Assessment of Exogenous Pigmentation on Clear Elastomeric Modules: An *in vitro* Study

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ABSTRACT

Objective: To assess *in vitro* changes in the shade of clear elastomeric modules from different manufacturers influenced by exogeneous pigmentation contained in everyday dietary substances.

Materials & Method: The specimen comprised of clear elastomeric modules (Group A: Libral, Group B: TP Orthodontics) which were immersed in dietary substances: ketchup, coffee, tea, pepsi & methylene blue. Their hue, saturation and intensity were figured after 72 hours by methods of Adobe photoshop CS3 to mirror the module recoloring seriousness.

Result: Significant difference was found between two types of modules analyzed in this study. Ketchup and methylene blue demonstrated higher staining potential compared to other staining media. Besides, there was no significant difference in staining contrast between tea and Pepsi.

Conclusion: Ketchup and methylene blue are strong staining media, ought to be avoided by the patients opting for aesthetic orthodontic appliances. Elastomeric modules manufactured by different companies have differing staining potential.

Keywords: aesthetic, elastomeric modules, exogenous pigment

INTRODUCTION

The desire for stylish orthodontic appliances has expanded among adult orthodontic patients in orthodontic market. These arrangements incorporate the utilization of ceramic and tooth coloured brackets with clear elastomeric modules for wire ligation. One problem that associates with the use of elastomeric modules is staining due to daily consumption of various dietary substances.[1,2] While the ceramic sections are impervious to shading change, elastomerics are liable to staining by substances which have a greater potential for colouring, bringing about aesthetic issue.[3,4] Patients who look for imperceptibility of orthodontic appliances more often incline toward elastic modules that supplement the aesthetic appearance of ceramic and clear brackets. The staining characteristics of these modules prompt more continuous substitution of the modules by the clinicians with extension of follow-up visits and chairside time. Thus, selecting the most stain resistant modules becomes a priority for clinicians. The staining capability of these elastomeric modules, originate from chemical degradation and mechanical staining. At first, chemical degradation leads to staining of the modules followed by basic mechanical staining over the exposure time to the staining media.[4]

The evaluation of staining of elastomeric modules after presentation to dietary substances can be completed utilizing advanced instrumentation, for example, cameras or spectrophotometer.[1,3,5,6] These instruments fail to provide a information on staining and aesthetical assessment of elastomeric modules. The surface characteristics of the modules play a vital role in staining. The modules exhibiting a higher surface porosity is related to staining of these materials.[3] To additionally describe the exogenous shading modification of elastomeric modules affected by dietary foods and refreshments, this study attempted to evaluate the conceivable colour change of clear elastomeric ligatures as per the different types of food and beverage.

MATERIALS AND METHOD

Clear elastomeric modules from two orthodontic companies (Group A: Libral and Group B: TP

Orthodontics) were analyzed. Elastomeric modules of both manufacturing company were immersed in plastic holders containing dietary substances: ketchup, coffee, tea, Pepsi, methylene blue. These containers were kept for 72 hours and from that point onward, modules were removed, rinsed with two fold distilled water and dried. Their hue, saturation, intensity were analyzed. Advanced pictures were taken and computed utilizing commercial programming software Adobe Photoshop CS3. Statistical analysis was done using paired t-Test to compare the difference between the modules before staining and after staining. The level of significance was set at $p>0.05$.

RESULT

Results showed that both brands underwent significant staining when exposed to the dietary substances. The hue of Group A changed after dipping it in all the solutions, but *p*-value significantly changed with methylene blue ($p=0.034$). Saturation of Group A changed significantly with ketchup ($p=0.048$). Intensity of Group A changed with tea ($p=0.036$). The hue of Group B changed with tea ($p=0.036$) and methylene blue ($p=0.002$), saturation of Group B changed significantly with tea ($p=0.003$). Intensity of Group B changed with ketchup ($p=0.978$).

Table 1: Comparison of hue of Module A before staining and after staining in different solutions

Hue	N	Group 1 (Module A –before staining) (Mean ± SD)	Group 2 (Module A – after staining) (Mean ± SD)	Paired 't' test	*p*-Value
Ketchup	4	143.25 ± 26.87	24 ±5.45	28.65*	< 0.001**
Coffee	4	143.25 ± 26.87	28 ±9.54	24.13	< 0.001**
Tea	4	143.25 ± 26.87	53 ±15.37	18.76	< 0.001**
Pepsi	4	143.25 ± 26.87	71 ±16.34	15.29	< 0.001**
Methylene blue	4	143.25 ± 26.87	198 ±41.23	9.87	0.034*

***Highly significant, *Significant*

Table 2: Comparison of saturation of Module A before and after staining in different solutions

Saturation	N	Group 1 (Module A –before staining) (Mean ± SD)	Group 2 (Module A – after staining) (Mean ± SD)	Paired 't' test	*p*-Value
Ketchup	4	16.5 ± 3.89	24 ±5.45	4.87	0.048*
Coffee	4	16.5 ± 3.89	28 ±9.54	13.56	< 0.001**
Tea	4	16.5 ± 3.89	53 ±15.37	21.67	< 0.001**
Pepsi	4	16.5 ± 3.89	71 ±16.34	25.48	< 0.001**
Methylene blue	4	16.5 ± 3.89	198 ±41.23	38.91*	< 0.001**

Table 3: Comparison of intensity of Module A before and after staining in different solutions

Intensity	N	Group 1 (Module A –before staining) (Mean ± SD)	Group 2 (Module A – after staining) (Mean ± SD)	Paired 't' test	*p*-Value
Ketchup	4	58 ± 17.87	24 ±5.45	23.13	< 0.001**
Coffee	4	58 ± 17.87	28 ±9.54	18.96	< 0.001**
Tea	4	58 ± 17.87	53 ±15.37	5.67	0.036*
Pepsi	4	58 ± 17.87	71 ±16.34	9.47	< 0.001**
Methylene blue	4	58 ± 17.87	198 ±41.23	29.46*	< 0.001**

Table 4: Comparison of hue of Module B before and after staining in different solutions

Hue	N	Group 1 (Module B –before staining) (Mean ± SD)	Group 2 (Module B – after staining) (Mean ± SD)	Paired 't' test	*p*-Value
Ketchup	4	195.5 ± 46.87	44 ± 8.23	24.58*	< 0.001**
Coffee	4	195.5 ± 46.87	45 ±9.54	23.47	< 0.001**
Tea	4	195.5 ± 46.87	54 ±15.37	21.06	0.036*
Pepsi	4	195.5 ± 46.87	77 ± 17.89	17.36	< 0.001**
Methylene blue	4	195.5 ± 46.87	212 ± 32.12	5.89	0.002**

Table 5: Comparison of saturation of Module B before and after staining in different solutions

Saturation	N	Group 1 (Module B –before staining) (Mean ± SD)	Group 2 (Module B – after staining) (Mean ± SD)	Paired 't' test	*p*-Value
Ketchup	4	12.5 ± 2.52	32 ± 6.71	12.87	< 0.001**
Coffee	4	12.5 ± 2.52	47 ±5.34	19.34*	< 0.001**
Tea	4	12.5 ± 2.52	17 ±2.13	5.98	0.003**
Pepsi	4	12.5 ± 2.52	6.5 ±1.07	16.37	< 0.001**
Methylene blue	4	12.5 ± 2.52	44 ± 2.33	15.1	< 0.001**

Table 6: Comparison of intensity of Module B before and after staining in different solutions

Saturation	N	Group 1 (Module B –before staining) (Mean ± SD)	Group 2 (Module B – after staining) (Mean ± SD)	Paired 't' test	*p*-Value
Ketchup	4	72.75 ± 17.82	72 ± 7.82	0.845*	0.978
Coffee	4	72.75 ± 17.82	94 ± 11.43	8.91	0.0012**
Tea	4	72.75 ± 17.82	99 ± 14.56	14.76	< 0.001**
Pepsi	4	72.75 ± 17.82	99 ± 12.45	14.76	< 0.001**
Methylene blue	4	72.75 ± 17.82	46 ± 7.23	11.32	0.001**

DISCUSSION

Assessment of staining properties of elastomeric modules is of utmost importance to the orthodontists. It gives a chance to choose among the materials accessible with certainty, that can help serve better to their patient longing for tasteful arrangements. In addition, the orthodontist would give certain recommendations and better instruction toward the food and drinks to be minimize the staining of the modules during their treatment. Immersion of the food substance for Seventy-two hour is adequate to simulate the clinical interruption and exposure of the elatomeric modules to staining diet substances during the 3 weeks appointment interval.[5,8] The hue, saturation & intensity of group A changed significantly after staining with methylene blue. Hue changed significantly with methylene blue in group B, saturation & intensity changed with coffee & tea. In view of these findings, it is prescribed that orthodontists should advice patients, who opt for the esthetic solutions for their appliances, to limit or maintain a strategic distance from coffee and tea drinking amid treatment.[9] The differences in the clinical optical behaviour among different commercial companies could be related to the manufacturing process of these modules that will lead to different surface porosities and topographical characteristics of elastomeric modules.[5]

After evaluating both the brands of aesthetic elastomeric modules, both of them showed significant staining which appeared to be more pronounced in TP orthodontic modules than Libral.

CONCLUSION

Methylene blue and coffee are strong staining media that should be avoided by patients who opt to have aesthetic appliances for orthodontic treatment. Ketchup has significantly higher staining potential. Elastomeric modules manufactured by different companies have various staining optical properties, which could be related to manufacturing processing of the materials.

OJN

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