Success and Survival Rates of Zirconia Implants

Systematic Review

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INTRODUCTION

In the past 40 years, titanium has been considered the "gold standard" in the manufacture of implants. Zirconia ceramic (zirconium dioxide ZrO_2) has emerged as an alternative, to the need to improve aesthetics.[1] This material has been used in orthopaedic surgery, like the titanium was before it.[2] Studies confirm the advantages of zirconia implants conferring better aesthetics, more biocompatibility, greater resistance to masticatory forces, increased soft tissue tolerance and less potential for bacterial colonization, when compared to titanium implants.[3-7]

OBJECTIVE

Analyse success and survival rates of zirconia implants in clinical trials. Can zirconia implants be recommended for clinical daily practice?

MATERIALS AND METHODS

Research in Medline/PubMed, COCHRANE CENTRAL and Scopus databases with the following keywords: "zirconia", "zirconium", "implant" and "implants" in different combinations. Were only included series of human clinical trails, in which, success and/or survival rates were evaluated. Single case clinical reports were excluded. 28 studies were obtained, eight of them excluded due to common samples previous analysed. In this review, a total of 20 studies were described.

RESULTS AND DISCUSSION

In eight trials, a distinction was made between success and survival rates.[8, 12-14, 17, 21, 23, 25] In the studies that evaluated survival rates (SR), the values were 60–100% up to two years of follow-up, 86–100% between two to four years, and 58.5–97.6% for more than five years. The success rate values for most of the trials[9, 15-16, 18-20, 22, 26-27] is between 91.7–100%, being only 66% in two studies[10-11] from the same author.

The SR considers a surviving implant, if it still remains minimally osseointegrated. The "success concept" varied between the studies reviewed.

Most of the studies didn't specify if the implant was placed in a fresh or cicatrized extraction socket. Never the less, results were comparable to titanium[10-12, 14-17, 20-22, 24-26].

Trials conducted with single crown rehabilitations[8-10, 12, 14-15, 17, 23, 26] obtained a 92–97.6% SR. A publication using two-piece implant[23] recorded a 86%, meanwhile a study on fresh extraction sockets[9] registered a 60%.

Trials with complete denture rehabilitation reported disparate SR values (90.9% and 67%) using the same implants and prosthetic design; Siddiqui et al. compared them with titanium obtaining similar results (66.7%), justifying this values with the prosthetic design.[13, 18]

One piece implants were used in most of the studies, except in four in which the authors used two-piece implants. In 3/4 trials[14, 17, 21], SR was 93.3–96.5% and 86% in the other one[23] (1/4). The microgap absence in one-piece implants is the success factor according to Borgonovo et al.[20, 22]

Table 1. Results up to 1–2 of follow-up years.

Authors	Study	Patients	Implants	Brand and (Ø/L)	Follow-up	Survival Rate	Success Rate	Prothesis / Definitive loading
Pirker et al. 2009[8]	PC	18	GR A – 6 RS GR B – 12 MR	Manufactured in Zi blocks	2 years	GR A – 0% GR B – 92%	NR	SC / 3–13 months
Cannizzaro et al. 2010[9]	RCT	40	40	Z–Look 3 (Z-Systems) 3.25–6 mm / 10–15.5 mm	1 year	97% CES 60% FES	100%	SC / 4–5 months
Kohal et al. 2012[10]	CPC	65	66	ZiUnite (Nobel) 4.3–5 mm / 10 mm	1 year	95.4%	66% G I 86% G II	SC / Md 6 weeks; Mx 14 weeks
Kohal et al. 2013[11]	CPC	28	56	ZiUnite (Nobel) 4.3–5 mm / 10–16 mm	1 year	98.2%	60%	SC and FPD / Md 6 weeks; Mx 14 weeks
Payer et al. 2013[12]	CPC	20	20	White-Sky (Bredent) 3.5–4.5 mm / 8–16 mm	2 years	95%	NR	SC / 4 months
Osman et al. 2014[13]	RCT	24	73	Southern Implants 3.8–5 mm / 10–13.5 mm	1 year	90.9%	NR	OD / 4 months
Becker et al. 2015[14]	CPC	52	52	ZV3 (Zircon Vision) 4.5–5 mm / 9–13 mm	2 years	95.8%	NR	SC / Md 10 weeks; Mx 12 weeks
Gahlert et al. 2015[15]	CPC	44	44	PURE (Straumann) 4.1 mm / 8–14 mm	1 year	97.6%	97.6%	SC / 24–28 weeks
Jung et al. 2015[16]	CPC	60	71	VITA Zahnfabrik 4–5.5 mm / 8–14 mm	1 year	98.6%	98.6%	SC and FPD / Md 2 months; Mx 4 months
Payer et al. 2015[17]	RCT	22	16 Zi 15 Ti	Ziterion vario t (Ziterion) 4 mm / 10–13 mm	2 years	93.3% Zi 100% Ti	NR	SC / Md 4 months; Mx 6 months
Siddiqi et al. 2015[18]	RCT	12	68	Southern Implants 3.8–5 mm / 10–13.5 mm	1 year	67.9%	100%	OD / 3–4 months
Spies et al. 2016[19]	CPC	27	27	Ziraldent FR1 (Metoxit) 3–5 mm / > 9 mm	1 year	88.9%	91.7% G I 100% G II	SC and FPD / Md 6 weeks; Mx 14 weeks

PC, Prospective Cases; RCT, Randomized Clinical Trial; CPC, Cohort Prospective Cases; GR, Group; G, Grade; NR, Non-Registered; RS, Rough Surface; MR, Macro Retention; CES, Cicatrized Extraction Sockets; FES, Fresh Extraction Sockets; Md, Mandible; Mx, Maxilla; SC, Single Crown; FPD, Fixed Partial Denture; OD, Overdentures.
*Grade I success criteria: marginal bone loss ≤ 2 mm in the first year of follow-up; Grade II: marginal bone loss ≤ 3 mm in the first year of follow-up.

Table 2. Results between 2–4 of follow-up years.

Authors	Study	Patients	Implants	Brand and (Ø/L)	Follow-up	Survival Rate	Success Rate	Prothesis / Definitive loading
Borgonovo et al. 2013[20]	PC	13	35	White-Sky (Bredent) 3.5–4.5 mm / 8 - 16 mm	4 years	100%	100%	SC and FPD / 6 months
Brüll et al. 2014[21]	RC	74	121	ZV3 (Zircon Vision) > 3.5 mm / > 8 mm	3 years	96.5%	100%	SC and FPD / 4 months
Borgonovo et al. 2015[22]	RC	13	20	White-Sky (Bredent) 3.5–4.5 mm / 8–16 mm	4 years	100%	100%	SC and FPD / 6 months
Cionca et al. 2015[23]	PC	52	76	Zeramex T (Dentalpoint) 3.5–5.5 mm / 8–12 mm	3 years	86%	NR	SC / 3 months
Spies et al. 2015[24]	CPC	40	53	Ziraldent FR1 (Metoxit) 3–5 mm / > 9 mm	3 years	94.2%	95.9% G I 100% G II	SC and FPD / Md 6 weeks; Mx 14 weeks

PC, Prospective Cases; RC, Retrospective Cases; CPC, Cohort Prospective Cases; G, Grade; NR, Non-Registered; Md, Mandible; Mx, Maxilla; SC, Single Crown; FPD, Fixed Partial Denture;

Table 2. Results for ≥ 5 of follow-up years.

Authors	Study	Patients	Implants	Brand and (Ø/L)	Follow-up	Survival Rate	Success Rate	Prothesis / Definitive loading
Oliva et al. 2010[25]	PC	378	831 (total) - 249 (CS) - 249 (US) - 333 (AE)	CeraRoot (Oral Iceberg) 4.1–6.5 mm / 10–14 mm	5 years	92.77% CS 93.54% US 97.6% AE	NR	SC and FPD / 4 months
Grassi et al. 2015[26]	CPC	17	31	White-Sky (Bredent) 3.5–4.5 mm / 8–16 mm	5 years	96.8%	96.6% G I 100% G II	SC / 3–4 months
Roehling et al. 2015[27]	RC	71	161	Z-Look 3 (Z-Systems) 3.25–5 mm / 10–13 mm	6 years	58.5% en ∅ 3.25 mm 88.9% en ∅ 4 mm 78.6% en ∅ 5 mm	100 %	SC, FPD, HCD / 3 months

PC, Prospective Cases; RC, Retrospective Cases; CPC, Cohort Prospective Cases; CS, Coated Surface; UC, Uncoated Surface; AE, Acid-etched; G, Grade; NR, Non-Registered; SC, Single Crown; FPD, Fixed Partial Denture; HCD, Hybrid Complete Denture.
*Grade I success criteria: marginal bone loss ≤ 2 mm in the first year of follow-up; Grade II: marginal bone loss ≤ 3 mm in the first year of follow-up.

CONCLUSIONS

1. Although the operator skill and experience plays an important role in the failure rate of implant placement into fresh extraction sockets, zirconia implants achieved results comparable to titanium.
2. In future trials, the primary stability should be measured with proper equipment.
3. SC rehabilitation of zirconia implants has better results than FPD and OD. However, operator skill and experience still play a key role.
4. Bacterial contamination is noticed in the two-piece zirconia implants microgap, unlike in the one-piece implants.
5. Recent trials with better macro y micro design implants achieved rates comparable to titanium.
6. Due to analysis criteria heterogeneity in the studies reviewed, better design and long time trials are needed in order to recommend clinical use of zirconia implants as an alternative to titanium.

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