

Criteria for Success in Dental Implants: A Systematic Review

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Abstract: ***Aim and Objective:** The purpose of this study was to examine the most frequently used criteria to define treatment success in implant dentistry. **Materials and Method:** An electronic search in the MEDLINE/PubMED database was performed for studies published in English from January 1980 until October 2010. The search strategy included the following key word combinations: 'success criteria AND 'implant', 'success rates' AND 'implant', 'survival rates' AND 'implant', and 'outcomes' AND 'implant dentistry'. **Results:** The electronic and manual search yielded 2 randomized clinical trials and 15 prospective. In total, 17 publications were suitable for analysis. Some of the included articles had mixed data reporting on more than one type of prosthesis. Most of the articles included four most used parameters which are taken into consideration are the implant fixture, the peri-implant soft tissue, prosthetic level and also patient's satisfaction. **Conclusion:** Each criteria has its own consideration to be evaluated in order to determine success. Pain, mobility and bone loss are the most commonly used criteria to report success at the implant level. Suppuration and probing depth are the frequently used criteria at peri-implant soft tissue level. As for prosthetic level, the commonly used criteria include function and esthetics while patient's satisfaction is commonly considered a success if comfort and appearance satisfaction are achieved. The reported success rate consistently decreased when the number of parameters included for the assessment of success was increased.*

Keywords: implant success criteria, implant survival rates, implant success rate, implant dentistry outcome, implant dentistry

1. Introduction

Research and technology of implants has made a revolutionary change during the last two decades in thereplacement of missing teeth with endosseous implants the standard care and an implant supported prosthesis as the first line of treatment and long lasting rehabilitation. Over the pass thirty years, success and survival in implant dentistry has been evaluated by the survival rate, radiographic crestal bone loss, prosthesis stability and also the presence of peri-implant diseases.[1-6] Albrektsson and colleagues[1] proposedcriteria for the assessment of implant success, to determine implant survival and clinical evidence of successful osseointegration, which is the most commonly accepted criteria.

There are many new parameters that have been introduced to assess success in implant restorations, which includes health status and natural-looking peri-implant soft tissues, aesthetics and patient fulfilment. However, osseointegration remains as an important parameter in implant dentistry. It appears to be coherent that the current meaning of success criteria ought to be comprehensive, to incorporate these additional factors.[6-10]

This systematic review is done to find out the most frequently used criteria to determine success of treatment in implant dentistry.

2. Materials and Methods

The search strategy involves the MEDLINE/PubMED database electronic search. The key word which was searched include: 'implant success criteria', 'implant

survival rates', and 'implant dentistry outcome'.The search for studies in English which were published from January 1980 until October 2010.

This systematic review focuses on specific studies of success and survival rate of implants, therefore, a few inclusion criteria were used to conduct the studies selection. The inclusion criteria include studies with five-year follow up (minimum), studies which involves at least 10 patients, studies reporting on success or survival criteria used to assess the outcomes of a treatment. The success rate of implant of the selected articles are the primary outcome variable. The studies were grouped according to four differentiated clinical situations which are implant fixed complete dental prostheses (FCDP), implant overdentures (IOD), fixed partial dentures (FPD), and single crowns (SC). This is done so to ensure the homogeneity of the result. The parameters used to define success are the secondary outcome variables: implant fixtures, peri-implant soft tissue, prosthesis, and patient's evaluation.

3. Results

Identification of Studies

The initial search according to the key words yielded 231 citations. Out of the 231 studies, 214 studies were excluded as the studies did not meet the inclusion criteria. A majority of the studies did not have either a minimum follow-up period of 5 years, less than 10 patients in the study and/or did not have a detailed report on the survival and success rate of implant and the treatment outcome. After two rounds of inclusion and exclusion, a total of 17 studies were eligible for analysis.

Included studies

A total of 17 articles satisfy the inclusion criteria and were suitable for analysis. The included studies are of 2

randomized clinical trials and 15 perspective studies. Some of the studies reported more than one type of prosthesis.

Table 1: Selected Articles Classified according to Their Implant Prosthetic Design

Clinical situation	Study	Patients	Follow up (years)	Criteria	Success/Survival Rate
Implant Fixed Complete Dental Prostheses (FCDP)	Degidi <i>et al.</i> , 2009 [11]	38	5	Based on Albrektsson <i>et al.</i> , 1986	100% for implants; 100 % for prostheses
	Fischer <i>et al.</i> , 2008 [12]	24	5	Self-defined criteria	95.2% for implants; 100% for prostheses
	Rasmussen <i>et al.</i> , 2004[13]	36	10	Self-defined criteria	96.9% for implants; 100% for prostheses
	Astrand <i>et al.</i> , 2004 [14]	66	5	Based on Albrektsson <i>et al.</i> , 1986	96.30%
	Buser <i>et al.</i> , 1997[15]	1003	Up to 8 yrs	Based on Buser <i>et al.</i> , 1990	97.3% for 5 yrs; 93.3 % for 8 yrs
	Romeo <i>et al.</i> , 2004[16]	255	1.3~7 (Mean: 3.85)	Based on Albrektsson <i>et al.</i> , 1986 & Buser <i>et al.</i> , 1990	63.8 % for prostheses
Implant Overdentures (IO)	Ma <i>et al.</i> , 2010[17]	79	10	Based on Albrektsson <i>et al.</i> , 1986	85.9% for 5 yrs; 74.5 % for 10 yrs
	Al Fadda <i>et al.</i> , 2009[18]	77	5	Based on Albrektsson & Zarb, 1998	98%
	Zinsli <i>et al.</i> , 2004[19]	149	10	Based on Buser <i>et al.</i> , 1990	98.70%
	Buser <i>et al.</i> , 1997	1003	Up to 8 yrs	Based on Buser <i>et al.</i> , 1990	97.3% for 5 yrs; 93.3 % for 8 yrs
	Romeo <i>et al.</i> , 2004	255	1.3~7 (Mean: 3.85)	Based on Albrektsson <i>et al.</i> , 1986 & Buser <i>et al.</i> , 1990	63.8 % for prostheses
Implant Fixed Partial Denture (FPD)	Payer <i>et al.</i> , 2010[20]	24	5	Self-defined criteria	92.50%
	Degidi <i>et al.</i> , 2009	72	5	Based on Albrektsson <i>et al.</i> , 1986	99.4% for implants, 100% for prostheses
	Glauser <i>et al.</i> , 2007[21]	38	5	Based on Albrektsson <i>et al.</i> , 1986	97.10%
	Bornstein <i>et al.</i> , 2005[22]	51	5	Based on Buser <i>et al.</i> , 1990	99%
	Zinsli <i>et al.</i> , 2004	149	10	Based on Buser <i>et al.</i> , 1990	98.70%
	Romeo <i>et al.</i> , 2004	255	1.3~7 (Mean: 3.85)	Self-defined criteria	63.8 % for prostheses
	Buser <i>et al.</i> , 1997	1003	Up to 8 yrs tients	Based on Buser <i>et al.</i> , 1990	97.3% for 5 yrs; 93.3 % for 8 yrs
	Weber <i>et al.</i> , 2000[23]	46	5	Self-defined criteria	99.10%
Implant Single Crown (SC)	Payer <i>et al.</i> , 2010	24	5	Self-defined criteria	92.50%
	Degidi <i>et al.</i> , 2009	38	5	Based on Albrektsson <i>et al.</i> , 1986	100% for implants; 100% for prostheses
	Glauser <i>et al.</i> , 2007	38	5	Based on Albrektsson <i>et al.</i> , 1986	97.10%
	Bornstein <i>et al.</i> , 2005	51	5	Based on Buser <i>et al.</i> , 1990	99%
	Romeo <i>et al.</i> , 2004	255	1.3~7 (Mean: 3.85)	Based on Albrektsson <i>et al.</i> , 1986 & Buser <i>et al.</i> , 1990	75.6 % for prostheses
	Zinsli <i>et al.</i> , 2004	149	10	Based on Buser <i>et al.</i> , 1990	98.70%
	Buser <i>et al.</i> , 1997	1003	Up to 8 yrs tients	Based on Buser <i>et al.</i> , 1990	97.3% for 5 yrs; 93.3 % for 8 yrs
	Weber <i>et al.</i> , 2000	46	5	Self-defined criteria	99.10%
	Rocuzzo <i>et al.</i> , 2008[24]	27	5	Self-defined criteria	100%
Wennstrom <i>et al.</i> , 2005[25]	36	5	Self-defined criteria	97.70%	

Six articles reported on Implant Fixed Complete Dental Prosthesis, five articles were on Implant Over Dentures, eight articles reported on Implant Fixed Partial Denture and Single Crown was reported by ten articles.

To determine the success of implant, most of the articles included four most used parameters which are taken into consideration are the implant fixture, the peri-implant soft tissue, prosthetic level and also patient's satisfaction. Each

criteria has its own consideration to be evaluated in order to determine success. Pain, mobility and bone loss are the most commonly used criteria to report success at the implant level. Suppuration and probing depth are the frequently used criteria at peri-implant soft tissue level. As for prosthetic level, the commonly used criteria include function and esthetics while patient's satisfaction is commonly considered a success if comfort and appearance satisfaction are achieved.

Table 2: Reported Success Criteria as Described in All Selected Articles

Success Criteria		FCDP	IOD	FPD	SC
		(6 articles)	(5 articles)	(8 articles)	(10 articles)
Implant level	Pain	4	5	5	7
	Annual bone loss < 0.2 mm thereafter	2	3	4	3
	Radiolucency	3	3	5	7
Peri-implant soft tissue	Mobility	5	5	6	8
	Probing depth > 3 mm	2	1	2	2
	Suppuration	3	3	5	6
	Bleeding	2	0	0	0
	Swelling	1	0	0	0
	Recession	1	0	0	0
Prosthetic level	Minor complications (chairside approach)	2	0	0	0
	Major complications/failures	2	0	1	0
	Esthetics	1	0	0	0
	Functional	1	2	3	3
Patient satisfaction	Discomfort/paresthesia	4	4	1	4
	Satisfaction with appearance	1	0	4	1
	Ability to chew	1	0	0	0
	Ability to taste	1	0	0	0

Table 3 shows the range of success rate of implant for each of the number of parameter included. As the number of parameter adds up, the range of success rate decreases.

Table 3: Number of Included Parameters and Success Rate

No. of Parameters	FCPD (6 articles)		FPD (8 articles)		IOD (5 articles)		SC (10 articles)	
	Reported Articles	Range of Success Rate	Reported Articles	Range of Success Rate	Reported Articles	Range of Success Rate	Reported Articles	Range of Success Rate
1	6 (100%)	95.2%-100%	8 (100%)	92.5%-100%	5 (100%)	63.8%-98.7%	10 (100%)	75.6%-100 %
2	-	-	2 (25%)	98.7%-99.1%	1 (20%)	74.5%-85.9%	4 (40%)	97.7 %-99.1%
3	4 (66.7%)	92.7%-100%	4 (50%)	93.3%-100%	2 (40%)	93.3%-98%	4 (40%)	97.1 %-100%
4	2 (33.3%)	63.8%	1 (12.5%)	63.8%	1 (20%)	63.80%	1 (10%)	75.60%

4. Discussion

As shown in Table 3, there is a constant decrease in the rate of success when there is an increase in the number of parameters included. This indicated that as the higher the number of parameter are considered in an implant, the chances of a successful implant thins down as many aspects need to be taken into consideration and evaluated to measure the outcome. The four most used parameters in this systemic review included the implant level, peri-implant soft-tissue level, prosthesis level, and the patient's subjective assessment. Besides that, aesthetics is also as important in dentistry and sets a benchmark for the inclusion of other various factors to measure the success of implant prostheses.

The success or failure of dental implants is influenced by many factors. Well-defined criteria that report and evaluate outcomes and also complications should ideally be used. [26] Many modifications have been made throughout the years that involves other parameters, for example; aesthetics and patient-centered outcome as a criteria to measure success on dental implants.

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