Review Article

COLOUR STABILITY OF MAXILLOFACIAL SILICONE MATERIALS AFTER DISINFECTION AND AGING PROCEDURES A SYSTEMATIC REVIEW

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ABSTRACT

Maxillofacial prosthesis should restore the appearance to near normal so that the affected person should have a normal mental status as well as quality of life. The longevity of any kind of maxillofacial silicone prosthesis is determined by its color and mechanical properties. To systematically assess the current published literature on the stability of color of maxillofacial silicone materials after 10 minutes of disinfection and aging, a literature search on PubMed and Google Scholar was done from January 2000 to December 2020 on the stability of color of maxillofacial silicone materials after disinfection and aging. In addition, a hand search was performed through standard dental journals for the years 2000 to 2020 using the keywords; color stability and maxillofacial silicone, maxillofacial silicone and disinfection, maxillofacial silicone, and aging. A total of 52 studies were recognized and 6 in vitro studies were appended for this systematic review. The color stability of maxillofacial silicone materials was affected by disinfection and aging procedure.

Key words: Aging process, Colour stability, Disinfection, Maxillofacial prosthesis, Maxillofacial silicone, Nanoparticles.

Introduction

Colour is the principal feature appreciated by patients rehabilitated with maxillofacial prostheses [1, 2]. The principal objective of a maxillofacial prosthodontist is to restore the patient's aesthetics, enhance their self-confidence, and aid to lead a regular life as possible [3]. The average clinical life of maxillofacial silicone is approximately 1 year. Patients have to clean the maxillofacial prosthesis for 3 to 5min every day with a brush to prevent contamination [4]. There are several disinfection procedures and materials were opted for disinfection of maxillofacial prosthesis. Chlorhexidine was considered the most efficacious disinfectant in dentistry [5].

Chemical disinfection give rise to changes in properties of the maxillofacial silicone materials used for fabrication of maxillofacial prosthesis, so it is important to evaluate these changes during fabrication is mandatory to use as chemical disinfection. Furthermore, these disinfectants should not elicit any reaction in human tissues and also should conserve the properties of maxillo-facial silicones [6]. Disinfectants like2% to 4% chlorhexidine, 1% sodium hypochlorite, neutral soap and cleansing tablets, were used in many types of research [1, 4, 7].

Nanomaterials such as Titanium dioxide, silaned silica, fumed silica, zinc oxide, cerium oxide, polyhedral silsesquioxane, magnesium silicate, tulle were used as reinforcement material in maxillofacial silicone. The mechanical properties of maxillofacial silicone-like tensile strength, tear strength, percentage of elongation, hardness, dimension stability, and color stability were improved by reinforcement with nanoparticles [8].

There was no systematic review on the stability of color of maxillofacial silicone after disinfection procedures to date. Hence this systematic review was aimed to analyze the color stability of maxillofacial silicone after disinfection and 252, 504, and 1004 hours of aging in the available literature. The research question on which we focused for this systematic review was "Does the disinfection solution affect the color stability of maxillofacial silicones?"

Materials and Methods

The current systematic review follows the criteria of the PRISMA statement [9]. The electronic search was done in PubMed and Google Scholar for relevant publication from January 2000 to December 2018. The search was done with the key terms color stability of maxillofacial silicone, disinfection of maxillofacial silicone WITH or AND. Also, publication in Journal of Prosthetic Dentistry, International Journal of Prosthodontics, Journal of Prosthodontics, Journal of Prosthodontic Research, Journal of Advanced Prosthodontics, Journal of Indian Prosthodontic Society, and Indian Journal of Dental Research from January 2000 to December 2020 manually.

Eligibility criteria

Studies that were included were in vitro studies on color stability published in the English language and exclusion

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criteria were case reports, animal studies, and review articles.

Study selection

The titles were screened independently by two reviewers SD and ASC. Studies that meet the inclusion criteria were retrieved.

Results and Discussion

Studies identified through databases were 52 that included 18 PubMed/Medline 34 Google Scholar. The identification and removal of duplicate articles by applying the inclusion/exclusion criteria reported with 12 articles. Totally 6 studies were taken for systemic review **(Figure 1)**.

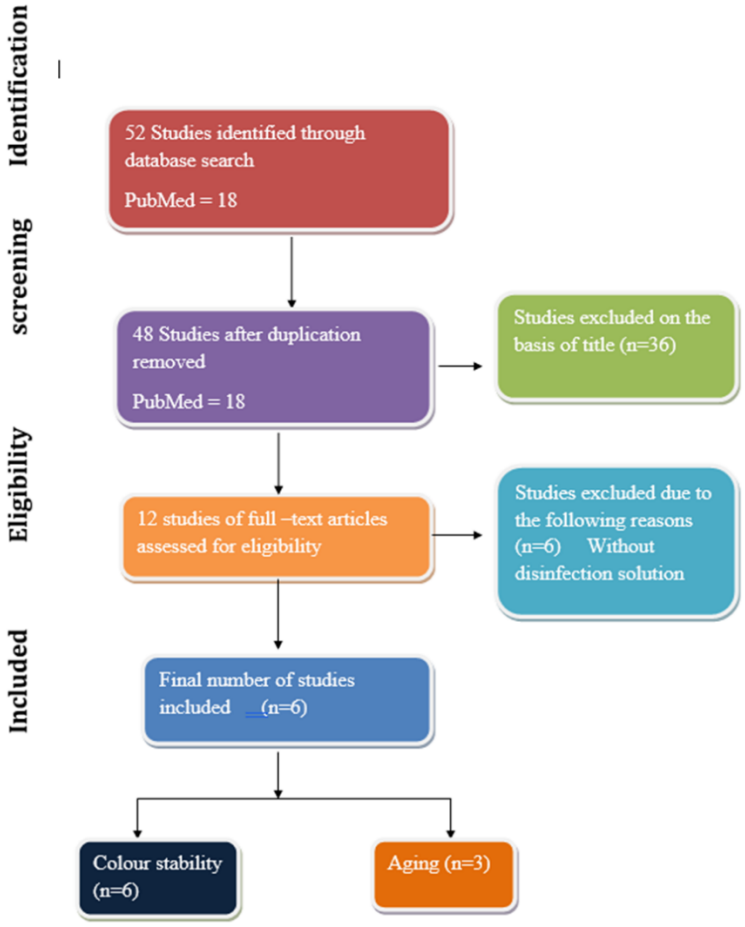

Figure 1. Diagram of the search strategy

The purpose of the present systematic review was to analyze the stability of color of maxillofacial silicone materials after disinfection and aging. Recent research showed that incorporation of oil pigments, nanoparticles, and opacifiers into silicone materials increases the shelf life of maxillofacial silicone prostheses and also increased the color stability, and protects the silicone material from UV rays [10-14].

Disinfection is a process by which the microorganisms are eliminated from the surface by a chemical agent. It should not damage the human tissues and conserves the properties of silicone. The antimicrobial properties, compatibility, and retaining the properties of the materials are the important factors for the selection of disinfectants [15]. Various disinfectants like neutral soap, sodium hypochlorite solution, 4% chlorhexidine, efferdent tablet, plant extract, the commercial disinfecting solution can produce some property changes in the maxillofacial silicone materials [13, 16-18].

The device for aging helps to investigate the response of the subject in the natural atmosphere by simulating environmental factors like humidity, heat, and radiation [7]. Photooxidative potential to alter the chemical structure of any material by heat and light. The scientists have accepted that the changes in maxillofacial silicone materials are due

to changes produced by the ultraviolet radiation in mechanical and optical properties of silicones which helps us to determine the acceptability of the environment by the materials [19, 20].

In the present systematic review, the color stability of the maxillofacial silicone material is analyzed by using the ultraviolet-visible reflection spectrophotometer **(Table 1)**.

Table 1. Characteristic of studies included

Study	Material	Instrument	Disinfectant Solution	Duration	Aging	Significance
Goiato *et al*. -2009[2]	MDX 4-4210 Silastic 732	Visible UV Reflectance E spectrophotometer,	Neutral Soap Efferdent	3 days a week for 60 days	nil	Significant Not significant
Marcelo Coelho Goiato et-al 2011 [23]	MDX4-4210 MDX4-4210 with barium sulphate MDX4-4210 with titanium dioxide	Visible Ultraviolet Reflection Spectrophotometer,	Efferdent effervescent tablet neutral soap 4% chlorhexidine gluconate	three times a week for 2 months for 15 minutes	252, 504, and 1008 h of artificial aging	Significant Significant Significant
Haddad *et al*. 2011[22]	MDX4-4210 Silicone MDX4-4210 silicone pigmented with ceramic powder MDX4-4210 silicone pigmented with BaSO4 MDX4-4210 silicone pigmented with BaSO4 and ceramic powder	UV reflection spectrophotometer	Neutral soap Efferdent Evervescent tablets 4% chlorexidine	3 days a week for 60 days	252, 504, and 1008 h of artificial aging	Significant Significant Significant
Aldie ris Alves Pesqueir *et al*. 2011[6]	1.Silastic MDX 4-4210 2.Silastic MDX 4-4210 (Ceramic Powder) 3.Silastic MDX 4-4210 (Makeup	Visible Ultraviolet Reflection Spectrometer	neutral soap effervescent tablets	3 days a week for 60 days	252, 504, and 1008 h of artificial aging	Significant Significant
Panagiota Eleni *et al*. 2013 [17]	polydimethylsiloxane (PDMS) chlorinated polyethylene (CPE)	MiniScan XE Spectrophotometer	Microwave sodium hypochlorite, neutral soap Commercial disinfecting soap	5 minutes per day for 1 year (30 hours)	nil	Significant Not clinically acceptable Not clinically acceptable Not clinically acceptable
Guiotti, Aimee Maria-*et al*. (2016) [21]	MDX4-4210 (polydimethylsiloxane) Functional Intrinsic II – Silicone Coloring System(Medium-shade) Functional Intrinsic II – Silicone Coloring System (dark shade) Dry opacifier (Zinc oxide – ZnO)	ultraviolet-visible reflection spectrophotometer	Saline solution Neutral soap Chlorhexidine 4% Hydrastis canadensis (Hydrastis) Cymbopogon nardus (Cytronella	daily for 30 days for 10 minutes	1008 hours	Not clinically acceptable

The stability of color of maxillofacial silicone material after the addition of pigment and opacifier, disinfected with conventional and plant extracted disinfected solution for 30 days, and accelerated aging for 1008 hrs. They mentioned that silicones MDX 4-4210 exhibited clinically impermissionable color change regardless of the disinfecting

solution [21]. The color stability of chlorinated polyethylene (CPE) and polydimethylsiloxane (PDMS) after disinfection and microwave exposure was tested and concluded that microwave exposure was recommended for polydimethylsiloxane (PDMS) and chlorinated polyethylene (CPE) material to be disinfected with sodium hypochlorite solution [17]. Maxillofacial silicone silastic MDX 4-4210 with different pigmentations after disinfection and aging, ceramic powder showed more color stability compared with makeup and colorless after disinfection and 252, 504,1008 hrs aging period [6]. Maxillofacial elastomer mixed with an opacifier and/or a nanoparticle underwent artificial aging and disinfection. The samples with BaSO4 opacifier and ceramic nanoparticles were the most stable material on color, without intent for aging and disinfection [22]. The color stability MDX 4-4210 maxillofacial silicone after disinfection and accelerated aging was tested and mentioned that chlorhexidine showed more color change in the facial silicone compared to neutral soap and efferdent tablet. Also, they mentioned that accelerated aging had a significant effect on the color stability of all kinds of silicone materials. The barium sulfate opacifier was more stable than titanium dioxide [23]. The color stability of Silastic 732 RTV and MDX 4-4210 after disinfection with neutral soap and Efferdent tablet and concluded that neutral soap showed the least effect of color stability than efferdent tablet [24].

Conclusion

The authors concluded that the color stability of maxillofacial silicones was affected by disinfection solution and aging procedure. Among the disinfection, solution chlorhexidine produced the maximum color change in the maxillofacial silicone in the various aging period.

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