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Clinical and immunological aspects of gingival retraction systems in fixed dental prostheses: A systematic review

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Corresponding author:
Artak Heboyan

heboyan.artak@gmail.com

Author Affiliation:
Autonomous University of Guerrero.

Alarcón-Sánchez, MA[1]; Minervini, G[2]; Heboyan, AX[3].

ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 03 January 2024 and was last updated on 03 January 2024.

INTRODUCTION

Review question / Objective This systematic review aimed: 1) To describe the clinical aspects of different gingival retraction systems on the effectiveness of gingival displacement. 2) To evaluate the effects of different gingival retraction systems on the biological functions of gingival fibroblasts. 3) To assess the influence of gingival retraction systems on the levels of proinflammatory biomarkers.

Rationale The primary purpose of prosthetic restorations, in addition to meeting the requirements of function, esthetics, and biocompatibility with the supporting tissues of the teeth, is to preserve the remaining tooth structure [1] and not just to make the decision to extract the tooth involved for the sake of replacing what is missing [2, 3]. Periodontal health before, during, and after the prosthetic treatment is essential to successfully rehabilitating the patient with this problem [4-6]. Commonly, prosthetic margins are located in the gingival sulcus [7], i.e., the line of completion of the dental preparation is subgingival, which often tends to increase periodontal problems and complications such as increased retention of periodontopathogenic bacteria and thus more significant inflammation and destruction at the local level [6, 8-10]. However, with thorough oral hygiene and good soft tissue management, periodontal health can undoubtedly be preserved [4, 6]. Notably, the prosthetic margin should be 0.5mm from the healthy marginal ridge or 3-4mm from the alveolar bone gingiva and follow the natural scalloping of the gingiva and alveolar process [11, 12].

Well-contoured prosthetic restorations with tight margins on the tooth preparation finish line are achieved by adequate impression-taking [13,14], preceded by the use of an excellent gingival retraction system (GRSs) [15,16]. The use of GRS aims at displacing the marginal gingiva, i.e., they allow the folding of the gingival margin at a considerable distance from the tooth surface, providing a virtual vertical and horizontal space

between the tooth surface and the junctional epithelium where the impression material is going to be applied [13,17]. At least 0.2 mm width in the sulcus is needed to decrease the risk of tearing the impression material and a reduction in marginal accuracy [18].

Currently, there are two methods of gingival retraction, which include surgical procedures using electrosurgery, rotary curettage, and lasers [19], and non-surgical procedures, which include mechanical and chemo-mechanical methods that can be used individually or in combination [20]. Concerning chemo-mechanical methods, i.e., the use of retraction cords and medications, the chemical substances used are classified into vasoconstrictors such as α- and β-adrenergic [21], astringents such as ferric sulfate, chloride, aluminum sulfate and potassium [22], as well as cordless retraction methods, which include the use of biomaterials such as magic foam cord, retraction paste, retraction capsule, among others [23]. Various techniques are required depending on the case and the clinical setting [24]. It is presumed that the dentist and prosthodontist are familiar with the workflow of the clinical steps for determining the degree of lateral gingival displacement. Figure 1 summarizes the workflow for assessing the degree of lateral gingival displacement using different GRSs.

Ideally, GRSs should be simple, fast, inexpensive, with antimicrobial activities, and with fewer adverse effects on the periodontium, i.e., biocompatible with the cells that constitute periodontal tissues [25]. Several studies have compared the clinical efficacy of different GRSs according to the biomaterials and techniques used [26-41]. On the other hand, at the cellular and molecular level, further in vitro studies have evaluated the biological effects of human gingival fibroblasts (HGFs) exposed to different GRSs, including vasoconstrictor, astringent and cordless type chemical biomaterials [42-49]. Researchers are trying to find new drugs with less cytotoxic effects on these cells. In addition, as GRSs produce inflammation, the levels of different proinflammatory mediators have been evaluated to understand the dynamics of inflammation in teeth with prosthetic devices [50-52].

Condition being studied The effects of different gingival retraction systems on the degree of gingival displacement, gingival fibroblasts and proinflammatory mediators.

METHODS

Search strategy The search strategy included reviewing titles and abstracts to select articles that met the inclusion criteria and excluding those that did not. Keywords related to "gingival retraction agents/methods" were combined with keywords such as "gingival displacement," "gingival fibroblasts," or "inflammatory biomarkers." Boolean operators "OR" and "AND" were used to combine the searches. The following MeSH terms and their combinations were used: (Gingival Retraction Systems, agents, methods) OR (Gingival Fibroblast) OR (Degree of displacement) OR (Vertical) OR (Horizontal) OR (Inflammatory Biomarkers) OR (Gingival Crevicular Fluid) OR (Salivary) OR (Vasoconstrictive Agents) OR (Oral Rehabilitation) OR (Hemostatics) OR (Astringents) OR (Cordless Retraction Methods) OR (Periodontal Health) OR (Gingivitis).

Participant or population Gingival tissues around teeth to receive fixed dental prostheses from adult subjects and gingival fibroblasts.

Intervention Gingival retraction systems; retraction cords, pastes, strips, lasers, and other chemicals.

Comparator The previously mentioned methods served for comparisons. Also, teeth without pre-displacement.

Study designs to be included Randomized controlled trials.

Eligibility criteria The research focused on which type of GRSs are ideal for gingival sulcus impressions and those that measure the degree of gingival displacement; in vitro research studying the effects of different GRSs on the biological functions of fibroblasts such as cell morphology, viability, and cytotoxicity; and research on the influence of GRSs on the levels of different proinflammatory mediators were included. Articles had to be published in English and have full text available. Original research, such as retrospective and prospective randomized clinical trials and in vitro experimental studies, were included in the present investigation. Studies that evaluated the response of cells other than gingival fibroblasts were eliminated. Case reports, editorials, short communications, and research conducted in a language other than English were excluded.

Information sources A digital search was performed in the databases PubMed/MEDLINE, Scopus, Science Direct, Web of Science, and Google Scholar for literature published in the English language in the last 23 years (from December 10th, 2006, to May 15th, 2023). The search was limited to humans and cells (gingival fibroblasts).

The reference lists of the selected articles were checked for cross-references. In addition, additional hand searches were performed in the following journals from 2006 to 2023: Journal of Prosthodontics-Implant Esthetic and Reconstructive Dentistry, Journal of Prosthodontic Research, Journal of Advanced Prosthodontics, International Journal of Prosthodontics, European Journal of Prosthodontics and Restorative Dentistry, Journal of Esthetic and Restorative Dentistry, Journal of Prosthetic Dentistry, Journal of Indian Prosthodontics Society and Journal of Prosthodontics.

Main outcome(s) Most studies (93.7%) evaluated periodontally healthy patients, and only one (6.3%) evaluated patients with mild gingivitis. Also, a total of 882 teeth were sampled, of which the majority were central incisors (31.3%), followed by premolars (25%), molars (25%) and canines (13%). The most commonly used GRSs was aluminum chloride gingival retraction paste (74%), followed by chemical-free gingival retraction cord (53%), polyvinyl siloxane (43. 3%), polyvinyl acetate strips, Er, Cr: YSGG laser and ferric sulfate (11%), as well as polytetrafluoroethylene, naphazoline hydrochloride and tetrahydrozoline (5.3%). It was also found that the Merocel Strips system (Mystic, conn, USA) achieved the highest level of gingival displacement with a mean of 1.66 mm [40], while the Retraction Paste system (Expasyl, Pierre-Roland, Bordeaux, France) achieved the lowest level of gingival displacement with a mean of 0.4 mm [36]. Degree of clinical gingival displacement, the response of gingival fibroblasts to pre-displacement GRSs exposure, and levels of inflammatory biomarkers.
Two studies (67%) sampled gingival crevicular fluid (GCF), and only one study (33%) sampled saliva for the determination of inflammatory markers. In the three previously mentioned articles, the enzyme-linked immunosorbent assay (ELISA) was performed. In addition, the most frequently analyzed marker was TNF-α (67%), followed by MCP-1 (33%). Smooth knitted gingival retraction cord was found to maintain increased levels of TNF-α (16.08 ± 3.13 pg/ml) 28 days after the gingival displacement process; so far, the highest levels reported in the literature [50], whereas braided cords (Ultrapak knitted retraction cord, #0, Ultradent, Inc, South Jordan, UT) produced the lowest levels of this cytokine (0.43 ± 0.08pg/ml) [52].

Additional outcome(s) The most frequently evaluated cell type in the in vitro studies was HGFs (100%). The most commonly used technique was the MTT (3-(3,4 -dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay (50%) to measure cellular metabolic activity as an indicator of cell viability, proliferation, and cytotoxicity. This technique is followed by laser scanning confocal microscopy (37.5%) to assess the organization of the cytoskeleton. FGH have been most frequently exposed to agents such as injection with 0.01 and 0.05% adrenaline (Self-made dilution of Injec. Adrenalini 0.1%), Visine® classic (Pfizer, Warsaw, Poland), Afrin® (Schering-Plough, Brussels, Belgium), Neosynephrin-POS® 10% (Ursaphamar, Saarbücken, Germany) and Starazolin® (Polpharma, Warsaw, Poland) (37.5%). In addition, astringent systems such as ferric sulfate produced higher toxicity in FGH.

Data management The methodological validity of the selected articles was assessed independently by two investigators (M.A.A.S and A.H). For randomized clinical trials and longitudinal studies, the critical appraisal tool of the Joanna Briggs Institute (https://jbi.global/critical-appraisal-tools) was used. This tool is based on a series of questions grouped according to the type of studies included in the systematic review that can be rated as "Yes", "No", "Unclear" or "Not applicable". The selected articles were ordered by their design and a specific instrument was used for each group. Whereas, for studies with an experimental design (in vitro studies), the modified Consolidated Standards of Reporting Trials (CONSORT) [54] checklist was used.
For practical purposes and according to the assessment instrument, the risk of bias was classified as high when the study reached up to 49% of the "Yes" scores, moderate from 50% to 69% and low when it reached scores above 70%.

Strategy of data synthesis Two independent researchers (M.A.A.S and A.H) primarily screened the articles by reading the title and abstract. Subsequently, the content of each paper was summarized. The validity of the studies was assessed, and duplications were identified. The same investigators selected the articles that met the eligibility criteria or those with insufficient data. If any disagreement arose between the principal investigator, it was resolved by discussion with an independent third investigator. The following information was extracted for each article included:
- First author, year, and country.
- Type of study.
- Journal.
- Study population.
- Age.
- Gender.
- Gingival retraction system used.

• Location and number of teeth.
• Periodontal status.
• Cell type.
• Technique used.
• Oral fluid.
• Method of detection.
• Biomarkers.

Subgroup analysis Gingival displacement. Proinflammatory mediators. Gingival fibroblasts.

Sensitivity analysis Not applicable.

Country(ies) involved México.

Keywords Gingival retraction methods, gingival fibroblasts, cytokines, astringents, cordless methods, vasoconstrictors.

Dissemination plans Scientific article.

Contributions of each author

Author 1 - Mario Alberto Alarcón-Sánchez - Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – Original Draft, Writing – Review and editing, Visualization, Supervision, Project administration.
Email: marioaasanchez@hotmail.com
Author 2 - Giuseppe Minervini - Formal analysis, Writing – Review & Editing, Project administration.
Email: giuseppe.minervini@unicampania.it
Author 3 - Artak Heboyan - Formal analysis, Writing – Review & Editing, Project administration.
Email: heboyan.artak@gmail.com
Author 4 - heboyan.artak@gmail.com.