

REVIEW ARTICLE



Survival of short dental implants ≤ 7 mm: A review

Papi Piero, Condello Lorenzo, Rosella Daniele, Giardino Rita, Piccoli Luca, Pompa Giorgio

Department of Oral and Maxillofacial Sciences, "Sapienza" University of Rome, Rome, Italy

Correspondence

Papi Piero, Department of Oral and Maxillofacial Sciences, "Sapienza" University of Rome, Via Caserta 6, 00161, Rome, Italy.
Tel.: +00393934360087.
Email: papi.piero@gmail.com

Received 02 October 2015;
Accepted 04 November 2015

doi: 10.15713/ins.ijcdmr.89

How to cite this article:

Papi Piero, Condello Lorenzo, Rosella Daniele, Giardino Rita, Piccoli Luca, Pompa Giorgio, "Survival of short dental implants ≤ 7 mm: A review," Int J Contemp Dent Med Rev, vol.2015, Article ID: 011015, 2015.
doi: 10.15713/ins.ijcdmr.89

Abstract

The first long-term successful outcome of short dental implants was demonstrated by Frieberg *et al.* in 1991, however, the definition of "short" implants is still controversial and without uniform consensus nowadays. The specific aim of this review was to evaluate and to compare cumulative survival rate (CSR) of short dental implants of the two groups. The survival rate of short dental implants was the primary outcome variable to be extracted and analyzed. An electronic search was conducted through the Medline (PubMed) database of the National Library of Medicine, and EMBASE to find all relevant articles published between January 1, 1990, and April 30, 2015. The electronic search identified 347 publications, which were all carefully screened by title and abstract. About 65 articles qualified for a thorough full-text analysis: 35 studies were excluded because CSR% was not calculable. Finally, 30 studies with relevant data on CSR were selected to be included in this review. Articles were divided into two groups: All relevant articles published between 1991 and 2000 as Group 1 and between 2001 and 2015 as Group 2. In Group 1 CSR was $83.53\% \pm 19.46\%$, a considerable statistically significant difference compared to $93.65\% \pm 7.94\%$ of Group 2. This review further identified the causes of failure: In Group 1 the majority of short implant failures occurred early, within the first 4 months, for an insufficient quantity of bone tissue. In Group 2, causes of early failures considered were low bone quality while prosthetic reasons were responsible for delayed failures.

Keywords: Short dental implants, short implants, survival rate

Introduction

The first long-term successful outcome of short dental implants was demonstrated by Frieberg *et al.* in 1991,^[1] however, the definition of "short" implants is still controversial and without uniform consensus nowadays. In many studies, dental implants < 8 mm were defined as "short" while several authors considered also implants < 10 mm.^[1-4] In this review, the authors considered "short" dental implants with length < 7 mm, because < 7 mm was the length examined by the articles that were available and consequently selected. Articles were divided into two groups: All relevant articles published between 1991 and 2000 as Group 1, and between 2001 and 2015 as Group 2. The specific aim of this review was to evaluate and to compare cumulative survival rate (CSR) of short dental implants of the two groups.

Materials and Methods

Search strategy

The systematic review was conducted by following previously outlined recommendations and preferred reporting items for

systematic reviews and meta-analysis principles.^[5] The survival rate of short dental implants was the primary outcome variable to be extracted and analyzed. Implant survival was defined as "the presence of an implant with or without complications during the follow-up period."^[6,7]

The electronic search was conducted through the Medline (PubMed) database of the National Library of Medicine, and EMBASE to find all relevant articles published between January 1, 1990, and April 30, 2015.

Key words used in this meta-analysis were "dental implant," "short implant," "ultra-short implant," "survival rate," "short implant failure," and "ultra-short implant failure."

These terms were also combined with AND/OR to perform the searches. Moreover, a manual search of the following journals from 1990 to 2015 was conducted: Clinical Oral Implant Research, International Journal of Oral and Maxillofacial Implants, Clinical Implant Dentistry and Related Research, Journal of Periodontology, Journal of Clinical Periodontology, International Journal of Periodontics and Restorative Dentistry, Quintessence International.

Titles, abstracts, and full-text articles were screened; duplicated articles were eliminated.

To be included in this review, articles had to fulfill the following inclusion criteria:

1. Length of dental implants clearly defined
2. Implant survival rate clearly indicated or calculable from data reported in the text
3. Failure criteria clearly defined
4. Dental implant treatment sites specified
5. Total number of short dental implants with diameter and length
6. Publication in English.

All types of studies were included; they were divided for a quality assessment according to the levels of Evidence Based Medicine of the Oxford Centre. Two reviewers (Papi Piero, Condello Lorenzo) independently identified the studies obtained from the search based on an initial title.

Statistical analysis

Specific statistical software (IBM SPSS V10 Statistics, IBM, Armonk, USA) was used to analyze the data. Articles were divided into two groups: Group 1 from 1990 to 2000 and Group 2 from 2001 to 2015. Mean CSR% were extracted from each article and computed for the two groups.

Results

The electronic search identified 347 publications, which were all carefully screened by title and abstract. About 65 articles qualified for a thorough full-text analysis: 35 studies were excluded because CSR% was not calculable. Finally, 30 studies with relevant data on CSR were selected to be included in this review. The procedural flow chart of the study selection process is shown in Figure 1. Articles selection resulted in 1 randomized controlled trial, 1 systematic review, 11 cohort prospective studies, 11 cohort retrospective studies, and 6 case-control studies [Table 1]. A descriptive overview of the

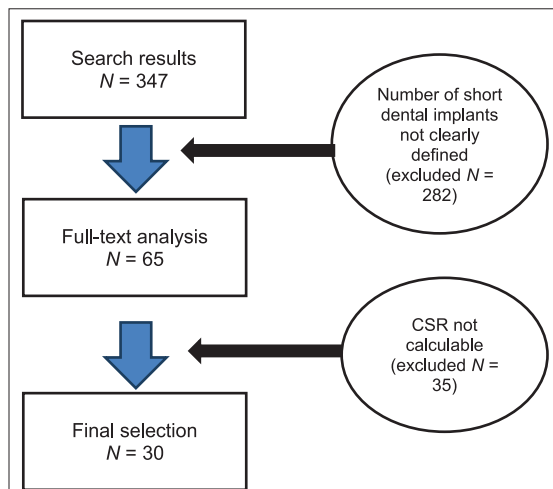


Figure 1: Preferred reporting items for systematic reviews and meta-analysis flow diagram

eligible studies and the data extracted from them is reported in Table 2. A total of 3854 short dental implants were utilized in these articles: 7 mm length dental implants were placed in 20 studies, 6 mm length in 14 articles and 5 mm length in just 3 papers [Table 2]. Mean follow-up period was 4.15 ± 3.85 months (range: 4-96 months) [Table 3]. Articles were divided into two groups: Group 1 from 1990 to 2000 and Group 2 from 2001 to 2015. Fourteen articles were included in Group 1 while 16 articles composed Group 2. CSR was $83.53\% \pm 19.46\%$ in the first group and $93.65\% \pm 7.94\%$ in Group 2 [Table 4].

Discussion

In clinical practice, short dental implants were considered having lower survival rate compared to standard length implants.^[1,2] However, their application was limited to atrophic jaws and non-ideal/compromised alveolar situations, therefore registering lower CSR values.^[8,9] The definition of “short dental implants” is still controversial nowadays: According to the authors only dental implants with a length ≤ 7 mm should be considered, as in this review. In Group 1 CSR was $83.53\% \pm 19.46\%$, a considerable statistically significant difference compared to $93.65\% \pm 7.94\%$ of Group 2 [Tables 3 and 4]. This review further identified the causes of failure: In Group 1 the majority of short implant failures occurred early, within the first 4 months, for the insufficient quantity of bone tissue.^[36] In Group 2, causes of early failures considered were low bone quality, while prosthetic reasons were responsible for delayed failures.

Conclusions

CSRs were lower for dental implants with a standard diameter compared to larger diameters. According to the authors, short dental implants can avoid bone augmentation procedures, therefore representing an excellent clinical option for patients with insufficient bone quantity on a case-by-case basis.

Table 1: Levels of EBM, Oxford Centre

Levels of evidence	Characteristics	Number included
1a	Systematic review	1
1b	RCT	1
2a	Systematic review of cohort studies	-
2b	Prospective cohort studies	11
2c	Retrospective cohort studies	11
3a	Systematic review of case-control studies	-
3b	Case-control studies	6
4	Clinical reports	-
5	Expertise opinion	-

RCT: Randomized controlled trials, EBM: Evidence Based Medicine

Table 2: Descriptive overview of the data extracted from the reviewed studies

Study (first author and year)	Type of study	Number of patients	Number of short implants	Diameter	Length
Friberg <i>et al.</i> , 1991 ^[11]	Retrospective	889	793	-	7
Triplett <i>et al.</i> , 1991 ^[9]	Retrospective	28	46	3.75	7
Jemt, 1994 ^[29]	Case-control	67	54	-	7
Nevins and Langer, 1993 ^[3]	Retrospective	338	119	-	7
Lekholm <i>et al.</i> , 1994 ^[4]	Prospective	159	120	3.75, 4	7
Jemt and Lekholm, 1995 ^[10]	Retrospective	150	298	4	7
ten Bruggenkate <i>et al.</i> , 1998 ^[11]	Prospective	126	253	3.5 e 4.1	6
Grunder <i>et al.</i> , 1999 ^[12]	Prospective	143	5	3.75	7
Renouard <i>et al.</i> , 1999 ^[8]	Prospective	74	50	5	6
Snauwaert <i>et al.</i> , 2000 ^[30]	Case-control	1315	194	3, 3.3, 4, 5	6 e 7
Becker <i>et al.</i> 1999 ^[28]	Prospective	212	13	3.75, 4, 5	6 e 7
Lekholm <i>et al.</i> , 1999 ^[7]	Prospective	127	101	3.75 e 4	7
Friberg <i>et al.</i> , 2000 ^[13]	Retrospective	49	260	3.75 e 5	6 e 7
Bahat, 2000 ^[14]	Case-control	202	92	3.75, 4, 5	6 e 7
Testori <i>et al.</i> , 2001 ^[15]	Prospective	181	7	3.25, 3.75, 4, 5, 6	7
Deporter <i>et al.</i> , 2001 ^[16]	Case-control	24	32	3.5, 4.1, 5	7
Nedir <i>et al.</i> , 2004 ^[17]	Prospective	236	6	-	6
Tawil and Younan, 2003 ^[18]	Case-control	111	43	3.3, 3.75, 4, 5	6 e 7
Weng <i>et al.</i> , 2003 ^[19]	Prospective	493	27	3.25, 3.75, 4, 5, 6	7
Fugazzotto <i>et al.</i> , 2004 ^[20]	Retrospective	325	16	4.1, 4.8, 4.9	6+
Renouard and Nisand, 2005 ^[21]	Retrospective	85	33	3.75, 4, 5	6 e 7
Rokni <i>et al.</i> , 2005 ^[22]	Prospective	74	72	-	5 e 7
Gentile <i>et al.</i> , 2005 ^[2]	Retrospective	35	45	5 e 6	5.7 e 6
Arlin, 2006 ^[23]	Case-control	264	35	4.1 e 4.8	6
Bischof <i>et al.</i> , 2006 ^[24]	Prospective	212	4	-	6
Maló <i>et al.</i> , 2007 ^[25]	Retrospective	237	131	3.75 e 4	7
Felice <i>et al.</i> , 2009 ^[26]	RCT	30	60	6	5
Anitua and Orive, 2010 ^[27]	Retrospective	661	148	2.5, 3, 3.3, 3.5, 3.75, 4, 4.5, 5, 5.5, 6	6.5 e 7
Srinivasan <i>et al.</i> , 2014 ^[34]	Systematic review	983	690	-	6
Demiralp <i>et al.</i> , 2015 ^[35]	Retrospective	111	118	3, 3.5, 4, 4.5, 5	5, 6 e 7

Table 3: Mean follow-up period and CSR%

Study (first author and year)	Type of study	Length	CSR (%)	Follow-up (months)
Friberg <i>et al.</i> , 1991 ^[11]	Retrospective	7	94.45 (749/793)	36
Triplett <i>et al.</i> , 1991 ^[9]	Retrospective	7	96 (44/46)	15-62
Jemt, 1993 ^[29]	Case-control	7	90.7 (49/54)	60
Nevins and Langer, 1993 ^[3]	Retrospective	7	92.43 (110/119)	72
Lekholm <i>et al.</i> , 1994 ^[4]	Prospective	7	93.3 (112/120)	60
Jemt and Lekholm, 1995 ^[10]	Retrospective	7	73.82 (220/298)	60
ten Bruggenkate <i>et al.</i> , 1998 ^[11]	Prospective	6	97 (246/253)	84
Grunder <i>et al.</i> , 1999 ^[12]	Prospective	7	20 (1/5)	12-36
Renouard <i>et al.</i> , 1999 ^[8]	Prospective	6	89.74 (35/39)	12

(Contd...)

Table 3: (Continued...)

Study (first author and year)	Type of study	Length	CSR (%)	Follow-up (months)
Sнауwaert <i>et al.</i> , 1999 ^[30]	Case-control	6, 7	78.35 (152/194)	6-12
Becker <i>et al.</i> , 1999 ^[28]	Prospective	6, 7	69.23 (9/13)	72
Lekholm <i>et al.</i> , 1999 ^[7]	Prospective	7	94.05 (95/101)	96
Friberg <i>et al.</i> , 2000 ^[13]	Retrospective	6, 7	93.4 (243/260)	96
Bahat, 2000 ^[14]	Case-control	6, 7	87 (80/92)	60
Testori <i>et al.</i> , 2001 ^[15]	Prospective	7	99.3 (6/7)	48
Deporter <i>et al.</i> , 2001 ^[16]	Case-control	7	100 (32/32)	32.6
Nedir <i>et al.</i> , 2003 ^[17]	Prospective	6	100 (6/6)	84
Tawil and Younan, 2003 ^[18]	Case-control	6, 7	88.37 (38/43)	12-92
Weng <i>et al.</i> , 2003 ^[19]	Prospective	7	74 (20/27)	72
Fugazzotto <i>et al.</i> , 2004 ^[20]	Retrospective	6	100 (16/16)	73-84
Renouard and Nisand, 2005 ^[21]	Retrospective	6, 7	90.9 (30/33)	36-48
Rokni <i>et al.</i> , 2005 ^[22]	Prospective	5, 7	97.22 (70/72)	60
Gentile <i>et al.</i> , 2005 ^[2]	Retrospective	5, 6, 7	93.33 (42/45)	24.5
Arlin, 2006 ^[23]	Case-control	6	94.3 (33/35)	31.7
Bischof <i>et al.</i> , 2006 ^[24]	Prospective	6	75 (3/4)	12-60
Maló <i>et al.</i> , 2007 ^[25]	Retrospective	7	96.18 (126/131)	60
Felice <i>et al.</i> , 2009 ^[26]	RCT	5	98.33 (59/60)	4
Anitua and Orive, 2010 ^[27]	Retrospective	5, 6, 7	99.3 (147/148)	36.18
Srinivasan <i>et al.</i> , 2013 ^[34]	Systematic review	6	96.4 (665/690)	12-96
Demiralp <i>et al.</i> , 2015 ^[35]	Retrospective	≤ 7	95.76 (113/118)	23

RCT: Randomized controlled trials, CSR: Cumulative survival rate

Table 4: Group 1 and Group 2 analysis

Variable	1991-2000 (14 articles)	2001-2015 (16 articles)
Number of short implants	2387	1467
Length (mm)	6, 7	5, 6, 7
Diameter (mm)	3, 3.3, 3.5, 3.75, 4, 4.1, 5	2.5, 3, 3.25, 3.3, 3.5, 3.75, 4, 4.1, 4.5, 4.8, 4.9, 5, 5.5, 6
Mean follow-up	4.25 years (range: 6-96 months)	4.15 years (range: 4-96 months)
CSR (%)	83.53 \pm 19.46	93.65 \pm 7.94

CSR: Cumulative survival rate

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