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Review of the Application of Antimicrobial Photodynamic Treatment in Orthodontics and Related Fields

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ABSTRACT:-

The current study set out to conduct a thorough evaluation of the indexed literature on the possible application of antimicrobial photodynamic treatment (aPDT) in orthodontics. Using the following keywords, indexed databases were searched up to and including January 2019: (A) orthodontics; (B) photodynamic chemotherapy; (C) antimicrobial photodynamic therapy; and (D) orthodontics. Case reports, case series, and original (clinical and experimental) investigations were all included. Review articles, opinions, and letters to the editor were not included. Four studies were processed for data extraction out of the 29 studies discovered during the first search. Three studies involved human randomised clinical trials, and one study was an experiment. Results from two studies demonstrated that aPDT is efficient in treating gingival inflammation in those receiving orthodontic treatment (OT). According to one study, patients receiving OT can successfully use aPDT for oral decontamination. According to the experimental study's findings, aPDT is useful for cleaning the surfaces of orthodontic implements. The prospective use of aPDT in OT is not supported by enough data in the literature that has been indexed. Therefore, more research is needed in this area.

Keywords: Antimicrobial, Orthodontics, Orthodontic, Photodynamic therapy, Antimicrobial photodynamic therapy.

INTRODUCTION: -

Modern treatment methods such as antimicrobial photodynamic therapy (aPDT) include interactions between a light source and a photosensitive dye (photosensitizer) in an aerobic environment. The photosensitizer is often injected into the area of interest and then subjected

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to light with a wavelength between 630 and 700 nm. Examples of such photosensitizers are toluidine blue and methylene blue (MB). Reactive oxygen species (ROS) are created as a result of the interaction, which harm the target cells (such as cancer cells) and have antibacterial properties against a variety of harmful microbes [1-3]. According to studies [4–8], aPDT may be used as a management method for diseases like osteomyelitis and stomach infections, as well as malignancies of the skin, breast, and colon. Additionally, aPDT has been employed as a complementary therapy in the treatment of inflammatory dental disorders as periodontitis and peri-implant diseases [9–12]. Additionally, aPDT has been utilised to cure denture stomatitis and clean the surfaces of implants and acrylic-based dentures [13–16].

In general, orthodontics is a branch of dentistry that deals with the science and treatment of malocclusions that have skeletal and dental causes. In clinical orthodontic practise, brackets, wires, elastics, and stainless-steel bands are frequently utilised to realign teeth and enhance the facial profile. However, achieving patient compliance towards regular oral hygiene maintenance is often challenging during orthodontic treatment (OT) [15,16]. Studies [17,18] have shown that periodontal or gingival inflammation (GI) is often manifested in patients with poor oral hygiene maintenance undergoing orthodontic treatment (OT). Gómez et al. [19] evaluated the effectiveness of aPDT for the prevention of GI in patients undergoing OT in a recent clinical research. The findings demonstrated that aPDT helps young children receiving fixed OT postpone GI and the development of white spot lesions (caused by enamel demineralization) [19,20]. Additionally, aPDT has been demonstrated to be a successful method for cleaning orthodontic devices of microorganisms such Escherichia coli, Staphylococcus aureus, and Streptococcus mutans [21]. It was discovered after a thorough search of the indexed literature that there are no studies that have thoroughly examined the possible role of aPDT in the dental speciality of orthodontics. Given this context, the current study's goal was to thoroughly review all indexed literature pertaining to the possible use of aPDT in orthodontics.

MATERIALS AND METHODS :-

The present literature review was carried out in accordance with the Preferred Reporting Items for Systemic Reviews and MetaAnalysis (PRISMA) criteria [22]. Does aPDT have a potential role in the field of orthodontics? was the addressed key question. Case-reports, caseseries, and original (clinical and experimental) investigations were all included. Commentaries, commentary, and letters to the editor were not included. The pertinent studies that discuss the potential application of aPDT in the field of orthodontics were found using a structured literature search.

Up until and including January 2019, the following key phrases were used to search indexed databases (PubMed/Medline, OVID, EMBASE, ISI Web of Knowledge, and Google-Scholar): (a) antimicrobial photodynamic therapy; (b) antimicrobial photodynamic chemotherapy; (c) orthodontic; and (d) orthodontics. The Open-GRAY database was searched to find grey literature (unpublished studies), and the reference lists of the studies

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that met the eligibility requirements were hand-searched to find any possible omissions from the first search. Discussions were used to settle disagreements on the choice of studies.The initial search turned up 29 research, of which 4 studies [22] met the prerequisites for eligibility (as previously mentioned) and were processed for data extraction.

Summary of results from human studies

One study [21] had an experimental design, while three studies [19,20,22] were human randomised clinical trials. The research that were omitted were either review articles or didn't address the key subject. Participants in the clinical investigations ranged in age from 21 to 45. One study [19] provided the participants' average age. Participants in this study [19] who had aPDT and ultrasonic scaling (US) were 15, 8, and 14, 2, respectively, in terms of age. The findings of 2 studies [19,20] demonstrated the efficacy of aPDT as a therapeutic approach for the management of GI in patients undergoing OT, while the findings of Panhóca et al. [23] demonstrated the efficacy of aPDT for the oral decontamination of patients undergoing OT.

Summary of results from the experimental study

The impact of aPDT on the surface decontamination of orthodontic equipment was evaluated in the experimental investigation [21]. The findings demonstrated that soaking orthodontic instruments in 100 mol/L of MB for 20 min, followed by another 20 min of exposure to 660 nm laser light with an energy density of 026 J/cm2, caused a statistically significant decrease in the colony forming units of both gramme positive (S. aureus and S. mutans) and gramme negative (E. coli) microbes.

DISCUSSION:-

A thorough analysis of the applicable literature revealed that only a small number of research [19-21,23] with a range of results met the eligibility requirements. This restriction prevented the performance of a systematic review and metaanalysis of the studies. Despite the fact that Despite the lack of indexed literature on the importance of aPDT in orthodontics, the evidence [19-21,23] suggests that patients undergoing OT may benefit from using aPDT. In the study by Gómez et al. [19], for instance, both aPDT and US were successful in treating GI in patients receiving OT. Similar findings by Foggiato et al. [21] demonstrated that aPDT is a successful method for sterilising metallic tools used in clinical orthodontic practise. However, it must be stressed that standard mechanical debridement (MD) and sterilisation methods like autoclaving and US should never be replaced by aPDT. Studies [24] have demonstrated that MD combined with adjunct aPDT is more efficient than MD alone in treating periodontal disorders (PD) (such as chronic periodontitis). Additionally, the study by Foggiato et al. [21] investigated the effectiveness of aPDT as a disinfectant against a select group of microorganisms (S. aureus, S. mutans and E. Coli). It is predicted that adjunct aPDT makes US and instrument sterilisation more efficient than US and autoclaving alone. To test these hypotheses, additional research is required.

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Dental caries, periodontal disease, and white spot lesions are typical OT side effects. Jurii et al. claim that maintaining oral hygiene in patients receiving OT helps lower the prevalence of white spot lesions (WSL) in teenagers. In patients receiving permanent and detachable OT, it is consequently imperative to reiterate basic oral hygiene guidelines through routine follow-up. According to characteristics of the Included Studies, it is hypothesised that aPDT-based full-mouth disinfection combined with routine dental checkups and oral hygiene maintenance is a trustworthy methodology to reduce the risk of PD and WSL in patients. becoming OT However, there haven't been any research that have investigated this theory yet in the indexed literature.

The results of OT have reportedly been compromised by frequent nicotinic product use, such as smoking tobacco [24]. Additionally, systemic illnesses like poorly managed diabetes mellitus and psychosocial disorders may have a deleterious impact on the results of OT. Additionally, it has been shown that the use of drugs such corticosteroids and bisphosphonates can have an impact on OT. According to the authors' knowledge, no studies have examined the effectiveness of OT with adjunct aPDT in smokers, patients with systemic and/or psychological illnesses, or people taking drugs like corticosteroids and bisphosphonates. In the patient groups mentioned above, it is expected that OT outcomes, whether they use aPDT or not, are hampered. To test these hypotheses, additional research is required.

CONCLUSION :-

There is not enough data in the indexed literature to support the possibility that aPDT could play a function in occupational therapy. Accordingly, there is a need for additional research in this area.

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