



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



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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, 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

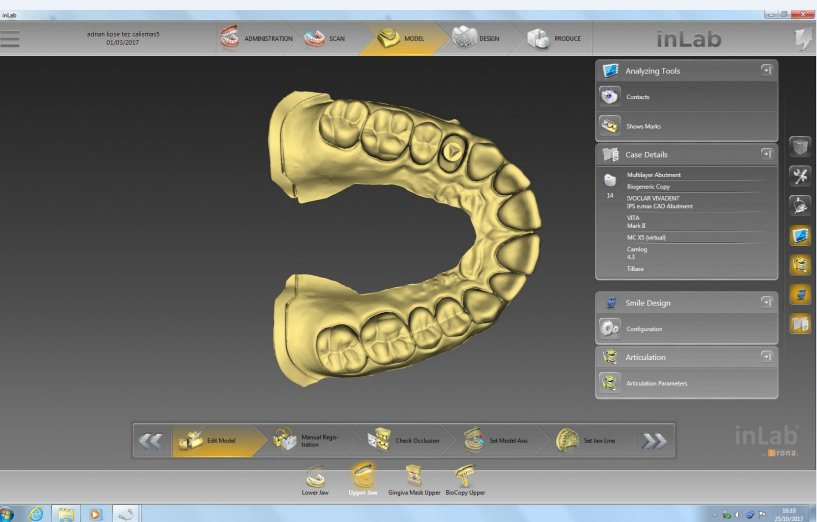


Fig 4

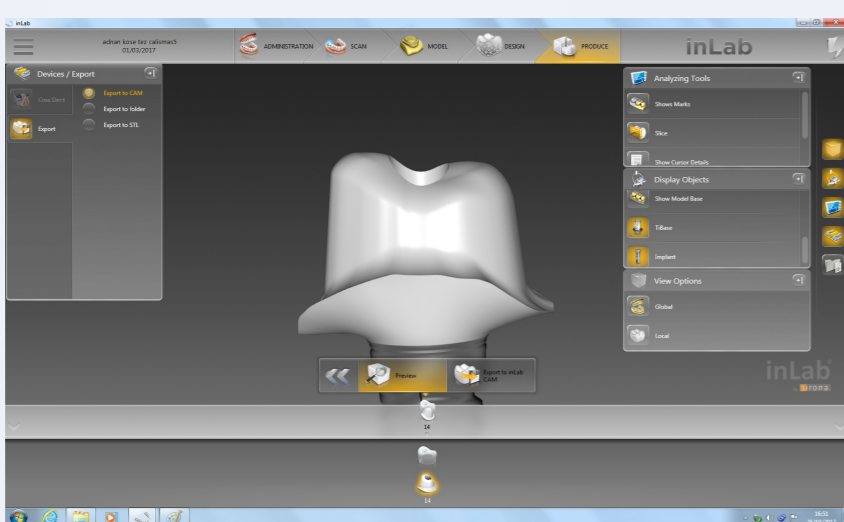


Fig 5

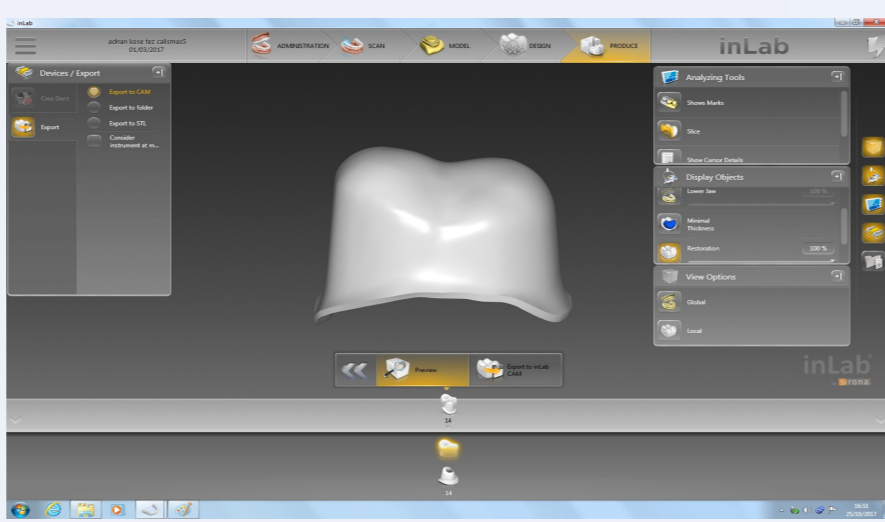


Fig 6



Fig 7



Fig 8



Fig 9

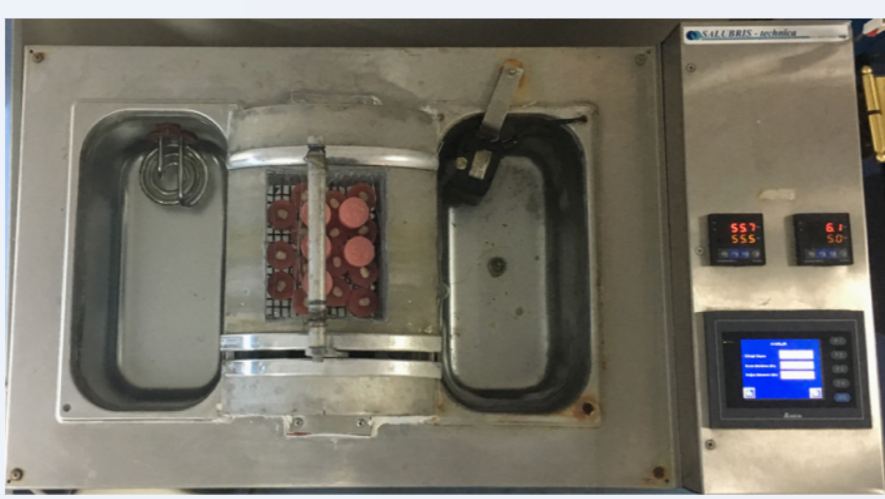


Fig 10



Fig 11

The data were analyzed statistically by SPSS software. The data were analyzed by 3-way ANOVA to test the effect of abutment design, framework design, two different layering material 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 platinum, for 120 s and observed with a scanning electron microscope (SEM) (JSM 7000 F, JEOL, Japan) at an original magnification of $\times 10$, and fracture mode classified as veneer fracture or framework fracture.

Results

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 layering material ($p < 0.05$). Porcelain layered groups performed 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

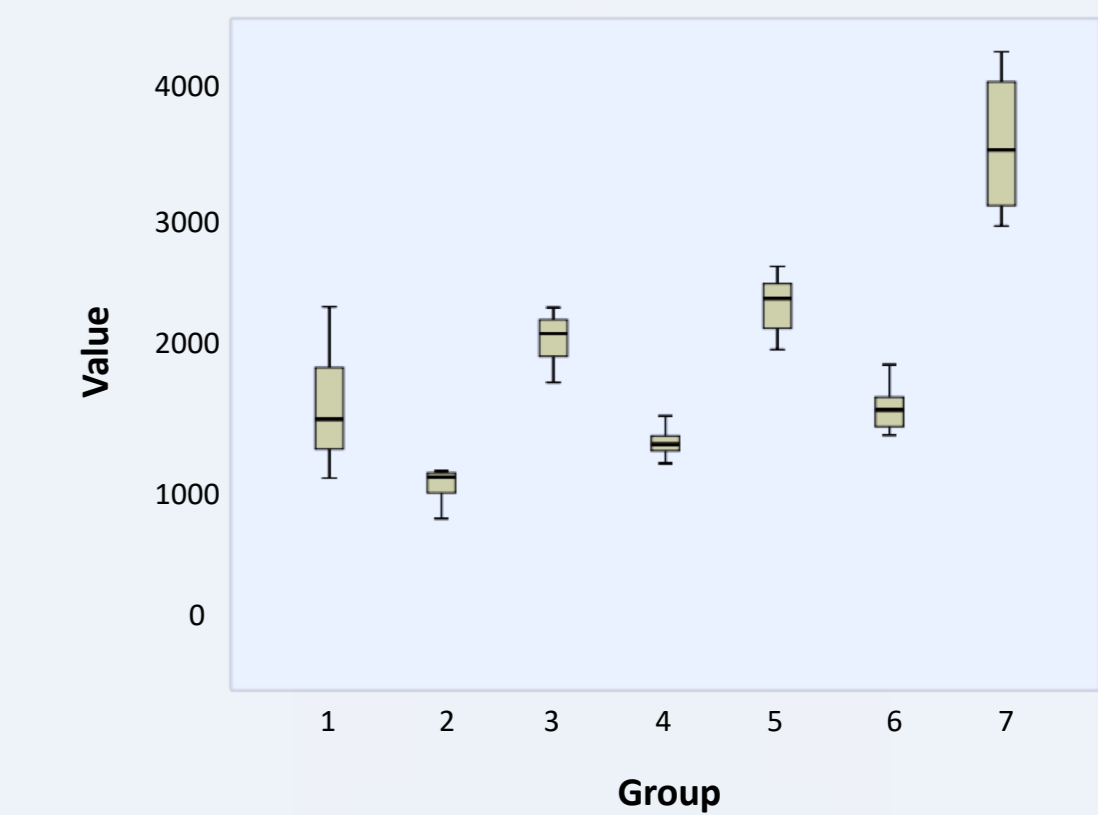
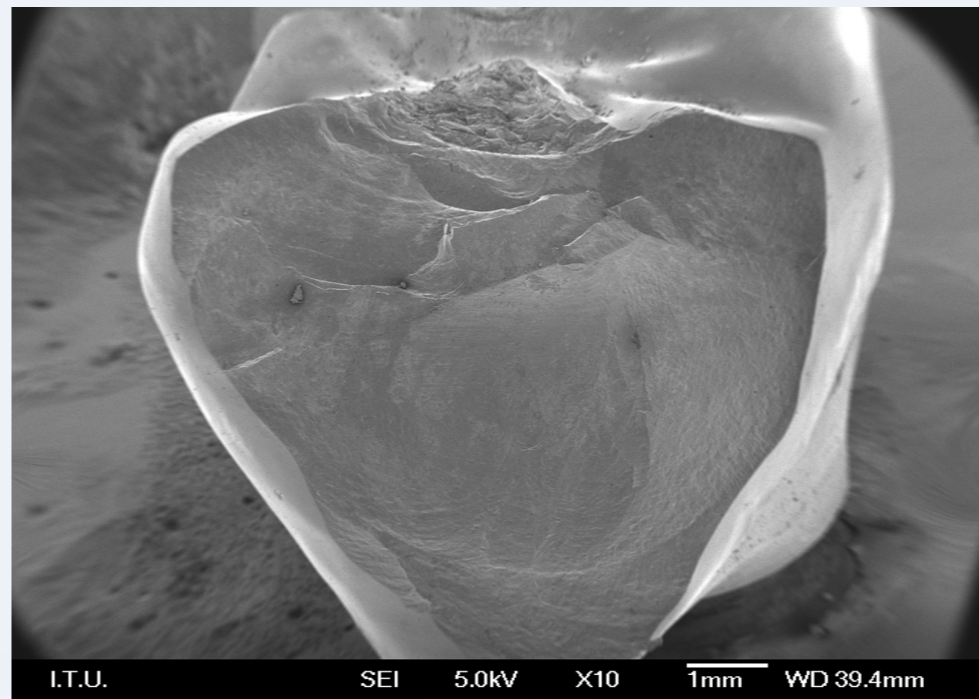
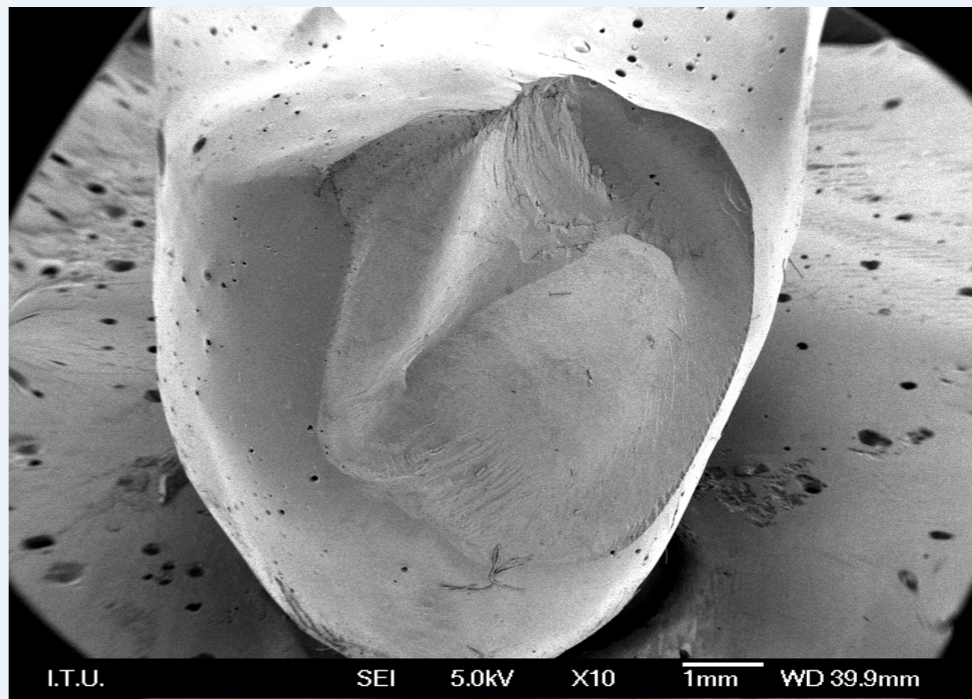


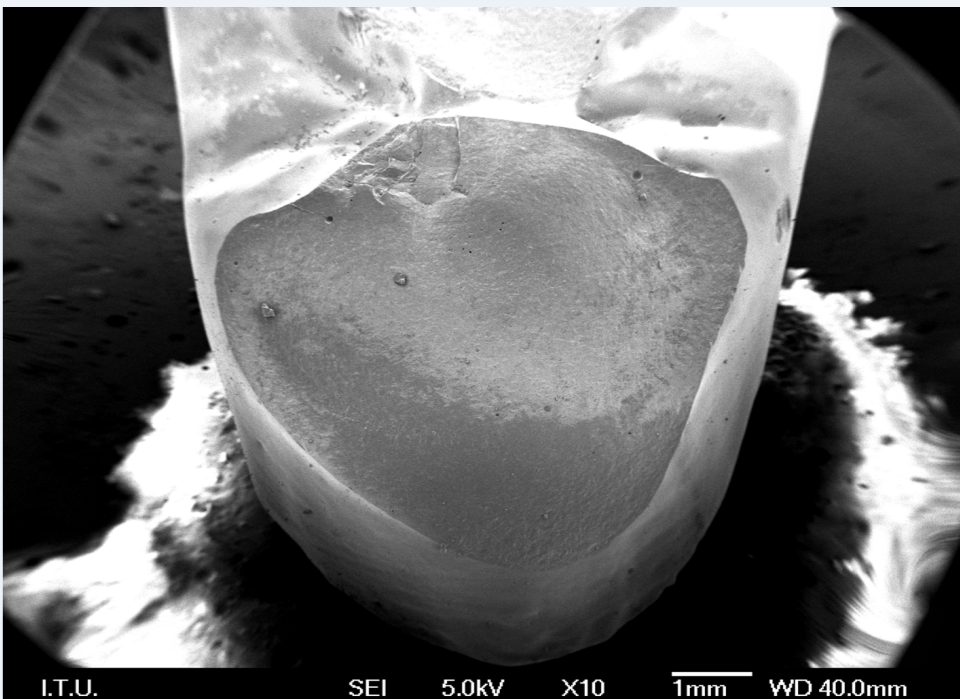
Fig 12. SEM analysis of all groups after thermocycling



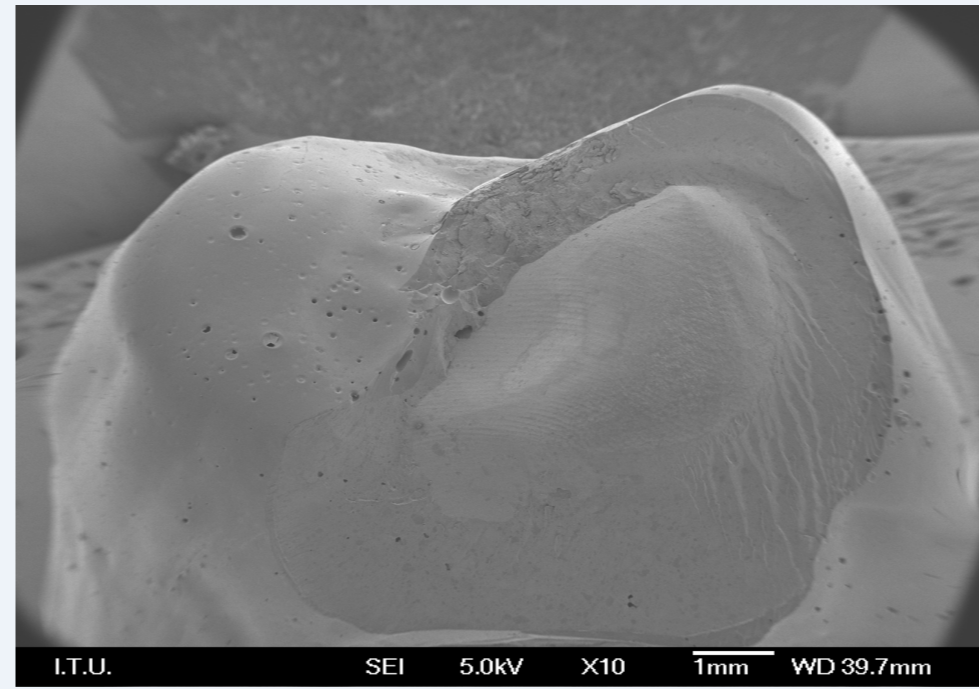
Group 1



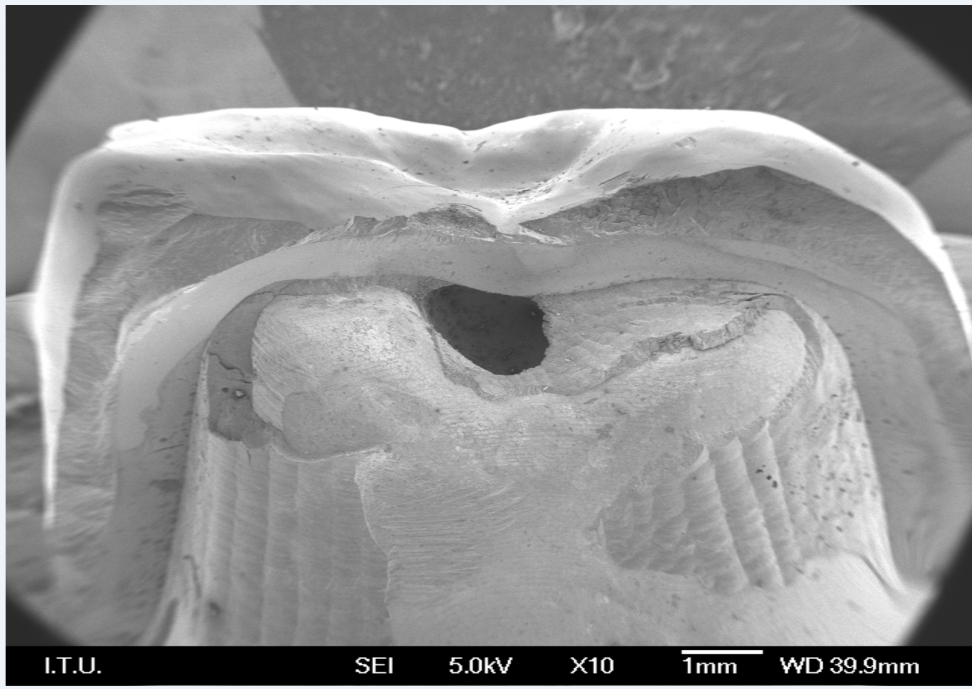
Group 2



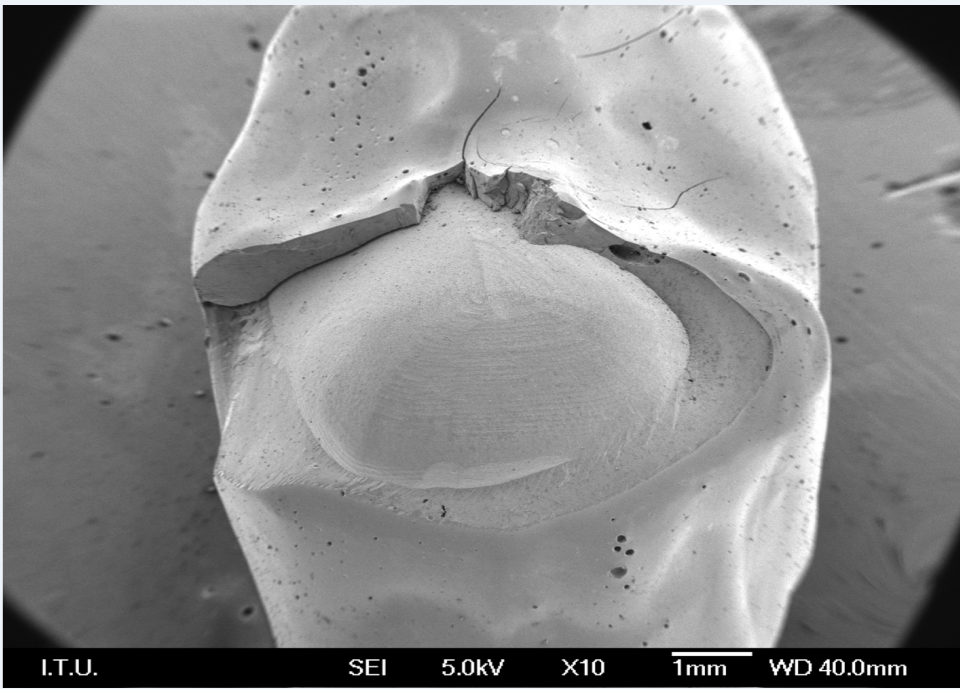
Group 3



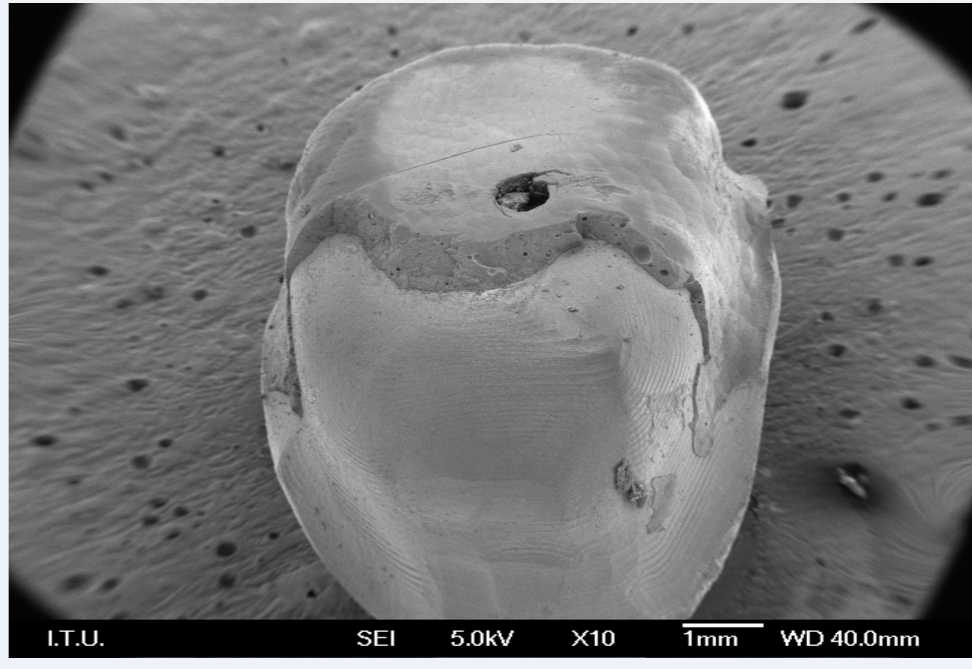
Group 4



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 layering feldspathic porcelain groups were significantly higher than those in the layering indirect composite 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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