation along with general anesthesia and 4 studies did not specify the type of anesthesia used.

Before indicating general anesthesia, it is necessary to know the risks entailed. Due to complex craniofacial and cardiovascular abnormalities, DS patients tend to have increased anesthetic complications and airway management difficulties [59]. Likewise, deep sedation does not come without risks. Reference [60] have found out that among patients with disabilities treated under IV deep sedation, DS patients were the most at risk of low peripheral oxygenation. The use of oral benzodiazepines for conscious sedation on patients with disruptive behavior is poorly documented [61].

In the absence of clear-cut guidelines and because an implant treatment involves multiple steps of varying degrees of technicality over many appointments, a concerted approach involving a multidisciplinary team of anaesthesiologists and cardiologists is necessary before embarking on this therapeutic option.

- Survival of implants

While a failing implant is easy to define, the same cannot be said for a successful implant. There has been a distinction in the literature between success and survival of implants. Success is used for implants placed in ideal conditions, whereas survival (satisfactory or compromised) describes implants placed in less-than-ideal conditions [62]. There has been much debate over the years about objective criteria for implant outcome, especially since many studies interchangeably use the terms success and survival [63].

The most commonly used criteria allow a loss of 0.2 mm marginal bone per year after an acceptable 1.0–1.5 mm in the first-year post implantation. The majority of studies in this review relied on radiographs to measure marginal bone loss. Some studies included probing and clinical mobility tests as well. After implant placement, some authors reported difficulties in taking x-rays and probing measures due to compliance problems of certain patients. This has led to some missing data in follow up visits. Moreover, marginal bone loss measurements were not standardized between the
studies, as some used long cone x-rays, others calculated mean values from panoramic radiographs or CBCTs. Not only are these radiographic calculations operator-sensitive and prone to errors, but the time interval needs to be sufficiently long to consider a successful outcome [64].

An adequate follow up period is indeed crucial to establish 5 and 10-year survival rates. However, with the exception for three studies [13], [17], [24], the rest of the research in this review reported results after short follow up periods of less than 4 years and most were isolated case reports involving one patient. The calculated survival rate of 80.7% can indicate an increased risk of failure with time. Lack of osseointegration, bone loss, oral habits and poor hygiene were attributed to the high failure rate.

More cases with bigger cohorts and longer follow up periods are needed for drawing definite conclusions about implant modalities in DS patients. These longer observation periods would also allow the addition of prosthesis assessment, patient satisfaction, economic and social impact as important parameters for a more comprehensive definition of success criteria.

V. CONCLUSION

Although the present review provided an important insight on advances made in implant therapy for DS patients, there is still a big gap of knowledge and more questions than answers. Most of our current understanding of implant outcome in DS patients in based on select case reports with short follow up time with a marked heterogeneity in implant parameters. Furthermore, while biological risk factors have been identified for DS patients, there is still lack of evidence-based information about their mechanism and contribution to early and late implant failure. Studies on DS patients have great social relevance, so as to enable higher quality of life for this population. Until better designed studies with rigorous methodology and control groups are available, careful patient selection and approach in planning the implant treatment is advisable. Parents and caregivers should be informed of the current scientific knowledge available about survival chances and prognoses.

REFERENCES


