REVIEW ARTICLE

Efficacy of GLUMA for the Treatment of Dentin Hypersensitivity Compared to Lasers: A Systematic Review

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Abstract

Objective: Dentin hypersensitivity (DH) is characterized by a short, sharp pain in response to a thermal or tactile stimulus. The application of desensitizing agents such as GLUMA and laser is a non-invasive and safe approach to decrease sensitivity. The evidence for the efficacy of GLUMA desensitizer compared to laser desensitization in patients with DH was evaluated for 6 months.

Design: In March 2022, an electronic search of PubMed, Scopus, and Web of Science databases was conducted. Articles published in English that compared GLUMA and laser in the treatment of DH with a follow-up of 6 months or more were included. Randomized, non-randomized controlled trials, and clinical trials were included. Risk of bias assessment tools developed by the Cochrane collaboration ROB 2 and ROBINS-I were used to assess the quality of studies. The GRADE assessment method was used to assess the certainty of evidence.

Results: About 36 studies were identified in the search results. After applying the predefined eligibility criteria, eight studies with 205 participants and 894 sites were included in this review. Of the eight studies, four were judged to be at high risk of bias, three had some concerns, and one had a serious risk of bias. The certainty of the evidence was graded as low.

Conclusion: Based on limited evidence, GLUMA and laser appear to be equally effective in providing relief from DH. GLUMA showed an immediate effect and provided pain relief. Over the course of a week, laser showed long-term stable results. GLUMA is effective in providing immediate relief.

Keywords: Dentin hypersensitivity, Desensitization, GLUMA, Low-level laser, Glutaraldehyde, Pain relief.

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Introduction

Dentin hypersensitivity (DH) commonly referred to as "sensitive teeth," remains a silent epidemic plaguing the globe and affecting billions of people. Patients report pain after being exposed to cold, sweets/food, or tactile stimuli. Dentin hypersensitivity is defined as a short, sharp pain that occurs in response to non-noxious thermal, evaporative, or chemical stimuli.[1] Global epidemiological studies spanning three decades suggest a prevalence between 3 and 98%[2] with an average of 40% of adults affected.[3,4] Women are slightly more affected than men, with a higher proportion of sufferers not seeking dental professional advice.[5] Pressure changes in the exposed dentinal tubules in response to thermal, chemical, tactile, and osmotic changes are believed to excite nerves and cause pain.[1] Various physiological factors like attrition, erosion of enamel and cementum, abrasion, occlusal pressure, gingival recession, and faulty tooth brushing can cause DH.[6,7] Iatrogenic factors such as periodontal treatment, tooth whitening, and tooth preparation may also play a part in developing DH.[8,9] Dentin hypersensitivity can impact a patient's quality of life, trigger the development of chronic pain and become a source of consistent frustration, inducing psychological and emotional distress.[10,11] It can impact a patient's physical, emotional, and cognitive functioning along with social and family life.[12]

Treatment of DH is broadly divided into two approaches: using depolarizing treatments to block neural transmission of pain stimuli or using occluding agents to obstruct fluid movement in the dentinal tubules.[13] When used regularly, desensitizing toothpaste provides relief. However, they have the drawback of delayed gradual symptomatic over weeks.[14] Professional in-office treatments for DH include the use of adhesive resin sealants or lasers.

GLUMA is a biological adhesive sealant used to treat DH. It is a combination of 5% glutaraldehyde and 35% hydroxyethyl methacrylate. It prevents hypersensitivity by clotting proteins in the dentinal tubules, reducing permeability and fluid flow.[15] It is a non-irritating, painless, easy-to-apply procedure with immediate and long-lasting effects. Clinical trials have shown GLUMA to have success rates ranging from 92 to 100% at 1–6 months post-treatment.[16,17] However, proximal tooth areas with poor access for adhesive application may remain vulnerable to sensitivity. GLUMA desensitizers are more effective than oxalates or placebo applications.[18] In patients with DH, the majority of sensitive surfaces are present on the cervical, buccal, or labial aspects of the teeth.[19] GLUMA shows rapid and sustained desensitizing action that is effective in reducing dentinal sensitivity in cervical regions.[20]

The use of different low- and high-intensity lasers has resulted from the search for effective and long-lasting alternative treatment options. Lasers increase the temperature of dentinal tubules, causing them to fuse and obliterate the tubules.[21,22] Low-intensity

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lasers provide an analgesic effects by stimulating mitochondrial ATP production and increasing the threshold to excite free nerve fibers' excitability.[23] The analgesic effect of lasers may be due to the alteration of sensory axons nerve endings blocking C and Aβ fibers.[24] Laser therapy with CO_2, Er:YAG, and Nd:YAG lasers is thought to have a clinical advantage over topical medicament in treating DH. The effectiveness of laser treatments ranges from 50 to 94.5% at different follow-up periods from 1 to 3 months.[25–27] However, given the treatment's cost, complexity, and unknown safety profile in comparison to other proven treatment modalities, caution is urged during treatment planning for DH. The adverse effects, such as pulpal effects, allergic reactions, or clinically detectable complications, are still unknown.[28] The evidence base recommending lasers over other treatments remains weak.[29]

Overall, these studies provide mixed evidence for the effectiveness of one treatment modality over the other.[30] To date, few studies have systematically investigated and compared the evidence for the desensitizing effects of GLUMA and lasers. The present study aimed to systematically evaluate the efficacy of GLUMA desensitizer compared to laser desensitization in patients with DH for 6 months.

Materials and Methods

The present systematic review followed the Preferred Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines[31] and was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42022329971.

Focused Question

"Is GLUMA desensitizer effective in treating DH compared to laser desensitization over 6 months?"

Eligibility Criteria:

Inclusion Criteria:

The following PICOS question was adopted to conduct this systematic review:

Participants: Patients with DH

Intervention: Application of GLUMA desensitizing agent

Comparison: Application of laser for desensitization

Outcome: Decreased pain and DH

Study Design: Randomized and non-randomized controlled trials, prospective clinical trials with a minimum of 6-month follow-up, English language studies.

Exclusion Criteria

- Studies involving patients who have undergone treatment for DH before the start of the study.
- Studies assessed DH without a standardized scale or scoring system.
- Studies that had a follow-up of fewer than 6 months.
- Studies with incomplete or missing outcome data.
- *In vitro* studies, *in vivo* studies, case series, observational studies, case reports, letters to editors, and conference proceedings.

Search Strategy

Two independent researchers (NAH and SGP) individually conducted electronic database searches of the PubMed, Web of Science, and SCOPUS databases, followed by a grey literature search on Google Scholar. The search strategy with combined MeSH and free text keywords is shown in Figure 1. The search was performed on March 5, 2022.

Study Selection

For study selection, the two researchers (NAH and SB) independently analyzed the search results. Duplicated articles were excluded. Titles were screened based on predefined inclusion criteria. The full text of all the eligible articles was retrieved. Any disputes in selection between the authors were discussed with a third author (ATR) until a consensus was reached.

Data Extraction

Data extraction was carried out by two authors (NAH and SGP) independently. Relevant details regarding, the type of study, types of interventions, author and year of publication sample size, method of outcome assessment, duration of follow-up, and study results were entered into a customized data extraction sheet (Microsoft Excel, Microsoft Inc., Redwood, CA, USA). The data extraction was corroborated for accuracy by a third author (ATR).

Quality Assessment

The quality of the selected studies was evaluated using the guidelines of the Cochrane Handbook for Systematic Reviews.[32] Two researchers (NAH, and SGP) individually assessed the risk of bias for randomized controlled trials using the ROB 2 risk of bias tool.[33] Non-randomized controlled trials were assessed using the ROBINS-I tool.[34] Any disputes between the authors were discussed with a third author (SB).

Five domains were assessed in the ROB2 risk of bias tool based on the signaling questions. The domains included bias due to randomization, measurement of outcome deviations from intended interventions, selection of the reported result, and missing outcome data. The possible ratings were given as low, with some concerns.

Based on the signaling questions, the ROBIN-I risk of bias tool assigned ratings of low, moderate, serious, and critical risk of bias to all seven domains. The domains include risk of bias due to confounding, selection of the participants, missing outcome, deviations from intended deviations measurement outcomes, classification of interventions, and selection of the reported result. The results of all the domains were analyzed, and an overall score was obtained.

Quality of Evidence for Outcomes in Summary of Findings Table

We assessed each outcome in the summary of findings table using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) tool.[35] One author (NAH) initially applied the GRADE system and the evidence was reviewed by two independent researchers (SB, SGP). The final rating was decided after the three review team members reached a consensus. The certainty of the evidence was graded as very low, low, moderate, and high. Evidence for each outcome was graded as "high quality" at the start in the case of RCTs. The evidence rating was downgraded by one level for serious or two levels for very serious concerns regarding the study limitations, indirectness of evidence, inconsistencies in the outcomes, imprecision of effect estimates, or publication bias.

Results

Study Selection

The initial electronic search from the databases yielded a total of 36 articles. Eight duplicate articles were removed manually. The titles and abstracts of the remaining 28 articles were screened for eligibility based on the predefined inclusion criteria. The

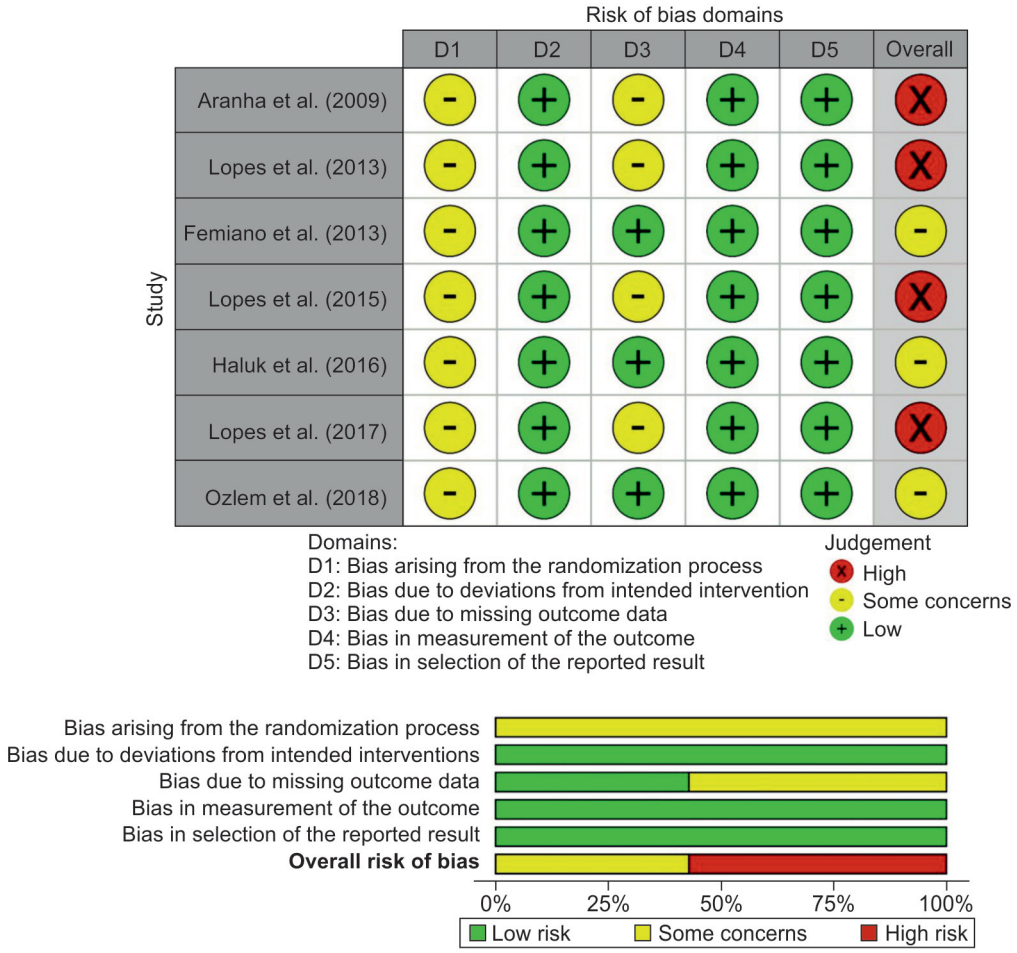

Fig. 1: Summary of risk of bias of randomized control trials (ROB2)

full text of nine articles was selected for further analysis. Of the nine articles, one article was excluded for not satisfying the inclusion criteria. Finally, eight studies were included in this review.[36–43] The PRISMA flowchart of the selection is depicted in Flowchart 1.

Study Characteristics

Studies with a minimum follow-up period of 6 months were included in the study. The eight studies examined 205 participants (894 sites). Of the included eight studies, seven were randomized control trials and one was a prospective clinical trial. The prospective clinical trial included was a split-mouth clinical study with a sample size of 22 patients (150 teeth) comparing GLUMA and laser desensitization.[37] Six studies were randomized clinical trials with a sample size of 163 patients (668 teeth).[36,38,40–43] The characteristics of the selected studies are shown in Table 1.

GLUMA desensitizer was compared to laser treatment in all eight included studies. Four studies compared the effectiveness of GLUMA with laser desensitization in the treatment of dentin hypersensitivity.[36–39] Four studies examined a combination of GLUMA and laser.[40–43] Both low- and high-intensity lasers were used in the studies. After the treatment, a follow-up period ranging from immediately after treatment to 6 months was done in the majority of the studies.

Flowchart 1: PRISMA flowchart

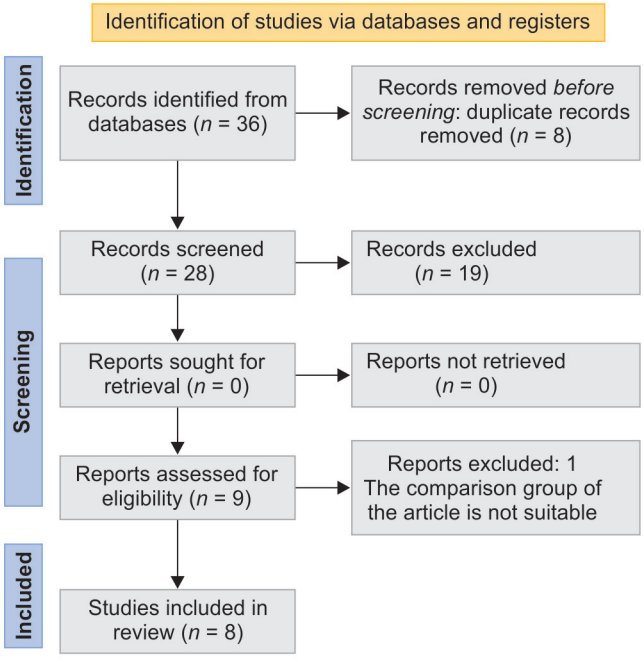

Table 1: Characteristics of the selected studies

Author/year	*Study design*	*Groups*	*Sample size*	*Follow-up time*	*Outcome variable*	*Result*
Aranha et al. (2009)[36]	Randomized clinical study	GLUMA desensitizer, Seal and protect, Oxa-Gel, Acidulated Phosphate flouride, Low-intensity laser therapy	39 patients 101 teeth	1 week, 1, 3, and 6 months	Air spray VAS analysis	Gluma desensitizer provided immediate relief from sensitivity. Reduced pain relief continued for 6 months. Low-intensity laser therapy effectiveness was not immediate. My sensitivity level reduced gradually over a week. Laser and Gluma reduced sensitivity equally 6 months post-treatment ($p = 0.0165$).
Ehlers et al. (2012)[37]	Prospective, split-mouth clinical study	Laser desensitization on one side, GLUMA application on the other side	22 patients 150 teeth	After treatment, 1 week, 1, 3, and 6 months	Air stimulation VAS analysis	Significant differences in pain scores between the laser and GLUMA group ($p < 0.001$). Both GLUMA and laser application were effective in treating DH. No statistical difference between GLUMA and laser at 3 or 6 months.
Lopes et al. (2013)[42]	Randomized longitudinal clinical study	GLUMA desensitizer, Nd: YAG laser, GLUMA and Nd:YAG laser	24 patients 33 teeth	Post-treatment: 5 min, 1 week, 1, 3, and 6 months	Air stimulus exploratory probe analyzed using VAS analysis	Air stimulus showed statistically insignificant changes. A comparison of pain stimuli among the three groups showed statistically significant changes ($p < 0.001$). Effective desensitization was achieved with both GLUMA and Nd:YAG laser. However, the combination of GLUMA and Nd:YAG laser has an immediate effect with a long-lasting effect.
Femiano et al. (2013)[38]	Double-blind randomized clinical trial	Sodium flouride, sodium fluoride and laser, laser, GLUMA	24 patients 262 teeth	Immediately after treatment, 1 month, and 6 months	Air stimulus VAS analysis	Sodium fluoride and laser showed significant changes immediately, post 1 and 6 months ($p < 0.001$). A combination of sodium fluoride and laser was effective in decreasing sensitivity and effective in the long term. Although GLUMA was effective, it decreased its effect in 1 and 6 months.
Lopes et al. (2015)[40]	Randomized clinical trial	GLUMA desensitizer, low-power laser, high-power laser, GLUMA and low-power laser, GLUMA and high-power laser	27 patients 55 teeth	Post-treatment: 5 min, 1 week, 1, 3, and 6 months	Air stimulus exploratory probe analyzed using VAS analysis	Air stimulus and probing showed statistically significant differences between the studied time intervals ($p < 0.001$). A similar effect of desensitization was observed with all protocols with no increase in pain for 6 months. GLUMA provided immediate relief from pain.
Haluk et al. (2016)[22]	A randomized split-mouth clinical study	Laser desensitization, GLUMA desensitizer	20 patients 76 teeth	Post-treatment: 1 day, 1 week, and 2 weeks	Probing VAS analysis	Comparison of VAS scores of laser and GLUMA were statistically insignificant ($p > 0.05$). GLUMA and laser were equally effective in reducing tooth preparation sensitivity

Lopes et al. (2017)[41]	Randomized clinical trial	GLUMA, low power laser with low dose (LPLD), low power laser with high dose (LPHD), LPLD and GLUMA, LPHD and GLUMA, Nd: YAG laser, Nd: YAG laser and GLUMA, LPLD and laser, LPHD and laser	32 patients 117 teeth	Post-treatment: 5 min, 12, and 18 months	Air stimulus exploratory probe analyzed using VAS analysis	Statistically insignificant changes were observed in the comparison of all groups. Air stimulus and probing pre-treatment ($p = 0.097$, 0.131), 5 min ($p = 0.365$, 0.131), 12 months ($p = 0.964$, 0.770) All groups reduced hypersensitivity with similar effects in all time intervals. GLUMA group showed stable results and was considered an effective and non-invasive treatment.18 months ($p = 0.620$, 0.754).
Ozlem et al. (2018)[43]	Randomized clinical trial	GLUMA, Nd: YAG laser, GLUMA and Nd: YAG laser, Er, Cr: YSGG laser, GLUMA and Er, Cr: YSGG laser	17 patients 100 teeth	7, 90, and 180 days	Yeaple probe with 10 gm force	Results were statically insignificant in all groups 30 min after treatment ($p > 0.05$). Significant changes were observed for 7, 90, and 180 days ($p < 0.05$). Er, Cr: YSGG, and a combination of Er, Cr: YSGG is the most effective in the treatment of DH. GLUMA and Nd:YAG laser showed similar results.

Outcome Measurement

Patient-reported pain outcomes were elicited before and after treatment. Baseline values were recorded before starting treatment. The change in pain and sensitivity was recorded. The methods used to assess DH were different among the included studies, with the visual analog scale (VAS) scoring being predominantly used. The VAS scoring in the range of 0–10 was assessed before the start of treatment and was considered baseline value and compared with the VAS scoring assessed after the treatment and follow-up. The stimulus was given by either air stimulus by compressed air or by tactile stimulation using probes. In one study, a customized yeaple probe with a force of 10g was used to assess pain using VAS scoring.[43] In three studies, a combination of air spray blast and probing stimuli were used to record pain and analyze it using VAS scoring.[40–42] VAS scoring for pain varied from 0–10 based on the pain perception of the patient.

Effects of Intervention

All the included studies showed improved results in treating DH from the baseline values to the post-treatment values. The studies differed in their findings. Two studies showed statistically superior results achieved using a laser.[38,39] Two studies reported that combination therapy of GLUMA and laser desensitization was superior to individual treatment with laser or GLUMA alone.[40,42] Four studies reported no statistically significant difference between GLUMA and laser.[36,37,41,43] The immediate effect of pain relief was higher with GLUMA. The long-term effect analgesic effect was greater for laser therapy.[38] No statistically significant changes were observed between low-level and high-level laser therapy.

Risk of Bias

ROB 2 tool was used to analyze the risk of bias in randomized control trials. Of the seven studies, four studies demonstrated an overall high risk of bias,[36,40–42] and three studies demonstrated some concerns.[38,39,43] Shortcomings in reporting regarding allocation concealment and randomization resulted in the high-risk rating. ROBINS-I risk of bias tool was used to assess the risk of bias for non-randomized control trials.[34] The analysis showed a low risk of bias in all the domains except for missing outcome data. In that domain, it showed serious concerns and thus, the overall risk of bias was demonstrated as a serious risk bias.[37] The total risk of bias is presented in Figure 2 and Table 2.[44]

Certainty of Evidence

Our review examined eight studies with 205 participants and 894 sensitive tooth sites. Based on GRADE, the overall quality of the evidence in this study was low. This suggests limited confidence in estimating the outcome of decreased DH and raises doubts regarding the magnitude of the effect of the interventions examined. The reasons for downgrading the study were due to methodological insufficiencies, i.e., the imprecision and the risk of bias. The majority of the involved studies were at either some concerns or a high risk of bias. The summary of findings is shown in Table 3.

Discussion

Dentin hypersensitivity is a condition that can cause pain and distress to patients. Pain due to DH is problematic enough to affect eating, sleeping, and work.[45] Research has shown various methods of varying effectiveness to relieve pain and manage DH. Although GLUMA and lasers have different mechanisms of action, they seal the open dentinal tubes and treat DH. The study aimed to systematically assess the efficacy of GLUMA to lasers in alleviating DH.

A total of eight studies were included in this systematic review. A majority of studies reported no performance differences between the two modalities. Two studies compared the efficacy of GLUMA and laser in desensitization and reducing pain in DH and concluded that both GLUMA and laser were equally effective in treating

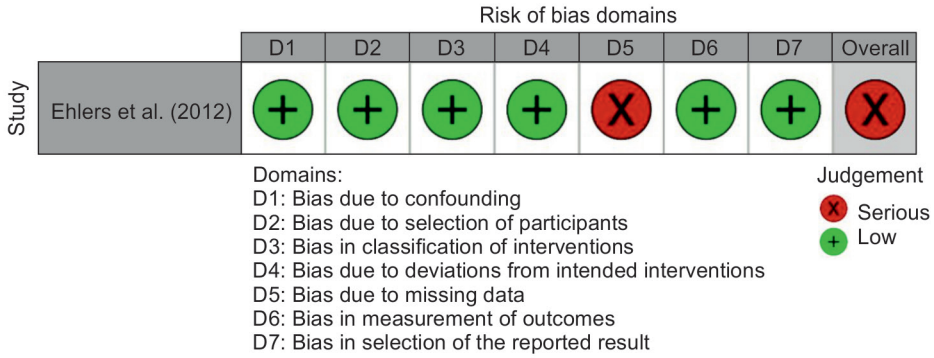

Fig. 2: Summary of risk of bias of non-randomized studies (ROBINS-I)

Table 2: Search strategy and keywords

Database	Search Query	Articles
PubMed	Search: laser gluma desensitization ("lasers"[All Fields] OR "lasers"[MeSH Terms] OR "lasers"[All Fields] OR "laser"[All Fields] OR "lasered"[All Felds] OR "lasering"[All Fields]) AND ("gluma"[Supplementary Concept] OR "gluma"[All Fields] OR "gluma"[All Fields]) AND ("desensitize"[All Fields] OR "desensitized"[All Fields] OR "desensitizer"[All Fields] OR "desensitizes"[All Fields] OR "desensitizing"[All Fields] OR "desensitization, immunologic"[MeSH Terms] OR ("desensitization"[All Fields] AND "immunologic"[All Fields]) OR "Immunologic desensitization"[All Fields] OR "desensitization"[All Fields] OR "desensitization"[All Fields] OR "desensitizations"[All Fields] OR "desensitize"[All Fields] OR "desensitized"[All Fields] OR "desensitizer"[All Fields] OR "desensitizers"[All Fields] OR "desensitizes"[All Fields] OR "desensitizing"[All Fields]) Translations laser: "laser's"[All Fields] OR "lasers"[MeSH Terms] OR "lasers"[All Felds] OR "laser"[All Fields] OR "lasered"[All Fields] OR "lasering"[All Fields] gluma: "Gluma"[Supplementary Concept] OR "Gluma"[All Fields] OR "gluma"[All Fields] desensitization: "desensitize"[All Fields] OR "desensitized"[All Fields] OR "desensitizer"[All Fields] OR "desensitizes"[All Fields] OR "desensitizing"[All Fields] OR "desensitization, immunologic"[MeSH Terms] OR ("desensitization"[All Fields] AND "immunaiagic"[All Fields]) OR "immunologic desensitization"[All Fields] OR "desensitization"[All Fields] OR "desensitization"[All Fields] OR "desensitizations"[All Fields] OR "desensitize"[All Fields] OR "desensitized"[All Fields] OR "desensitizer"[All Fields] OR "desensitizers"[All Fields] OR "desensitizes"[All Fields] OR "desensitizing"[All Fields]	27
SCOPUS	laser AND gluma AND desensitization	5
Web of Science	laser gluma desensitization	4

DH [36,37,39]conducted a study comparing the desensitization effect of Acidulated Phosphate Fluoride, GLUMAOxa-Gel, Seal and Protect, and low-intensity laser. The results stated that all the treatment therapies were effective in treating DH without statistically significant changes.[36]

A study conducted by Femiano et al.[38] compared GLUMA, laser, sodium fluoride, and a combination of sodium fluoride and laser and reported that the immediate effect was greater in the GLUMA group. The laser was superior to GLUMA at 1- and 6-month follow-ups.[38]

Four studies compared GLUMA, low-intensity and high-intensity laser, and a combination of low-intensity laser and GLUMA, and high-intensity laser and GLUMA. Two studies concluded that a combination of laser and GLUMA was effective compared to individual treatment therapy.[40,42] One study concluded that a follow-up for 18 months showed no statistically significant difference among all treatments.[41] One study concluded that high-intensity laser with or without GLUMA was equally effective to treat DH. This was due to nerve desensitization which melts peritubular dentin and blocks dentinal tubules. Lasers achieved long-term desensitization without any adverse effects on the pulp.[43]

These results are consistent with data obtained from a systematic review conducted by on the application of lasers and other desensitizing agents to treat DH. The review found that laser desensitization was effective and long-lasting compared to the other treatment modalities. A combination of desensitizing agents and laser desensitization was proved to have immediate and long-lasting effects.[30]

A systematic review conducted by Rosa et al. concluded that adhesive sealants and lasers were effective in treating DH. However, the review indicated a lack of studies that evaluated different types of desensitization techniques.[46] Two systematic reviews conducted by Mahdian et al. and Sgolastra et al. concluded that laser desensitization using high- and low-intensity lasers effectively reduced DH.[29,47]

This systematic review differs from the previous reviews in its intervention and control group selection. This review exclusively included studies that compared the use of GLUMA desensitizer to laser therapy for pain relief in patients with DH for 6 months. This review summarizes evidence to assist clinicians in treatment planning and decision-making for the appropriate modality to

Table 3: Summary of findings table

Quality assessment						*Summary of findings*		
Outcome	*Risk of bias*	*Inconsistency*	*Indirectness*	*Imprecision*	*Publication bias*	*Impact*	*No of participants*	*Certainty of evidence (GRADE)*
Decreased DH	Serious[a]	Not serious	Not serious	Serious[b]	Not serious	Our confidence in the effect estimate is limited	205 (8)	Low ☐☐

[a]Six studies showed serious concerns due to no information on allocation concealment, one study showed missing outcome data, and four studies have no information of outcome data

[b]Two studies showed superiority with laser, four studies showed null effect, and two studies showed better effects with combination of Laser and GLUMA

reduce the pain and discomfort associated with DH. The available treatment modalities, along with their merits and demerits have been listed to assist clinicians in making an informed choice. As a result of the limited availability of evidence, a definitive conclusion regarding the efficacy of GLUMA over laser therapy in desensitization could not be reached. The findings do suggest that combining the two methods may be more effective than either method alone. A meta-analysis was not possible due to studies' heterogeneity.

Overall Completeness and Applicability

A majority of the studies in this review used air blasts using compressed air or tactile stimulation for assessment of sensitivity. None of the studies carried out thermal stimulation for DH. The use of thermal stimuli as a benchmark is vital.[48] The effects of the interventions may vary with the methods applied for testing sensitivity.

The trials all uniformly used pain scales to measure the subjective phenomenon of pain. However, reporting for confounders was limited in the included studies. As a result, our review could not identify the efficacy of interventions in groups with greater risk, such as older females. This might cause a detected indifference to treatment effects in different dentitions. The university dental clinic setting may result in study participants that are not representative of the general population. Future studies examining interventions on hypersensitivity should be conducted on patients with different risk profiles to evaluate the influence of age and gender. The majority of studies had low sample sizes of less than 30 patients. This may lead to a misestimation or exaggerated estimation of the effect of the intervention.

All studies included in this review had a minimum follow-up time of 6 months as both patients and clinicians would be interested in the intervention's long-term clinical efficacy.

Extensive *in vitro* research has shown that glutaraldehyde-containing dentin desensitizing agents may have mutagenic potential in mammalian cells.[49] Several cell lines are toxic when glutaraldehyde combined with components such as HEMA.[50] The cytotoxicity of these agents is concerning.[51] Potential biocompatibility hazards should not be neglected.

Quality of Evidence

The evidence presented in this review does not lend itself to robust conclusions. Based on the GRADE framework, the quality of evidence for the outcome is low, limiting our confidence in the effect estimates, i.e., the true effect may be considerably different from the effect estimates.[52] Two studies reported no effect on the treatment outcomes, suggesting imprecision in the certainty of the effect of treatment that cannot be explained. The overall risk of bias was deemed serious in the majority of the studies. Therefore, the evidence was downgraded to low quality.

The unclear and high risk of bias seen in the randomized and non-randomized studies The ROBINS-I analysis showed the serious risk of bias. Missing outcome data during the follow-up period could lead to attrition bias. The ROB2 analysis showed some concerns or a high risk of bias. This rating was a result of missing information about allocation concealment in all the included studies. This limits our confidence in the effect estimates suggesting that the true estimate and effect estimate may vary considerably.

Overall, the methodological flaws within the studies lead to significant bias. The current assessment may be affected by future well-designed large-scale studies that will provide opportunities for further testing and refinement.

The strengths of our review include a comprehensive search of four distinct databases supplemented with a manual search of the references to identify all relevant articles. Multiple reviewers independently assessed the eligibility of these studies for inclusion using well-defined criteria. One limitation of our review is that we only included studies published in English, as translated articles may lack veracity. This may have inadvertently led to publication bias. Further research focusing on human clinical trials with well-matched subjects with homogeneity in the type and method of laser applications will derive conclusive results on the efficacy of lasers in the re-osseointegration of implants.

Limitations

Within the limitations of this study, there is low-quality evidence that both GLUMA and laser were equally effective in the treatment of DH. Effective and long-lasting results were obtained with laser and the immediate effect was achieved with GLUMA. GLUMA can be used as an alternative treatment option for treating DH. A combination of GLUMA and laser may be more effective in treating sensitivity than either alone.

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