

Durability of Color Stability of Denture Teeth-Systematic Review

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Abstract

This article aims at demonstrating the type of acrylic teeth with the highest degree of color stability with references to the chemical disinfectant (denture cleanser) with the lowest color changing effect on acrylic teeth. The literature search was conducted using different electronic databases. Specific terms were used for the database search, which spanned the years from 1996 to 2016. The articles specific to discuss the factor affecting the color stability of acrylic teeth were scanned. The search was augmented by using the option of "related articles" and was conducted by two individuals. Relevant studies were selected according to predetermined inclusion and exclusion criteria, only fourteen studies fulfilled the inclusion criteria. The results revealed that

there was significance difference between the color stability of different types of acrylic teeth also, Cigarette smoking and aging affect color stability of denture teeth while, staining susceptibility of teeth were dependent on time. Coffee and cola being the most chromogenic liquids. Although the color change was clear when calculated by a spectrophotometer, many participants failed to notice it. We concluded that, Biolux and

Mondial 6 are the most color stable type of acrylic teeth regardless of discoloring agents and Lighter shade is more affected than darker shade. Between different denture cleansers, natural soap cause the least color change on acrylic teeth.

Keywords: *Denture teeth, Color stability, Discoloring agents, Staining agents.*

1. Introduction

Removable dentures have been used for many years to rehabilitate edentulous patients and can restore self-confidence, esthetics, masticatory function, and the capacity for socialization⁽¹⁾. Artificial teeth are a fundamental part of complete denture and partial removable denture aesthetics. In order to maintain this function over the course of time, these artificial teeth must be present clinically acceptable color stability⁽²⁻⁶⁾. Artificial teeth enable the replacement of lost natural teeth and have a significant role in the esthetic and functional outcomes of complete dentures^(5, 7). For dentures, selection of artificial teeth is of great interest since the color stability and staining susceptibility of artificial teeth play a significant role in the overall esthetics of the denture^(5, 8). In dentures, artificial teeth are a significant part of the overall esthetical outcome⁽⁹⁾. Acrylic resin teeth are more susceptible to discoloration and wear⁽⁵⁾. Denture staining can be caused by many factors, which can be divided into intrinsic factors, such as the characteristics of the material composition (e.g., type of photo initiator and inorganic material), and extrinsic factors relating to wear and exposure to staining substances inducing absorption and adsorption of stains^(1, 5, 7, 8, 10, 11). also, the effect of cigarette smoke on the color stability of commercially available acrylic resin teeth needs to be evaluated for clinical success and to determine which type has superior properties⁽¹²⁾. In addition, if the artificial material is in contact with liquid containing staining agents, the situation may worsen, and a discoloration may be unavoidable⁽¹³⁾. Dental materials could be discolored when they are

subjected to colorant agents such as tea, coffee, or cigarette smoke⁽¹⁴⁾. Imirzalioglu et al⁽¹⁵⁾ investigated the effects of tea, coffee, and nicotine on the color stability of acrylic resin denture bases and found that the color difference with each staining solution could be perceived by the human eye. Routine denture hygienic methods recommended by dental healthcare provider consist of mechanical and chemical methods⁽¹⁶⁾. Numerous studies have thoroughly investigated the effects of different chemical disinfectants on the dimensional stability, wettability, and flexural strength of various dental materials⁽¹⁷⁻²¹⁾. Chemical cleaning of dentures includes the use of denture cleansing agents, an antimicrobial solution, denture cream, dishwashing agent, etc⁽²²⁾. Improper brushing technique could potentially cause wear of denture teeth and adversely affect the esthetic of the denture⁽²³⁾. The color degradation of denture teeth is one of the factors that affect the esthetic durability of dentures⁽⁵⁾.

2. Methods and Materials

Search strategy: The literature search was conducted by two individuals using different electronic databases: PubMed, ScienceDirect and ResearchGate. for English-language, clinical studies reporting on color stability of acrylic teeth/ esthetic complication of denture teeth /esthetic durability of denture teeth. The search terms were used, alone or in combination were "denture tee- th" , "acrylic teeth", "discoloration" color stability", denture teeth", teeth color perception", dental spectrophotometer", and acrylic resin". The search covered a time span from January 2000 to April 2016 . The option of "related articles" was also used. Review articles, as well as references from different studies, were also used to identify relevant articles.

Selection of studies

The review process consisted of two phases: During the first phase, the titles, abstracts, and/or full texts

were reviewed by the two reviewers together. Initially, titles were screened for relevance, and the abstracts of the relevant articles were obtained. The articles obtained were screened using the following exclusion and inclusion criteria. Articles that were technical articles, or were in a language other than English or had no English-language abstract were excluded. The selected full texts were further screened independently by the two reviewers in the second phase of review using the following inclusion criteria:

1. Studies conducted on all types of acrylic teeth.
2. Studies included different staining agents.
3. Details reported on exposure time to of acrylic teeth to staining agents.
4. Studies published in English.

Exclusion criteria

- 1- Studies on Porcelain teeth.
- 2- Studies used acrylic teeth impregnated with Mica.
- 3- Studies not published in English.

3. Results

Figure 1 shows the process used to identify the studies finally included from the initial yield of 1900 titles. Initial analysis of titles lead to one hundred eighty two abstracts. ninety eight abstracts were excluded, so eighty four full texts were obtained. eighty four full text were screened for inclusion/exclusion criteria in the first phase. Of these fifty two studies were excluded and thirty two studies passed the first review phase. In the second review phase, eighteen studies were excluded and sixteen studies were deemed to have met the inclusion criteria. After studies of the same cohorts were excluded, fourteen studies were finally selected.

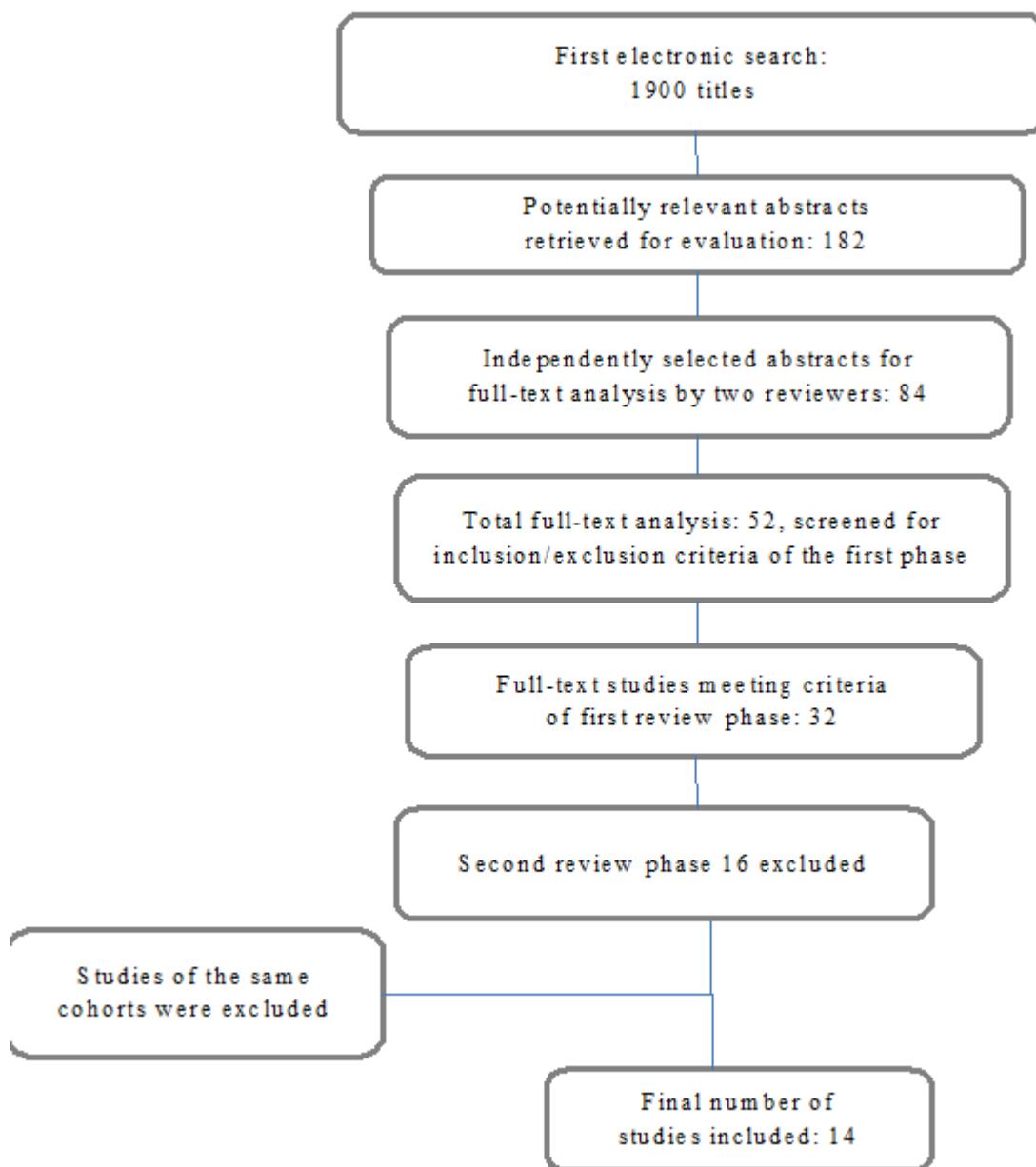


Fig 1 Search Strategy

Table 1 Effect of different discoloring agents

No	Study title	Methods	Exposure time	Type of acrylic teeth	Specimens	Result
1	Effect of Cigarette Smoke on Acrylic Resin Teeth.	Teeth stored in artificial saliva for 24h and exposed to cigarette smoke.	21 days and color change calculated.	Premadent, Astra, and Sanyo- Dent.	20 specimens of each brand divided into two groups.	Premadent was more color stable followed by Astra then Sanyo- Dent.
2	Effects of cigarette smoke and denture cleaners on the surface roughness and color stability of different denture teeth.	Different types of acrylic teeth divided into two groups and exposed to smoke.	Exposed to 20 cigarette smoke (10 minutes per cigarette).	Acrylux ,SR Orthosit PE-O and Ivoclar.	10 specimens of each brand.	Reinforced polymethyl methacrylate (SR Orthosit PE-O; Ivoclar) was more color stable than Polymethyl methacrylate (Acrylux)
3	Colour stability of denture teeth submitted to different cleaning protocols and accelerated artificial aging	Dark (2E) and light (1C) shade selected from type of acrylic teeth submitted to accelerated artificial aging.	384 hours, which corresponded to approximately 1 year of clinical use.	Different shades of SR Vivodent.	30 specimens.	1C shade of acrylic teeth was more color stable than darker 2E shade.
4	Effects of ageing and staining on color of acrylic resin denture teeth	Four different shades of acrylic resin denture teeth were selected from three different types of acrylic teeth and exposed to artificial ageing in a Weather- Ometer device	Exposed to artificial ageing by exposure to (150 kJ/m ²) in a Weather- Ometer.	Different shades of three types of acrylic teeth :Portrait IPN,SR Vivodent PE, and Vita Physiodens .	20 specimens of each type of acrylic teeth	Portrait IPN was more color stable followed by SR Vivoden then by Vita Physiodens.
5	Influence of surface sealant agents on the surface roughness and color stability of artificial teeth.	Treatment of two different types of acrylic teeth using different surface sealant and a thermal cycling procedure applied than color change identified before and after 7 days of storage in coffee solution.	7 days of storage in a coffee solution.	SR Vivodent and Vitapan.	160 specimens.	Using Palaseal and Optiglaze sealant agents provide smoother and more color-stable denture tooth surfaces than the conventional polishing technique.
6	Long-term clinical evaluation of the color stability and stainability of acrylic resin denture teeth.	participants rehabilitated with complete dentures from February 2008 to December 2013 were selected and Color change in 3 regions of the denture teeth (incisal, middle, and cervical) evaluated.	acrylic teeth evaluated after 5 years of usage.	Biolux ,Biotone ,	50 participants.	With usage ,Acrylic teeth show greater chromatic alterations were noted in the incisal third of the teeth than in the cervical and middle thirds.
7	Effect of polymerization methods and thermal cycling on color stability of acrylic resin denture teeth.	Different brands of acrylic teeth divided into 2 groups, each group were subjected to 1 of 2 polymerization methods, then thermally cycled and color change calculated.	Microwave, 500 W for 3 minutes, or water bath, 74°C for 9 hours. After polymerization, all of the specimens were thermally cycled between 5°C and 55°C.	Art Plus, Biolux, Biotone IPN, Magister, Mondial 6, Premium 6, SR Vivoden PE, Trilux , Trubyte Biotone, and Vipi Dent Plus.	240 specimens.	Biotone IPN ,and SR Vivoden teeth exhibited the greatest degree of color instability.

Table 2 Effect of staining liquids and disinfectant solutions

No	Study title	Methods	Exposure time	Type of acrylic teeth	Specimens	Staining agents	Result
1	Color degradation of acrylic resin denture teeth as a function of liquid diet: Ultraviolet-visible reflection analysis.	Ten acrylic resin denture teeth brands were evaluated by immersing in staining solutions and color differences calculated	Color changes calculated after immersion of acrylic teeth in coloring solutions for (1, 7, 15, and 30 days).	Art Plus, Biolux , Biogene IPN , Magister , Mondial 6 , Premium 6 , SR Vivodent PE , Trilux , Trubyte Biogene , and Vipi Dent Plus.	240 specimens.	Coffee, cola, and orange juice.	Biotone IPN and Trilux teeth exhibited the lowest color stability while Biolux and Mondial 6 teeth were the highest.
2	Color Stability of Different Denture Teeth Materials against Various Staining Agents.	Three brands of reinforced acrylic teeth were used. shade A1 acrylic teeth were immersed into staining solutions. And color change determined.	Color changes calculated after immersion of acrylic teeth in solutions for 1 day, 1 week, 2 weeks, and 4 weeks.	SR-Vivodent DCL ,Vitapan and Optostar.	120 specimens.	Coffee, tea and cola.	Instant coffee was found to be the most chromogenic solution among the solutions tested .
3	Colour Stability of Denture Teeth Submitted to Different Cleaning Protocols and Accelerated Artificial Aging.	Dark (2E) and light (1C) shade of acrylic teeth selected and divided into groups. each group immersed in different cleaning solutions and color change calculated.	Ranging from(5 minutes/30 days) to(20 minutes/30days.).	Different shades of (SR Vivodent)	60 specimens.	0.5% Sodium Hypochlorite and Alkaline Peroxide	Color stability of artificial teeth was influenced by the cleaning solutions and dark shade was more susceptible to color alteration than lighter one.
4	Effect of Different Chemical Disinfectants on Color Stability of Acrylic Denture Teeth.	Acrylic teeth immersed into different type of chemical disinfectant and color change calculated.	Color changes were calculated after 10 ,30,48,72,144 and 960 immersion cycles, the time of immersion cycle is 15 minutes.	Ultraplus.The same study demonstrating both the effect of ageing and staining agents.	120 specimens.	Natural soap ,Sodium Hypochlorite 2%, Sodium Hypochlorite 5.25%, Sodium Perborate 4%, Povidone-iodine 10%, Chlorhexidine Gluconate and 4%, Glutaraldehyde 2%.	Sodium hypochlorite 5.25% show the greatest color change on acrylic teeth and color change increase with immersion cycle.

5	Evaluation of staining susceptibility of resin artificial teeth and stain removal efficacy of denture cleansers.	Four brands of acrylic teeth divided into groups and immersed in coloring solutions (coffee ,red wine and tea)then color change calculated after those acrylic teeth immersed into different types of denture cleanser.	14h in staining solution and 8h into cleaning solution .	Ivostar, SR Vivodent PE, Major Dent and Integral.	300 Specimens	Corega Tabs , Fittydent and Sodium hypochlorite.	Ivostar and Vivodent were the highest color stable while coffee had the greatest effect on color change and there was no difference among the denture cleansers in terms of stain removal efficacy.
6	The effect of various staining agents on color stability of acrylic denture teeth materials. (In vitro study).	Acrylic teeth immersed into three different staining solution and color change calculated after immersion.	1 month.	Major Dent.	128 Specimens	Tea, coffee and cola.	Cola found to be the most chromogenic liquid.
7	effect of repeated immersion solution cycles on the color stability of denture tooth acrylic resins	Two different brands immersed into five different types of disinfectant solutions, and color measurements were determined after subjecting the specimens to 7, 21, 30, 45, 60, and 90 immersion cycles in each tested solution	Color changes were calculated after 7, 21, 30, 45, 60, and 90 immersion cycles interval and immersion time for each cycle range from (5-10 minutes).	Artiplus and Trilux.	60 specimens.	1% Sodium hypochlorite ,2% Sodium hypochlorite ,5.25% Sodium hypochlorite,2% Glutaraldehyde and 4% Chlorhexidine Gluconate	Repeated immersion cycles in the solutions altered the color of acrylic teeth, but this change was not clinically visible.
8	Color stability of denture teeth and acrylic base resin subjected daily to various consumer cleansers.	Two brands of denture teeth in shades A1, B1, and C1 exposed to four cleansers and color differences calculated.	48 weeks.	Trubyte and Vivadent SR.	225 Specimens	Clorox Bleach, Polident Anti-Bacterial Denture Cleanser, Efferdent Anti-Bacterial Denture Cleanser, Kleenite Dental Cleanser.	Trubyte teeth was more color-stable than Vivadent in all cleansers .

4. Discussion

Color maintenance is the property of a material that allows color to be maintained over a period of time in a given environment⁽²⁴⁾. The importance of

artificial tooth staining is clear considering that a great part of the population need rehabilitation treatment with dentures⁽⁸⁾. In the following studies, the color difference was calculated using spectrophotometer device that CIE L * a * b * color

space (in which the brightness is shown with L *, red-green chromacy with a *, and yellow-blue chromacy with b *) used⁽²⁵⁾. The present study aimed to determine the color stability of acrylic teeth after exposure different coloring agents. The study revealed that color stability of acrylic teeth affected by different factors as type of acrylic teeth, the shade of teeth, concentration, type of discoloring agent and time of exposure of acrylic teeth to the discoloring agent. Valentim *et al* ⁽²⁶⁾ demonstrated that by using a spectrophotometer to calculate color change after five years of usage of different type of acrylic teeth, chromatic alterations in the incisal third of the teeth is greater than in the cervical and middle thirds and the color changes increased by increasing consumption of the staining fluids, but participants failed to notice it. Two studies^(8, 27) demonstrated the effect of artificial ageing on color stability of acrylic teeth one of them show that artificial ageing affect color stability of acrylic teeth. the other one that used (weather ometer which is artificial ageing device)showing Vita Physiodens are more color stable than another different type of acrylic teeth used in the study .Two studies^(12, 28) explained the effect of cigarette smoke on color of acrylic teeth. the first study Expose the artificial teeth to artificial cigarette smoke the results show artificial smoke discolored the teeth while ,the other study which used(Custom made smoke chamber) showed that Premadent has great color stability followed by Astra then Sanyodent on exposure to cigarette smoke. Wirley *et al*⁽⁷⁾ found there was no significant difference between microwave or water bath polymerization methods on color stability of acrylic teeth but after thermal cycling of different types of acrylic teeth Biotone IPN and SR Vivodent show more color instability than other types of acrylic teeth used in this study. Sahin *et al*⁽²⁹⁾ demonstrated the effect of sealant agent on color maintenance of acrylic teeth ,Showing that the use of Palaseal and Optiglaze sealant agents provide more color-stable denture tooth surfaces than the conventional polishing technique .many studies ^(5, 8, 30, 31), discussed the relation between color stability and different staining agents . Ana , Koksal, Sevcan and Gregorius agreed that coffee was the most chromogenic staining solution and staining susceptibility was dependent on time , Ana also revealed that Biolux and Premium 6 have the

greatest color stability between ten different types of acrylic teeth being tested .On the other hand, Salman ⁽³⁵⁾showed the cola solution was the most chromogenic staining solution which was different from the previous studies. Although all of them used approximately the same exposure time, the difference may be caused by using different concentrations of staining solution or using different types of acrylic teeth. Many studies ^(25, 31-33). discussed the relation between color stability and different denture cleansers. Piskin *et al* ⁽²⁵⁾showed that between seven chemical disinfectants ,(Natural soap) had the lowest color changing effect on acrylic denture teeth and all the studies agreed that color change increase with increasing immersion cycles (time)and concentration of the solution.

5. Conclusion

1. Biolux and Mondial 6 are the most color stable type of acrylic teeth regardless of discoloring agents .
2. Lighter shade is showing less color stability than darker shades.
3. The incisal edge has less color stability than middle and cervical third.
4. Natural soap is denture cleaner which cause the least color change effect on acrylic teeth.
5. Palaseal and Optiglaze sealant agents provided more color stable denture tooth surfaces than the conventional polishing technique.

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