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Research Article

All-Ceramic Restorations of Disilicate Lithium, Alumina and Zirconia Part B: Clinical Data

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Abstract

All-ceramic restorations are a growing trend in dentistry as they offer better aesthetics and biocompatibility than metal-ceramic. Occasionally different ceramic systems have appeared. The purpose of this review was to explore the FDP's survival rates on natural teeth, which are manufactured by Alumina, Lithium Disilicate and Zirconia ceramics, possible complications (technical/biological) and the frequency of occurrence.

The survival rates of Lithium Disilicate ceramics were 86.1-98.2% over 10 years for single crowns, while for bridges survival rates ranged from 51-87.9% over 10 years. For Alumina ceramics the survival rates were 90.2-99.1% for single crowns in 3-6 years and 86.2% for bridges in 5 years. Finally, Zirconia ceramics showed survival rates of 79-91.2% for single crowns and 70.5-100% for bridges in 5 years. From the complications studied, it turned out that caries are the most common biological complication, while chipping is the most frequent technical complication.

In summary, all-ceramic systems can be an alternative to metal-ceramic restorations, especially in areas with aesthetic demands.

Keywords: Disilicate Lithium, Alumina, Zirconia, survival rates, complications

Introduction

Fixed dental prostheses (FDPs) may be manufactured with various materials. Metal-ceramic restorations were regarded as the 'gold standard' for many years. Nevertheless, the fact that aesthetics make up most of the requirements the last decades, all-ceramic systems present a promising alternative solution. In the past, many kinds of full-ceramic restorations were developed to combine the resistance necessary for the internal function with the increased aesthetic properties of ceramics. Many researchers advocate that statistically there are no significant differences in survival rates between all-ceramic and metal-ceramic FDPs [1-5]. Indicatively, survival rates for all-ceramic and metal-ceramic FDPs are mentioned for five-year check periods, 88%-100%6 and 94.4% [5] respectively. Chipping of the veneer ceramic constitutes the most common complication [7,8]. Among the most widely known all-ceramic FDPs are the ones using Alumina, Lithium Disilicate and Zirconia for manufacturing the ceramic core (framework). The aim of this review was research of survival percentages for FDPs manufactured with the above material on natural teeth as well as possible complications of the all-ceramic restoration (technical and biological)but also frequency of their appearance.

Material and Methods

The present study reviews English literature from 2000 to 2017. The inclusion criteria were: 1 clinical studies and bibliographic reviews, 2) all-ceramic restorations on natural teeth manufactured with Alumina, Lithium Disilicate or Zirconia, 3) single crowns or fixed bridges in anterior or posterior teeth, 4) follow-up period of at least three years. The criteria for exclusion were: 1) implant-supported all-ceramic restorations 2) partially coated crowns, inlays/onlays, veneers and non-rigid fixed bridges, 3) absence of recalling. The material of the study consists of four clinical studies pertaining to all ceramic restorations with Lithium Disilicate framework, five pertaining to restorations with Alumina framework, eight pertaining to restorations with Zirconia framework and veneer ceramic and four literature reviews including comparative assessment among Zirconia, Lithium Disilicate and Alumina all ceramic restorations but also with conventional metal-ceramic ones. All studies concern FDPs on an at least three-year follow-up period most of them referring to survival rates after five years.

Results

The results on survival rates and complications of FDPs for all three kinds of ceramics are mentioned in detail in Tables 1,2,3.

Authors	Follow up time	Framework	Number of restorations (n)	Type of restoration	Area	Type of preparation	Retention cement	Survival (%)
Vult Von Steyern P., *et al.* (2001)	5 years	Alumina (In ceram alumina)	20	3 unit FDPs	Posterior	Shoulder	Zinc phosphate*	90
Sailer I., *et al.* (2006)	3 years	Zirconia*	46	3-5 unit FDPs	Posterior	Chamfer	-	84,8

Sailer I., *et al.* (2007)	5 years	Zirconia (Cercon)	57	3-5 unit FDPs	Posterior	Chamfer	Resin (Variolink, Ivoclar Panavia TC, Kuraray)	73,9
Della Bona A., *et al.* (2008)	3 years	Zirconia (In-Ceram Zirconia)	18	3 unit FDPs	Posterior	-	Glassinomer*	94,5
	5 years	Zirconia (Cercon)	33					74
Sailer I., *et al.* (2009)	3 years	Zirconia (Cercon)	76	3-5 unit FDPs	Posterior	Chamfer	Resin (Panavia TC, Kuraray)	100
Sorrentino R., *et al.* (2012)	6 years	Alumina (Procera all ceram alumina)	128	Single Crowns	Anterior	Shoulder	Zinc phosphate* or Resin*	97,6%
					Posterior			
Kokubo Y., *et al.* (2009)	5 years	Alumina (Procera all ceram alumina)	75	Single Crowns	Anterior	Chamfer	Resin*	97,1
					Posterior			86,7
Kokubo Y., *et al.* (2011)	5 years	Alumina (In ceram alumina CAD/CAM)	95	Single Crowns	Anterior	Chamfer	Glassinomer* or Resin*	96,9
					Posterior			87,7
Schley J-S., *et al.* (review 2010)	5 years	Zirconia *	330	3-5 unit FDPs	-	-	Glassinomer* or Resin*	94,2
Sorrentino R., *et al.* (2012)	5 years	Zirconia (Procera)	48	3 unit FDPs	Posterior	Chamfer	Resin (RelyX Unicem, 3M ESPE)	95.4
Vigolo P., *et al.* (2012)	5 years	Zirconia (Lava system)	20	Single Crowns	Posterior	Chamfer	Glassinomer (Ketac-Cem, 3M ESPE)	85
		Zirconia (Procera)	20					79
Moráguez O., *et al.* (2015)	6.3 years	Zirconia (Nobel Procera Zirconia)	22	Single Crowns	Anterior and Posterior	Chamfer	Glassinomer (Ketac-Cem, 3M ESPE) or Resin	89,4
	9.5 years	Alumina (Nobel Procera Alumina)	49					90,9
Tartaglia G., *et al.* (2015)	7 years	Zirconia *	130	Single Crowns	Anterior (26)	Chamfer	Glassinomer (Ketac-Cem, 3M ESPE)	95
					Posterior (104)			
			49	3-6 unit FDPs	Anterior (27)			94.7
					Posterior (22)			
Le M., *et al.* (review 2015)	5 years	Zirconia *	887	3-5 unit FDPs	Posterior	-	-	93.3
Pjetursson B., *et al.* (review 2015)	5 years	Zirconia (Densely Sintered)	1049	Single Crowns	-	-	-	91.2
		Lithium Disilicate*	2689					96,6
		Alumina (Glass Infiltrated)	2389					94.6
		Alumina (Densely Sintered)	1099					96
Pjetursson B., *et al.* (review 2015)	5 years	Zirconia (Densely Sintered)	673	Fixed bridges	-	-	-	90,4
		Lithium Disilicate*	208					89,1
		Alumina (Glass Infiltrated)	229					86,2
Kern M. (2016)	15 years	Alumina (In ceram Alumina)	14	FDPs with cantilever	Anterior	-	Zinc phosphate*	95.4
		Zirconia (In ceram Zirkonia)	8					

Marquadt P., et al. (2006)	5 years	Lithium Disilicate (Empress 2)	27	Single Crowns	Posterior	Chamfer	Resin (Variolink II Proffesional)	100
			31	3 unit FDPs	Posterior (7)			78
					Anterior (24)			
Pieger S., et al. (review 2014)	5-10 years	Lithium Disilicate *	702	Single Crowns	Posterior (453)	-	-	97,8 (5 years) 96,8 (10years)
					Anterior (249)			
			145	Fixed bridges	-			78,1 (5 years) 70,9 (10years)
Teichmann M., et al. (2016)	5-10 years	Lithium Disilicate (Empress 2)	87	Single Crowns	Anterior (38)	Chamfer	Resin (Panavia TC, Kuraray)	89,7 (5years) 86,1 (10years)
					Posterior (49)			
			27	Fixed bridges	Anterior (11)	Chamfer or Shoulder	Glassinomer* or Resin*	63 (5years) 52 (10years)
					Posterior (16)			
*: No brand names are mentioned								

Table 1

Authors	Follow-up time	Framework material	Chipping of veneer ceramic	Loss of retention	Framework fracture	Marginal adjustment
Vult Von Steyern P., *et al*. (2001)	5 years	Alumina (In ceram Alumina)	0%	0%	10%	-
Sailer I., *et al*. (2006)	3 years	Zirconia*	13%	2,1%	0%	56,5% marginal gap
Sailer I., *et al*. (2007)	5 years	Zirconia (Cercon)	15,2%	1,7%	2,2%	58,7% marginal gap
Della Bona A., *et al*. (2008)	3-5 years	Zirconia (In-Ceram Zirconia, Cercon)	15,2%	-	1,7%	-
Sailer I., *et al*. (2009)	3 years	Zirconia (Cercon)	25% (8% clin. unacceptable)	-	0%	16,7% marginal gap
Sorrentino R., *et al*. (2012)	6 years	Alumina (Procera all ceram alumina)	0,8%	2,3%	0,8%	0%
Kokubo Y. *et al*. (2009)	5 years	Alumina (Procera All Ceram alumina)	4%	-	8%	1,3% marginal gap
Schley J-S., *et al*. (review 2010)	5 years	Zirconia *	20,6%	2,7%	3,1%	20% clinically acceptable
Kokubo Y. *et al*. (2011)	5 years	Alumina (In ceram alumina CAD/CAM)	3,1%	-	5,2%	0%
Sorrentino R., *et al*. (2012)	5 years	Zirconia (Procera)	6,3%	-	0%	-

Moráguez O., *et al.* (2015)	6.3 years	Zirconia (Nobel Procera)	7% (7 clin. unacceptable)	-	0%	-
	9.5 years	Alumina (Nobel Procera)	14% (7% clin. Unacceptable)			
Tartaglia G., *et al.* (2015)	7 years	Zirconia *	1,8% (anterior)	5,6% (anterior)	0%	-
			1,5% (posterior)	0% (posterior)		
Le M., *et al.* (review 2015)	5 years	Zirconia *	19,7% (2,2% failure)	2% (0,5% failure)	1,4%	0,1% Marginal discoloration
Pjetursson B., *et al.* (review 2015)	5 years	Zirconia (Densely Sintered)	3,1%	4,7%	0,4%	0% Marginal discoloration
		Lithium Disilicate*	1,5%	1%%	1,1%	2,3% Marginal discoloration
		Alumina (Glass Infiltrated)	1,8%	0,5%	0,8%	8,3% Marginal discoloration
		Alumina (Densely Sintered)	3,5%	3,6%	1,1%	0% Marginal discoloration
Pjetursson B., *et al.* (review 2015)	5 years	Zirconia (Densely Sintered)	19,4%	6,2%	1,9%	28,5% Marginal discoloration
		Lithium Disilicate *	5,2%	2,9%	8%	3,5% Marginal discoloration
		Alumina (Glass Infiltrated)	31,4%	2,6%	12,9%	17,2% Marginal discoloration
Kern M. (2016)	15 years	Alumina (In ceram Alumina)	0%	0%	11,5%	-
		Zirconia (In ceram Zirkonia)				
Marquadt P., *et al.* (2006)	5 years	Lithium Disilicate (Empress 2)	1,7%	-	5,1%	-
Pieger S., *et al.* (review 2014)	5-10 years	Lithium Disilicate *	-	-	-	-
Teichmann M., *et al.* (2016)	5-10 years	Lithium Disilicate (Empress 2)	16,6% (4,3% failure)	5,2%	10,5%	1,7% marginal gap
*: No brand names are mentioned						

Table 2: Technical Complications.

Authors	Follow up time	Framework material	Caries	Vitality Loss	Abutment Fracture	Periodontitis
Vult Von Steyern P. et al. (2001)	5 years	Alumina (In ceram alumina)	0%	0%	0%	0%
Sailer I. et al. (2006)	3 years	Zirconia*	10,9% (6,5% FDP loss)	2,1% (FDP loss)	2,1% (απώλεια ΑΠΑ)	-
Sailer I. et al. (2007)	5 years	Zirconia (Cercon)	21,7% (10,5% FDP loss)	1,7%	3,5%	-
Della Bona A. et al. (2008)	3-5 years	Zirconia (In-Ceram Zirconia, Cercon)	21,7%	-	-	-

Sorrentino R. et al. (2012)	6 years	Alumina (Procera all ceram alumina)	-	-	0%	-
Kokubo Y. et al. (2009)	5 years	Alumina (Procera all ceram alumina)	-	All were endodonti-cally treated	2,6%	0%
Schley J-S. et al. (review 2010)	5 years	Ζιρκονία*	3,9% (2,1% FDP loss)	3,6%	0,9%	0%
Kokubo Y. et al. (2011)	5 years	Alumina (In ceram alumina CAD/CAM)	1%	1%	1%	-
Sorrentino R. et al. (2012)	5 years	Zirconia (Procera)	0%	0%	0%	0%
Tartaglia G. et al. (2015)	7 years	Zirconia *	1,% (Posterior, FDP loss)	-	0,5% (Πρόσθια)	-
					3,4% (Οπίσθια)	
Le M. et al. (review 2015	5 years	Zirconia *	2,6% (0,9% FDP loss)	2,6% (0,3% FDP loss)	0,7%	0%
Pjetursson B. et al. (review 2015)	5 years	Zirconia (Densely Sintered)	0,5% (0,1% FDP loss)	-	0,1%	-
		Lithium Disilicate*	0,5% (0,06% FDP loss)	0,7%	0,2%	-
		Alumina (Glass Infiltrated)	2,1% (0,3% FDP loss)	-	0,7%	-
		Alumina (Densely Sintered)	1,4% (0,2% FDP loss)	-	0,5%	-
Pjetursson B. et al. (review 2015)	5 years	Zirconia (Densely Sintered)	3,2% (1,9% FDP loss)	2,2%	1%	0,5%
		Lithium Disilicate*	0,5% (0,4% FDP loss)	-	0,4%	2,9%
		Alumina (Glass Infiltrated)	2% (0,5% FDP loss)	-	0,5%	7,6%
Kern M. (2016)	15 years	Alumina (In ceram Alumina)	-	-	-	-
		Ζρκονία (In ceram Zirkonia)				
Marquadt P. et al. (2006)	5 years	Lithium Disilicate (Empress 2)	-	-	1,7%	-
Pieger S. et al. (review 2014)	5-10 years	Lithium Disilicate*	-	-	-	-
Teichmann M. et al. (2016)	5-10 years	Lithium Disilicate (Empress 2)	3,5% FDP loss	6,1% (3,5% FDP loss)	-	9,6% (5,2% FDP loss)
*: No brand names are mentioned						

Table 3: Biological Complications

Alumina

Survival rate of single crowns with Alumina framework amounts to 90.2-99.1% for a three to six-year check period, with mean rate 97.7% for the anterior and 87.2% for the posterior area, while the Sorrentino., *et al*. [6] report 100% survival rate of single anterior crowns after a five year check period. The mean rate for a five-year survival period for three-unit FDPs with Alumina framework is 82% the higher rates observed on anterior bridges compared to the respective percentages for posterior bridges.

Pjetursson., *et al*. (2007)[2] report that the single alumina crowns on anterior and posterior teeth with Procera framework, show comparable survival percentages with the respective metal-ceramic restorations after a five-year follow-up period, while smaller percentages (mean rate 90.4%) are observed in posterior crowns with In Ceram framework. The same authors in another study (2015) [5] report, that survival percentages for all-ceramic three-unit bridges are lower than the ones of metal-ceramic restorations however, without statistical significant difference. On the contrary, Vult von Steyern., *et al*. [9] mark a significantly reduced survival percentage in three-unit posterior bridges compared to metal-ceramic ones.

Technical complications

The most significant complication is chipping of the veneer ceramic or, more severely fracture of the framework. Vult von Steyer., *et al*. [9] report that 70-78% of chipping is observed between veneer and framework due to a difference in flexibility between the two materials resulting in detachment of the veneer ceramic from the framework. In three-unit bridges fracture of the framework in the connector area between the pontic and the distal abutment tooth due to increasingly accumulated strain is the major reported complication.

As far as the posterior area is concerned, the frequency of fractures is increased in restorations that replace molars compared to these replacing pre-molars [9,11]. Kokubo., *et al*. (2011) [11] report that all restoration fractures pertained to restorations cemented with resin cement (Panavia F 2.0)

Loss of retention is more frequently reported when zinc phosphate cement is used on condition that the cementing procedure has been conducted with precision adhering to the manufacturer's instructions [6].

Marginal adjustment after a five-year monitoring is considered outstanding at a rate of 96.8% and acceptable at a rate of 1.5-32% [6,10,11], while the need for replacement during the second year of function is reported on one case only [10]. Respectively, the color of the restoration is judged as outstanding at a rate of 83.9-94.5% and acceptable at a rate of 3.9-16.1% after a five-year follow-up period [6,10,11]. The crown morphology appears excellent at a rate of 93.3-98.4% and acceptable at a rate of 0-6.7% [6,10,11], with one case judged as not acceptable and the same one needing replacement [10].

Finally, the surface morphology is considered outstanding at a rate of 92-96.6% and acceptable at a rate of 3.4-8% [6,10,11], with one case needing replacement the first year of function [10].

Biological complications

Appearance of caries constitutes the most frequent biological complication (0-2.1% in five years) [3,5,9,11]. Vitality loss has also been reported (0-1.06% in five years) [9,11]. A more serious complication constitutes fracture of the abutment tooth (0-2.6% in five years) [3,5,9-11],which is more frequently traced at the root and appears increasingly frequent in endodontically treated teeth [10,11]. Small is the percentage of appearance of periodontal inflammation [5,9,10].

Lithium Disilicate

The survival rate of lithium disilicate single crowns amounts to 8.1-98.2% for a ten year follow up period with the highest rates corresponding to IPS E-MAXX PRESS material without mentioning statistical significant difference between the anterior and posterior area. However, Marquart., *et al*. [12] report 100% survival of single crowns manufactured with EMPRESS 2. The survival percentage for three-unit bridges amounts to 51-87.9% for a 10-year follow up period, with a mean rate 89.1% in five years, while it is not clear whether there is significant difference between anterior and posterior restorations.

All restorations mark outstanding performance of color and morphology. The marginal adjustment on abutment teeth is judged acceptable to outstanding as the need for replacement due to marginal micro-penetrationis limited to 3.5% after five years [5], while the respective rate appears fivefold for Alumina all ceramic and tenfold for Zirconia all ceramic.

Technical Complications

The fracture of the ceramic framework constitutes the most significant technical complication as replacement of the restoration is deemed necessary. It is observed mainly in bridges (8%/5 years) [5] with a fourfold frequency in the respective zirconia restorations5 and rarely in single crowns (0%/5 years [12], 3.8%/5 years [13]). The fracture is usually located in the posterior area, however, Marquardt., *et al*. [12] report fracture of framework mainly on anterior bridges attributing however this result to inadequate dimensions of the connectors.

Chipping of the veneer ceramic constitutes an ordinary but intra-orally repairable complication with major appearance frequency 5.2%in five years [5] and 16.6% after 5-10 years [13], whereas for zirconia all ceramics chipping reaches 20.6% after five years [14].

Loss of retention is more rarely observed and appears irrelevant to the type of cement used, while Bissasu., *et al*. [15] report that the

use of resin cement reinforces the resistance of the restoration due to the use of adhesive systems.

Biological complications

Caries constitutes the most common biological complication (0.5-3.5% in five years) [3,5,13] although the frequency of their appearing is quite lower than this of zirconia all ceramics. Reported also are vitality loss (0.7-6.1% in five years) [3,13] and periodontitis (2.9-9.6% in five years) [5,13]. Fracture of the abutment tooth constitutes the most serious complication (0.2-1.7% in five years) [3,5,12] necessitating the replacement of the restoration.

Zirconia

Most zirconia framework bridges are three-unit ones and concern posterior areas. Survival of zirconia single crowns is 85.1% (79-91.2%) after a five-year function. There are, however, reports of 95% seven-year survival [16], 89.4% survival in 6.3 years [17] and 93-100% survival after 3-year function of zirconia single crowns [8]. For fixed bridges with zirconia framework survival 93.1% (94.5-100%) in three years and 87.7% (70.5-100%) in five years is reported. Sailer., *et al*. [4] report 93.67% success rate for three-unit FDPs after five years of function while Tartaglia., *et al*. [16] 91.6% after seven years.

Technical complications

The most frequent complication leading many times to Zirconia FDP replacement was chipping of the veneer ceramic. It is reported that the percentage of appearance of veneer ceramic chipping is 19% (13-25%) of three years [4,18] and 15.7% (6.3-22%) in five years for Zirconia fixed bridges [5,14,19-22], while 3.1% for Zirconia single crowns in five years [3]. Moreover, Tartaglia., et al. [16] report chipping of veneer ceramic at 1.5% in bridges and 1.8% in single crowns after seven years of function. When chipping is restricted to the veneer ceramic it is confronted by smoothing or replenishing with composite, while complete detachment of the veneer ceramic often leads to replacement of the FDP.

A frequent complication is loss of retention of FDPs amounting to 4.7% for Zirconia single crowns [3] and 3.8% (1.7-6.2%) for Zirconia bridges after five years of function [5,14,19-22]. Sailer., *et al*. (2006) [18] report one loss of retention for a four-unit bridge (1/46) after three years of function, while the same group of researchers report in a later paper (2007) [19] one loss of retention for one four unit bridge (1/57) after five years of funciton. Finally, Tartaglia., *et al*. [16] found a loss of retention percentage of 1.6% in anterior teeth FDPs after seven years of function.

Fracture of Zirconia framework has been observed quite rarely. Success of Zirconia framework in fixed bridges was estimated at 100% for three years of function [4,18] and 98.6% for five years of function [5,14,19-22]. For Zirconia single crowns success of the framework was 99.6% in five years [3] and 100% in 6.3 years [17]. In all cases fracture of the bridge framework concerned five unit bridges [14,19]. Only Beuer., *et al*. [14] report fracture in a three unit bridge after five years of function.

Finally, Pjetursson., *et al*. [3,5] report marginal discoloration of Zirconia single crowns 0% and 25.5% in Zirconia bridges after five years of function. Moreover, the marginal adjustment of Zirconia bridges is rendered non-acceptable at a rate of 36.6% after three years [4,18] and 39.35% after five years [14,19]. The respective rates for metal ceramic bridges are 6.5% after a three year period.

Biological Complications

Biological complications include caries, periodontitis, abutment tooth fracture and pulp inflammation. Every single one of them can lead to extraction of the abutment tooth and therefore restoration failure.

Appearance of caries in Zirconia bridges was estimated at 10.9% in three years of function [18] and 7.8% in five-year function [5,14,19,20]. For zirconia single crowns the rate of caries appearance was 0 .5% in five years [3]. Tartaglia., *et al*. [16] observed caries at a rate of 1.1% after seven years of function. All cases of the latter concerned posterior FDPs which finally were removed. By and large a decrease of the possibility of caries appearance in the latest research and reviews is observed.

Vitality loss of abutment teeth of Zirconia FDPs was estimated at 2% in five years for bridges [5,14,19,21,22] (2.4% in three years [4,18]). For single crowns only Pjetursson., *et al*. [3] reported 0% vitality loss.

Fracture of the abutment tooth presents a complication leading to loss of the FDP. The percentage reported for Zirconia bridges is 1.6% in five years [5,14,19,21,22] (2.1% in three years [18]), while for single crowns fracture it reaches 0.1% in five years [3]. According to another research group fracture in 7 years is 4% on average (0.5% for anterior and 3.5% for posterior FDPs) [16].

The majority of studies shows that all ceramic Zirconia FDPs show less plaque retaining, while the various periodontal indexes do not present statistically significant differences between the different Zirconia systems and between Zirconia FDPs and metal ceramic FDPs. Loss of abutment tooth from periodontitis in Zir-

conia bridges was estimated to 0.17% after five years of function [5,14,21,22].

Discussion

Alumina

The survival percentage of alumina single crowns in the anterior area appears comparable to those of the respective metal ceramic ones and given the aesthetic advantage they present, their use in the anterior aesthetic zone is considered acceptable and frequently necessary. Survival of single alumina crowns in the posterior area is high for all ceramic Procera and comparable to those of the respective metal ceramics providing there is a favorable occlusion of equally allocated bite forces [17]. The respective percentages for all ceramics with In Ceram framework are smaller, raising questions about their selection [9,11]. As far as three unit bridges are concerned the results are encouraging for anterior area restorations, however, their use in the posterior area is at present considered treacherous. Further investigation is however deemed necessary with longer follow up time [2,6,9-11].

The most significant complication of alumina restorations constitutes the fracture of ceramic framework resulting in the need for replacement of the restoration. It is mainly observed in bridges and customary in the posterior area, in the distal connector position, as this operates as an area of increasingly cumulative strain. 70-78% of chipping is traced between the framework and the aesthetic veneer due to the strains developed during function in the adjacent surface of the two different materials given the different flexibility distortion. This causes complete detachment of the veneer ceramic from the restoration and the need for its replacement. Finally there can be observed partial chipping of the aesthetic veneer which is intra-orally repaired without reporting of further complication in five years follow up time [3,5,6,9-11,17]. Vult von Steyern., *et al*. [9] report that Shoulder preparation increases up to threefold the danger of restoration chipping compared to chamfer preparation.

Increased frequency of loss of retention is observed in cases where zinc phosphate cement is used [6]. The cements of this category despite their convenient use lack significantly in resistance to chipping and wear, in marginal sealing and the final coloration performance of the restoration compared to the resin cement ones, while at the same time they are 'unfriendly' to the ceramic surface due to acidity [6]. The resin cement seems to fortify the restoration, preventing its loss of retention from the abutment tooth and decrease the marginal micro-penetration. Therefore, use of resin cement is recommended for the increase of survival percentage for all ceramic alumina [6].

The most severe biological complication even though it is the rarest, is fracture of the abutment tooth and mainly the root, which indicates the necessity of correct selection of the abutment teeth [3,5,6,9-11]. More frequently, caries is observed, mainly in the margins and also vitality loss [3,5,9,11]. Periodontitis is rare, however all research is done on non-smokers with good to excellent oral hygiene [5,9,10].

The color, surface and morphology of the FDPs are judged in the majority of cases as acceptable to outstanding and the patients report full satisfaction after five years follow up time [6,10,11].

The use of Alumina all ceramic is recommended of anterior and posterior single crowns and for three unit bridges to the pre-molar area due to increased possibility of fracture in the molar area according to Vult von Steyern., *et al*. [9] and Kokubo., *et al*. [10,11]

Lithium Disilicate

Survival of Lithium Disilicate all ceramic crowns is comparable to the one of metal ceramic FDPs for ten-year follow up time [23]. Lithium Disilicate bridges present lower survival percentages whereas there are questions and doubts for their use in the posterior area [12,13,23]. Compared to metal ceramic and also alumina and zirconia all ceramic ones though, Lithium Dislicate FDPs present a significant aesthetic advantage [3,5] due to the increased translucency of the material [24]. Therefore, it seems they constitute a reliable and aesthetic solution for the restoration of the anterior area. Their use is recommended on the anterior aesthetic zone, in single crowns and three unit bridges.

They seem to present a significant advantage to the marginal adjustment as well, as this appears up to ten times better compared to the respective on of zirconia FDPs. The biological complications include: caries, vitality loss, periodontitis and fracture of the abutment tooth, however, the frequency of their appearance is decreased.

Usually there are observed technical complications the most significant being fracture of the framework almost four times more frequently than the respectively registered percentage in Zirconia restorations [5]. It is observed mainly in the posterior bridges connector area, without excluding fracture of anterior ones as well [12,13]. In single crowns fracture of the framework appears less frequently. Chipping of the veneer ceramic constitutes the most frequent technical complication, with the potential of intra-oral repair in most cases without the need for replacement of the FDP. Loss of retention is more rarely reported with 1-5.2% in five years [3,5,13], while it seems that this is irrelative to the cement used.

Zirconia

Upon reviewing of the literature it is obvious that Zirconia framework FDPs may constitute a viable alternative solution to the metal ceramic ones. However, posterior Zirconia bridges mainly concern three or four unit restorations, whereas longer bridges present more complications [14,19].

Long term research reports 67.2% single crown survival in ten years where chipping of the veneer ceramic presents the most frequent complication [24], while Sax., *et al*. [25] reported 67% survival rate in a decade for FDPs 3-5 units.

For Zirconia FDPs the most frequent complication continues to be chipping of the veneer ceramic. Most times though this chipping is restricted to the veneer ceramic and can be repaired by intra-oral smoothing. Detachment of the veneer ceramic can lead to FDP loss. Better results are anticipated by monolithic Zirconia nevertheless this material is not the subject of the present study. A frequent complication also is appearance of caries in the FDP margins. Some researchers attribute this increased frequency is related to worse marginal adjustment of the Zirconia FDPs compared to metal ceramic FDPs. Nonetheless, the results from the various studies on correlation of marginal adjustment with caries remain controversial.

Patients seem to express 100% satisfaction from the Zirconia FDPs aesthetic results in three [18] and five year [19], while functional adjustment to Zirconia FDPs reaches 94.4% in three years18 and 91.7% in five years19. However, most studies have short follow up period (3-5 years) which indicates the necessity for longer clinical studies.

Thus it appears that Zirconia single crowns can be used not only in anterior but also in posterior areas. The same stands for Zirconia bridges but only for ones up to four units.

Conclusions

The conclusions arising from the literature review are the following;

- Lithium Disilicate single crowns present the highest survival rate (96%) and the respective Alumina ones follow (93%) and finally those from Zirconia (86.6%) in five years.
- For bridges, the highest survival rate concerns Zirconia (87.7%) followed by Alumina (86.2%) and Lithium Disilicate (77%) in five years.
- All ceramic FDPs manufactured with the three ceramics studied are at an advantage as regards aesthetics and biocompatibility over metal ceramics.
- Lithium Disilicate ceramics present exceptional aesthetics and better marginal adjustment compared to Alumina and Zirconia ceramics.
- Chipping of veneer ceramic constitutes a more frequent but usually repairable technical complication of the Lithium Disilicate Alumina and Zirconia ceramics.
- Caries constitutes the most frequent biological complication for the all ceramic FDPs especially the Zirconia ones.
- Alumina ceramics possess a resilient ceramic core which adds resistance to the FDP, satisfactory aesthetics and acceptable marginal adjustment to the abutment tooth.
- Zirconia ceramics are made up of a strong ceramic framework, rendering the FDPs resilient to fracture even in posterior bridges, however the chipping phenomenon to the aesthetic material appears frequent.

Bibliography

1. Vigolo P and Mutinelli S. "Evaluation of Zirconium-Oxide-Based Ceramic Single-Unit Posterior Fixed Dental Prostheses (FDPs) Generated with Two CAD/CAM Systems Compared to Porcelain-Fused-to-Metal Single-Unit Posterior FDPs: A 5-Year Clinical Prospective Study". *Journal of Prosthodontics* 21 (2012): 265-269.

2. Pjetursson BE., *et al*. "A systematic review of the survival and complication rates of all-ceramic and metal-ceramic reconstructions after an observation period of at least 3 years. Part I: single crowns". *Clinical Oral Implants Research* 18 (2007): 73-85.

3. Pjetursson BE., *et al*. "All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part I: Single crowns (SCs)". *Dental Materials* 31 (2015): 603-623.

4. Sailer I., *et al*. "Randomized Controlled Clinical Trial of Zirconia-Ceramic and Metal-Ceramic Posterior Fixed Dental Prostheses: A 3-year Follow-up". *The International Journal of Prosthodontics* 22 (2009): 553-560.

5. Pjetursson BE., *et al*. "All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part II: Multiple-unit FDPs". *Dental Materials* 31 (2015): 624-639.

6. Sorrentino R., *et al*. "Clinical Evaluation of 209 All-Ceramic Single Crowns Cemented on Natural and Implant-Supported Abutments with Different Luting Agents: A 6-Year Retrospective Study". *Journal of Clinical Implant Dentistry and Related Research* 14 (2012): 184-197.

7. Kontonasaki E., *et al*. "Contemporary ceramic systems: Classification, fabrication techniques and clinical applications". *Stoma* 41 (2013): 87-106.

8. Siarampi E. "Investigation of the substrate binding region of stabilized zirconium oxide (Y-TZP) ceramics and coatings for prosthetic restorations". *Doctoral thesis AUT* (2015): 45-46.

9. Vult von Steyern P., *et al*. "Five-Year Evaluation of Posterior All-Ceramic Three-Unit (In-Ceram) FPDs". *The International Journal of Prosthodontics* 14 (2001): 379-384.

10. Kokubo Y., *et al*. "Clinical evaluation of Procera All Ceram crowns in Japanese patients: results after 5 years". *Journal of Oral Rehabilitation* 36 (2009): 786-791.

11. Kokubo Y., *et al*. "Five-year clinical evaluation of In-Ceram crowns fabricated using GN-I (CAD/CAM) system". *Journal of Oral Rehabilitation* 38 (2011): 601-607.

12. Marquardt P and Strub JR. "Survival rates of IPS Empress 2 all-ceramic crowns and fixed partial dentures: Results of a 5-year prospective clinical study". *Quintessence International* 37 (2006): 253-259.

13. Teichmann M., *et al*. "Ten-year survival and complication rates of lithium-disilicate (Empress 2) tooth-supported crowns, implant-supported crowns, and fixed dental prostheses". *Journal of Dentistry* 56 (2017): 65-77.

14. Schley JS., *et al*. "Survival probability of zirconia-based fixed dental prostheses up to 5 yr: a systematic review of the literature". *European Journal of Oral Science* 118 (2010): 443-450.

15. Bissasu SM and Al-houri NA. "Replacement of missing lateral incisors with lithium disilicate glass-ceramic veneer- fixed dental prostheses: a clinical report". *Clinical Case Reports* 2 (2014): 128-132.

16. Tartaglia GM., *et al*. "Seven-year prospective clinical study on zirconia-based single crowns and fixed dental prostheses". *Clinical Oral Investigation* 19 (2015): 1137-1145.

17. Moráguez OD., *et al*. "Three- to nine-year survival estimates and fracture mechanisms of zirconia- and alumina-based restorations using standardized criteria to distinguish the severity of ceramic fractures". *Clinical Oral Investigation* 19 (2015): 2295-2307.

18. Sailer I., *et al*. "Prospective clinical study of zirconia posterior fixed partial dentures: 3-year follow-up". *Quintessence International* 37 (2006): 685-693.

19. Sailer I., *et al*. "Five-Year Clinical Results of Zirconia Frameworks for Posterior Fixed Partial Dentures". *The International Journal of Prosthodontics* 20 (2007): 151-156.

20. Della Bona A and Kelly JR. "The clinical success of all-ceramic restorations". *JADA* 139 (2008): 8s-13s.

21. Sorrentino R., *et al*. "Five-year prospective clinical study of posterior three-unit zirconia-based fixed dental prostheses". *Linear Oral Investigation* 16 (2012): 977-985.

22. Le M., *et al*. "The clinical success of tooth- and implant-supported zirconia-based fixed dental prostheses. A systematic review". *Journal of Oral Rehabilitation* 42 (2015): 467-480.

23. Pieger S., *et al*. "Clinical outcomes of Lithium Disilicate single crowns and partial fixed dental prostheses: A systematic review". *Journal of Prosthetic Dentistry* (2014): 1-9.

24. Edelhoff D and Brix O. "All-ceramic restorations in different indications: A case series". *JADA* 142 (2011): 14-19.

25. Miura S., *et al*. "Clinical evaluation of zirconia-based all-ceramic single crowns: an up to 12-year retrospective cohort study". *Clinical Oral Investigation* (2017).

26. Sax C., *et al*. "10-year clinical outcomes of fixed dental prostheses with zirconia frameworks". *International Journal of Computerized Dentistry* 14 (2011): 183-202.

27. Belli R., *et al*. "Fracture Rates and Lifetime Estimations of CAD/CAM All-ceramic Restorations". *Journal of Dental Research* 95 (2015): 67-73.

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