Sains Malaysiana 54(9)(2025): 2243-2251
http://doi.org/10.17576/jsm-2025-5409-11

Evaluation of Dimensional Stability and Tear Strength: A Preliminary Study on Polyvinyl Siloxane Impression Material

(Penilaian Kestabilan Dimensi dan Kekuatan Koyakan: Kajian Awal terhadap Bahan Impresi Polivinil Siloksana)

MOHAMAD FIRDAUS AHMAD[1], NURUL IZZAH ROSLI[1], ROS ANITA OMAR[2], MUHAMMAD AIDIL ROSLAN[3] & NOOR AZLIN YAHYA[2,*]

[1]*Faculty of Dentistry, Universiti Malaya, 50603 Kuala Lumpur, Malaysia*
[2]*Department of Restorative Dentistry, Faculty of Dentistry, Universiti Malaya, 50603 Kuala Lumpur, Malaysia*
[3]*Department of Science and Technology Studies, Faculty of Science, University Malaya, 50603 Kuala Lumpur, Malaysia*

Received: 18 April 2025/Accepted: 11 July 2025

ABSTRACT

This study investigated the tear strength and dimensional stability of polyvinyl siloxane (PVS) impression materials following chemical disinfection and storage at various intervals. Aquasil Ultra+ was evaluated for dimensional stability, with 10 specimens fabricated according to American National Standards Institute/American Dental Association (ANSI/ADA) Specification No. 19. After 1-h immersion in disinfectant, samples were sealed and stored for 24 h, 7 days, and 14 days. Dimensional changes were assessed using an image analyser at 20× magnification. Tear strength was tested in 12 specimens each of Aquasil Ultra+ and Chromaclone, prepared in accordance with American Society for Testing and Materials (ASTM) 1004 and evaluated using a universal testing machine at a crosshead speed of 51 mm/min. Statistical analysis included repeated measures analysis of variance and independent t-tests. The dimensional stability of Aquasil Ultra+ remained within the ADA's 0.5% limit across all time points (p = 0.051). Tear strength differed significantly (p = 0.002), with Aquasil Ultra+ (7.48 ± 1.35 N/mm) outperforming Chromaclone (5.98 ± 0.70 N/mm). Both materials exceeded the minimum acceptable tear strength after 5 min of setting. Clinical implication: Aquasil Ultra+ offers clinicians reliable performance and flexibility in delayed model fabrication without compromising accuracy or material durability.

Keywords: Dental impression; dimensional stability; disinfectant; elastomeric materials; polyvinyl siloxane; tear strength

ABSTRAK

Kajian ini menilai kekuatan koyakan dan kestabilan dimensi bahan impresi polivinil siloksana (PVS) selepas pembasmian kuman secara kimia dan penyimpanan pada pelbagai selang masa. Aquasil Ultra+ dinilai dari segi kestabilan dimensi dengan 10 spesimen dihasilkan mengikut spesifikasi ANSI/ADA No. 19. Selepas perendaman selama 1 jam dalam bahan pembasmi kuman, sampel dimeterai dan disimpan selama 24 jam, 7 hari dan 14 hari. Perubahan dimensi dianalisis menggunakan penganalisis imej dengan pembesaran 20×. Ujian kekuatan koyakan dijalankan ke atas 12 spesimen masing-masing bagi Aquasil Ultra+ dan Chromaclone yang disediakan mengikut piawaian ASTM 1004 dan diuji menggunakan mesin ujian universal pada kelajuan rentas kepala 51 mm/min. Analisis statistik melibatkan ANOVA ukuran berulang dan ujian-t bebas. Kestabilan dimensi Aquasil Ultra+ kekal dalam had 0.5% yang ditetapkan oleh ADA bagi semua selang masa (p = 0.051). Kekuatan koyakan menunjukkan perbezaan ketara (p = 0.002) dengan Aquasil Ultra+ (7.48±1.35 N/mm) mengatasi Chromaclone (5.98±0.70 N/mm). Kedua-dua bahan melebihi ambang minimum kekuatan koyakan selepas 5 minit pengerasan. Aquasil Ultra+ menunjukkan kestabilan dimensi dan kekuatan mekanikal yang sangat baik walaupun selepas penyimpanan berpanjangan. Implikasi klinikal: Aquasil Ultra+ menawarkan prestasi yang boleh dipercayai dan kefleksibelan dalam pembuatan model tertunda tanpa menjejaskan ketepatan atau ketahanan bahan.

Kata kunci: Bahan elastomerik; bahan pembasmi kuman; impresi pergigian; kekuatan koyakan; kestabilan dimensi; polivinil siloksana

INTRODUCTION

Dental impressions serve as a negative replica of the oral structures, including the teeth and their supporting tissues, and are used in the fabrication of dental casts for prosthetic applications in a laboratory setting (Ferro et al. 2023). Elastomeric materials are the most commonly used dental impression materials in clinical practice. These elastomers are categorised into four main groups based on their chemical composition: polysulphide, polyether, addition silicone, and condensation silicone (Huettig et al. 2021).

Polyvinyl siloxane (PVS) has recently emerged as one of the most frequently used dental impression materials for indirect prosthetic restorations because of its superior properties (Chen, Liang & Chen 2004; Saini et al. 2024). PVS offers several advantages, including minimal polymerisation shrinkage, excellent dimensional stability and durability, high accuracy in detail reproduction, biocompatibility with no toxic or allergenic effects, sufficient tear strength, and rapid elastic recovery (Chen, Liang & Chen 2004). Although all elastomers exhibit complete elastic recovery, PVS demonstrates a significantly superior elastic recovery capacity compared with other elastomers (Kanehira, Finger & Endo 2005).

PVS is widely used for dental cases requiring highly accurate impressions because of its minimal setting shrinkage (Keyf 1994). Notably, studies have demonstrated that clinicians can delay the pouring of PVS impressions for up to 72 h (Walker et al. 2007). Nevertheless, it is essential for dental practitioners to be aware of the maximum allowable time before dimensional distortion occurs (Walker et al. 2007). Most manufacturers report that PVS impressions maintain their dimensional accuracy even when stored for up to 14 days (Franco, Cunha & Benetti 2007). These impressions can be successfully poured within 1 week after the impression-taking procedure without any adverse effects (Smith, Wright & Brown 1986).

PVS, also referred to as addition silicone, undergoes a chemical reaction that produces no by-products during polymerisation, resulting in minimal polymerisation shrinkage (McCabe & Wilson 1978). The dimensional stability of impression materials is influenced by elastic recovery, polymerisation shrinkage, evaporation of volatile components, and gypsum expansion (Cayouette et al. 2003). In addition, environmental humidity, the time interval between mixing and pouring, and the thickness of the impression material within the tray can also impact its dimensional accuracy (Kanehira, Finger & Endo 2005). Therefore, to ensure accurate impressions, the selected materials must demonstrate high dimensional stability (Martins et al. 2017).

The ability of impression materials to resist various stresses upon removal while maintaining dimensional stability and structural integrity depends on their mechanical properties (Re et al. 2015). The mechanical rupture of elastomeric materials, leading to tearing, occurs in regions of high stress concentration, mainly due to cuts, defects, or localised distortions (Re et al. 2015). Impression materials with superior mechanical strength can enhance clinical outcomes by improving impression accuracy, reducing patient discomfort, and minimising trauma to the gingival tissues (Re et al. 2015).

Several studies have reported that variations in tear strength among different viscosities and brands of PVS do not have a statistically significant impact on the accuracy of prosthetic impressions (Re et al. 2015; Shen, Rawls & Esquivel-Upshaw 2022). PVS materials exhibit slow deformation and tend to tear at points where no visible permanent distortion has occurred. In comparison to other elastomeric materials, such as polyether and vinyl polyether siloxane, PVS can absorb more than three times the amount of energy before reaching the point of permanent distortion, contributing to its superior mechanical performance (Shen, Rawls & Esquivel-Upshaw 2022).

In dental practice, impression materials are considered semi-critical objects, necessitating a high level of disinfection or sterilisation (Rutala 1996). However, the dimensional stability of these materials may be adversely affected by several sterilisation techniques, making such methods generally not recommended (To et al. 2020). In 2003, the American Dental Association (ADA) and the Centers for Disease Control and Prevention recommended the use of a hospital-grade disinfectant with tuberculocidal properties for decontaminating surfaces exposed to human body fluids. Two important criteria must be considered when selecting appropriate disinfection protocols: the antibacterial efficacy of the disinfectant and its impact on the mechanical properties of the impression materials (Demajo et al. 2016). This is because the accuracy of impression materials, in terms of dimensional stability and detail reproduction, plays a crucial role in fabricating well-fitting prostheses.

Given that PVS maintains its stability over time, as claimed by manufacturers, there are limited studies investigating the effects of prolonged storage in disinfectant on its stability. Furthermore, a review of the existing literature shows a lack of studies evaluating tear strength in relation to two impression materials with different compositions. Variations in dimensional stability led to prosthetic inaccuracies, compromising clinical outcomes, while insufficient tear strength increases the risk of impression distortion or failure during removal from the oral cavity. To further understand the impacts of prolonged disinfectant storage on PVS dimensional stability and tear strength across two impression materials with different compositions, this study evaluated the dimensional stability changes of Aquasil Ultra+ following immersion in a disinfectant at four storage intervals (i.e., 1 h, 24 h, 7 days, and 14 days). Additionally, the tear strength of two PVS impression materials - Aquasil Ultra+ and Chromaclone - was examined to determine potential differences in mechanical performance. The null hypothesis was that no significant difference would be observed in the dimensional stability of PVS across the four storage intervals. Furthermore, it was hypothesised that no significant differences would exist in tear strength between the Aquasil Ultra+ and Chromaclone PVS impression materials.

MATERIALS AND METHODS

Two commercially available elastomeric impression materials and one type of disinfectant were used in this study (Table 1). The study was divided into two parts: Part A evaluated linear dimensional stability, while Part B assessed tear strength. For the linear dimensional stability test (Part A), the sample size was calculated based on previous studies that adhered to ANSI/ADA Specification No. 19 (Hafezeqoran et al. 2021; Taymour et al. 2024). Based on statistical parameters, including a significance level of 0.05, a statistical power of 80%, a mean difference of 0.3, and a standard deviation of 0.2, the minimum required sample size was determined to be 8. To enhance the reliability, standardisation, and accuracy of the findings, a total of 10 specimens were used.

For the tear strength test (Part B), 12 specimens per material group were prepared in accordance with the American Society for Testing and Materials (ASTM) standards for mechanical testing, ensuring sufficient statistical power to detect significant differences between the two impression materials. The estimated sample size was determined based on established protocols in a previous study (Abhijeet et al. 2022). With a statistical power of 91%, a significance level of 0.05, and adjusted mean and standard deviation values of 1.35 and 1.0, respectively, the required total sample size for two-group comparison was calculated to be 24. The selected sample sizes were deemed adequate to ensure precision in evaluating material performance while maintaining methodological feasibility.

PART A: LINEAR DIMENSIONAL STABILITY TEST

Aquasil Ultra+ (Dentsply Sirona, Charlotte, NC, USA), an impression material made of PVS, was used in this study. Ten impression discs of this material were prepared according to American National Standards Institute/ ADA Specification No. 19 using a stainless-steel mould consisting of a test die and ring (Figure 1(a)) (Sabri Dental Enterprises, Downers Grove, IL, USA). Two vertical lines, d1 and d2 (25 mm apart), and three horizontal lines, A, B, and C, with widths of 20 µm, 50 µm, and 70 µm, respectively, were engraved on the test die (Figure 1(b)). A schematic drawing representing both the vertical and horizontal lines is illustrated in Figure 1(c).

The impression material was injected into the stainless steel mould until it was completely filled, and the mould was covered with a Perspex sheet. A constant pressure was applied on top of the Perspex sheet using a 500-g weight to standardise the material thickness during setting (Figure 2(a)). The disc was then carefully removed, and a scalpel was used to clean the test die and ring of any excess material before fabricating the next disc (Figure 2(b)).

For disinfection, 10 discs of Aquasil Ultra+ were immersed in Medaprint® (Medalkan, Athens, Greece) for 1 h, following the manufacturer's recommendations. All discs were stored in zip-lock bags, and dimensional stability measurements were taken at four storage intervals: 1 h, 24 h, 7 days, and 14 days. An image analyser (Infinite Focus Real 3D, Alicona, Belgium) at 20× magnification was used to assess dimensional stability by measuring the distance between lines d1 and d2 on the test die (L1). A similar measurement was performed on the impression discs (L2). Each sample was measured in triplicate, and the average value was recorded by the same examiner under consistent conditions (Figure 3).

The percentage of dimensional change was calculated using the following formula:

$$\Delta L = 100 \times [(L1-L2) / L1]$$

where L1 and L2 represent the distances between lines d1 and d2 on the test die and the impression disc, respectively.

PART B: TEAR STRENGTH TEST

Twelve specimens of each impression material (i.e., Aquasil Ultra+ and Chromaclone) were prepared using an acrylic mould recommended by the ASTM specification for tear strength, 'Die C 12' (Figure 4(a)). Each material was handled according to the manufacturer's instructions, injected into the mould, and immediately covered with a Perspex sheet, with every corner of the mould secured using screws. After setting, the specimens were removed from the mould, and any flash was carefully trimmed using a sharp scalpel (Figure 4(b)). A schematic drawing representing the mould, with dimensions of 96.4 mm in width, 19.5 mm in length, and 2.0 mm in thickness at the tearing point, is shown in Figure 4(c).

All specimens were stretched at a constant rate of 51 mm/min using a universal testing machine (Shimadzu Corporation, Kyoto, Japan). Tear strength was calculated using the following equation:

$$T\ (N/mm) = F / d$$

where T is the tear strength, F is the force required to tear the specimen, and d is the thickness of the specimen.

STATISTICAL ANALYSIS

Numerical data are presented as mean and standard deviation. Statistical analysis was performed using SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). The normality of the data was assessed using the Shapiro–Wilk test (α = 0.05). A one-way repeated-measures analysis of variance was conducted to evaluate the dimensional changes of the tested material (Aquasil Ultra+) across four storage intervals (1 h, 24 h, 7 days, and 14 days). An independent t-test was used to compare the tear strength of the two impression materials (Aquasil Ultra+ and Chromaclone) used in the present study. The significance level was set at $p < 0.05$.

RESULTS

PART A: LINEAR DIMENSIONAL STABILITY

A one-way repeated-measures analysis of variance was conducted to determine whether there was a statistically significant difference in the material's dimensional stability across the four storage intervals. There were no outliers, and the data were normally distributed at each time interval, as assessed by a boxplot and the Shapiro–Wilk test ($p > 0.05$). As a result, the storage intervals did not produce statistically significant changes in the dimensional stability of the tested material (Aquasil Ultra+) ($p = 0.051$) (Table 2). After 1 h of storage, Aquasil Ultra+ exhibited a mean dimensional change of 0.27 ± 0.16%, which rose slightly at 24 h to 0.28 ± 0.17% and remained stable over the following week at 0.28 ± 0.15%, before increasing more notably to 0.31 ± 0.14% after 2 weeks. The highest mean dimensional change was observed after 7 days of storage.

PART B: TEAR STRENGTH

An independent t-test was conducted to determine whether there was a statistically significant difference in tear strength between the two impression materials tested in this study. The statistical analysis of the mean tear strength values (N/mm) for the two materials is presented in Table 3. The results showed a statistically significant difference in tear strength between the two materials ($p = 0.002$), with Aquasil Ultra+ demonstrating a higher mean tear strength of 7.48 ± 1.35 N/mm compared with Chromaclone, which showed a mean tear strength of 5.98 ± 0.70 N/mm.

TABLE 1. Impression materials and disinfectant used in the study

Tested materials	Composition	Manufacturer
Impression material		
Aquasil Ultra+ medium body regular set	• Polydimethylsiloxane polymer • Polymethylhydrogen siloxane • Silicon dioxide • Sodium aluminosilicate • Organic platinum complex • Surfactant • Titanium dioxide • Metallic oxide pigments • Peppermint oil	Dentsply Sirona, Charlotte, NC, USA
Chromaclone™ PVS medium regular set	• Cristobalite • Alcohols • C12-14, • Ethoxylated	Ultradent Products, South Jordan. UT, USA
Disinfectant		
Medaprint®	• N-(3-aminopropyl)-N- dodecylpropan- 1,3 diamine • Didecyldimethyl ammonium chloride • Isopropyl alcohol • 5-15% nonionic surfactants • Anti-foaming agent • Excipients	Medalkan, Athens, Greece

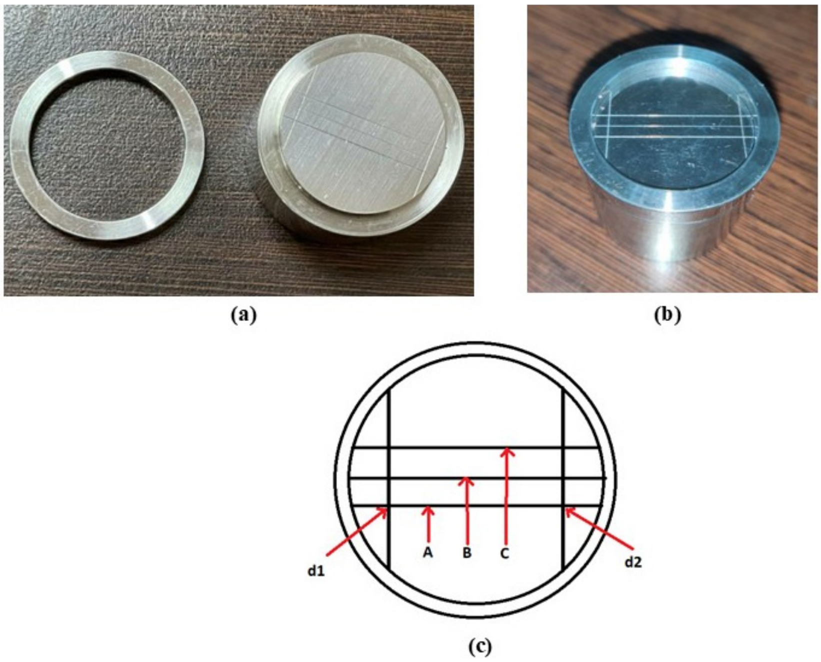

FIGURE 1. (a) stainless-steel mould consisting of a test die and ring, (b) stainless-steel test die showing the two vertical and three horizontal lines, (c) schematic drawing indicating the verticals d1 and d2 lines, horizontal A, B, and C lines

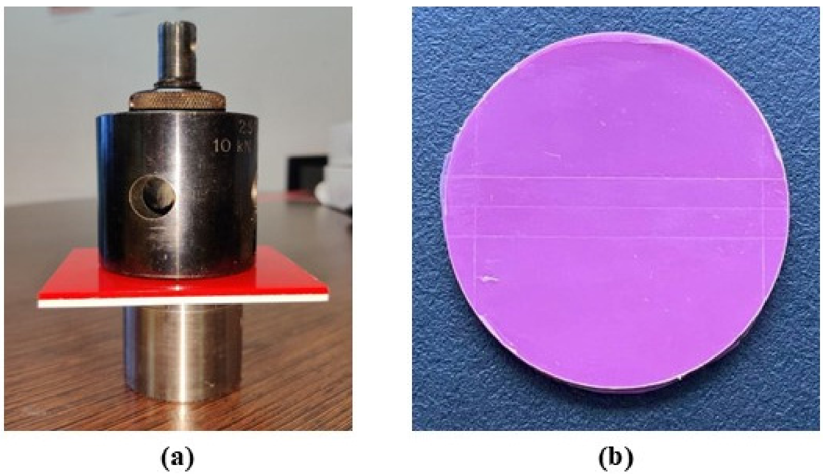

FIGURE 2. (a) stainless-steel test die covered by the Perspex sheet with a 500 g weight load, (b) final version of impression material disc after excess removal

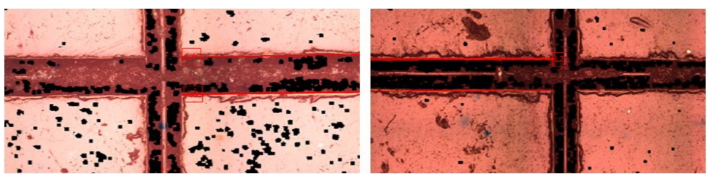

FIGURE 3. Images showing microscopic measurement of the linear dimension

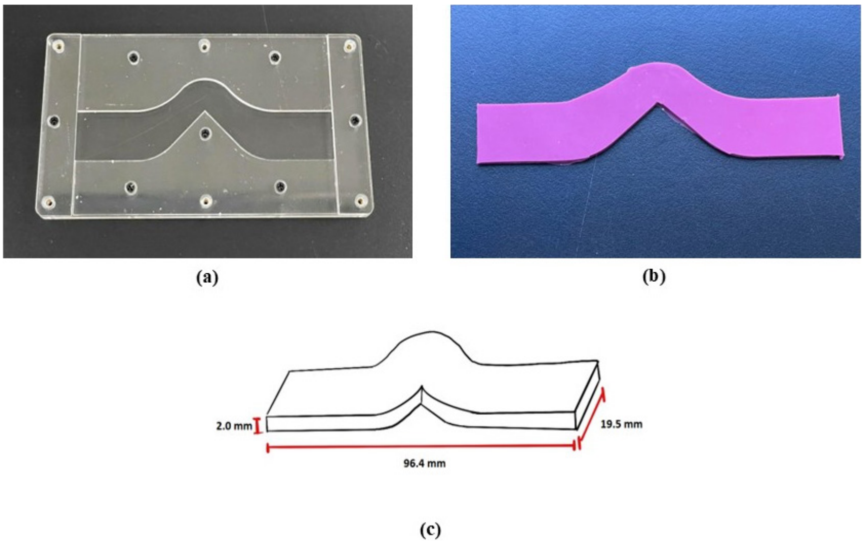

FIGURE 4. (a) Acrylic mould used in tear strength test; (b) final version of tested materials; (c) schematic drawing represent the width, length, and thickness of the tested material

TABLE 2. Descriptive and statistical analysis of dimensional change of Aquasil Ultra+ (n=10) at four storage intervals

Storage intervals	% Dimensional change (Mean ± SD)	*p**
1 h	0.27 ± 0.16	0.051
24 h	0.28 ± 0.17	
7 days	0.28 ± 0.15	
14 days	0.31 ± 0.14	

*one-way repeated measure ANOVA

TABLE 3. Descriptive and statistical analysis of tear strength of Aquasil Ultra+ and Chromaclone (n=12)

Tested materials	Tear strength (Mean ± SD N/mm)	*p**
Aquasil Ultra+	7.48 ± 1.35	0.002
Chromaclone	5.98 ± 0.70	

*Independent t-test

DISCUSSION

The impression-taking process is one of the most critical steps in the fabrication of precise prostheses, with the selection of impression materials significantly influencing the overall procedure. That said, the mechanical properties of elastomeric impression materials play a crucial role in ensuring both accuracy and durability (Hondrum 1994). Furthermore, infection control protocols in healthcare settings, such as dental clinics and hospitals, necessitate the disinfection of impression materials to prevent cross-contamination - an essential requirement that must be achieved without compromising dimensional accuracy. PVS has been recognised as one of the most reliable impression materials, offering superior dimensional stability and minimal dimensional changes following exposure to disinfectants, making it well-suited for clinical applications (Samra & Bhide 2018).

In the present study, the disinfection procedure was carried out by immersing the samples in a 1% diluted Medaprint solution for 60 min across all test groups. This concentration and contact time have been reported to effectively eliminate microorganisms, including tuberculocidal and mycobactericidal agents (Reichel et al. 2014). Given the chemical properties and reactions of PVS, it is expected to exhibit high dimensional stability even after 1 h of immersion in disinfectant. Additionally, PVS impressions can be stored for up to 14 days prior to stone pouring without compromising their dimensional accuracy.

The null hypothesis proposed that there would be no significant difference in the dimensional change of PVS impression materials following prolonged storage for 14 days. The findings of this study showed that 14 days of storage did not result in statistically significant dimensional changes, confirming the material's long-term stability. By contrast, a study by Carvalhal et al. (2011) reported that PVS (Xantopren VPL) samples exhibited significant dimensional changes after 60 min of immersion. Previous studies on Aquasil Ultra Monophase (Germany) align with the present findings, showing dimensional changes of 0.32% after 24 h and 0.40% after 1 week. Similarly, earlier investigations by Jagger et al. (2007) and Walker et al. (2007) reported dimensional changes of 0.30% for the same material, further supporting the stability of Aquasil Ultra Monophase over time.

The present results indicated that while statistically significant dimensional changes were observed after 14 days compared with 7 days of storage, these changes remain clinically acceptable because they fall within the ADA guideline range of 0.5% (Walker et al. 2007). The hydrophobic properties of PVS prevent water absorption during storage, contributing to its optimal dimensional stability (Craig, Urquiola & Liu 1990). This stability is primarily attributed to its addition polymerisation reaction, which produces no by-products, provided that the correct proportions are maintained and no impurities are present (Carvalhal et al. 2011). This likely explains the minimal dimensional changes observed in this study, which are consistent with previous findings. The results further demonstrated that PVS materials maintain satisfactory dimensional stability for over 14 days without adverse effects, providing strong support for the null hypothesis.

A tear strength test assesses the resistance of an elastomeric material to fracture when subjected to tensile stress applied perpendicular to defect areas (ASTM 2020). This property is particularly relevant when the impression material is removed from thin intersulcular and interproximal zones, where tearing is most likely to occur (Abhijeet et al. 2022). Impression materials should exhibit sufficient tear resistance to withstand the tensile forces exerted during impression removal and cast separation without failure (Gupta, George & Balakrishnan 2020).

In the current study, tear strength was assessed immediately after the manufacturer's recommended setting time of 5 min. This 5-min testing interval was chosen to simulate the clinical scenario in which the impression material is withdrawn from the patient's mouth. Although high tear strength is not necessarily preferable over low tear strength in clinical applications, selecting an appropriate material that tears before undergoing irreversible deformation is essential (Singer et al. 2022). Compared with other elastomeric materials, PVS exhibits a slower rate of distortion and tears only at a point where no apparent permanent deformation occurs, making it a reliable option for precision impression-taking in clinical procedures (Surapaneni et al. 2013).

The present findings showed that Aquasil Ultra+ exhibits significantly higher tear strength than does Chromaclone, with a difference of 1.5 N/mm. The tear strength value obtained for Aquasil Ultra+ aligns with an earlier study, which reported values of 9 N/mm and 8 N/mm for non-disinfected and disinfected Aquasil, respectively (Gupta, George & Balakrishnan 2020). Nevertheless, limited data are available on the tear strength of Chromaclone. Despite this, both materials remain clinically acceptable because their tear strength values fall within the ideal range for addition silicone impression materials, which is between 1.5 and 4.3 N/mm (Shen, Rawls & Esquivel-Upshaw 2022). Recent developments in PVS materials have demonstrated greater tear strength than with other elastomeric impression materials, particularly during removal from undercuts and interdental spaces under both tensile and compressive stresses (Sinobad et al. 2014). Furthermore, the incorporation of quadri-functional (multi-functional) vinyl-terminated poly(dimethylsiloxane) (pre-polymer) in Aquasil (PVS) formulations has been patented to enhance tear strength, further improving its mechanical performance (Pant et al. 2008).

This study has several limitations. Although a single investigator was responsible for measurement and microscopic analysis, the accuracy and precision of the data inherently depend on the investigator's consistency (Lawson, Burgess & Litaker 2008). Additionally, the current study was conducted without the presence of saliva, limiting its ability to fully replicate actual clinical conditions (Yilmaz 2020). Regarding tear strength, only a single variable - tear resistance after material setting - was evaluated. Multiple factors should be considered in future investigations, including the effect of disinfectant immersion on tear strength, to better reflect clinical scenarios. Moreover, the methodology used in this study adhered to ADA guidelines, although the experimental conditions did not fully simulate actual clinical practice (Walker et al. 2007).

CONCLUSIONS

Aquasil Ultra+ demonstrates an acceptable level of dimensional stability following disinfection and prolonged storage. This impression material also exhibits superior tear strength compared to Chromaclone, with both materials producing clinically acceptable tear strength values, supporting their suitability for use in impression procedures.

ACKNOWLEDGEMENTS

We would like to thank Dentsply Sirona and Ultradent for their material support and the staff at the Biomaterial Research Laboratory (BRL), Faculty of Dentistry, Universiti Malaya for their assistance and for the use of the facilities. We would also like to thank Dr. Marhazlinda Jamaludin and Dr Mohammad Zabri Johari for their assistance in the data analysis. There is no potential conflict of interest and financial interest were included in this study.

REFERENCES

Abhijeet, K., Jei, J.B., Murugesan, K. & Muthukumar, B. 2022. Evaluation of setting time, tear strength, dimensional stability and antimicrobial property of silver and titanium nanoparticles incorporated elastomeric impression material. *Journal of Oral Biology and Craniofacial Research* 12(5): 547-551.

ASTM. 2020. *Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers*. ASTM International.

Carvalhal, C.I., Mello, J.A., Sobrinho, L.C., Correr, A.B. & Sinhoreti, M.A. 2011. Dimensional change of elastomeric materials after immersion in disinfectant solutions for different times. *Journal of Contemporary Dental Practice* 12(4): 252-258.

Cayouette, M.J., Burgees, J.O., Jones Jr., R.E. & Yuan, C.H. 2003. Three-dimensional analysis of dual-arch impression trays. *Quintessence International* 34(3): 189-198.

Chen, S.Y., Liang, W.M. & Chen, F.N. 2004. Factors affecting the accuracy of elastometric impression materials. *Journal of Dentistry* 32(8): 603-609.

Craig, R.G., Urquiola, N.J. & Liu, C.C. 1990. Comparison of commercial elastomeric impression materials. *Operative Dentistry* 15(3): 94-104.

Demajo, J.K., Cassar, V., Farrugia, C., Millan-Sango, D., Sammut, C., Valdramidis, V. & Camilleri, J. 2016. Effectiveness of disinfectants on antimicrobial and physical properties of dental impression materials. *International Journal of Prosthodontics* 29(1): 63-67.

Ferro, K.J., Morgano, S.M., Driscoll, C.F., Freilich, M.A., Guckes, A.D., Knoernschild, K.L., McGarry, T.J. & Twain, M. 2023. *The Glossary of Prosthodontic Terms*. 10th. ed. New York: Mosby Company.

Franco, E.B., Cunha, L.F. & Benetti, A.R. 2007. Effect of storage period on the accuracy of elastomeric impressions. *Journal of Applied Oral Science* 15(3): 195-198.

Gupta, M., George, V.T. & Balakrishnan, D. 2020. A comparative evaluation of tear strength and tensile strength of autoclavable and non-autoclavable vinylpolysiloxane impression material: An *in vitro* study. *Journal of International Oral Health* 12(2): 153-157.

Hafezeqoran, A., Rahbar, M., Koodaryan, R. & Molaei, T. 2021. Comparing the dimensional accuracy of casts obtained from two types of silicone impression materials in different impression techniques and frequent times of cast preparation. *International Journal of Dentistry* 2021: 9977478.

Hondrum, S.O. 1994. Tear and energy properties of three impression materials. *International Journal of Prosthodontics* 7(6): 517-521.

Huettig, F., Klink, A., Kohler, A., Mutschler, M. & Rupp, F. 2021. Flowability, tear strength, and hydrophilicity of current elastomers for dental impressions. *Materials* 14(11): 2994.

Jagger, D.C., Vowles, R.W., McNally, L., Davis, F. & O'Sullivan, D.J. 2007. The effect of a range of disinfectants on the dimensional accuracy and stability of some impression materials. *European Journal of Prosthodontics and Restorative Dentistry* 15(1): 23-28.

Kanehira, M., Finger, W.J. & Endo, T. 2005. Volatilization of components from and water absorption of polyether impressions. *Journal of Dentistry* 34(2): 134-138.

Keyf, F. 1994. Some properties of elastomeric impression materials used in fixed prosthodontics. *Journal of Islamic Academy of Sciences* 7(1): 44-48.

Lawson, N.C., Burgess, J.O. & Litaker, M. 2008. Tear strength of five elastomeric impression materials at two setting times and two tearing rates. *Journal of Esthetic and Restorative Dentistry* 20(3): 186-193.

Martins, F., Branco, P., Reis, J., Barbero Navarro, I. & Maurício, P. 2017. Dimensional stability of two impression materials after a 6-month storage period. *Acta Biomaterialia Odontologica Scandinavica* 3(1): 84-91.

McCabe, J.F. & Wilson, H.J. 1978. Addition curing silicone rubber impression materials. An appraisal of their physical properties. *British Dental Journal* 145(1): 17-20.

Pant, R., Juszczyk, A.S., Clark, R.K. & Radford, D.R. 2008. Long-term dimensional stability and reproduction of surface detail of four polyvinyl siloxane duplicating materials. *Journal of Dentistry* 36(6): 456-461.

Reichel, M., Schlicht, A., Ostermeyer, C. & Kampf, G. 2014. Efficacy of surface disinfectant cleaners against emerging highly resistant Gram-negative bacteria. *BMC Infectious Diseases* 14: 292.

Re, D., De Angelis, F., Augusti, G., Augusti, D., Caputi, S., D'Amario, M. & D'Arcangelo, C. 2015. Mechanical properties of elastomeric impression materials: An *in vitro* comparison. *International Journal of Dentistry* 2015: 428286.

Rutala, W.A. 1996. APIC guideline for selection and use of disinfectants. 1994, 1995, and 1996 APIC Guidelines Committee. Association for Professionals in Infection Control and Epidemiology, Inc. *American Journal of Infection Control* 24(4): 313-342.

Saini, R.S., Alshadidi, A.A.F., Hassan, S.A.B., Aldosari, L.I.N., Mosaddad, S.A. & Heboyan, A. 2024. Properties of a novel composite elastomeric polymer vinyl polyether siloxane in comparison to its parent materials: A systemic review and meta-analysis. *BMC Oral Health* 24(1): 54.

Samra, R.K. & Bhide, S.V. 2018. Comparative evaluation of dimensional stability of impression materials from developing countries and developed countries after disinfection with different immersion disinfectant systems and ultraviolet chamber. *Saudi Dental Journal* 30(2): 125-141.

Shen, C., Rawls, H.R. & Esquivel-Upshaw, J.F. 2022. *Phillips' Science of Dental Materials*. 13th. ed. Amsterdam: Elsevier.

Singer, L., Bourauel, C., Habib, S.I., Shalaby, H.E.A. & Saniour, S.H. 2022. Tear strength and elastic recovery of new generation hybrid elastomeric impression material: A comparative study. *BMC Research Notes* 15: 224.

Sinobad, T., Obradović-Djuricić, K., Nikolić, Z., Dodić, S., Lazić, V., Sinobad, V. & Jesenko-Rokvić, A. 2014. The effect of disinfectants on dimensional stability of addition and condensation silicone impressions. *Vojnosanitetski Pregled* 71(3): 251-258.

Smith, B.G.N., Wright, P.S. & Brown, D. 1986. *The Clinical Handling of Dental Materials*. 11th. ed. Bristol: IOP Publishing Limited.

Surapaneni, H., Pallavi Samatha, Y., Ravi Shankar, Y. & Attili, S. 2013. Polyvinyl siloxanes in dentistry: An overview. *Trends in Biomaterials and Artificial Organs* 27(3): 115-123.

Taymour, N., Hussein Abdel Kader, S., Aboushelib, M.N. & Gad, M.M. 2024. Comparative analysis of dimensional changes in autoclavable polyvinyl siloxane (PVS) impressions under various sterilization/disinfection protocols: A randomized controlled trial. *Saudi Dental Journal* 36(4): 603-609.

To, K.K., Tsang, O.T., Yip, C.C., Chan, K.H., Wu, T.C., Chan, J.M., Leung, W.S., Chik, T.S., Choi, C.Y., Kandamby, D.H., Lung, D.C., Tam, A.R., Poon, R.W., Fung, A.Y., Hung, I.F., Cheng, V.C., Chan, J.F. & Yuen, K.Y. 2020. Consistent detection of 2019 novel coronavirus in saliva. *Clinical Infectious Diseases* 71(15): 841-843.

Walker, M.P., Rondeau, M., Petrie, C., Tasca, A. & Williams, K. 2007. Surface quality and long-term dimensional stability of current elastomeric impression materials after disinfection. *Journal of Prosthodontics* 16(5): 343-351.

Yilmaz, E.Ç. 2020. Effect of artificial saliva storage time of composite materials with different filler structure (micro/nanofiller) on the mechanical and tribological behavior. *Journal of Dental Research and Review* 7(2): 37-41.

*Corresponding author; email: nazlin@um.edu.my