Influence of Different Coloured Solutions on Some Plastics used for Prosthetic Restoration Materials

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The purpose of this study was to evaluate colour changes of aesthetic fixed prosthetic restoration materials, when these materials are exposed to a drink rich in colorants, in this case, cola, coffee and red wine. For the study were required 18 fixed partial dentures: 6 integral polymeric dentures, 6 metal-polymeric dentures and 6 metal-ceramic dentures. To verify the colour there were used: VITA EASYSHADE spectrophotometer and the VITA shade for ceramic restorations. Following the results obtained, it was concluded that prosthetic composite resin changes quickly their colour, compared to the ceramic. Also, the liquid that affect the most in changing the colour of this material is coffee.

Keywords: composite resin, colour change, aesthetic restorative materials

At present aesthetic dentistry passes through modifications and improvements that have a tendency to an efficient development of techniques and materials to fulfill the patients requirements, which in turn, in addition to effective therapeutic treatments are looking for an as natural as possible aesthetic aspect.

One of these materials is represented by composite resins, because it shows similar properties with those of the natural teeth [1].

However, in spite of surprisingly good results which can be obtained after such restorations, if was noticed that the lifetime of a acrylate or polymeric dental crowns are much less, compared with a ceramic dental crown, for example. The colour stability represents one of the most important factors for the selection of composite resin materials in aesthetic restorations. The success and the failure of such prosthetic restorations depend on the colour stability and its changes, their evaluation resulting to improvement thereafter the chemical structure leading to improvements in the dental field of aesthetics [2]. The colour modifications might be caused by intrinsic factors namely the quality of the resin matrix, photoinitiators as well as anorganic filling material [3-4]. Change of colour is mainly due to extrinsic absorption of colorants existing in food and drinks. The result of interactions between the external colorants and resin composite material components resulting in damage of colour[5]. There are numerous studies in vitro, which demonstrated that the common drinks like coffee, red wine [6-9] or cola drinks [10-12] may cause visible alteration in the colour of composite resins surfaces.

This fact is mainly due to the porosity of these materials results in losing the original properties, among the effects are found: the halitosis, changing the colour to these contributing the lack of corresponding oral hygiene. Through vigorous hygiene procedures can be removed colorants absorbed on the surface of the material, instead, colorants absorbed in the deep matrix of the material most of the time requires the replacement of the fixed prosthetic restoration.

The lack of the porosity of ceramics and its biocompatibility with the oral environment represented the main reason for which this kind of prosthetic construct has been chosen as being the term of comparison in the idea that studies have shown that ceramic prosthetic restorations have the ability to maintain the original colour a longer time.

Experimental part

Materials and methods

For this study were needed 18 fixed prosthetic restorations: 6 integral polymeric partial prosthesis, 6metal-polymeric fixed partial prosthesis and 6metal-ceramic fixed partial prosthesis. There have been also used, six receptacles: two filled with red wine, two with coffee and other two with cola drinks. In each of the six receptacles were immersed: an integral polymeric fixed partial prosthesis, a fixed partial metal-ceramic prosthesis and a fixed partial metal-polymeric prosthesis. The six receptacles have been divided into two categories: three receptacles, with each of the three drinks, in which no thermic factor has occurred and the other three receptacles in which the intervened and thermic factor.

The three sets of tests in which did not interfere the thermic factor were left for 90 days at a constant temperature of 37°C, receptacles liquids being changed every day.

In the other three receptacles, in which thermal factor intervened, the samples were moved constant, every 10 minutes at a temperature of 50°C at temperatures of -18° C, two hours per day for the same number of days, in order to simulate an usual masticatory habit.

A very important aspect was that before immersion in solutions, all 18 restorations have been checked their colour by using a spectrophotometer,*VITA EASYSHADE* (fig.1).

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Fig.1. Spectrophotometer*VITA EASYSHADE* used to determine the key colour of the prosthetic restorations focused on three points of interest (cervical, middle and incisal area)

Fig.2. Quality assessment between the prosthesis before and after immersion in the considered liquids with the influence of the temperature factor

Fig.3. Quality assessment between the prosthesis before and after immersion in the considered liquids without the influence of the temperature factor

In order to validate the results obtained with this apparatus there were also used the *VITA classical A1-D4* colour keys.

The novelty brought, compared with other similar studies was that in this study there has been evaluated three distinct areas of the future prosthetic restoration: third cervical, the middle third and the incisal third, in the idea of determining the most accurate measurements of colour of the materials used in these restorations.

At the end of the time period in which the prosthetic constructs were kept into solutions, it was rechecked the colour by using the same materials and methods.

Results and discussions

After performing the final measurements, it was noticed that there have been changes in the colour of all three types of prosthetics, in the metal-ceramic prosthesis were the lowest changes.

Also there has been observed that in the case of the samples in which the temperature was constant (fig.3) the effects were less than harmful, compared to those in which there has been a fluctuation in temperature (fig.2).

In table 1 and 2 there were presented the exact values of the initial colour of the prosthetics involved in the study. In table 1 is presented a table with initial values of the samples to come to be immersed in drinks that shall be subject to the thermic factor, while in table 2 is a table with sample color values to be immersed in drinks which will not be influenced by the thermic factor, being kept at a constant temperature of 37° C, human's body temperature. In table 3 are shown in a table determinations of the color samples after the period in which they were immersed in the liquids with temperature variations. In table 4 is also presented a table in which the color values are presented after the period in which the samples were immersed in liquids with temperature variations.

For each set of samples has been used a single type of drink, while in reality, every day, in an oral environment a variety of dietetic colorants can interact dynamically with the composite resin restorations. The purpose of this study is, in addition to verify what type of prosthetic changes its colour, and to verify which of the three kind of drinks occurs mostly in colour change. Moreover, several studies took into consideration the thermal stress and *p*H of the medium

		Cola drinks	Coffee	Red wine
Integral polymeric prosthesis	1/3 cervical	A4	A4	A4
	1/3 medial	A4	B4	A4
	1/3 incisal	EN4	EN2	EN4
Metal-polymeric prosthesis	1/3 cervical	C2	A4	A4
	1/3 medial	D2	A4	A4
	1/3 incisal	EN2	EN4	EN2
Metal-ceramic prosthesis	1/3 cervical	A3	B4	A3.5
	1/3 medial	A3	B4	A3
	1/3 incisal	EN2	EN2	EN2

Table 1
THE COLOUR OF THE FIXED PARTIAL DENTURE BEFORE IMMERSION IN A SPECIFIC KIND OF DRINK

		Cola drinks	Coffee	Red wine
Integral polymeric prosthesis	1/3 cervical	C3	C3	C3
	1/3 medial	C3	C3	C4
	1/3 incisal	EN2	EN2	EN2
Metal-polymeric prosthesis	1/3 cervical	A4	A4	C4
	1/3 medial	A4	A4	A4
	1/3 incisal	EN3	EN4	EN2
Metal-ceramic prosthesis	1/3 cervical	A2	A3	A3.5
	1/3 medial	A2	A2	A3
	1/3 incisal	EN2	EN2	EN2

Table 2
THE COLOUR OF THE FIXED PARTIAL DENTURE BEFORE IMMERSION IN A SPECIFIC KIND OF DRINK

		Cola drinks	Coffee	Red wine
Integral polymeric prosthesis	1/3 cervical	A4	C4	C4
	1/3 medial	C4	C4	C4
	1/3 incisal	EN2	EN2	EN2
	1/3 cervical	C2	C4	C4
Metal-polymeric prosthesis	1/3 medial	C2	C4	C4
	1/3 incisal	EN4	EN2	EN2
	1/3 cervical	A3.5	B4	A3.5
Metal-ceramic prosthesis	1/3 medial	C3	A4	A3
	1/3 incisal	EN4	EN2	EN2

Table 3
THE COLOUR OF THE FIXED PARTIAL PROSTHESIS AFTER IMMERSION IN A SPECIFIC KIND OF DRINK CONSIDERING THE TEMPERATURE FACTOR

		Cola drinks	Coffee	Red wine
Integral polymeric prosthesis	1/3 cervical	C3	C4	C4
	1/3 medial	C3	C4	C4
	1/3 incisal	EN2	EN2	EN2
	1/3 cervical	A4	C4	C4
Metal-polymeric prosthesis	1/3 medial	A4	C4	C4
	1/3 incisal	EN3	EN2	EN2
	1/3 cervical	D3	A3.5	C4
Metal-ceramic prosthesis	1/3 medial	C3	A3.5	C4
	1/3 incisal	EN2	EN2	EN3

Table 4
THE COLOUR OF THE FIXED PARTIAL PROSTHESIS AFTER IMMERSION IN A SPECIFIC KIND OF DRINK WITHOUT CONSIDERING THE TEMPERATURE FACTOR

in oral cavity during the use of drinks and foods with high content of colour. Both the thermal stress as well as variations in *p*H can affect the structural integrity of the composite resin materials on the surface and result in sensitization staining by restorations and thereby discolouration. These two factors must be taken into consideration, because they can affect more or less structured materials present in the oral cavity.

Thus, analyzing these tables it was concluded that the temperature at which these samples were kept influenced the results. Metal-eramic prosthesis were the only ones, in spite of all the factors involved that suffered minor modifications. Regarding prosthesis composite resin, we observed that both prosthesis (fixed partial polymeric prosthesis and the integral metal-polymer prosthesis) have undergone drastic color changes. It is also worth mentioning that the fluid with the lowest influence on aesthetic restorative materials was represented by cola drinks, the opposite hovering coffee with results very close to those of red wine.

Conclusions

With these results it can be concluded, that the material which has been used for the aesthetic part in the prosthetic constructs is extremely important. After finishing the experiments it was observed that the composite resin materials showed a state of changing colour, when it was put in contact with liquids with a high concentration of colorants as cola drinks, coffee or red wine. It was also showed that the type of drink was very important in determining the type of aesthetic restoration materials which is most exposed to colour in contact with different colorants. It was determinated, that coffee is the most important agent in colouring the resin composite materials and cola drinks as being on the opposite site.

Acknowledgement: "This paper was published under the frame of European Social Found, Human Resources Development Operational Programme 2007-2013, project no. POSDRU/159/1.5/S/136893."

References

1. LUCE MS, CAMPBELL CE. Stain potential of four microfilled composites. J Prosteth Dent. 1988;60:151-4
2. DEMIRCI M, YILDIZ E, UYSAL O. Comparative clinical evaluation of different treatment approaches using a microfilled resin composite and a compomer in Class III cavities: two-year results. Operative Dentistry 2008;33:7–14
3. SCHULZE KA, MARSHALL SJ, GANSKY SA, MARSHALL GW. Color stability and hardness in dental composites after accelerated aging. Dental Materials 2003;19:612–9.
4. CELIK EU, ALADAG A, TURKUN LS, YILMAZ G. Color changes of dental resin composites before and after polymerization and storage in water. Journal of Esthetic & Restorative Dentistry Official Publication of the American Academy of Esthetic Dentistry 2011;23:179–88.
5. Y.F. REN, L. FENG, D. SERBAN, H. S. MALMSTROM. Effects of common beverage colorants on color stability of dental composite resins: The utility of a thermocycling stain challenge model in vitro. Journal of dentistry 40s (2012) e48–e56.
6. STOBER T, GILDE H, LENZ P. Color stability of highly filled composite resin materials for facings. Dental Materials2001;17:87–94.
7. GULER AU, YILMAZ F, KULUNK T, GULER E, KURT S. Effects of different drinks on stainability of resin composite provisional restorative materials. Journal of Prosthetic Dentistry 2005;94:118–24.
8.. FUJITA M, KAWAKAMI S, NODA M, SANO H. Color change of newly developed esthetic restorative material immersed in food-simulating solutions. Dental Materials Journal 2006;25:352–9.
9. ASHCROFT AT, COX TF, JOINER A, LAUCELLO M, PHILPOTTS CJ, SPRADBERY PS, et al. Evaluation of a new silica whitening toothpaste containing blue covarine on the colour of anterior restoration materials in vitro. Journal of Dentistry 2008;36(Suppl. 1(0)):26–31.
10. MOHAN M, SHEY Z, VAIDYANATHAN J, VAIDYANATHAN TK, MUNISAMY S, JANAL M. Color changes of restorative materials exposed in vitro to cola beverage. Pediatric Dentistry 2008;30:309–16.
11. DOMINGOSPADS. GARCIA PPNS, OLIVEIRA ALBMD. PALMA-DIBB RG. Composite resin color stability: influence of light sources and immersion media. Journal of Applied Oral Science 2011;19:204–11.
12. BAGHERI R, BURROW MF, TYAS M. Influence of food-simulating solutions and surface finish on susceptibility to staining of aesthetic restorative materials. Journal of Dentistry 2005;33:389–98

Manuscript received: 19.06.2014