出國報告（出國類別：開會）

赴日本參加日本齒科研討會

服務機關：國立成功大學醫學院附設醫院
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摘要

2024 年第 160 屆日本齒科保存學會 2024 年度春季學術大會之會議 (160th Meeting of the Japanese Society of Conservative Dentistry, 2023)在日本仙台舉辦，聚集了日本牙科材料領域的專家和學者。本次會議於 5 月 16-17 日舉行，本人與研究生 (林芝安、周冠宇、鄭光廷、侯達鈞、蘇家蓁)、研究助理 (李佳凌)，共同發表五篇論文， 會中也會晤了東北大學、大阪齒科大、東京醫科齒科大學等知名大學教授與學會幹部。於參加學會之外，5 月 15 日也至東北大學進行學術交流，參訪東北大學齒學部和齒科病院，同時商討成大學生今年將赴日參加短期交流事項。

日本齒科保存學會是保存齒科學的學術先驅，不僅提供深入瞭解牙科材料領域的最新趨勢和發展的機會，同時也讓與會者提供了學術交流的機會，是台日牙醫界交流的最佳平台。

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一、目的

此次出國的目的，是前往日本仙台參加「日本齒科保存學會 2024 年度春季學術大會」(160th Meeting of the Japanese Society of Conservative Dentistry, 2024)，在會上發表論文。同時，還至日本東北大學牙醫學院（Tohoku University Graduate School of Dentistry）進行學術研究交流並參訪東北大學之牙醫學院齒科研究室與臨床醫院。

日本齒科保存學會是日本最大的牙科學術組織之一，使命是通過治療來維護和保護牙齒，使人們能夠長期保有健康的牙齒並正常行使咀嚼功能。該學會重視預防和治療蛀牙及牙周病，在推動日本口腔醫學和牙科醫療領域的發展中具有重要任務。學會的主要成員包括保存修復學、牙內治療學和牙周治療學等專科的醫師和學術研究人員。他們致力於高質量的研究，不斷開發創新且先進的診斷、預防和治療方法。每年，學會成員都會有重要的學術發表和成就，這些成果被應用於臨床，對口腔醫療做出重要貢獻。

目前，該學會擁有約 4500 名會員，每年舉辦兩次學術大會並出版學會雜誌，開展各種學術、研究和教育活動。此外，學會還組織多種活動，以促進與齒科保存學相關的醫療預防和發展。

這次學術大會將吸引來自日本各地的學者前來參加，進行深入的學術討論，是牙科領域不可或缺的重要研討會。

圖一、2024 年日本齒科保存學會春季學術大會之會議

二、過程

2024 年 5 月 14 日，我們抵達仙台後，首先入住旅館，準備展開為期數日的學術交流與研討會活動。5 月 15 日早上，我們首先前往東北大學進行學術交流。由我介紹成功大學的地理位置、歷史背景、和我的研究方向 (圖二)，隨後研究生林芝安、周冠宇、鄭光廷、侯達鈞、蘇家蓁及研究助理李佳凌將依次介紹他們的研究題目，進行雙向學術互動 (圖二-四)。

下午的時候，我們參觀了東北大學附設醫院 (Tohoku University Hospital)及其齒科研究室。在實驗室裡，我們看到了台灣所沒有的齒科機器人病人，這讓我們覺得非常有趣，也發現們使用了許多日本國產製的材料和儀器設備。在診間參觀時，我們也注意到他們在特殊需求牙科醫療環境方面的完善設計（圖五至圖七）。

圖二、與東北大學之會議討論

圖三、研究生進行報告
中間: 東北大学大学院歯学研究科長・歯学部長- 小坂　健 (Ken Osaka)

圖四、與東北大學前院長-佐佐木 啟一、現任齒科院長小坂健、醫院院長 Dr. Sugiura、附研究科長洪光教授、中久木康一教授、等合影

圖六、參觀機器人病人

圖五、參觀力學實驗室

圖七、東北大學附設醫院之特殊需求環境

結束了東北大學的參訪後，我們於晚間 18:30 參加了日本齒科保存學會舉辦的懇親會。現場人潮眾多，因我本人代表中華民國牙體復形學會擔任甄審委員會主委，率領台大的曾琬瑜醫師、成大醫院兼任主治醫師楊靜宜以及研究助理李佳凌代表台灣參加晚間懇親會，也就是大會晚宴。我在懇親會上致詞，歡迎來自日本各地的學者、醫師和廠商到台灣進行交流，並代表花蓮牙醫師公會感謝日本齒科界對花蓮地震的關心與捐贈。在會中，我也與許多教授 (東北大學-齋藤 正寬教授、大阪齒科大學-林美 加子、神奈川齒科大学-半田 慶介教授、鶴見大学名誉教授桃井保子、九州齒科大学-鷲尾絢子教授、多倫多大學 Prof. Anil Kishen 等等)交換了名片，希望未來能有合作的機會，此外多倫多大學 Anil Kishen 教授也表明暑假也會到台灣進行交流。(圖八-十六)

圖八、大會長-齋藤 正寬

圖九、日本齒科保存學會-理事長 林美 加子

圖十、大會長-齋藤 正寬

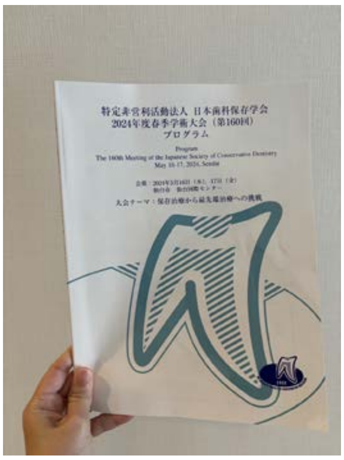
圖十一、日本齒科保存學會-理事長 林美加子與大會長-齋藤 正寬

圖十二、神奈川歯科大学-半田 慶介教授　圖十三、東北大學附設醫院

圖十四、與鶴見大學名誉教授桃井保子等交流　圖十五、本次特別演講講師-多倫多大學 Prof. Anil Kishen

圖十六、左一: 研究助理-李佳凌、左二: 楊靜宜醫師、左三:東北大學附設醫院院長 Dr. Sugiura、右二:莊淑芬醫師、右一:台大曾琬瑜醫師

今年 5 月 16 日至 17 日，日本齒科保存學會在日本仙台國際會議廳舉辦，聚集了來自日本各地的牙科材料領域專家和學者，促進了專業交流和學術互動。本次會議涵蓋了保存修復領域、再生醫療、歯科衛生士領域、臨床領域等主題。會議當天由日本齒科保存學會國際處的高見澤 俊樹教授提供了詳細會議手冊 (圖十七)，內容包含日程和地點信息。此外，參加者還可在官網上找到更詳細的資訊。



圖十七、會議手冊

本次行程分成兩主要目的，第一是參加日本齒科保存研討會，了解現今材料之應用、新產品等。第二則是與研究生共同發表 5 篇論文。

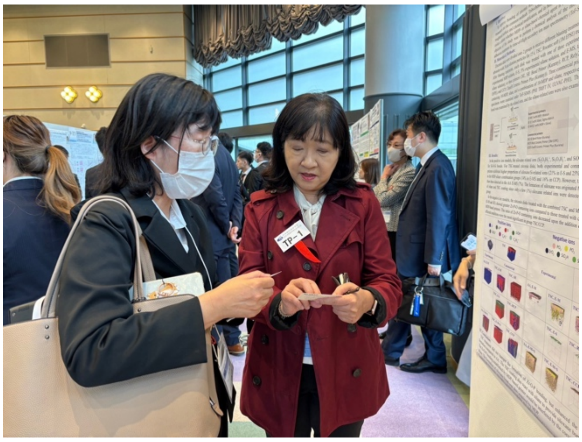
圖十八、研討會實況-多倫多大學 Prof. Anil Kishen 特別演講「Immunomodulation for periapical wound healing」

圖十九、參與研討會
左一: 碩一學生-蘇家臻、左二:研究助理-李佳凌、左三: 楊靜宜醫師、左四: 莊淑芬醫師、右一: 碩二學生-侯達鈞 、右二: 碩二學生-鄭光廷、右三: 碩二學生-周冠宇

日本海報展示有 83 篇發表再加上台灣發表 7 篇共有 90 篇，論文發表分為三大類: A 生物材料、B 生物學、C 診斷、教育、免疫學、其他。其中台灣七篇論文包含台灣大學兩篇、成功大學五篇。(圖二十)

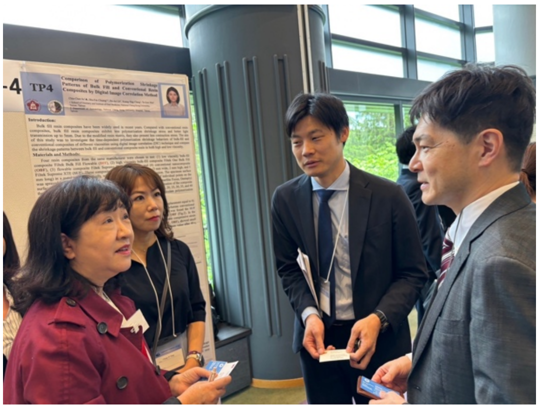
圖二十、發表論文 （左一）碩二學生-周冠宇、(左二）楊靜宜醫師、左三：台大黎博士生、(左四：莊淑芬醫師、(左五）台大曾婉瑜醫師、(左六）台大的陳映瑄醫師、(左七）碩一學生-蘇家臻、(左八）碩二學生-侯達鈞、(左九）研究助理-李佳凌、(左十)：碩二學生-鄭光廷

在 5/17 日會議的第二天 11:40-12:00，本人我與研究助理和研究生們一同發表，論文編號為 TP1、TP4、TP5、TP6、TP7，本人題目是:「Chemical Analysis of Zirconia Surfaces after Tribochemical Silica Coating and Various Adhesives Treatments by ToF-SIMS」，並與日本各地知名研究專家一起交流。本人指導之研究生周冠宇同學題目為:「Biomechanical Analysis of Endocrowns with Different Margin Designs」、研究生鄭光廷同學題目為:「Influences of Cavity Design on Biomechanical Behaviors of Zirconia and Lithium Disilicate Overlays」、研究生侯達鈞同學題目為:「Evaluations of Tissue-Dentin Adhesives Consisting of Isobutyl Cyanoacrylate and Octyl Cyanoacrylate」與研究生蘇家臻同學題目為:「 Comparison of Polymerization Shrinkage Patterns of Bulk-fill and Conventional Composites by Digital Image Correlation Method」（圖二十一），其中 3M 廠商對於樹脂縮收表示興趣，希望未來有機會可以邀請本人至日本演講、交流，此外，鶴見大學之教授也對於本人研究之黏著劑感到興趣，希望未來能夠互相合作，（圖二十二、二十三）在報告結束後，學者們展開了熱烈的討論並給予了寶貴的回饋。

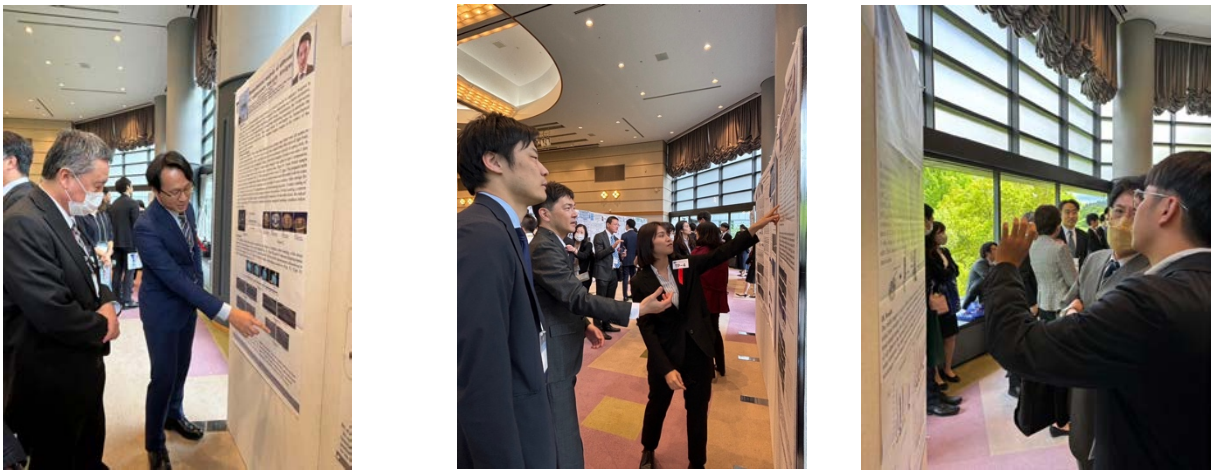


圖二十一、於發表海報前合影

圖二十二、與鶴見大學教授討論



圖二十三、與 3M 廠商討論



圖二十四、學生報告實況

在會議中，我遇到了好友東京醫科齒科大學的 Shimada 教授和北海道大學的教授。我們一起交流了最新的研究進展，並特別向 Shimada 教授請教了關於光學相干斷層掃描（OCT）的研究。他詳細解答了我們的問題，並分享了他在該領域的一些最新發現 (圖二十五)。

圖二十五、與東京醫科齒科大學的 Shimada 教授合影

三、心得

今年除了參加日本齒科保存學研討會與海報論文發表之外，還到東北大學去參訪並進行學術交流，研究生林芝安、周冠宇、鄭光廷、侯達鈞、蘇家蓁及研究助理李佳凌依次介紹了他們的研究題目，進行了雙向的學術互動，討論氛圍熱烈且富有建設性。下午，我們參觀了東北大學附設醫院及研究室。參觀時，我們注意到他們在診間的特殊需求環境方面的完善設計、研究室未來也將會注入許多 AR 練習給予學生學習，這些經驗和設計理念都讓我們受益匪淺。

5 月 16 日至 17 日，參加了在仙台國際會議廳舉辦的日本齒科保存學會研討會，在會場的時候見到許多學者及廠商，我們還與其他參與者進行了深入的交流，並且展示了我們的研究成果。

這次的日本之行讓我們增進了與國際學術界的聯繫，收穫頗豐。透過雙向交流，我們不僅展示了自己的研究成果，也吸收了大量的新知識和新技術，為未來的研究開闢了新的方向。這次經驗讓我們深刻體會到國際合作的重要性，也對未來的學術發展充滿期待。

四、建議事項

日本齒科保存學會，具有很多學術上豐富的內容，很適合推薦給牙醫師參與。這次經驗交流的過程除了研討會以外，還瞭解東北大學本身對於國際合作的積極，亦看到東北大學向海外招生的用心。經由參加研討會的機會，除可提升國際觀外，也可以更了解日本研究趨勢，同時藉此機會認識更多日本學者，有助於臨床工作以及論文發表。在發表論文的過程中，可以提升海外合作的機會，同時在研討會期間向國際社會展現台灣的實力。參加國際會議後，我的建議事項是政府部門應積極擴大國際交流機會。參加國際學術會議是與頂尖學者建立合作夥伴關係的絕佳機會。這些合作讓我們能夠共同討論牙科領域的最新趨勢、教育計畫以及研究活動，並促進跨國合作夥伴關係的發展。通過參與國際會議，我們能持續更新自身的知識，並提升自己的研究。然而，目前對於計畫主持人、學生和研究參與者的機會仍然相對有限，這限制了學界之間的交流。因此，我們應該積極促進更多的參與機會，讓更多人有機會參與國際學術會議，從而擴大國際合作的範圍，推動學術研究的發展。

五、附錄

一、會議行程表

時間	上午	下午
5/14（二）	抵達桃園機場	抵達仙台 check in
5/15（三）	東北大學齒科研究室參訪	東北大學附設醫院参訪＋ 日本齒科保存學會懇親會
5/16（四）	日本齒科保存學會研討會/ 貼示海報	
5/17（五）	日本齒科保存學會研討會/ 發表論文	

二、本人發表海報

TP1

Chemical Analysis of Zirconia Surfaces after Tribochemical Silica Coating and Various Adhesives Treatments by ToF-SIMS

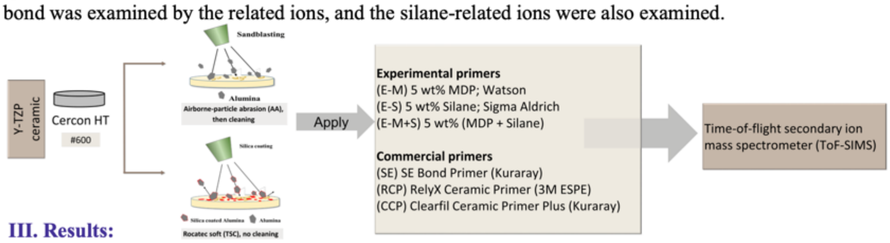
Shu-Fen Chuang [1,2▲], Chia-Ling Li[1], Bang-Yan Liu [1], Ching-Yi Yang[2]
[1] School of Dentistry and Institute of Oral Medicine, National Cheng Kung University, Tainan, Taiwan
[2] Department of Stomatology, National Cheng Kung University Hospital, Tainan, Taiwan

I. Objective:

To improve bonding of zirconia restorations, airborne-particle abrasion (AA) following by MDP monomers are the common methods. Tribochemical silica coatings (TSC) may create micromechanically roughened surface and chemical modification, and its bonding stability is recommended. However, there exists a debate whether MDP- or silane-based chemical agent is suitable for TSC treated zirconia. The objective of this study was to perform a chemical analysis of the zirconia surfaces after TSC and adhesives treatments by time-of-flight secondary ion mass spectrometry (ToF-SIMS).

II. Materials & Methods:

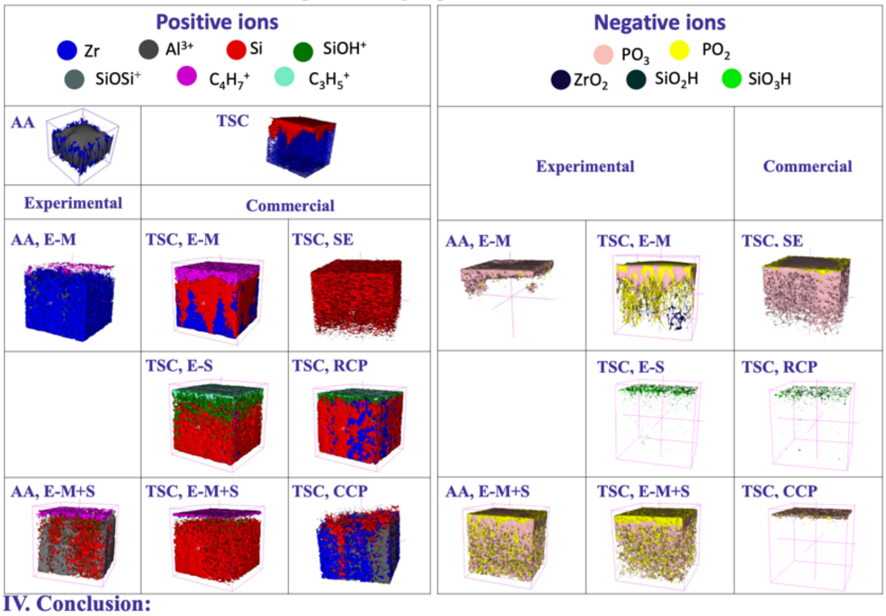
Zirconia disks were divided into 2 groups to receive different blasting treatments: AA, airborne-particle abrasion with 50 μm alumina particles for 15 s; TSC, Rocatec soft (3M EPSE) treatment for 15 s.
After blasting treatments, each disk was treated with one of three experimental primers (E-M, 5% experimental MDP solution, E-S, 5% experimental silane solution, and E-MS, the mixture of MDP and silane solution), or three primers (SE, SE Bond Primer (Kuraray); RCP, RelyX Ceramic Primer (3M ESPE), and CCP, Clearfil Ceramic Primer Plus (Kuraray)). Three commercial primers represent products containing 10-MDP, silane, and a combination of 10-MDP and silane, respectively. Subsequently, these specimens were examined under ToF-SIMS (PHI TRIFT IV, ULVAC-PHI). The formation of Zr-O-P bond was examined by the related ions, and the silane-related ions were also examined.



III. Results:

In the positive ion models, the siloxane related ions ($Si_2O_5H_3^+$, $Si_3O_7H_3^+$, and $SiOSi^+$) were calculated for Si-O-Si bonds. For TSC-treated zirconia disks, both experimental and commercial silane-based primers exhibited higher proportions of siloxane/Si-related ions (21% in E-S and 25% in RCP) compared to the MDP-silane combination groups (14% in E-MS and 16% in CCP). However, they were all higher than those detected in the AA /E-MS (7%). The formation of siloxane was originated from the interaction of silane and TSC coating since only a few (1%) siloxane related ions were detected in the TSC-only group.

In the negative ion models, the zirconia disks treated with the combined TSC and MDP-based primers (E-M and SE) showed greater Zr-P-O containing ions compared to those treated with combined AA and MDP-based primers. The ratio of Zr-P-O containing ions decreased upon the addition of silane, and the affected conditions were the most significant in group TSC/CCP.



IV. Conclusion:

TSC treatment did not hamper the formation of Zr-O-P bonding, but enhanced the bond formation compared to AA. The TSC coating also react with silane to provide siloxane bonding. The Zr-O-P bonding established by MDP-based primer would be interfered by the coexistence of silane. The formation of siloxane bond was also impaired by MDP.

(Funded by 108-2314-B-006 -016 -MY3 and 111-2314-B-006 -036 -MY3, National Science and Technology Council)

三、(本人指導) 海報

TP4

Comparison of Polymerization Shrinkage Patterns of Bulk Fill and Conventional Resin Composites by Digital Image Correlation Method

Chia-Chen Su[1]▲, Shu-Fen Chuang[1,2], Zhi-An Lin[1], Kuang-Ting Cheng[1], Ta-Jyun Hou[1]

1 School of Dentistry and Institute of Oral Medicine, National Cheng Kung University, Tainan, Taiwan

2 Department of Stomatology, National Cheng Kung University Hospital, Tainan, Taiwan

Introduction:

Bulk fill resin composites have been widely used in recent years. Compared with conventional resin composites, bulk fill resin composites exhibit less polymerization shrinkage stress and better light transmission up to 5mm. Due to the modified resin matrix, they also present less contraction stress. The aim of this study was to investigate the time-dependent polymerization shrinkage behaviors of bulk-fill and conventional composites of different viscosities using digital image correlation (DIC) technique and compare the shrinkage patterns between bulk fill and conventional composite resin in both high and low viscosity.

Materials and Methods:

Four resin composites from the same manufacturer were chosen to test: (1) low viscosity bulk-fill composite Filtek Bulk Fill Flowable (**BFF**), (2) high viscosity bulk-fill composite Filtek One Bulk Fill (**OBF**), (3) flowable composite Filtek Supreme Flowable (**SUPF**), and (4) conventional nanocomposite Filtek Supreme XTE (**SUP**). These composite material was filled into a slot (3 mm wide, 2 mm high, and 5 mm long) in a metal mold individually, with a coat of Vaseline to prevent adhesion. The specimen surface was sprayed with powders to produce sufficient contrast, allowing the tracking of individual points on the surface. The resin composites were light cured with irradiances of 1000mW/cm^2 (Smartlite Focus, Dentsply) through the lateral window of the slot for 40 s. A light microscope recorded the deformation of the composite specimen from the top before light curing and after light cured at intervals of 5, 10, 15, 20, 25, 30, 35, and 40 s. Subsequently, these images were input into a DIC software to analyze and calculate polymerization shrinkage strain and time-dependent changes.

Results:

In the results of horizontal displacement, it was observed that the shrinkage centers (displacement equal to 0) of bulk fill composites (**BFF**, **OBF**) were located deeper between 1mm to 2mm , whereas conventional composites (**SUPF**, **SUP**) were closer to the light-cured unit (Fig.1). Moreover, it was found the **SUP** exhibited the highest displacement value after 40-s, followed by **BFF**, **SUPF** and **OBF** (Fig.2). In the shrinkage strain analysis, both low-viscosity composites (**BFF**, **SUPF**) exhibited greater compressive strain compared to their high-viscosity counterparts (Fig.3). Two bulk fill composites (**BFF**, **OBF**), showed small discrete areas of low strain. It was found the **BFF** exhibited the highest shrinkage strain value after 40-s, followed by **OBF**, **SUPF**, and **SUP** (Fig.4).

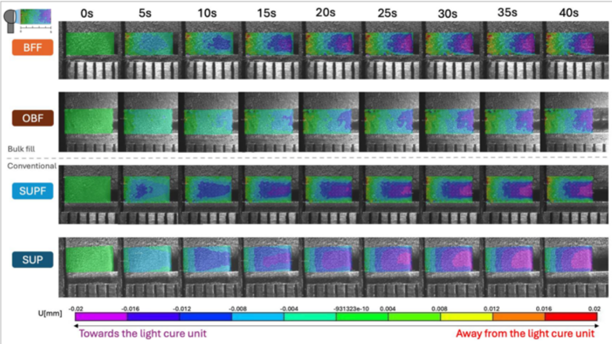


Figure 1. Horizontal displacement of resin-based composites.

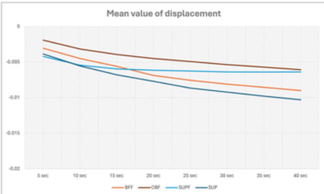


Figure 2. Mean value of horizontal displacement.

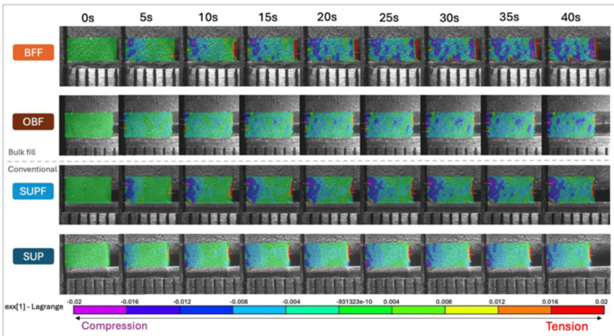


Figure 3. Horizontal shrinkage strain of resin-based composites.

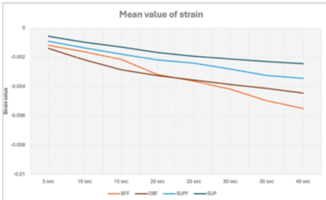


Figure 4. Mean value of horizontal strain.

Conclusion:

The analysis revealed that the bulk-fill and conventional resin composites exhibited different shrinkage behaviors. Conventional composites tend have concentrated strain at the tops, while bulk-fill composites showed modulated strain. Low-viscosity bulk-fill and flowable composites showed higher strain. DIC may offer advantages in observing polymerization shrinkage and strain.

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TP6

Influences of Cavity Design on Biomechanical Behaviors of Zirconia and Lithium Disilicate Overlays

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I. Objective:

Bonded porcelain restoration is gaining popular in dental clinics. Lithium disilicate (LS2) has been chosen for fabricating overlays for its translucency and excellent bond strength through adhesive treatments. However, LS2 overlays showed higher fracture prevalence. Zirconia (Zr) is considered as the alternative for overlay fabrication. For two ceramics overlays, there is no evidence that certain cavity design has the best performance. Hence, this study aimed to investigate the effect of cavity design on the stress distributions of LS2 and zirconia overlays using a finite element analysis.

II. Material & Method:

An intact human molar was selected and scanned under a micro-CT (Bruker Skyscan 1276). The data was imported into the Mimics software (Materalise) and then transformed into solid formats in a Geomagic software. At the meantime, resin teeth were printed out by a 3D printer to undergo four overlay preparations as: occlusal reduction only (O), occlusal reduction and boxes on two proximal surfaces (OB), OB preparation plus shoulder margins (OSB), and occlusal reduction, a central isthmus, and shoulder margins (OSI) (Fig. 1). The prepared teeth were scanned by an intraoral scanner to generate solid formats, and then combined with the sound tooth model to form four models of different overlays and their cement layers. These models were imported into a finite element analysis (ANSYS 2022) (Fig. 2). The overlay materials were assigned as either Zr or LS2, and then eight models were meshed using 0.2 mm elements. 600 N vertical force was applied on occlusal surfaces through a 6 mm diameter ball (Fig. 3). In the overlays and tooth, the maximum principal stress (MPS) were solved. In the cement, the shear stress was solved.

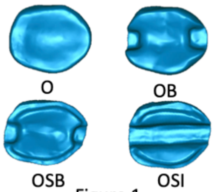

Figure 1.

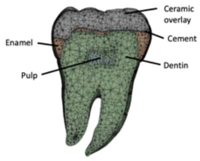

Figure 2.


Figure 3.

III. Results:

The MPS in LS2 and Zr overlays are shown in Fig. 4 and 5. All MPS in ceramic overlay were lower than its tensile strengths of LS2 (470MPa) and zirconia (>600MPa). In both materials, the MPS in dentin was the highest in OSB then in order OB > O > OSI (Fig. 6). OSB (LS2) showed the highest shear stress in cement layer, while the least is O (Zr) (Fig. 7). The tensile strength of enamel was 10Mpa which was lower than each group's MPS. If the fracture occurs, it will probably appear at enamel not ceramic overlay. On the other hand, design O had the lowest MPS among four designs when it came to overlay and dentin.

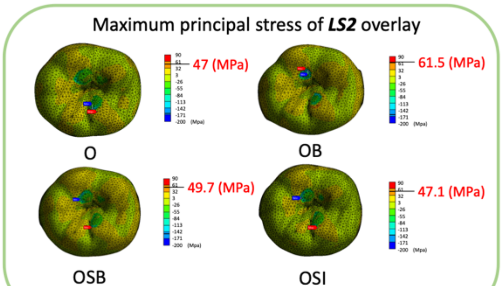

Figure 4.

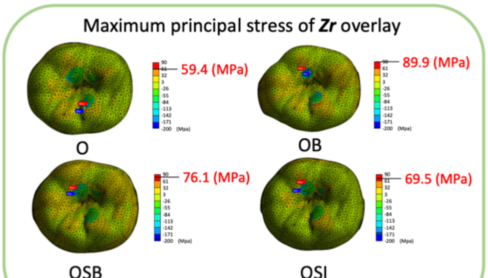

Figure 5.

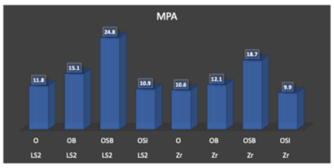

Figure 6. Maximum principal stress of ***dentin***

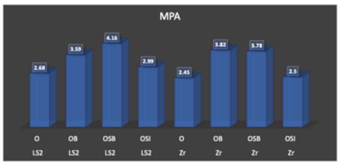

Figure 7. Maximum shear stress of ***cement***

IV. Conclusion:

In conclusion, the principal stress in ceramic overlays and dentin remains below their respective tensile strengths. This suggests a level of safety against fracture. Design O emerges as the preferred option for patients with higher masticatory forces and patient who favor hard food due to its lower maximum principal stress.

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TP7

Evaluations of tissue-dentin adhesives consisting of isobutyl cyanoacrylate and octyl cyanoacrylate

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I. Objective:

Various tissue adhesives have been developed in recent years. Cyanoacrylate adhesives are considered the most suitable for application in oral cavity. For root coverage surgery (Fig.1), a dentin-tissue adhesive may benefit the fixation of gingiva tissue. Cyanoacrylate adhesives vary in properties based on their side chain lengths. Those with short chains can form tight and stronger bonds rapidly, while those with long chains have better biocompatibility. This study was aimed to evaluate the bond strengths of tissue adhesives consisting of isobutyl cyanoacrylate and octyl cyanoacrylate adhesives of different proportions to dentin surface using an *in vitro* test.

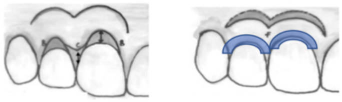


Fig.1
Use tissue adhesive to provide early immobilization of flap.

II. Material & Method:

Different proportions of 4-carbons isobutyl cyanoacrylates and 8-carbons octyl cyanoacrylate (both from StarSpeed, China) were blended to create five adhesives: ① 100% isobutyl cyanoacrylates (BC_{100}); ②-④ mixtures of isobutyl cyanoacrylates (70%, 50%, or 30%) and octyl cyanoacrylate (30%, 50%, or 70%) as $BC_{70}OC_{30}$, $BC_{50}OC_{50}$, and $BC_{30}OC_{70}$; and ⑤ 100% octyl cyanoacrylates (OC_{100}). A commercial tissue adhesive, PeriAcryl®90HV (PA) (GluStich Inc., Canada), served as a comparison. These adhesives were used to adhere bovine gingiva to human root dentine in bonding areas of 12.56 mm². Halves of spcimens in all groups received a early shear bond strength test after 5 min using an Universal Testing Machine (Shimadzu, Japan). Late bond strength was also tested after 24-h immersion in normal saline at 37°C. Failure patterns were observed under an optical microscope.

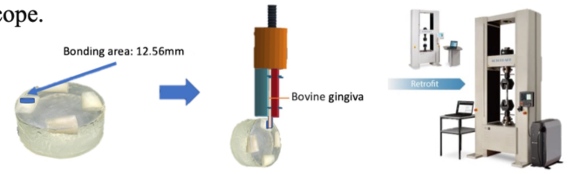


Fig.2
Workflow of bond strength test

III. Results:

The results suggest a positive correlation between the proportions of isobutyl cyanoacrylate and initial bond strengths (Fig.3). BC_{100} showed the best performance, and OC_{100} presented the lower bond strength among five experimental adhesives. In late bond strength results, the bond strengths of all adhesives has decreased (Fig.5). The difference between BC_{100} and OC_{100} decreased after water immersion. The failure modes are all mixed failure. As the proportion of BC decreased, the percentages of tooth-adhesive failure increased in both initial and late bond strength test (Fig. 4,6).

Fig.3

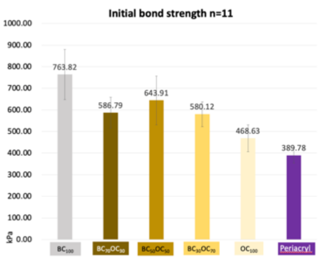


Fig.4

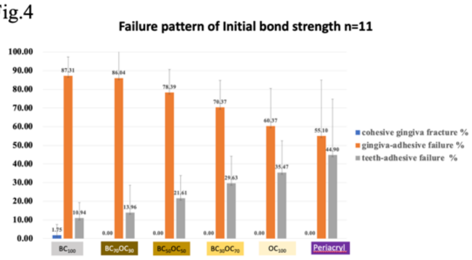


Fig.5

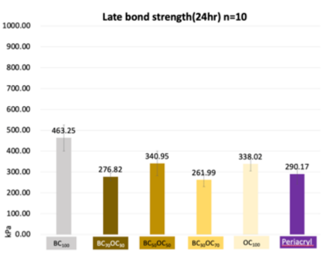
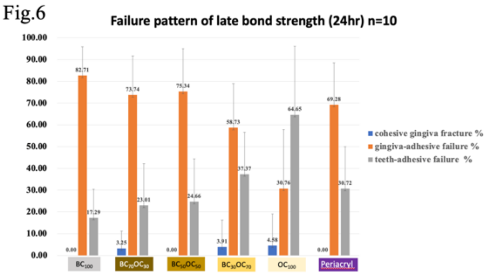


Fig.6



IV. Conclusion:

With the present results, the proportions of isobutyl cyanoacrylate adhesive affects the bond strength. The result suggests that short-chain isobutyl cyanoacrylate adhesive has stronger bonding to root dentin than long-chain octyl cyanoacrylate adhesive. All adhesives shwoed decreased bond strengths after 24 h.

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TP5

Biomechanical analysis of different of endocrown margin designs

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I. Objective:

The restorations of endodontically treated teeth is a crucial concern in dentistry. Progress in ceramic materials and adhesive techniques has introduced the endocrown as a viable alternative. Nevertheless, there is an ongoing debate regarding cavity design. Furthermore, the "compression dome" concept underscores the significance of preserving supporting structures to minimize the risk of tooth and restoration fractures. This study aimed to investigate the biomechanical behaviors of teeth receiving endocrowns with different margin designs in the context of the "compression dome" concept.

II. Material & Method:

64 teeth were collected. They were first endodontically treated and filled with GP points to leave 2mm coronal pulp space. The root of each tooth was coated with a thin layer of light body impression materials to simulate PDL, and then the teeth were planted vertically in epoxy resin. In this study, 4 cavity designs were investigated: Type I: butt-joint margins of endocrown were 1 mm above the inflection line (Fig. 1); Type II, 1-mm ferrule margin was added to type I preparation; Type III: butt-joint margins were 2 mm below the inflection line; Type IV: 1-mm ferrule margin was added to type IV preparation (Fig. 2). The inner axial walls were 12° taper. The prepared teeth received scanning then corresponding lithium disilicate endocrowns were fabricated with the same occlusal anatomy. These crowns were cemented with Variolink N resin cements. After storage for 24 h, the samples were fixed at a 15° inclination on a universal testing machine. A static loading of 100 N was applied to the distobuccal cusps using a stainless steel piston. During loading, a camera captured the images for the digital image correlation (DIC) analysis. On the other hand, the optical coherence tomography (OCT) was used to check restoration marginal bonding condition before and after loading.

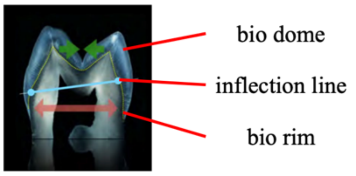

Figure 1.

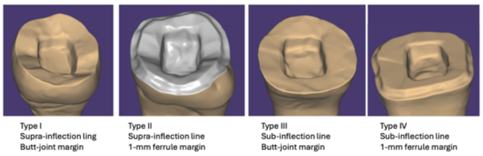

Figure 2.

III. Results:

DIC analysis revealed that strain occurred in all types of samples after loading, with strain observed to be concentrated at the cervical region (Fig. 3). Type III and IV showed displacements at margins. Under observation with OCT, types I and III did not show pronounced debonding in the butt-joint margin (Fig. 4, 6). Type II showed slight debonding condition (Fig. 5). Type IV exhibited apparent debonding (Fig. 7)

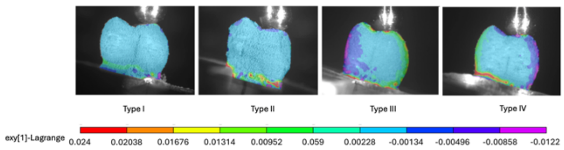

Figure 3.

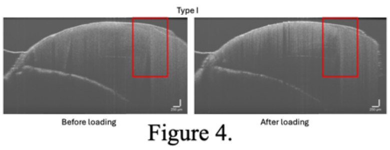

Figure 4.

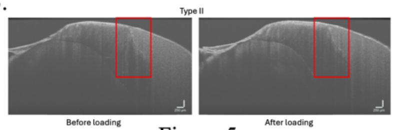

Figure 5.

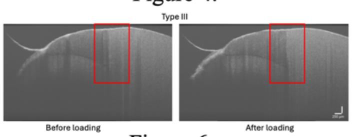

Figure 6.

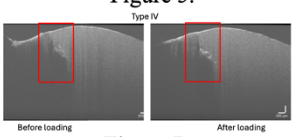

Figure 7.

IV. Conclusion:

The results conformed with the concept of "compression dome" since the supra-inflection line types, including type I and type II, exhibited less pronounced debonding, while the sub-inflection line types showed more apparent debonding. The type IV, with ferrule margin design, showed more pronounced debonding. However, further experiments are still needed to verify these findings.

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