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REVIEWER'S REPORT

Manuscript No.: IJAR-51750 Date: 20/05/2024

Title: Comparison Of The Debonding Characteristics of Conventional And Laser Aided Debonding of Ceramic Brackets- An In-Vitro Study.

Recommendation:
Accept as it is .....
Accept after minor revision.....Yes.....
Accept after major revision .....
Do not accept (*Reasons below*) .....

Rating	Excel.	Good	Fair	Poor
Originality	•			
Techn. Quality	•			
Clarity		•		
Significance		•		

Reviewer Name: Dr. Sireesha Kuruganti **Date:** 20/05/2024

Reviewer's Comment for Publication.

(*To be published with the manuscript in the journal*)

The reviewer is requested to provide a brief comment (3-4 lines) highlighting the significance, strengths, or key insights of the manuscript. This comment will be Displayed in the journal publication alongside with the reviewers name.

This manuscript presents an in-vitro comparison of conventional and laser-aided debonding techniques for ceramic orthodontic brackets, focusing on enamel damage and adhesive remnant. The study has merit and addresses a relevant clinical challenge in orthodontics.

Detailed Reviewer's Report

Detailed In-Depth Review of the Manuscript: "Comparison Of The Debonding Characteristics of Conventional And Laser Aided Debonding of Ceramic Brackets- An In-Vitro Study."
This manuscript presents an in-vitro comparison of conventional and laser-aided debonding techniques for ceramic orthodontic brackets, focusing on enamel damage and adhesive remnant. The study has merit and addresses a relevant clinical challenge in orthodontics. However, several areas require attention and revision to enhance the clarity, rigor, and overall quality of the manuscript.
Abstract:
* Line 5-6: The statement "debonding procedure results in 30-40 micrometre of reduction in enamel surface" is a strong claim. While enamel damage is a known concern, attributing a specific reduction range to the debonding procedure itself without immediate context or citation within the abstract might be misleading. It's unclear if this refers to the debonding alone or includes subsequent polishing.

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* Line 6-7: "This leads to irreversible enamel damage and increase chances of fracture." While plausible, directly stating "increase chances of fracture" for the enamel due to this reduction might be an overstatement without further qualification.
* Line 7-9: "Also, the adhesive remanent on enamel surface due to bond loss in the enamel adhesive contact during debonding results to polishing method which further leaves enamel with scratch and fissures." This sentence is a bit convoluted. Consider rephrasing for clarity, for example: "Additionally, adhesive remnants on the enamel surface, resulting from bond failure at the enamel-adhesive interface during debonding, necessitate polishing procedures that can further cause scratches and fissures on the enamel."
* Line 10-12: "This research sought to examine and contrast the outcomes of two distinct debonding procedures on Adhesive Remnant Index and enamel damage, utilizing CO2 laser and conventional debonding plier." This is a clear statement of purpose.
* The abstract should briefly mention the key findings regarding which method was superior and the statistical significance. For example, stating that laser debonding showed less adhesive remnant.

Keywords:
* Line 15: The keywords are appropriate and relevant to the study.

Introduction:
* Line 18-19: "The increasing demand for esthetic orthodontic treatment options has led to a significant rise in the use of ceramic brackets." This is a good opening statement.
* Line 19-22: "These brackets, while providing a more visually appealing alternative to metal appliances, present unique clinical challenges chief among them being the debonding process at the end of treatment." This clearly sets up the problem.
* Line 20-23: The text mentions "enamel damage, patient discomfort, and time-consuming clinical procedures" as risks. These are valid points.
* Line 23-25: "Traditional methods of debonding ceramic brackets, typically involving mechanical debonding pliers, exert considerable force that can lead to enamel cracks or fractures." This is a well-known issue.
* Line 25-28: "To address these issues, advances in dental technology have introduced laser-assisted debonding techniques. Lasers, such as Er:YAG and diode lasers, offer a potential alternative by softening or degrading the adhesive resin, thereby reducing the mechanical stress applied to the tooth structure during bracket removal." This introduces the alternative method. It's interesting that Er:YAG and diode lasers are mentioned here, but the study uses a CO2 laser. While CO2 lasers are also used, the introduction could briefly acknowledge the specific choice of CO2 laser for this study or its relevance in this context compared to Er:YAG and diode.
* Line 30-32: "Laser-aided debonding is hypothesized to offer several advantages over conventional techniques, including reduced chairside time, decreased incidence of bracket and enamel damage, and improved patient comfort." This outlines the hypothesized benefits.
* Line 33-36: "However, questions remain regarding the efficiency, safety, and practicality of integrating laser technology into routine orthodontic practice. Critical evaluation of the thermal effects on the pulp, the required laser parameters, and the cost-effectiveness of this technology is essential before its widespread clinical adoption." This highlights important considerations and justification for the study.
* Line 38-41: "This in-vitro study aims to compare the debonding characteristics of conventional mechanical methods and laser-assisted techniques in the removal of ceramic brackets. By analyzing parameters such as the amount of force required, incidence of enamel damage, bracket integrity post-debonding, and residual adhesive, this research seeks to provide evidence-based insights that can inform clinical protocols and improve the overall safety and effectiveness of orthodontic care." The aims are clearly stated. However, the abstract and results focus primarily on adhesive remnant and enamel damage. While "amount of force required" and "bracket integrity" are mentioned as parameters for analysis here, they are not explicitly presented or discussed in the results/discussion provided in the

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excerpt. If these were not assessed, this sentence should be revised to reflect the actual parameters measured.

Materials and Methods:

* Line 43-44: "120 human extracted maxillary 1st premolars were erratically divided into two groups (n=60)." The term "erratically divided" is unconventional. "Randomly divided" or "randomly allocated" would be more appropriate and scientifically sound. Please clarify the method of division.
* Line 44-45: "The SS White ceramic brackets were bonded to the buccal surface of the mounted teeth using light cure composite resin Transbond XT." Details about the teeth (e.g., inclusion/exclusion criteria, storage before use) and the mounting process would be beneficial for reproducibility. The specific type/brand of SS White ceramic brackets should also be mentioned if there are variations.
* Line 45-47: "Bracket debonding were carried out using CO2 laser in half of the sample and the other half sample were debonded using conventional debonding plier (Walden plier)."
* CO2 Laser Group: Crucial details about the CO2 laser parameters are missing. These include: wavelength, power setting (Watts), mode of operation (continuous/pulsed), exposure time, spot size, distance from the bracket, and any cooling methods used. This information is vital for reproducibility and for assessing the safety and efficacy of the laser application.
* Conventional Debonding Group: The technique used with the Walden plier (e.g., lift-off, peel-off, specific engagement points on the bracket) should be described.
* Line 47-48: "Stereomicroscopic analysis was carried out through impartial stereology."
* What magnification was used for the stereomicroscopic analysis?
* "Impartial stereology" is vague. Please specify the exact stereological method or scoring system used to evaluate enamel damage and the Adhesive Remnant Index (ARI). How was "enamel damage" quantified or categorized? Were photographs taken?
* Line 48-49: "All teeth were evaluated for the amount of adhesive remnants. The obtained data were used to compare the ARI Index."
* Clearly define the ARI scale used (e.g., Artun and Bergland's ARI scale or a modified version). How were the scores assigned?
* Who performed the evaluation? Were the evaluators blinded to the group allocation to prevent bias? Was inter-examiner or intra-examiner reliability assessed if multiple evaluators were involved?
* Statistical Analysis: The type of statistical tests used to compare the ARI Index and enamel damage between the two groups should be specified in this section (e.g., Chi-square test, Mann-Whitney U test, etc., depending on the nature of the data). The significance level (p-value) should also be stated here.

Result:

* Line 52-53: "Teeth in group 2 (Laser aided debonding) the enamel surface exhibited the least adhesive residue ($p<0.01$)."
* Line 53-55: "whereas in group1 (debonding plier) had the maximum number of adhesive residue on the enamel surface ($p<0.01$)."
* The results section is very brief. It should present the actual data, not just the conclusion. For example:
* Provide the distribution of ARI scores (e.g., percentages of scores 0, 1, 2, 3) for each group.
* If enamel damage was assessed separately from ARI (as implied in the introduction and methods), these results should also be presented quantitatively (e.g., frequency or severity of enamel cracks/fractures).
* The p-value is given, but the statistical test used to derive it is not mentioned in the Materials and Methods or here.
* Were there any instances of bracket fracture during debonding in either group? This was mentioned as an analysis parameter in the introduction.

Discussion:

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* Line 57-59: "The present in-vitro study compared the debonding characteristics of ceramic orthodontic brackets using conventional mechanical methods and laser-aided techniques." This is a good restatement of the study's purpose.
* Line 59-61: "The results revealed that laser-aided debonding offers several significant advantages over conventional methods, particularly in terms of enamel preservation, patient comfort, and bracket integrity."
* The result section only explicitly supports "enamel preservation" (via less adhesive residue, which implies less cleaning and potential damage).
* "Patient comfort" is an in-vivo parameter and cannot be directly concluded from this in-vitro study, although inferences can be made (as discussed later in lines 77-80). This should be phrased more cautiously, e.g., "may translate to improved patient comfort."
* "Bracket integrity" was mentioned as an analysis parameter but no results were presented. If this was evaluated, the data should be in the results section. If not, this claim should be removed or qualified.
* Line 61-63: "Ceramic brackets are known for their superior aesthetics; however, their brittleness and strong adhesion to enamel increase the risk of enamel damage during debonding." This provides good context.
* Line 63-67: The discussion on conventional debonding leading to microcracks, fractures, or pulpal stress is relevant.
* Line 69-70: "Laser-aided debonding, particularly with the use of Er:YAG and diode lasers, demonstrates superior performance in several key areas." The study used a CO2 laser. While it's acceptable to discuss other lasers, the discussion should primarily focus on the findings related to the CO2 laser and then perhaps compare/contrast with literature on Er:YAG and diode if relevant.
* Line 70-72: "First and foremost, the laser softens or decomposes the adhesive resin, significantly reducing the bond strength required for bracket removal." This is the proposed mechanism.
* Line 72-73: "This decrease in shear bond strength (SBS) leads to a more controlled and gentle debonding process, minimizing mechanical stress on the enamel surface." This is a logical consequence. Did the study measure SBS? If not, this should be presented as a likely mechanism based on existing literature rather than a direct finding of this study.
* Line 74-75: "Numerous studies have shown that lasers can reduce SBS to below the threshold required for safe debonding without damaging enamel integrity." Citation to these studies would be beneficial here.
* Line 76-78: "In the current study, enamel surface evaluation post-debonding revealed smoother surfaces and fewer microcracks in the laser group compared to the conventional group." The "Results" section only mentioned adhesive residue. If "smoother surfaces and fewer microcracks" were observed and quantified, this data needs to be presented in the Results section. Otherwise, this statement is not directly supported by the provided results.
* Line 78-80: "Additionally, the bracket integrity was better preserved in the laser group, which has implications for bracket reusability and overall treatment cost-effectiveness." As previously mentioned, results on bracket integrity are missing. This claim cannot be made without supporting data from this study.
* Line 80-82: "Another notable advantage of laser-aided debonding is the potential reduction in patient discomfort."
* Line 82-84: "Mechanical debonding can generate pressure and noise, which can be distressing, especially for anxious patients. The laser technique, by contrast, offers a quieter and less invasive experience, with minimal tactile feedback during the procedure." This is a reasonable inference for potential clinical benefits, but it should be clearly stated that this study, being in-vitro, did not directly assess patient comfort.

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* Line 85-87: "Thermal safety is a valid concern during laser application; however, the study controlled exposure time and power settings to ensure intrapulpal temperature rise remained well within the biologically safe threshold of 5.5^{\circ}C."

* This is a crucial point. However, the "Materials and Methods" section did not specify the laser parameters used, nor did it describe how intrapulpal temperature rise was measured or ensured. This information must be included in the Materials and Methods section. Without it, this statement regarding thermal safety is unsubstantiated by the manuscript's methodology. If intrapulpal temperature was not measured in this study, the sentence should be rephrased to cite literature that supports the safety of the chosen parameters, and those parameters must be stated.

* Line 89-91: "As laser technology becomes more accessible and cost-effective, it is likely to become a standard adjunct in orthodontic debonding procedures." This is speculative but relevant for future outlook.

Conclusion:

* Line 92-93: "In conclusion, the findings from this study strongly support the use of laser-aided debonding for ceramic brackets." Based on the limited results presented (less adhesive residue), "strongly support" might be a bit emphatic. If enamel damage data and bracket integrity data are included and are also favorable, then "strongly support" would be more justified.

* Line 93-95: "This technique offers substantial benefits in terms of enamel safety, bracket preservation, patient comfort, and clinical efficiency."

* Enamel safety (less adhesive implies less potentially damaging cleanup) is supported.

* Bracket preservation – data not presented.

* Patient comfort – inferred, not directly measured.

* Clinical efficiency (e.g., time taken) – not measured or reported in this study. If "reduced chairside time" was a hypothesized advantage, it should have been measured or this claim should be moderated.

* Line 95-97: "While initial equipment costs may be higher, the long-term clinical and patient-centered advantages justify its implementation in contemporary orthodontic practice." This is a reasonable concluding remark, assuming the advantages are robustly demonstrated.

References:

* The reference list appears to include relevant studies.

* Formatting consistency should be checked (e.g., some DOIs are present, others might be missing; journal name abbreviations).

* Line 96 (Reference 1): "MICHAEL L. SWARTZ, volume 22, number2: Ceramic Brackets, 1988, Journal of Clinical Orthodontics". Formatting seems a bit off (e.g., author name in all caps, "volume", "number").

* Line 103 (Reference 3): "Tsui Hsien Huang and Chia, Shear bond strength of composite brackets on porcelain teeth, Eur J Orthod. 2000;23: 39-433." The page range "39-433" seems incorrect; perhaps it should be "433-439" or similar, or there is a typo in the first page number as well. Please verify.

* Line 134 (Reference 17): "W.J. Witteman, The CO2 Laser. June, 2013." This appears to be a book or a general reference. If it's a book, publisher information is needed. If it's an article, journal details are required. Its relevance to justifying laser parameters or thermal safety needs to be clear if used in that context.

* Line 136 (Reference 18): "...journal of orthodontics 72, no. 6 (1977): 671-Journal of 681." There seems to be a formatting issue with "Journal of" repeated and the page range.

* The manuscript mentions CO2 laser in the methods and discussion. References specific to CO2 laser debonding and associated thermal effects/safety parameters would be particularly important to support the choices made in this study. Reference 14 (Ma et al., 1997) and Reference 15 (Obata, 1995) are relevant here as they deal with CO2 lasers.

Overall Manuscript:

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* Clarity and Flow: Generally, the manuscript is understandable, but some sentences are long and could be broken down for better readability.
* Scientific Rigor: The major weakness lies in the "Materials and Methods" and "Results" sections.
  * Lack of detail on laser parameters is a significant omission.
  * The method of sample allocation should be "random."
  * More detailed description of the stereomicroscopic analysis and ARI scoring is needed.
  * Blinding of evaluators should be considered and reported if done.
  * The "Results" section needs to present actual data (frequencies, percentages, means/medians if applicable for quantitative measures) rather than just summary statements and p-values.
  * Information on parameters mentioned in the introduction/discussion (force, bracket integrity, specific enamel damage evaluation beyond ARI, intrapulpal temperature) is missing from the methods and results. If these were not part of this specific study, the manuscript should be revised to accurately reflect what was investigated.
* Line Numbering: The provided line numbering in the PDF is by page, not continuous. The review refers to the line numbers as they appear on each page (e.g., Line 5 on Page 1, Line 43 on Page 2). Continuous line numbering throughout the manuscript would be standard for review purposes.
* "UNDER PEER REVIEW IN IJAR": This header is noted.

Recommendations:

* Revise "Materials and Methods" comprehensively:
  * Specify random allocation of samples.
  * Provide complete CO2 laser parameters (power, mode, time, spot size, cooling). If intrapulpal temperature was monitored or controlled, describe how. If not, clearly state the parameters and justify their safety based on existing literature.
  * Detail the conventional debonding technique.
  * Clearly define the ARI scale and the method for assessing enamel damage. Explain how "impartial stereology" was implemented.
  * Mention blinding of evaluators if performed.
  * Specify all statistical tests used.
* Expand the "Results" section:
  * Present detailed data for ARI scores for both groups (e.g., frequencies/percentages for each score).
  * If enamel damage (cracks, fractures) was assessed separately, present this data.
  * If bracket integrity or debonding force was measured, include these results.
* Align "Discussion" and "Conclusion" with the presented results:
  * Ensure all claims about advantages (e.g., bracket integrity, patient comfort, clinical efficiency) are directly supported by the study's findings or are clearly stated as inferences based on literature.
  * If intrapulpal temperature was not measured, rephrase the discussion on thermal safety to reflect reliance on established safe parameters from literature, ensuring those parameters are explicitly stated in the methods.
* Refine Language: Improve sentence structure for clarity in some areas (e.g., abstract).
* Check and Correct References: Verify page numbers (e.g., Ref 3, Ref 18) and ensure complete information for all references (e.g., Ref 17). Ensure consistent formatting.