Int. J. Oral Maxillofac. Surg. 2018; xxx: xxx–xxx
https://doi.org/10.1016/j.ijom.2018.02.010, available online at https://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Systematic Review
Dental Implants

Survival of dental implants placed in HIV-positive patients: a systematic review

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C. A. A. Lemos, F. R. Verri, R. S. Cruz, J. F. Santiago Júnior, L. P. Faverani, E. P. Pellizzer: Survival of dental implants placed in HIV-positive patients: a systematic review. Int. J. Oral Maxillofac. Surg. 2018; xxx: xxx–xxx.

Abstract. No consensus has been reached on the use of dental implants in human immunodeficiency virus (HIV)-positive patients. This systematic review evaluated dental implants in HIV-positive patients in terms of implant survival and success rates, marginal bone loss, and complications. The review was conducted according to the PRISMA checklist. Two independent reviewers performed a comprehensive search of the PubMed/MEDLINE, Scopus, and Cochrane Library databases for studies published until October 2017. Six studies were selected for review. In total, 821 implants were placed: 493 in 169 HIV-positive patients, and 328 in 135 HIV-negative patients. The mean duration of follow-up was 47.9 months. Weighted mean survival rate, success rate, and marginal bone loss values were calculated for the HIV-positive patients. Mean survival and success rates at the patient level (according to the number of patients) were 94.76% and 93.81%, respectively; when calculated at the implant level (according to the number of implants), these rates were 94.53% and 90.37%, respectively. Mean marginal bone loss was 0.83 mm at the patient level and 0.99 mm at the implant level. Thus, dental implants are suitable for the rehabilitation of HIV-positive patients with controlled risk factors and normal CD4+ cell counts.

Key words: dental implant; human immunodeficiency virus; complications; success; marginal bone loss; systematic review.

Accepted for publication 23 February 2018

Dental implants are considered a favourable treatment option for the rehabilitation of patients who present partial or total edentulism, as survival and success rates are high[1]. However, treatment longevity can be reduced in patients with a compromised medical status or systemic conditions[2]. In addition, the effects of general health problems on implant failure rates are still poorly documented[2], especially in human immunodeficiency virus (HIV)-positive patients[3].

Infection with HIV may lead to the development of acquired immunodeficiency syndrome (AIDS), which is associated with increased morbidity and mortality rates[4]. The virus attacks the immune system, especially CD4+ T-cells, and causes a reduction in host resistance to different pathogens[5,6]. Furthermore, some studies have linked the presence of HIV/AIDS to an increased risk of complications from oral surgical procedures[6,7].

Such an increased risk of complications may compromise implant survival and contribute to failures[8,9]. However, as a result of the introduction of highly active

0901-5027/000001+07

Please cite this article in press as: Lemos CAA, et al. Survival of dental implants placed in HIV-positive patients: a systematic review, *Int J Oral Maxillofac Surg* (2018), https://doi.org/10.1016/j.ijom.2018.02.010

antiretroviral therapy (HAART), HIV/AIDS is becoming a chronic disease, and the life expectancy of patients with HIV/AIDS has increased due to an increase in their immunological resistance[6,10]. As a result, more HIV-positive patients are likely to seek dental treatment, including dental implants, for oral rehabilitation.

No consensus has been reached concerning the risks associated with dental implant placement in HIV-positive patients. This systematic review was performed to evaluate the clinical performance of implants placed in HIV-positive patients. The null hypotheses were as follows: (1) the survival rate of implants in HIV-positive patients is similar to that in HIV-negative patients; (2) marginal bone loss and complications in HIV-positive patients are similar to those in HIV-negative patients.

Materials and methods

Registry protocol

This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist[11] and in accordance with models proposed in the literature[12–14]. Furthermore, the methods used in this systematic review have been registered in the International Prospective Register of Systematic Reviews (PROSPERO; CRD42017059318).

Eligibility criteria

The focused question addressed was ''Are dental implants placed in HIV-positive patients at increased risk of implant failure, marginal bone loss, and complications?'' The primary outcome evaluated was the implant survival rate, and secondary outcomes were the implant success rate, marginal bone loss, and complication rate.

Study types eligible for inclusion were randomized controlled trials (RCTs), prospective studies, and retrospective studies (retrospective studies were included because of the limited number of RCTs and prospective studies available). All studies reported the survival rates of implants in HIV-positive patients and were published in English. In vitro studies, animal studies, case series, case reports, and reviews were excluded.

Information sources and search

Two independent authors (C.A.A.L. and R.S.C.) conducted an electronic search of the PubMed/MEDLINE, Scopus, and Cochrane Library databases for articles published up until October 2017. The key words used were: (HIV [MeSH Terms] and Dental implants [MeSH Terms]) OR (Human Immunodeficiency Virus [All Fields] and Dental implants [MeSH Terms]) OR (AIDS [All Fields] and dental implants [MeSH Terms]) OR (Acquired Immunodeficiency Syndrome [MeSH Terms] and dental implant [MeSH Terms]). The same researchers performed a manual search of the following journals: *Clinical Implant Dentistry and Related Research*, *Clinical Oral Implants Research*, *Implant Dentistry*, *International Journal of Oral and Maxillofacial Implants*, *International Journal of Oral and Maxillofacial Surgery*, *Journal of Clinical Periodontology*, *Journal of Dentistry*, *Journal of Oral and Maxillofacial Surgery*, *Journal of Oral Implantology*, *Journal of Oral Rehabilitation*, *Journal of Periodontology*, and *Periodontology 2000*. In addition, OpenGrey (http://www.opengrey.eu) was used to search the grey literature.

Data collection process

One author (C.A.A.L.) collected relevant information from the articles and a second author (L.P.F) checked all of the information collected. A careful analysis was performed to check for disagreements among the authors. Any such disagreements were resolved through discussion with a third author (J.F.S.J) until a consensus was reached.

Risk of bias

Two investigators (C.A.A.L. and F.R.V.) assessed the methodological quality of the studies using the Newcastle–Ottawa scale (NOS) for cohort studies, which is based on three major components: selection, comparability, and outcome. According to the NOS, a maximum of nine stars can be given to a study, which represents the highest quality. A score of five or fewer stars indicates a high risk of bias, while a score of six or more stars indicates a low risk of bias[15].

Additional analyses

The kappa statistic (κ) was used to determine inter-reader agreement during the article selection process in the database search. Weighted mean values for marginal bone loss, survival rate, and success rate were calculated using Microsoft Excel (Microsoft Corp., Redmond, WA, USA).

Results

Study selection

The database search retrieved 360 articles: 143 from PubMed/MEDLINE, 145 from Scopus, 57 from the Cochrane Library, and 15 from other sources (hand-search and grey literature). After reading the titles and abstracts against the eligibility criteria, eight articles remained. Two articles were excluded after full-text reading: one reported a duplicate sample of patients and data from another included article[16], and one was an editorial article[17]. Ultimately, six articles reporting four observational studies[3,8,9,18] and two retrospective studies[19,20] were included in this systematic review (Fig. 1). Three of the studies only evaluated HIV-positive patients[8,9,20], and three compared HIV-positive and HIV-negative patients[3,18,19].

The inter-investigator agreement for articles selected from PubMed/MEDLINE ($\kappa = 1.0$), Scopus ($\kappa = 0.81$), and the Cochrane Library ($\kappa = 1.0$) indicated a high level of agreement[21].

Study characteristics

A total of 821 implants were placed in 304 patients: 493 implants in 169 HIV-positive patients, and 328 implants in 135 HIV-negative patients. The mean age of the patients was 51.6 years. The mean follow-up period was 47.9 months (range 6–120 months). Implants were most often placed in the mandible. There were several variations in the implant systems used, including length (range 8–16 mm) and diameter (range 3.3–5 mm). The quantitative and qualitative study data are summarized in Tables 1 and 2.

The patients had a mean CD4+ T-cell count of <550 cells/mm^3 in the majority of studies. However, in the study by Gherlone et al.[9], the mean count was 726.3 cells/mm^3. Antiretroviral therapy was reported in four studies[3,8,18,20], all of which used HAART. One of the selected studies compared two groups: group 1 patients had been treated with protease inhibitor (PI)-based HAART and group 2 patients had been treated with non-nucleoside reverse transcriptase inhibitor (NNRTI)-based HAART (without a PI)[3]. The study found that antiretroviral therapy did not influence the implant survival rate.

Four studies reported the use of prophylactic drug therapy with antibiotics (amoxicillin with or without clavulanic acid)[3,9,18,20]. Two studies reported the use of anti-inflammatory drugs postoperative (sodium diclofenac, paracetamol, or piroxicam)[3,20]. One study did not use pro-

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