THE EFFECTS OF DIFFERENT FRAMEWORK DESIGNS AND DIFFERENT MATERIALS OF IMPLANT-SUPPORTED SINGLE CROWNS AFTER AGING

ORAL RECONSTRUCTION FOUNDATION

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Introduction

Replacing a missing tooth by a single implant-supported crown has increasingly gained popularity by both the clinicians and the patients (1). Long-term clinical studies have shown excellent survival rates of single implant tooth replacement (2-3). However, the success of an implant treatment does not only depend on the successful osseointegration of the implant, but also the prosthetic design i.e abutment-crown complexes materials and designs. (4-5). Zirconium dioxide (zirconia) is the strongest and toughest of all dental ceramics and meets the mechanical requirements for high-stress-bearing posterior restorations (6).

The purpose of this study is to evaluate the effects of abutment and framework design, different layering materials (feldspathic porcelain, indirect composite material), and monolithic restorations on the fracture strength of implant-supported zirconia-based single crowns after thermocycling.

Materials and Methods

Seventy ti-base abutments (Conelog 4.3-0.8mm, C2242.4308, Camlog® Implant, Basel, Switzerland) were screwed onto dental implants (Conelog 4.3-11mm, C1062.4311, Camlog® Implant, Basel, Switzerland). Abutment-implant complexes were randomly divided into seven groups (n = 10) according to the design of the zirconia abutment and framework (VITA YZ T, VITA Zahnfabrik, Germany) as follows: uniform-thickness zirconia abutment and uniform-thickness zirconia framework layered with feldspathic porcelain (Group 1); layered with indirect composite material (Group 2); uniform-thickness zirconia abutment and anatomic design zirconia framework layered with feldspathic porcelain (Group 3); layered with indirect composite material (Group 4); anatomic design zirconia abutment and anatomic design zirconia framework layered with feldspathic porcelain (Group 5); layered with indirect composite material (Group 6); uniform-thickness zirconia abutment and monolithic zirconia crown (Group 7). All fabricated zirconia abutments were cemented on ti-base abutments, and then all crowns were cemented on ti-base-zirconia abutment complexes. All specimens were exposed to 10,000 thermal cycles between 5°C and 55°C and then tested for fracture strength.

Fig 1

Fig 2

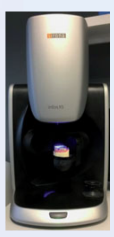


Fig 3

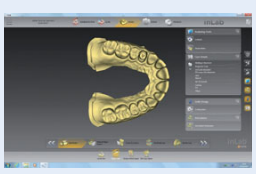
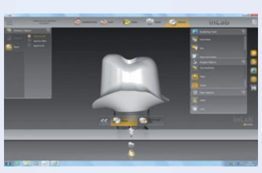


Fig 4



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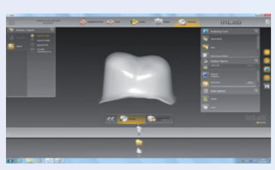

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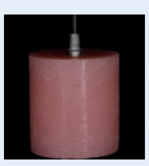


Fig 7

Fig 8

Fig 9

Fig 10

Fig 11

The data were analysed statistically using SPSS software. The data were analyzed by 3-way ANOVA to test the effect of abutment design, framework design, two different layering materials, and their interaction on the fracture strength. Post-hoc assessment was performed using independent sample t-test and Bonferroni corrected tests ($p \leq 0.05$). After fracture resistance testing, randomly selected specimens were sputtered with platin, for 120 s and observed with a scanning electron microscope (SEM) (JSM 7000 F, JEOL, Japan) at an original magnification of ×10, and then fracture mode classified as veneer fracture or framework fracture.

Results

The mean fracture strength values of groups were found to be statistically different with a ranking from highest to lowest as follows: Group 7 > Group 5 > Group 3 > Group 1 > Group 6 > Group 4 > Group 2 ($p<0.05$). Anatomical abutment and framework designs showed significantly higher strength compared to uniform abutment and framework designs regardless of layering material ($p<0.05$). Porcelain-layered groups had significantly higher fracture strength values in comparison to the groups layered with indirect composite ($p<0.05$).

Table 1. Three-way ANOVA analysis.

Source of variation	Sum of squares	df	Mean square	F	p
Model	8921246.48	5	1784249.30	36.086	<0.001**
Intercept	115785136.07	1	115785136.07	2341.741	<0.001**
Abutment	458116.23	1	458116.23	9.265	0.004**
Framework	1252119.46	1	1252119.46	25.324	<0.001**
Layering Material	3440215.47	1	3440215.47	69.578	<0.001**
Abutment * Layering material	5157.67	1	5157.67	0.104	0.748
Framework* Layering material	66437.17	1	66437.17	1.344	0.251

Table 2. Results of fracture strength.

Groups	n	Mean (N)	Sd
Group 1	10	1658,57	±394,28
Group 2	10	1176.26	±163.45
Group 3	10	2093.94	±169.15
Group 4	10	1448.60	±175.94
Group 5	10	2330.68	±185.63
Group 6	10	1639.93	±143.06
Group 7	10	3396.25	±420.19

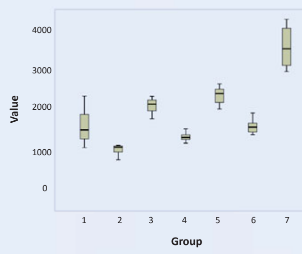
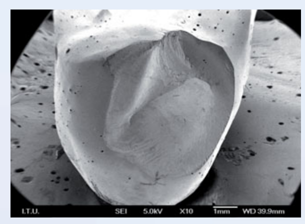
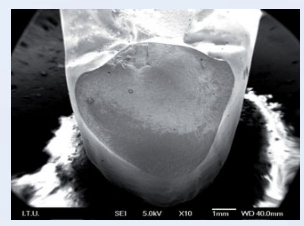


Fig 12. SEM analysis of all groups after thermocycling

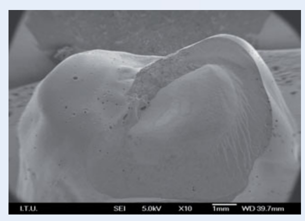
Group 1



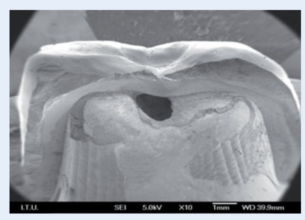
Group 2



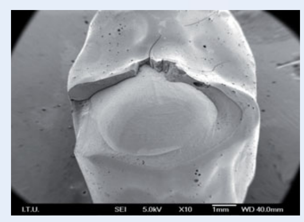
Group 3



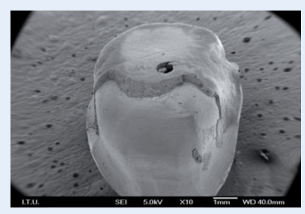
Group 4



Group 5



Group 6



Group 7

Conclusions

Within the limitations of this *in vitro* study, it is concluded that uniformly-thick layering material (anatomic abutment/framework design) of zirconia frameworks improve fracture resistance of implant-supported zirconia-based prostheses after thermocycling. The fracture loads for flat abutment/anatomic framework and anatomic abutment/anatomic framework designs in the feldspathic porcelain layered groups were significantly higher than those in the indirect composite layered groups. All types of implant-supported zirconia-based prostheses tested after thermocycling have the potential to withstand clinical chewing forces in posterior applications.

Acknowledgements

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References

1.Jokstad, A., Braegger, U., Brunski, J.B., Carr, A.B., Naert, I., Wennerberg, A., 2003. Quality of dental implants. Int. Dent. J. 53 (6 Suppl 2), S409–S443.

2. Jung, R.E., Zembic, A., Pjetursson, B.E., Zwahlen, M., Thoma, D.S., 2012. Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. Clin. Oral Implant. Res. 23 (Suppl 6), S2–S21.

3. Maló, P., de Araújo Nobre, M., Lopes, A., Ferro, A., Gravito, I., 2015. Single-tooth rehabilitations supported by dental implants used in an immediate- provisionalization protocol: report on long-term outcome with retrospective follow- Up. Clin. Implant Dent. Relat. Res. 17 (2), e511–e519.

4. Saadoun, A.P., Le Gall, M.G., Touati, B., 2004. Current trends in implantology: part II – treatment planning, aesthetic considerations, and tissue regeneration. Pract. Proced. Aesthet. Dent. 16 (10), 707–714.

5. Tischler, M., 2004. Dental implants in the esthetic zone. Considerations for form and function. NY State Dent. J. 70 (3), 22–26

6. Christel P, Meunier A, Heller M, Torre JP, Peille CN., 1989. Mechanical properties and short-term in-vivo evaluation of yttrium-oxide-partially-stabilized zirconia. J Biomed Mater Res. 23: 45-61

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