COLOR VARIATION ASSESSMENT OF ESTHETIC BRACES

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ABSTRACT

Orthodontics is nowadays a friend to adults, just as much as it is to children. Adults are interested in orthodontic corrections but they also have a keen interest in their aspect during treatment. Esthetic braces are frequently used by adults, but few patients are properly informed in respect to the color changes that may occur to the braces during treatment. In order to better inform our patients, and to explain the disadvantages of different types of esthetic braces on the market, we have conducted a comparative study between three producers. The braces were exposed to different food dyes, for various periods of time- (from 24 to 144 hours) and their color variation was analyzed with a spectrophotometer. Results show that esthetic braces suffer color alteration regardless of the producer, with little variation related to the food dye investigated.

Keywords: aesthetic brackets, color alterations, food dyes, orthodontic

INTRODUCTION

Orthodontic treatment hasn't been a children exclusive treatment for a very long time. It has become elective for numerous adult patients who need it for facial improvement but also for solving issues determined by postponed dental treatments. The results of orthodontic treatment are a purpose for the patients but the physiognomic costs associated during treatment have always been a problem, especially for the patients who are in positions were the aspect is of high importance. Attempting to neutralize the negative visual effect of metallic braces, different types of esthetic braces have appeared.

Plastic braces that have appeared in 1969 [1] presented several problems related to poor torque control [2,3], structural fragility and excessive wear [4,2], reduced adhesion [5], increased wire friction [6], major chromatic instability [7] and structural deformation [8]. Then, their structure has been improved through glass fiber insertions or ceramic particle inclusions in the plastic matrix, producing hence composite braces [3].

In 1986, in order to eliminate the problems associated with the polymeric composition ceramic braces have appeared, in their two forms- polycrystalline and monocrystalline [9].

Two types of color alterations can affect these types of braces- intrinsic and extrinsic. Intrinsic coloration are generated by water absorption, incomplete polymerization of the adhesive resins, bracket matrix composition, the content and the size of the ramforsation particles [10-12], whereas extrinsic color

alteration is generated by the contact with different food dyes. The most frequent food dyes encountered are high caffeine containing products (coffee, tea, coke), mouth water colorants, colored saliva [13], nicotine [14], lipsticks [15,12], heat [7], duration and intensity of polymerization [16]. Dependant on the type of bracket used, on the producer and on the material it is made of, variation will be significant.

When choosing esthetic braces patients expect the same aspect all throughout treatment. It is important therefore to be aware of the aging effect of the bracket in order to be able to express a competent point of view in relation to the long time esthetic braces chromatic stability. Numerous studies developed so far have identified unanimously, color variation in esthetic braces, which is a good reason to try to identify on the local market which product best satisfies patient's physiognomic exigencies.

The purpose of this study was to evaluate color variation of esthetic braces after immersing them in potentially color altering solutions.

MATERIAL AND METHODS

The ideal study design that would best identify esthetic bracket color variation would be a randomized controlled trial. Such a structure is difficult to be obtained in vivo, for numerous reasons. That is why, we have chosen an experimental, control group, in vitro study.

The methodology we have chosen for this study consisted in selecting three types of brackets form three producers- SIA Italy, with the ceramic braces made of pure polycrystalline alumina oxide, produced through CIM(injection molding ceramic), at 1800°C. The second producer is Opal Orthodontics, with their ceramic braces-alumina oxide Avex CX, and the third producer is Lancer Orthodontics, with their polycrystalline ceramic braces. The selected braces were exposed to possible color variation through their immersion in various food dyes.

For each of the braces type we have constituted four groups. One group has been exposed to coffee, a second group was exposed to black tea, a third group was exposed to Coca Cola and the forth group is the control group, where braces are immersed in distillated water. 12 groups have resulted, and they were then chromatically analyzed with a spectrophotometer.

We have examined upper central left and right incisor braces, MBT prescription with a 0,22 slot.

Each of the groups was analyzed at baseline and the follow-ups were at 24h exposure time, 72 hours and 144 hours exposure time.

Braces were stored in transparent polypropylene recipients. The solutions were changed every 12 hours in order to avoid bacterial colonization since it can have a cromogenous effect that might alter the results. The braces were immersed suspended in the colorants to avoid solution precipitation on the bracket. Every six hours the solutions were stirred to avoid the same effect. We have tried in this manner to limit uneven color alteration that might generate errors.

Before analyzing the braces with the spectrophotometer each was washed for 20 seconds with clear water to remove excess coloring from their surface.

For color evaluation we have used the Thermo Helios Epsilon spectrophotometer, which was available in the Biophysics laboratory of the Biophysics Department in the Carol Davila University.

Before analyzing the braces in the study groups, the spectrophotometer was initially calibrated for the same type of bracket. This step was necessary in order to establish the wave length to be used and to establish the

position of the bracket, for us to obtain similar results at each measurement, without allowing the position of the bracket to influence the measured values.

In order to place the braces for each measurement in the same position we have built a frame that has helped us to reproduce the same position every time. This way, braces positioning has little influence in generating errors.

Color alteration has been evaluated at different wave lengths- from 400nm to 600nm, respectively 480nm, 510nm, 540nm, 570nm, 600nm. Absorption was evaluated every time for a different color.

For data registration we have used an electronic archive which has been than used for assessing color variation and color modifying direction stability, in relation to the type of dye used and in relation to the type of bracket used. The same archive has also registered loses that have occurred through the study, due to either bracket deterioration or unexpected solution alterations.

For data analysis, Friedman tests were used in order to appreciate the difference between 24h, 3 days and 6 days and Wicoxon test for assessing the difference between two measurements. The threshold of statistical significance was established at $p<0,05$.

RESULTS

Following preliminary data analysis of the results generated by the spectrophotometric evaluation, we have selected the values obtained for the 540nm wavelength – as the one which has generated maximum absorption.

For the SIA brackets we have registered good color stability on the 6 day follow-up when analyzing the immersion in tea and coffee, and a lower color stability – with more coloration following the immersion in Coca Cola, which has had a cumulative effect (Fig. 1). No statistically significant differences of color absorption were noticed, for either one of the evaluated solutions (Table 1).

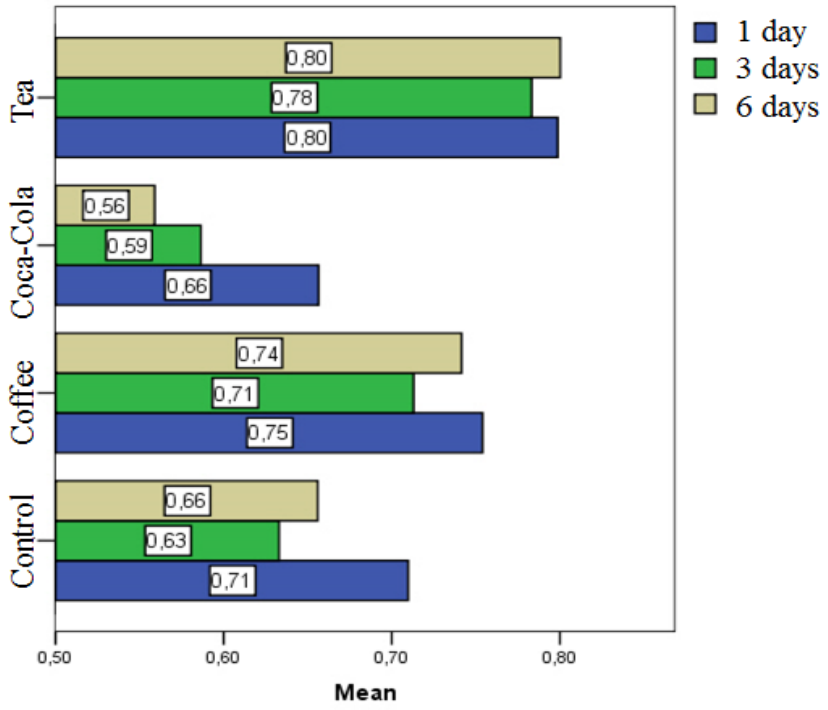

Figure 1. Average values of absorption for SIA brackets at 1, 3 and 6 days

Table 1. Threshold values of statistical significance (p) when analyzing compared SIA brackets absorption at 1, 3, 6 days

	1-3-6 days	1-3 days	3-6 days	1-6 days
Control	1,00	0,46	1,00	0,71
Coffee	1,00	0,46	0,46	0,71
Coca-Cola	0,22	0,18	0,18	0,18
Tea	1,00	0,46	0,14	0,46

Opal brackets have had better color stability in comparison to the other brackets evaluated. Absorption has had relatively uniform values, with lower amplitude alterations (Fig. 2). For this type of bracket the most significant alterations were observed following coffee immersion. The cumulative effect of the coloring agent has also been noticed, with progressive absorption modification, in the same direction, but with a lower value variation. No significant statistical difference of absorption in time has been observed, but for all the food dyes analyzed the values observed in days 1 and 6 were close to the statistically significant threshold. This aspect has also been identified for coffee, for the day 3 and 6 measurements (Table 2). We can say that overall these brackets have had a more predictable behavior when immersed in coloring agents.

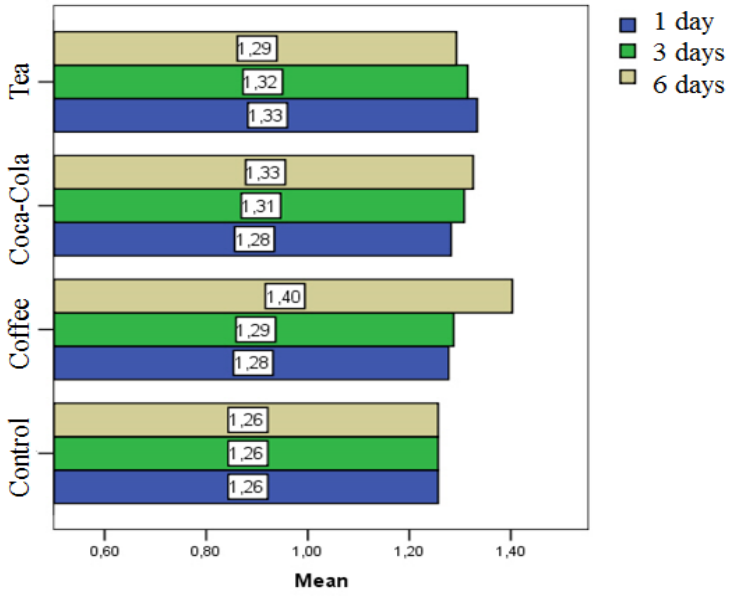

Figure 2. Average values of absorption for Opal brackets at 1, 3 and 6 days

Table 2. Threshold values of statistical significance (p) when analyzing compared Opal brackets absorption at 1, 3, 6 days

	1-3-6 days	1-3 days	3-6 days	1-6 days
Control	1,00	1,00	1,00	1,00
Coffee	0,05	0,46	0,06	0,06
Coca-Cola	0,10	0,35	0,14	0,06
Tea	0,24	0,71	0,28	0,06

Lancer brackets, resembling SIA brackets have registered uneven absorption values in time, with the highest variation when immersing in coca cola and coffee, high

amplitude differences have been identified especially in the 3-6 days period (Fig. 3). In coffee immersion analysis statistically significant values were registered between the measurements repeated at 1, 3 and 6 days (p=0.02), with values very close to the statistically significant threshold in peer analysis for two time moments. P-values close to the statistically significant threshold were also observed for Coca Cola immersion (Table 3).

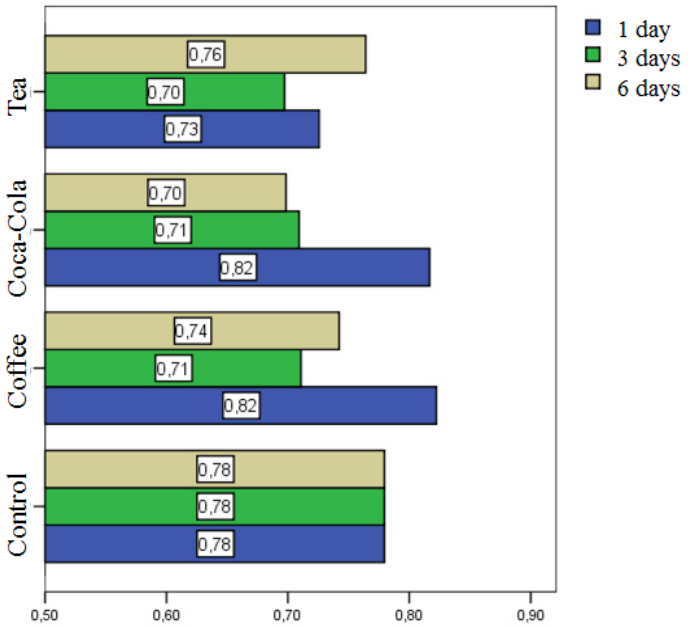

Figure 3. Average values of absorption for Lancer brackets at 1, 3 and 6 days

Table 3. Threshold values of statistical significance (p) when analyzing compared Lancer brackets absorption at 1, 3, 6 days

	1-3-6days	**1-3 days**	**3-6 days**	**1-6 days**
Control	1,00	1,00	1,00	1,00
Coffee	0,02*	0,06	0,06	0,06
Coca-Cola	0,05	0,06	0,70	0,06
Tea	0,17	0,46	0,06	0,71

DISCUSSION

The analysis operated based on spectrophotometry of absorption confirmed the fact that orthodontic brackets, once they are exposed to chromogenic food agents, are likely to get colored. Their structural particularities and production characteristics (different producers) have an impact on the effect magnitude and susceptibility level induced by a certain chromogenic agent. These results are backed by other experimental researches like the one conducted by Filho et al. He evaluated, using spectrophotometry, esthetic brackets made of ceramics and of plastic, and observed that once exposed to chromogenic agents and along with aging, major statistic color modifications occur among different commercial brands [17]. Akalcin et al. unveils that ceramic brackets prove to have a better resistance to chromogenic agents compared to those made of plastic [18]. Commercial plastic versions analyzed by Faltermeier et al. were, at the end of the

study, considered as inacceptable due to the magnitude of changes that appeared in time [19].

In this experimental study, the different commercial and structural variants of brackets have registered different levels of susceptibility to coloring agents- SIA to Coca Cola, Lancer to coffee and Opal to Coca Cola and coffee. This can be explained by the different chemical composition of the coloring agents, which more probably associate an interaction mechanism and have different effects on orthodontic brackets.

In respect to the particularities of orthodontic treatment, which has a long duration and is frequently provided to children and young people, for whom appearance is important, color alterations of the esthetic brackets can be associated with various dissatisfactions, that can have different outcomes. Therefore the possible color alterations of esthetic brackets should be referred to in relation to the patient in order to ensure optimal treatment evolution, and to keep a high level of patient satisfaction.

CONCLUSIONS

The positive outcomes in terms of aesthetics after using esthetic brackets are partially shadowed by the color modifications suffered by these elements in time. Brackets are sensitive to coloration as a result of exogenous food agents. The longer the exposure to the food pigment is, the more visible the color modification is.

The susceptibility of different esthetic brackets tested with various food pigments is diverse. In some cases, the coloration had a cumulative effect, with registered higher levels of light absorption. Spectrophotometry of absorption can be used for conducting an assessment of bracket quality and can serve as a means of imperfection identification that can be subsequently corrected. The working parameter standardization could thus facilitate these quality assessments of esthetic brackets.

In terms of treatment transparency, as a form of respect to patients, access to this kind of information should be granted-the possible variation in color that can occur to brackets during treatment and actions that can be undertaken in order to limit as much as possible these changes.

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