QUALITY IMPROVEMENT IN DENTAL AND MEDICAL KNOWLEDGE, RESEARCH, SKILLS AND ETHICS FACING GLOBAL CHALLENGES

Edited by
Armelia Sari Widyarman, Muhammad Ihsan Rizal,
Moehammad Orliando Roeslan & Carolina Damayanti Marpaung

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The proceedings of FORIL XIII 2022 Scientific Forum Usakti conjunction with International Conference on Technology of Dental and Medical Sciences (ICTDMS) include selected full papers that have been peer-reviewed and satisfy the conference's criteria. All studies on health, ethics, and social issues in the field of dentistry and medicine have been presented at the conference alongside clinical and technical presentations. The twelve primary themes that make up its framework include the following: behavioral epidemiologic, and health services, conservative dentistry, dental materials, dento-maxillofacial radiology, medical sciences and technology, oral and maxillofacial surgery, oral biology, oral medicine and pathology, orthodontics, pediatrics dentistry, periodontology, and prosthodontics. This proceeding will be beneficial in keeping dental and medical professionals apprised of the most recent scientific developments.

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Preface

Faculty of Dentistry Universitas Trisakti (Usakti) presents FORIL XIII 2022 Scientific Forum Usakti conjunction with International Conference on Technology of Dental and Medical Sciences (ICTDMS) on December 8th–10th 2022. The theme of the conference is "Quality Improvement in Dental and Medical Knowledge, Research, Skills and Ethics Facing Global Challenges".

The triennial conference has served as a meeting place for technical and clinical studies on health, ethical, and social issues in field medical and dentistry. It is organized around 12 major themes, including behavioral, epidemiologic, and health services, conservative dentistry, dental materials, dento-maxillofacial radiology, medical sciences and technology, oral and maxillofacial surgery, oral biology, oral medicine and pathology, orthodontics, pediatrics dentistry, periodontology, and prosthodontics.

The most recent findings in fundamental and clinical sciences related to medical and dental research will be presented in the conference that will be published as part of the conference proceeding. This proceeding will be useful for keeping dental and medical professionals up to date on the latest scientific developments.

Dr. Aryadi Subrata
Chairman FORIL XIII conjunction with ICTDMS

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Effect of air-abrasive particle and universal bonding to shear bond strength of zirconia

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ABSTRACT: **Background.** Zirconia ceramic restoration has gained popularity in dentistry. Numerous studies were conducted to investigate the bond strength of universal bonding agents and have set reliable cementation protocols for zirconia. This study aims to determine the different effects of air-abrasive particle size and types of universal bonding agents on the shear bond strength of zirconia with dentin. **Materials and Methods.** This study used 60 samples of bar-shaped zirconia (6x4x4 mm). These samples were randomly divided into 2 groups and 30 samples. Two groups were further divided into 4 subgroups according to a combination of 2 different sizes of aluminum oxide abrasive particles (50 μm and 110 μm) and two different universal bonding agents [Single Bond Universal (SB) and All Bond Universal (AB)]. Every 4 subgroups namely AB50, AB110, SB50, and SB110 consist of 15 samples. The sample was cemented with resin adhesive cement. All samples were tested for shear bond strength with Universal Testing Machine (MPa). Data were analyzed using one-way ANOVA and Tukey's test. **Results.** There was a significant difference between AB 50 μm (AB50) group and with SB 110 μm (SB110) group ($p<0.05$). The highest shear bond strength was the SB110 group and the lowest one was the AB50 group. **Conclusion.** The shear bond strength of zirconia to a dental substrate is affected by the combination of different air-abrasive particle sizes and types of universal bonding. Reliable cementation protocols which crucial for clinical long-term success affected by complex mechanisms and materials used.

1 INTRODUCTION

Ceramic restorations are frequently utilized in clinical practice and are rising in popularity (Goldstein *et al.* 2018). In recent years, zirconia restorations have been launched and have become one of the most popular dental materials (Madfa *et al.* 2014). The concern with zirconia as a restorative material is dislodged, fractured, or chipped due to inappropriate abutment preparation or cementation technique. Zirconia bonding concept consists of (A) air-abrasive particles, (P) zirconia primer, and (C) composite resin adhesive. Multiple researches were undertaken to discover the most effective surface treatment method and bonding protocol (Blatz *et al.* 2016).

Numerous producers have developed bonding solutions that are more simple, functional, and user-friendly. The universal generation is a distinct generation that exists to overcome self-etching or one-step adhesives (Sofan *et al.* 2017). Due to a lack of information,

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numerous investigations have been done to determine the adhesion capacity of the universal bonding generation. This research on the shear bond strength test of zirconia restorations was conducted to determine the best surface treatment procedure by comparing the combination of different air-abrasive particle sizes, namely 50 μm and 110 μm (Cobra, Renfert GmbH, Hilzingen, Germany), with universal generation bonding system commonly used in Indonesia, namely Single Bond Universal (SB) (3M ESPE, USA) and All Bond Universal (AB) (Bisco, USA).

2 MATERIAL AND METHODS

Sixty samples (6 x 4 x 4 mm) of zirconia (Cercon, Dentsply, UK) densely sintered were prepared. The grinding and polishing were conducted to minimize surface irregularities before testing. The 60 zirconia samples were randomly separated into two groups based on the air-abrasive particle size (50 μm and 110 μm). Based on the combination of 2 particle sizes and 2 bonding types (SB, AB), the two groups are separated into four subgroups each with 15 samples: AB50, AB110, SB50, and SB110.

Sandblaster machine (Micra2, Dentalfarm, Italy) was used to air-abraded zirconia surface for 10 seconds, 90° angle, 1 cm far from nozzle tip and 2 bar working pressure, using 50 μm to Group AB50 & SB50 and 100 μm to Group AB110 & SB 110 (Figure 1). Vertical cut on proximal side of premolars was made to expose the dentin surface, which was subsequently polished with enhance bur with handpiece. The tooth was embedded in a 2.54 cm-diameter, 2 cm-tall polyvinyl chloride (PVC) pipe and gypsum material. The dentin was etched for 15 seconds, washed for 20 seconds, and then aerated for 2 seconds. The teeth were bonded according to the manufacturer's instructions, using All-Bond Universal (Bisco, USA) for subgroups AB50 and AB110 then Single Bond Universal (3M ESPE, USA) for subgroups SB50 and SB110.

Zirconia primer (Z-Prime plus primer, Bisco, USA) was applied on the zirconia surface, left for 30 seconds then air-dried for 2 seconds (Figure 2). The zirconia block was bonded to the tooth surface using dual cure resin cement (RelyX Ultimate, 3M, USA) and polymerized for 60 seconds, 20 seconds for each side, buccal, occlusal, and palatal. The shear bond strength test was performed in the occlusal direction at a cross-head speed of 1mm/min in a universal testing machine (Shimadzu, Japan) (Figure 3). The maximum failure load was recorded, and the shear bond strength was measured in megapascals (MPa). One-way ANOVA was performed for statistical analysis. The data showed normal distribution using the Shapiro-Wilk test. Tukey's Post Hoc test was used as a comparative test with a significance level of $p<0.05$. All data were calculated using SPSS statistical software package (SPSS 20.0; SPSS Inc. Chicago, USA).

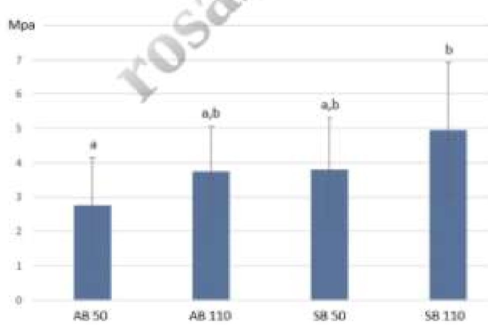

Figure 1. Chart of mean and standard deviation (MPa) of zirconia shear bonding strength and dentin. Only group a (AB50) and group b (SB110) showed significant differences.

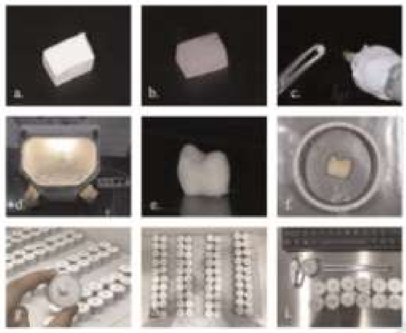

Figure 2. (a) Zirconia block prior to sintering. (b) Zirconia block after being sintered, shrunk from 18% to 20%. (c) Zirconia was air-abraded with Alumina Oxide powder. (d) Sandblaster unit device. (e) Premolar proximal and cervical preparation. (f) The tooth sample was placed in a cylindrical PVC tube. (g) Post-cemented zirconia on dentin. (h) 60 samples in the overall sample group. (i) Zirconia sample measurement before placement on the Universal Testing Machine.

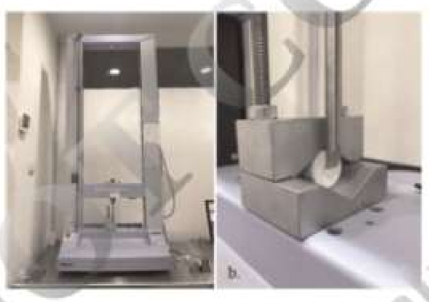

Figure 3. (a) Universal Testing Machine (Shimadzu, Japan) (b) Research sample was rested on the jig of the Universal Testing Machine (Shimadzu, Japan).

3 RESULTS

At the Laboratory of Dental Materials and Testing Center of Research and Education (DMT Core), Faculty of Dentistry, Universitas Trisakti, research has been conducted on the different impacts of combination air-abrasive particle size and universal bonding system on the shear bond strength of zirconia using universal testing machine (Shimadzu, Japan). The SB110 group has the highest average shear strength at 4.95 ± 1.05 Mpa, while the lowest average shear strength was 2.75 ± 1.37 MPa for the AB50 group (Table 1). The data were normally distributed according to the Shapiro-Wilk test (p>0,05). Homogeneous data in

Table 1. Results mean and standard deviation of dentin and zirconia Shear Bonding Strength (MPa).

Sample Group	n	Mean ± Standard Deviation
50 μm particles		
All Bond Universal	15	2,76 ± 1,39
Single Bond Universal	15	3,75 ± 1,30
110 μm particles		
All Bond Universal	15	3,78 ± 1,53
Single Bond Universal	15	4,95 ± 1,96

each group was performed by the Levene test (p>0,05). The data were analyzed by One Way ANOVA showed that there was a significant difference between these groups. The test was continued with Tukey Post Hoc Test was found that significant differences existed only between AB 50 μm (AB50) group with SB 110 μm (SB110) group by Tukey Post Hoc Test ($p<0.05$) (Table 2).

Table 2. Differences in the effect of air-abrasive particle size and universal bonding generation on zirconia shear bond strength tested by the Tukey test.

Main group	Comparison group	p value
All Bond Universal + Particle size 50 μm	*Single Bond Universal* + Particle size 110 μm	0,002*
	All Bond Universal + Particle size 110 μm	0,291
	Single Bond Universal + Particle size 50 μm	0,313
Single Bond Universal + Particle size 50 μm	*Single Bond Universal* + Particle size 110 μm	0,180
	All Bond Universal + Particle size 110 μm	1,000
All Bond Universal + Particle size 110 μm	*Single Bond Universal* + Particle size 110 μm	0,183

*sig p<0,05 | n = 15

4 DISCUSSION

Zirconia is a natural tooth-colored material that is compatible with gingival tissue. The long-term success of zirconia is depending on the preparation procedure, impacting the intaglio layer, bond strength, and durability between zirconia and cementation material (Madfa *et al.* 2014). Cementation is one of the most essential phases in assuring the longevity and continuity of a restoration. To optimize the bond strength of zirconia restorations, the air-abrasive or sandblasting system process is one of the crucial steps and treatments of the tooth surface with etching and bonding (Blatz *et al.* 2016; Melo & Souza 2015).

According to the one-way ANOVA test, there is a significant difference in shear bond strength (MPa) between the treatment groups, distinguishing the effect of the combination of air-abrasive particle size and two types of universal generation bonding on the shear bond strength of zirconia to teeth. When the Post Hoc Test was conducted with the Tukey test, only the AB50–SB110 pair was statistically different, but the other pairings, AB 50–SB 50, AB 110, and SB 110, were not significantly different. The considerable variation that occurs solely in the AB50–SB110 group may be caused by a variety of reasons, including variances in the bonding material content, the influence of roughness generated by abrasive air-particles, and other factors (Su *et al.* 2015; Tanış *et al.* 2015).

The SB group with a combination of 110 μm air-abrasive particles had the highest average shear bond strength for zirconia treated with air-abrasive particles and a universal bonding system, measuring 4.95 ± 1.96 MPa. This may be related to different compositions of Single Bond Universal and AB. SB contains silane, filler, and copolymer, whereas AB has not. According to reports, fillers enhanced mechanical qualities, reduced polymerization shrinkage, and lowered linear coefficient of thermal expansion which contributed to an increase in bond strength (Fanning *et al.* 1995). Silane increases surface free energy and wettability as a result improves initial bond strength (Kim *et al.* 2015). Methacrylate functional copolymer increases the stabilization of adhesive bonding and mitigates the negative effects of humidity. SB materials exhibit a degree of conversion of physical properties, with hydrophilic properties predominating prior to curing and during the application, while hydrophobic properties predominate post-drying, during processing, and after curing in order to increase the long-term bonding strength (Yang *et al.* 2018).

The group AB with a combination of 50 μm air-abrasive particles and a shear bond strength of 2,759 ± 1,378 MPa had the lowest average shear bond strength. This suggests that powder particles that are smaller and finer are more abrasive (Souza *et al.* 2013). However, the study conducted using particle sizes of 50 μm and 30 μm showed that small particles of 30 μm with a strength of 2.5 bar (medium) for 20 seconds were a more effective strategy for protecting restorative materials (Su *et al.* 2015).

The impact of the erosive material from the water-abrasive particles makes the surface rough, and clean, and increases the surface's wettability; however, this procedure can also create micro-defects and cracks; consequently, the firing strength of the powder particles, the distance between the nozzle tips and the zirconia, and particle size must be adjusted (Larsson 2014; Martins *et al.* 2019). Numerous variables, such as the orientation of the nozzle tip, the exposure duration to sandblasting, the flow rate of the powder stream deployed, and the pressure movement of the operator, contribute to the widely differing research outcomes. The operator should always reposition the tip of the nozzle to prevent localized blazing, which could cause damage to zirconia coating or other ceramic material. Modifications in the cementation method can affect the restoration's stability differently. There is a complex interrelationship between air-abrasive particles, the zirconia surface, and tooth-bonding adhesives (Guazzato *et al.* 2005; Kim *et al.* 2005; Saleh *et al.* 2019).

The structure of the dentin substrate makes ideal bonding strength difficult to achieve. Enamel is composed of 95% hydroxyapatite and has a regular structure, whereas dentin only contains 50% hydroxyapatite by volume and has an uneven structure. Dentin is made of tubules containing the pulp processes of the odontoblasts, making this structure susceptible and dynamically changing in response to age, caries, and dental operations. Fluid in the tubules might flow from the pulp to the external part, thereby reducing the adherence of the composite resin (Garg & Garg 2015; Ritter *et al.* 2019).

Bonding strength with dentin is affected by the bonding system's strategy, the dentin's dry-wet condition, and the bonding's pH level. By dissolving the dentin minerals, including the smear layer, with acid, the etch-and-rinse process could increase bond strength as well. The application of adhesives containing monomers infiltrates and displaces water between collagen fibrils. Following polymerization, a hybrid layer composed of resin tags and dentinal tubules is formed, resulting in micromechanical retention. Universal bonding stability was achieved as a result of the MDP monomer forming a stable nanolayer with less solubility that precipitated MDP-calcium deposits on the interfacial bond (Marchesi *et al.* 2014; Perdigao & Loguercio 2014; Van *et al.* 2003).

5 CONCLUSION

Reliable cementation methods, which are critical for long-term clinical success, are affected by the complex mechanism and material used. The shear bond strength of zirconia to the dental surface is affected by the combination of air abrasive particle size and type of the Universal Bonding Agent. This study suggests the use of combination of 110 μm air abrasive particles for zirconia surface treatment and SB as adhesive bonding for zirconia cementation protocols.

CONFLICT OF INTEREST

There are no conflicts of interest to declare by the authors. All co-authors have read and approved the article, and there are no financial conflicts of interest to disclose.

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Effect of air-abrasive particle and universal bonding to shear bond strength of zirconia

by Meiny Faudah Amin

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Effect of air-abrasive particle and universal bonding to shear bond strength of zirconia

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ABSTRACT: **Background.** Zirconia ceramic restoration has gained popularity in dentistry. Numerous studies were conducted to investigate the bond strength of universal bonding agents and have set reliable cementation protocols for zirconia. This study aims to determine the different effects of air-abrasive particle size and types of universal bonding agents on the shear bond strength of zirconia with dentin. **Materials and Methods.** This study used 60 samples of bar-shaped zirconia (6x4x4 mm). These samples were randomly divided into 2 groups and 30 samples. Two groups were further divided into 4 subgroups according to a combination of2 different sizes ofaluminum oxide abrasive particles (50 mm and 110 mm) and two different universal bonding agents [Single Bond Universal (SB) and All Bond Universal (AB)]. Every 4 subgroups namely AB50, AB110, SB50, and SB110 consist of 15 samples. The sample was cemented with resin adhesive cement. All samples were tested for shear bond strength with Universal Testing Machine (MPa). Data were analyzed using one-way ANOVA and Tukey's test. **Results.** There was a significant difference between AB 50 mm (AB50) group and with SB 110 mm (SB110) group ($p<0.05$). The highest shear bond strength was the SB110 group and the lowest one was the AB50 group. **Conclusion.** The shear bond strength of zirconia to a dental substrate is affected by the combination of different air-abrasive particle sizes and types of universal bonding. Reliable cementation protocols which crucial for clinical long-term success affected by complex mechanisms and materials used.

1 INTRODUCTION

Ceramic restorations are frequently utilized in clinical practice and are rising in popularity (Goldstein et al. 2018). In recent years, zirconia restorations have been launched and have become one of the most popular dental materials (Madfa et al. 2014). The concern with zirconia as a restorative material is dislodged, fractured, or chipped due to inappropriate abutment preparation or cementation technique. Zirconia bonding concept consists of (A) air-abrasive particles, (P) zirconia primer, and (C) composite resin adhesive. Multiple researches were undertaken to discover the most effective surface treatment method and bonding protocol (Blatz et al. 2016).

Numerous producers have developed bonding solutions that are more simple, functional, and user-friendly. The universal generation is a distinct generation that exists to overcome self-etching or one-step adhesives (Sofan et al. 2017). Due to a lack of information,

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numerous investigations have been done to determine the adhesion capacity of the universal bonding generation. This research on the shear bond strength test of zirconia restorations was conducted to determine the best surface treatment procedure by comparing the combi-nation of different air-abrasive particle sizes, namely 50 mm and 110 mm (Cobra, Renfert GmbH, Hilzingen, Germany), with universal generation bonding system commonly used in Indonesia, namely Single Bond Universal (SB) (3M ESPE, USA) and All Bond Universal (AB) (Bisco, USA).

2 MATERIAL AND METHODS

Sixty samples (6 x4x4mm) of zirconia (Cercon, Dentsply, UK) densely sintered were prepared. The grinding and polishing were conducted to minimize surface irregularities before testing. The 60 zirconia samples were randomly separated into two groups based on the air-abrasive particle size (50 mm and 110 mm). Based on the combination of 2 particle sizes and 2 bonding types (SB, AB), the two groups are separated into four subgroups each with 15 samples: AB50, AB110, SB50, and SB110.

Sandblaster machine (Micra2, Dentalfarm, Italy) was used to air-abraded zirconia surface for 10 seconds, 90 angle, 1 cm far from nozzle tip and 2 bar working pressure, using 50 mm to Group AB50 & SB50 and 100 mm to Group AB110 & SB 110 (Figure 1). Vertical cut on proximal side of premolars was made to expose the dentin surface, which was subsequently polished with enhance bur with handpiece. The tooth was embedded in a 2.54 cm-diameter, 2 cm-tall polyvinyl chloride (PVC) pipe and gypsum material. The dentin was etched for 15 seconds, washed for 20 seconds, and then aerated for 2 seconds. The teeth were bonded according to the manufacturer's instructions, using All-Bond Universal (Bisco, USA) for subgroups AB50 and AB110 then Single Bond Universal (3M ESPE, USA) for subgroups SB50 and SB110. Zirconia primer (Z-Prime plus primer, Bisco, USA) was applied on the zirconia surface, left for 30 seconds then air-dried for 2 seconds (Figure 2).

The zirconia block was bonded to the tooth surface using dual cure resin cement (RelyX Ultimate, 3M, USA) and polymerized for 60 seconds, 20 seconds for each side, buccal, occlusal, and palatal. The shear bond strength test was performed in the occlusal direction at a cross-head speed of 1mm/min in a universal testing machine (Shimadzu, Japan) (Figure 3). The maximum failure load was recorded, and the shear bond strength was measured in megapascals (MPa). One-way ANOVA was performed for statistical analysis. The data showed normal distribution using the Shapiro-Wilk test. Tukey's Post Hoc test was used as a comparative test with a sig-nificance level of $p<0.05$. All data were calculated using SPSS statistical software package (SPSS 20.0; SPSS Inc. Chicago, USA).

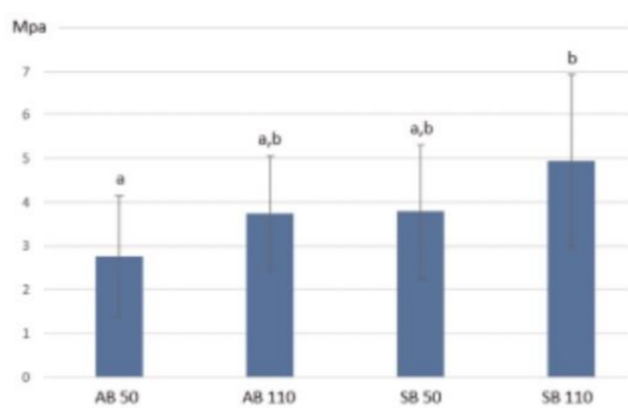

Figure 1. Chart ofmean and standard deviation (MPa) of zirconia shear bonding strength and dentin. Only group a (AB50) and group b (SB110) showed significant differences.

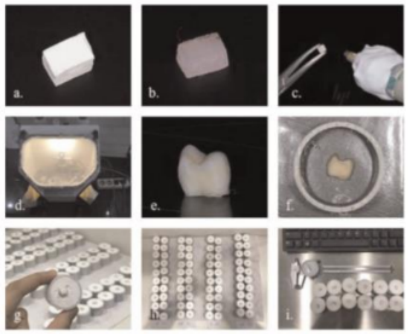

Figure 2. (a) Zirconia block prior to sintering. (b) Zirconia block after being sintered, shrunk from 18% to 20%. (c) Zirconia was air-abraded with Alumina Oxide powder. (d) Sandblaster unit device. (e) Premolar proximal and cervical preparation. (f) The tooth sample was placed in a cylindrical PVC tube. (g) Post-cemented zirconia on dentin. (h) 60 samples in the overall sample group. (i) Zirconia sample measurement before placement on the Universal Testing Machine.

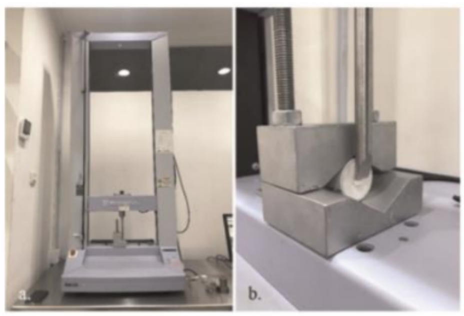

Figure 3. (a) Universal Testing Machine (Shimadzu, Japan) (b) Research sample was rested on the jig of the Universal Testing Machine (Shimadzu, Japan).

3 RESULTS

At the Laboratory of Dental Materials and Testing Center of Research and Education (DMT Core), Faculty of Dentistry, Universitas Trisakti, research has been conducted on the different impacts of combination air-abrasive particle size and universal bonding system on the shear bond strength of zirconia using universal testing machine (Shimadzu, Japan). The SB110 group has the highest average shear strength at 4.95 1.05 Mpa, while the lowest average shear strength was 2.75 1.37 MPa for the AB50 group (Table 1). The data were normally distributed according to the Shapiro-Wilk test (p>0,05). Homogeneous data in

Table 1. Results mean and standard deviation of dentin and zirconia Shear Bonding Strength (MPa).

Sample Group	n	Mean ± Standard Deviation
50 µm particles		
All Bond Universal	15	2,76 ± 1,39
Single Bond Universal	15	3,75 ± 1,30
110 µm particles		
All Bond Universal	15	3,78 ± 1,53
Single Bond Universal	15	4,95 ± 1,96

each group was performed by the Levene test (p>0,05). The data were analyzed by One Way ANOVA showed that there was a significant difference between these groups. The test was continued with Tukey Post Hoc Test was found that significant differences existed only between AB 50 mm (AB50) group with SB 110 mm (SB110) group by Tukey Post Hoc Test (p<0.05) (Table 2).

Table 2. Differences in the effect of air-abrasive particle size and universal bonding generation on zirconia shear bond strength tested by the Tukey test.

Main group	Comparison group	p value
All Bond Universal + Particle size 50 µm	*Single Bond Universal* + Particle size 110 µm	0,002*
	All Bond Universal + Particle size 110 µm	0,291
	Single Bond Universal + Particle size 50 µm	0,313
Single Bond Universal + Particle size 50 µm	*Single Bond Universal* + Particle size 110 µm	0,180
	All Bond Universal + Particle size 110 µm	1,000
All Bond Universal + Particle size 110 µm	*Single Bond Universal* + Particle size 110 µm	0,183

*sig p<0,05 | n = 15

4 DISCUSSION

Zirconia is a natural tooth-colored material that is compatible with gingival tissue. The long-term success of zirconia is depending on the preparation procedure, impacting the intaglio layer, bond strength, and durability between zirconia and cementation material (Madfa et al. 2014). Cementation is one of the most essential phases in assuring the longevity and con-tinuity of a restoration. To optimize the bond strength of zirconia restorations, the air-abrasive or sandblasting system process is one of the crucial steps and treatments of the tooth surface with etching and bonding (Blatz et al. 2016; Melo & Souza 2015).

According to the one-way ANOVA test, there is a significant difference in shear bond strength (MPa) between the treatment groups, distinguishing the effect of the combination of air-abrasive particle size and two types of universal generation bonding on the shear bond strength of zirconia to teeth. When the Post Hoc Test was conducted with the Tukey test, only the AB50–SB110 pair was statistically different, but the other pairings, AB 50–SB 50, AB 110, and SB 110, were not significantly different. The considerable variation that occurs solely in the AB50–SB110 group may be caused by a variety of reasons, including variances in the bonding material content, the influence of roughness generated by abrasive air-particles, and other factors (Su et al. 2015; Tanış et al. 2015).

The SB group with a combination of 110 mm air-abrasive particles had the highest average shear bond strength for zirconia treated with air-abrasive particles and a universal bonding system, measuring 4.95 1.96 MPa. This may be related to different compositions of Single Bond Universal and AB. SB contains silane, filler, and copolymer, whereas AB has not. According to reports, fillers enhanced mechanical qualities, reduced polymerization shrinkage, and lowered linear coefficient of thermal expansion which contributed to an increase in bond strength (Fanning et al. 1995). Silane increases surface free energy and wettability as a result improves initial bond strength (Kim et al. 2015). Methacrylate func-tional copolymer increases the stabilization of adhesive bonding and mitigates the negative effects of humidity. SB materials exhibit a degree of conversion of physical properties, with hydrophilic properties predominating prior to curing and during the application, while hydrophobic properties predominate post-drying, during processing, and after curing in order to increase the long-term bonding strength (Yang et al. 2018).

The group AB with a combination of 50 mm air-abrasive particles and a shear bond strength of 2,759 1,378 MPa had the lowest average shear bond strength. This suggests that powder particles that are smaller and finer are more abrasive (Souza et al. 2013). However, the study conducted using particle sizes of 50 mm and 30 mm showed that small particles of 30 mm with a strength of 2.5 bar (medium) for 20 seconds were a more effective strategy for protecting restorative materials (Su et al. 2015).

The impact of the erosive material from the water-abrasive particles makes the surface rough, and clean, and increases the surface's wettability; however, this procedure can also create micro-defects and cracks; consequently, the firing strength of the powder particles, the distance between the nozzle tips and the zirconia, and particle size must be adjusted (Larsson 2014; Martins et al. 2019). Numerous variables, such as the orientation of the nozzle tip, the exposure duration to sandblasting, the flow rate of the powder stream deployed, and the pressure movement of the operator, contribute to the widely differing research outcomes. The operator should always reposition the tip of the nozzle to prevent localized blazing, which could cause damage to zirconia coating or other ceramic material. Modifications in the cementation method can affect the restoration's stability differently. There is a complex interrelationship between air-abrasive particles, the zirconia surface, and tooth-bonding adhesives (Guazzato et al. 2005; Kim et al. 2005; Saleh et al. 2019).

The structure of the dentin substrate makes ideal bonding strength difficult to achieve. Enamel is composed of95% hydroxyapatite and has a regular structure, whereas dentin only contains 50% hydroxyapatite by volume and has an uneven structure. Dentin is made of tubules containing the pulp processes of the odontoblasts, making this structure susceptible and dynamically changing in response to age, caries, and dental operations. Fluid in the tubules might flow from the pulp to the external part, thereby reducing the adherence of the composite resin (Garg & Garg 2015; Ritter et al. 2019).

Bonding strength with dentin is affected by the bonding system's strategy, the dentin's dry-wet condition, and the bonding's pH level. By dissolving the dentin minerals, including the smear layer, with acid, the etch-and-rinse process could increase bond strength as well. The application of adhesives containing monomers infiltrates and displaces water between col-lagen fibrils. Following polymerization, a hybrid layer composed of resin tags and dentinal tubules is formed, resulting in micromechanical retention. Universal bonding stability was achieved as a result of the MDP monomer forming a stable nanolayer with less solubility that precipitated MDP-calcium deposits on the interfacial bond (Marchesi et al. 2014; Perdigao & Loguercio 2014; Van et al. 2003).

5 CONCLUSION

Reliable cementation methods, which are critical for long-term clinical success, are affected by the complex mechanism and material used. The shear bond strength of zirconia to the dental surface is affected by the combination of air abrasive particle size and type of the Universal Bonding Agent. This study suggests the use ofcombination of110 mm air abrasive particles for zirconia surface treatment and SB as adhesive bonding for zirconia cementation protocols.

CONFLICT OF INTEREST

There are no conflicts of interest to declare by the authors. All co-authors have read and approved the article, and there are no financial conflicts of interest to disclose. ACKNOWLEDGEMENT This work would not have been possible without the assistance of my lecturers in the Postgraduate Program of Conservative Dentistry at Universitas Trisakti's Faculty of Dentistry. I would like to thank them for their support and advice, which significantly enhanced this paper.

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