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Comparison of the Optical Properties between Different Esthetic Conventional & Self-Ligating Brackets Using Spectrophotometer

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Abstract

Background: Orthodontic patients, including the growing adult population, not only want an improved smile, but they also demand better aesthetics during treatment. Thus the aim of the study is to compare the optical properties namely color, translucence and fluorescence between different esthetic brackets using the spectrophotometer.

Methods: 50 esthetic brackets of 10 types were tested. The color and translucency of the brackets, as well as color of the maxillary premolars of 25 subjects, were measured with spectrophotometers. The fluorescence of the brackets was determined by duly calibrated appraisers. The color difference between the brands of brackets and teeth were determined. Data were analyzed by using Scheffe multiple comparison test.

Result: The highest color difference was found in Radiance Plus. On intergroup comparison, it was revealed that there was no statistical difference between the groups (P>0.05). Among the translucent brackets, Radiance plus showed the highest transmittance of 38.5%.Among the non-translucent brackets, Elegance had a high transmittance of 30.4%. All the brackets when tested showed no fluorescence, but after bonding to the translucent brackets, they showed different behavior from the non-translucent brackets in the visual perception of the teeth.

Conclusion: There was no major color difference between self-ligating ceramic, conventional ceramic and polycarbonate brackets but they had a reduced percentage of light transmittance due to the presence of metal clips. Fluorescence of the self-ligating brackets was affected due to the presence of the metal door/ clips.

Keywords: Esthetic brackets, color, translucency, Fluorescence.

Introduction

The number of adults seeking orthodontic care has considerably increased in the recent years due to which orthodontists have felt the need to provide their patients with more esthetically "appealing" appliances [1]. In the early 1970's plastic brackets made of polycarbonate were introduced [2].

In the mid-1980s, ceramic brackets were manufactured to meet the increasing demand for better aesthetics [3, 4]. Ceramic brackets can be of two types: monocrystalline

ceramic brackets are translucent due to the fact that they are made out of a single crystal that allows light rays to pass; whereas polycrystalline brackets are not translucent because boundaries between the crystals act as sites for imperfections and impurities incorporated during the manufacturing process, thereby hindering passage of light [4, 5].

Self-ligating bracket systems displayed a significantly lower level of frictional resistance [6], dramatically less chair-side time for arch wire removal and insertion, and promoted better maintenance of oral hygiene [7, 8].

Ceramic self-ligating brackets are supposed to satisfy both the esthetic demand and possess technical superiority over conventional brackets. However, because of the doors, slides or clips that can be a part of a self-ligating bracket, their use as a completely esthetic appliance remains to be justified.

Previous studies have assessed the optical properties of conventional ceramic & composite brackets [9], but none of the studies have assessed those of ceramic self-ligating brackets. Therefore, the purpose of the study was to evaluate and compare the optical properties namely color, translucency and fluorescence between various composite, conventional ceramic and ceramic self-ligating brackets.

Materials and Methods

A total of 50 maxillary right premolar brackets (slot size, 0.022-in MBT prescription) of 10 commercial brands were obtained. The list of materials used in the study with their code, brand and description are tabulated in table1.

Sample Size Determination

For sample size determination power analysis was done [table 2] using ‘n master software’ with alpha error 5, power of 80% and sample mean 18.6, the sample size was arrived at 5 per group for 10 groups.

After obtaining clearance from the ethical committee, maxillary right and left premolars of 25 patients, which were indicated for extraction for orthodontic purpose, were used in the study.

Inclusion criteria

1. no racial or social ethnic group discrimination
2. healthy permanent premolars (no cavities, fillings, root canal treatments, or patches of decalcification or pigmentation),
3. No history of tooth bleaching or whitening undergone for the past 6 months.

Exclusion criteria

1. Patient with the previous history of orthodontic treatment.
2. Patient with smoking and alcohol drinking habit, pan chewing.

Color

Digital portable spectrophotometer [23], Easy shade Compact (Vita Easy Shade Advance 4.0) was used to assess the color through a digital readout of the coordinates on the labial surface of the brackets and color is calculated using the formula

Chroma = L*a*b* [12]

Where L* indicates the lightness coordinate of the object (black to white),

a*(green to red) and

b*(blue to yellow) indicates the chromaticity coordinates, showing the three-dimensional position of the object in the color space and its direction [19].

Measurement of the Color of Non-Translucent Bracket

Non-translucent brackets don’t let the light to pass through, so the color was measured separately for the bracket and patient’s tooth. Patient’s tooth color was used as a standard and the difference between them was calculated as the Color change [10] (ΔE*) using the equation $\Delta E = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$

To avoid the interference of the background, brackets were placed on a mirror for measuring the color. To

exclude any environmental factors, a black opaque cardboard mask with a central window the size of the bracket was used [5]. The Spectrophotometer was positioned perpendicular to the bracket under the same luminosity [fig1]. The value obtained for each specimen (L * a * b *) was the mean of these measures. Thus 25 measurements were made for one bracket.

Color of Maxillary Premolar Tooth Measured In-Vivo

To assess the esthetic performance of the non-translucent bracket, an intact tooth color was used as a standard. All measurements were performed by one operator under the same light and a standardized protocol was followed [13]. Before evaluation, the teeth were subjected to prophylaxis with pumice & water and were lightly dried with a paper towel before taking the readouts. Immediately after the cleaning and drying procedure, the color of the teeth was measured using the spectrophotometer [fig 2]. Three measurements of each tooth were taken in the middle third region of the labial surface, without removing the spectrophotometer from its place, so that there would be no chance for drying and change in color.

After measuring the color of the intact tooth and the non-translucent brackets, the color difference (DE) [10] between the means was calculated using the above mentioned equation.

Measurement of Color of Translucent Brackets

Perceiving the color of translucent brackets is not possible, so the brackets were bonded to an extracted tooth to measure the same. Color coordinates were measured by the Spectrophotometer on extracted tooth five times before and five times after being bonded (Trans bond XT; 3M Unitek) with translucent brackets. After this, the color difference (ΔE*) was calculated by using the same equation.

Translucency of Brackets

Translucency can be measured as the percentage of light transmitted through the bracket. A spectrophotometer with DRS (Diffuse Reflectance Spectrometry) working under ultraviolet and visible light bands was used to evaluate the reflectance of the brackets [fig3]. The transmittance was calculated using the formula: T%=100- R Where R is reflectance. The sample was illuminated and the reflected light from the sample was collected to form spatially resolved reflectance spectra. The probe was initially standardized by checking the percentage of reflectance over a white background. The analysis of the direct transmission of the brackets was performed 3 times and a mean value was obtained at a wavelength of 400 to 700 nm, corresponding to the wavelength of visible light.

Fluorescence

Fluorescence of the brackets was evaluated by two examiners and it was noted as “yes” for fluorescing and “no” for non-fluorescing brackets. Fluorescence of the maxillary premolar extracted for orthodontic reasons was used as a reference. This procedure was performed in a completely dark room. The brackets were exposed to a UV light at a distance of 30 cm. The procedure was repeated after bonding the brackets to the extracted premolar tooth [fig 4].

Statistical Analysis

Statistical differences were investigated by using 1-way analysis of variance (ANOVA) with a level of significance of $P < 0.05$ for a parametric data. Kruskal Wallis test was used for non-parametric data. Intergroup comparison was done using Scheffe multiple comparison test (post hoc).

Results

Color

Among the non-translucent brackets, Elegance had the highest mean color difference while lowest was for Gemini Clear brackets [table 3]. Since the data were

normally distributed, ANOVA was done [table 4]. On intergroup comparison, Gemini clear brackets showed statistically less color difference when compared to all other brands of non-translucent brackets [table 5].

The mean color value of the extracted premolar before bonding was L: 80.222, a: 2.37 and b: 32.743 [chart 1] while for the extracted premolar after bonding with translucent brackets was L: 62.8828, a: 2.7852 and b: 7.583. The mean color differences for translucent brackets were tabulated in table 3. Since the data were not normally distributed, non-parametric KRUSKAL-WALLIS TEST was used to assess the statistical difference [table 6]. The highest color difference was found in Radiance Plus followed by QuicKlear while least in Inspire Ice. On intergroup comparison, there was no statistical difference between the groups (P>0.05) [table 7].

Translucency

The 1-way analysis of variance (ANOVA) was used to assess the statistical difference in the transmittance of the brackets with the level of significance P<0.05 [table 8, 10]. Among translucent brackets, Radiance plus showed the highest transmittance of 38.5%. Among non-translucent brackets, Elegance had high transmittance of 30.4% while least was in Envision brackets with 10.4% [Chart 2].On intergroup comparison between the translucent brackets, there was a significant difference in all 3 brands [table 9]. The translucency of non-translucent brackets were compared using Scheffe multiple comparison test which revealed that there was no statistical difference between translucency of Clarity Advance, Clarity SL and Virage brackets except for Elegance [table 11].

Fluorescence

The translucent brackets fluoresced in dark i.e. there was no color difference between the tooth and the bracket bonded whereas none of the non-translucent brackets fluoresced [fig 4]. The statistical difference between two groups was determined using McNemar's test. The two-tailed P value equals 0.023. This difference is considered to be statistically significant. Chi-squared equals 5.118 with 1 degree of freedom [table 12]. There was a significant difference between translucent and non-translucent brackets.

Discussion

Esthetics is the science of sensitive perception; in other words, the science of beauty. Adult orthodontics is a rapidly growing field and over the past two decades, there has been a noticeably increased demand for orthodontic treatment from adults[1].

Among the available appliances, ceramic is economical with less limitations when compared with Aligners/Lingual orthodontics. Some advantages of ceramic brackets like light reflection, biocompatibility, adequate mechanical strength encouraged their widespread use since 1980's [12].

Though the choice of ceramic brackets is innumerable in the market, the esthetic properties of these brackets both conventional and self-ligating brackets in daylight and darkness has not been investigated thoroughly. Therefore the aim of the study was to assess and compare the optical properties such as color, translucency and fluorescence between different esthetic brackets like plastic, ceramic brackets and ceramic self-ligating brackets.

The self-ligating brackets used in this study are QuicKlear, Empower and Clarity SL. QuicKlear brackets have ceramic slot with the locking clip which is made of metal. Likewise, the Empower bracket has a rhodium plated clip while the slot is ceramic. Of the above mentioned self-ligating brackets, Clarity SL brackets have metal slot which is designed such that the Nitinol self-ligating clips are attached to the mesial and distal side of the brackets.

The mean color coordinates of the non-translucent brackets were the following L* 57.2±9.9, a* 2.7±3.4 and b* 6.4±4.1 [chart 1] which was similar to the study conducted by Yong-Keun Lee [15] and Bin Yu et al [20]. When the color difference between natural tooth and non-translucent brackets was calculated and compared, it was found that the least color difference (ΔE) was for Gemini Clear 18.2±1.2 and the highest was for Elegance 40.9±2.8 [table 3]. In the translucent brackets, the least color difference was for Inspire Ice 21.1±7.4 [table 3].

But the color difference in our study does not correlate with the study conducted by Khashayar et al[17] and Wiegand et al [18] who have quoted that the perceptibility threshold for the color difference is ΔE*<3.7 which means that if ΔE is greater than 3.7, the bracket becomes perceptible. This can be explained by the variation in the tooth color between various racial groups [19] and not because of the brackets since the L*, a* and b* values of the brackets obtained in the study are similar when compared with the previous studies [13, 14, 15, 16, 20].

When the color difference of the non-translucent brackets was compared it was found that Gemini clear had a statistically lower color difference when compared with other brackets. In the intergroup comparison, Gemini clear had a significantly low difference when compared with all the other brackets. Similarly, Virage and Elegance had higher ΔE* values hence there was a significant difference when these two were compared with other brackets.

The mean color parameters of the extracted teeth were L*: 80.22, a*: 2.37 and b*: 32.7 but after bonding the translucent brackets the three parameters changed to L*: 73.8, a*: 3.02 and b*: 9.5. For the translucent brackets, the mean color difference value revealed that there was no significant difference between the three values. Post hoc test also reiterated that there was no statistically significant difference. In the translucent series, the least color difference was found in Inspire Ice 21.1±7.4 and the highest was for Radiance plus 37.3±7.8.

The color difference (ΔE) between the esthetic brackets and the tooth derived in this study was high when compared to the previous study done by Faltermeier et al [21], Seighi et al [22] and Da silva et al [23]. This could be attributed to various reasons. It is well known that there is a lot of variation in shades of the dentin in various racial groups [16]. This study was done in South Indian population. Hence this difference in tooth color inherent to various racial groups could be the reason for the huge difference in the color between human teeth and brackets.

When the translucent self-ligating bracket- QuicKlear was compared with other translucent brackets, there was no statistical color difference. When the non-translucent self-ligating brackets Clarity SL and Empower were compared with other conventional brackets they had a statistical color difference with Gemini Clear, Virage and Elegance while there was no difference with Clarity Advanced, and Envision brackets [table 5]. This shows that there is a negligible color difference between the Ceramic Conventional and self-ligating brackets.

Translucency was assessed using DRS spectrophotometer for all the brackets and measured as the percentage of light transmitted through the bracket. The highest percentage of light transmittance was found in Radiance Plus brackets 38.5±0.42 followed by Inspire Ice 37.5±0.34 and the least in Envision brackets 10.42±0.82 [chart 2]. There was a statistically significant difference in the percentage of transmittance of light in the translucent group.

For the non-translucent brackets, ANOVA revealed that there was a statistically significant difference in the percentage of transmission [table 10]. Among the non-translucent brackets, Elegance brackets had the highest percentage of light transmission followed by Empower brackets. In the post hoc test in non-translucent series,

Gemini clear brackets were statistically different with all other non-translucent brackets because of its low percentage of light transmission. On contrary elegance and empower had a statistically significant difference with all the other brackets because it had the highest percentage of transmission.

These results in the percentage of translucency correlate well with other studies by Eliades et al [24], Filho et al [9] and Yong Keun Lee [15]. In the study by Yong lee [15], it was found that Inspire ice had the greatest transmittance whereas in the study by Filho et al [9] Radiance plus of the translucent series had the greatest value which correlated with the present study. In the study by Eliades et al [24], starfire brackets of the translucent series had the greatest translucency. Hence all the studies [9], [24] and [15] indicated that the monocrystalline brackets had the better percentage of light transmission than polycrystalline brackets as is evidenced in the present study.

The translucency of translucent ceramic self-ligating bracket- QuicKlear on comparison with other monocrystalline brackets revealed that it had the least transmittance of 15.3% which was statistically significant. When the same comparison was done in polycrystalline brackets, Clarity SL brackets had significant difference only with Gemini Clear, Elegance while Empower bracket had a statistical difference with all other polycrystalline brackets because it had the higher transmittance than Clarity SL.

A substance which has the capacity to absorb non-visible light (UV light) and re-emit as visible light with greater wavelength is said to have Fluorescence. Natural teeth fluoresce and emit a blue light in the dark under UV light [25, 11]. Translucent brackets emitted fluorescence when tested both before and after bonding to extracted tooth whereas non-translucent bracket did not exhibit the same behavior. Instead, they appeared greyish to black in color. This indicated that translucent brackets allowed the fluorescence of natural tooth to pass through, while non-translucent series does not allow the fluorescence of the tooth to pass through. This property of non-translucent brackets would be unaesthetic in the dark.

Since the data was categorical i.e. Yes or No, McNemar test was done to find the marginal homogeneity which revealed that translucent and non-translucent series brackets had a statistical difference in fluorescence before and after being bonded to an extracted tooth [table 12].

When fluorescence was evaluated for ceramic self-ligating brackets, they displayed a black discoloration in regions where metal was present. Despite the fact that self-ligating brackets are more effective clinically, the absence of fluorescing property and presence of metal clips or door makes them unaesthetic under UV light/ dark [fig 4].

The color difference of plastic brackets was statistically different from other ceramic brackets and this finding is in agreement with the study conducted by Bin Yu et al [20]. The percentage of transmittance was least for Envision brackets with 10.42 [chart 2] which is comparable with the study done by Eliades et al [24]. This reveals that Polycarbonate brackets have color difference close to polycrystalline brackets but the percentage of transmittance is decreased when compared with other polycrystalline brackets. When these brackets were evaluated for fluorescence, it was found that they lack fluorescing property before bonding and after bonding to extracted tooth. Added to this, the presence of metal slot in Elegance bracket gave a blackish discoloration which was unpleasant.

Undoubtedly translucent brackets are always a better choice over non-translucent brackets under UV light. But the advantage of translucent brackets is overridden by their whitish appearance which shows a huge color

difference when compared with the color of human teeth in the present study.

To summarize the results, monocrystalline ceramic brackets offer the most esthetic alternative to the patients. Polycarbonate brackets were found to be poorer esthetically in all the parameters. Self-ligating ceramic brackets were not as translucent as conventional brackets but the color difference was not statistically different. Therefore the clinician should consider whether the other advantages of self-ligation outweigh the slight esthetic compromise of these brackets before their selection. The patient should also be informed of the available choices and their benefits before commencing treatment.

The limitation of the present study was not considering the influence of bonding material in the measurement of color, translucency and fluorescence. Brackets can be tested after bonding to an intact tooth to assess the influence of the surrounding environment.

Conclusion

1. Among non-translucent brackets, Gemini Clear had least color difference when compared with patient's tooth color and had a statistical difference with other brackets.
2. Among translucent brackets, Inspire Ice brackets had the least color difference.
3. The translucency of all brackets revealed that Radiance Plus and Inspire Ice brackets had the highest transmittance while least was for Envision brackets.
4. Radiance Plus and Inspire Ice were able to emit the fluorescence of the tooth due to their translucency.
5. Fluorescence of the self-ligating brackets was affected due to the presence of the metal door/ clips which appeared black under the dark light.

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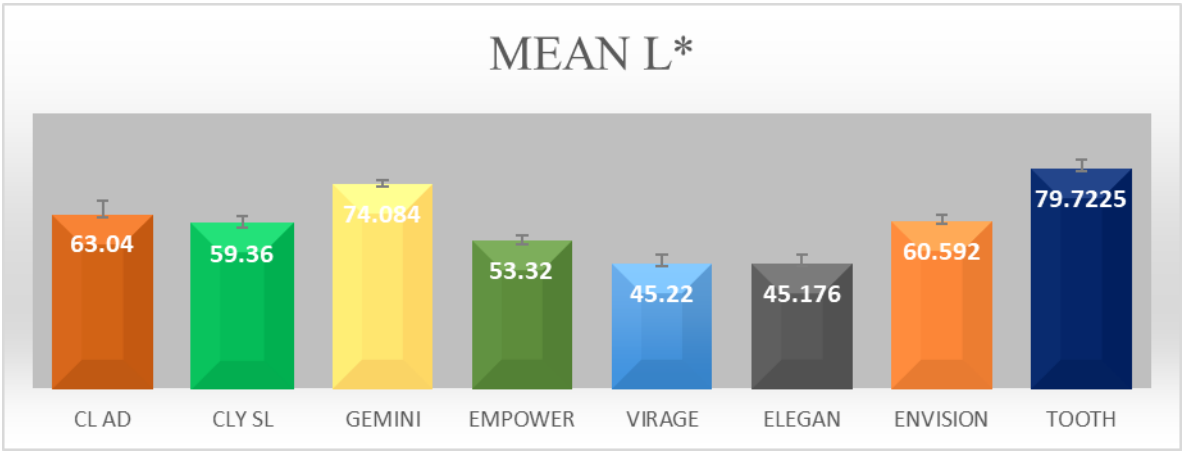
Legends Figures and Tables

Chart 1. Color Parameters (L*A*B*) Of Non-Translucent Brackets And Patient's Teeth With Their Standard Deviations



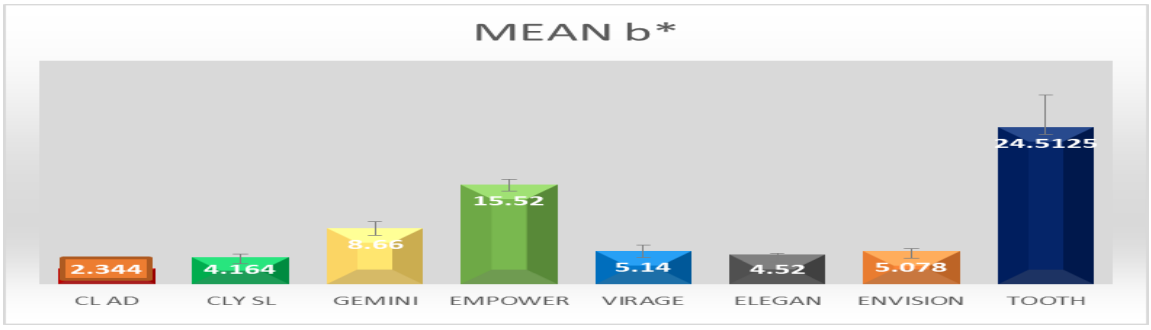


Chart 2. Percentages of Transmittance And Standard Deviations Of All The Brackets.

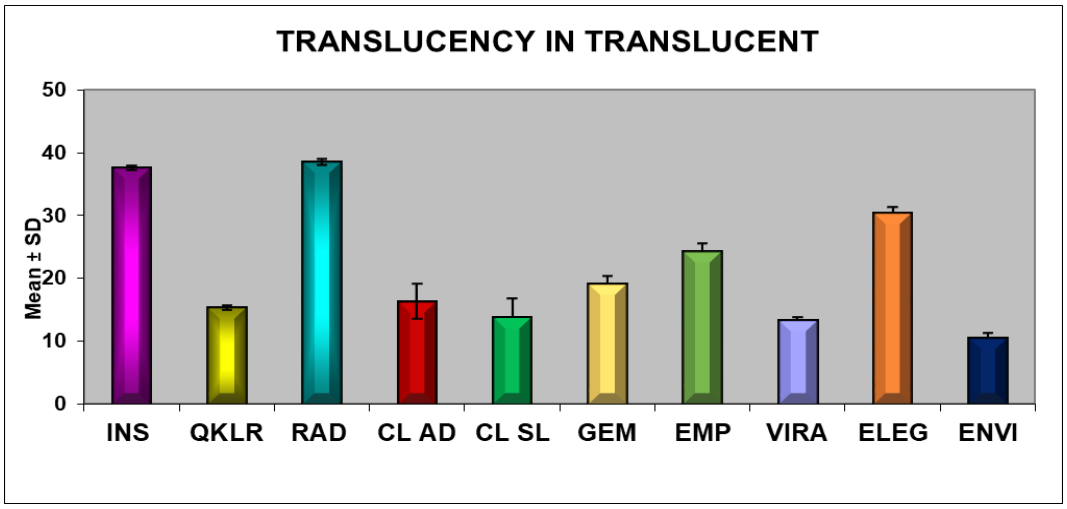


Table 1: Distribution Of List Of Materials Used In The Study With Code, Brand And Their Description

LIST OF MATERIAL	CODE	BRAND	DESCRIPTION
Clarity Advanced	CL AD	3M	Ceramic, Polycrystalline
Clarity SL	CL SL	3M	Ceramic, Polycrystalline and self-ligation
QuicKlear	QKR	Forestadent	Ceramic, monocrystalline and self-ligation
Radiance Plus	RAD	3M	Ceramic, Monocrystalline
Empower Clear	EMP	American Orthodontics	Ceramic, Polycrystalline and self-ligation
Gemini clear	GEM	3M	Ceramic, Polycrystalline
Inspire Ice	INS	Ormco	Ceramic, Monocrystalline
Elegance	ELEG	Dentarum	Plastic
Envision	ENV	Ortho Organizers	Plastic
Virage	VIR	American Orthodontics	Ceramic, Polycrystalline
Transbond	-	3M	Bonding agent

Table 2: Sample Size Determination Done Using ‘N Master Software

Single Mean-Hypothesis testing-one population		
Standard deviation (s)	0.2	
Sample mean	18.6	
Population mean	18.85	
Alpha error (%)	5	
Power (%)	80	
Sided	2	
Effect size (d)	1.25	
Number needed (n)	5	
Alpha error (%)	Power (%)	Sample size (n)
1	70	6
	80	7
	90	10

5	70	4
	80	5
	90	7
10	70	3
	80	4
	90	5

Table 3: mean and standard deviation for colour difference of the translucent and non-translucent brackets with extracted tooth colour and 25 patient's tooth colour respectively.

Name	NON TRANSLUCENT	TRANSLUCENT
	MEAN (SD)	MEAN(SD)
Clarity Advanced	29.2(3.3)	-
Clarity SL	30(2.5)	-
Gemini Clear	18.2(1.2)	-
Empower Clear	30.6(1.7)	-
Virage	40.6(2.6)	-
Elegance	40.9(2.8)	-
Envision	28.5(1.9)	-
Inspire Ice	-	21.1(7.4)
QuicKlear	-	34.5(18.3)
Radiance Plus	-	37.3(7.8)

Table 4: Anova Table For Color Difference Of Non-Translucent Brackets And Mean Of 25 Patients Tooth Color.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1823.526	6	303.921	51.491	.000 Significant
Within Groups	165.266	28	5.902		
Total	1988.793	34			

Table 5: Multiple Scheffe Comparison Between The Colour Differences Of Non-Translucent Brackets For Inter Group Comparison.

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Cl Ad	Cly Sl	-0.8135076	1.53654	1
	Gemini	10.9544780*	1.53654	0
	Empow	-1.4392687	1.53654	0.988

	Virage	-11.4298125*	1.53654	0
	Eleg	-11.7566733*	1.53654	0
	Envision	0.6560696	1.53654	1
Cly Sl	Cl Ad	0.8135076	1.53654	1
	Gemini	11.7679856*	1.53654	0
	Empow	-0.6257611	1.53654	1
	Virage	-10.6163050*	1.53654	0
	Eleg	-10.9431657*	1.53654	0
	Envision	1.4695772	1.53654	0.987
Gemini	Cl Ad	-10.9544780*	1.53654	0
	Cly Sl	-11.7679856*	1.53654	0
	Empow	-12.3937467*	1.53654	0
	Virage	-22.3842905*	1.53654	0
	Eleg	-22.7111513*	1.53654	0
	Envision	-10.2984084*	1.53654	0
Empow	Cl Ad	1.4392687	1.53654	0.988
	Cly Sl	0.6257611	1.53654	1
	Gemini	12.3937467*	1.53654	0
	Virage	-9.9905438*	1.53654	0
	Eleg	-10.3174046*	1.53654	0
	Envision	2.0953383	1.53654	0.926
Virage	Cl Ad	11.4298125*	1.53654	0
	Cly Sl	10.6163050*	1.53654	0
	Gemini	22.3842905*	1.53654	0
	Empow	9.9905438*	1.53654	0
	Eleg	-0.3268608	1.53654	1
	Envision	12.0858822*	1.53654	0
Eleg	Cl Ad	11.7566733*	1.53654	0
	Cly Sl	10.9431657*	1.53654	0
	Gemini	22.7111513*	1.53654	0
	Empow	10.3174046*	1.53654	0
	Virage	0.3268608	1.53654	1
	Envision	12.4127429*	1.53654	0

Envision	Cl Ad	-0.6560696	1.53654	1
	Cly Sl	-1.4695772	1.53654	0.987
	Gemini	10.2984084*	1.53654	0
	Empow	-2.0953383	1.53654	0.926
	Virage	-12.0858822*	1.53654	0
	Eleg	-12.4127429*	1.53654	0

*. The mean difference is significant at the 0.05 level.

Table 6: Kruskal-Wallis Test To Find The Significance In Colour Difference Of Translucent Brackets

	GROUP	N	Mean Rank	P Value
Delta E	Ins Ice	5	4.40	0.054 Not significant
	QUICKLEAR	5	8.40	
	RAD PLUS	5	11.20	
	Total	15		

Table 7: Multiple Scheffe Comparison Between The Colour Differences Of Translucent Brackets For Inter Group Comparison.

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Ins Ice	Quiklear	13.4072556	7.7855082	.266
	RAD PLUS	16.1994255	7.7855082	.157
Quicklear	Ins Ice	13.4072556	7.7855082	.266
	RAD PLUS	-2.7921699	7.7855082	.938
Rad Plus	Ins Ice	16.1994255	7.7855082	.157
	QUIKLEAR	2.7921699	7.7855082	.938

*.The mean difference is significant at the .05 level

Table 8: Anova Table To Access Significance Level For Translucency Of Translucent Brackets.

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	1725.674	2	862.83	5985.272	.000 Significant
Within Groups	1.73	12	.144		
Total	1727.404	14			

*.The mean difference is significant at the .05 level

Table 9: Multiple Scheffe Comparison between The Translucency Of Translucent Brackets.

Brackets(I)	Brackets(J)	Mean Difference(I-J)	Std.Error	Sig
Ins Ice	Quiklear	22.26*	.24013	.000
	Rad Plus	-.956*	.24013	.006
Quicklear	Ins Ice	-22.26*	.24013	.000
	Rad Plus	-23.216*	.24013	.000
Rad Plus	Ins Ice	.956*	.24013	.006
	Quiklear	23.216*	.24013	.000

*.The Mean Difference Is Significant At the .05 Level

Table 10: Anova Table for Translucency of Non-Translucent Brackets.

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	1470.366	6	245.061	80.803	.000 Significant
Within Groups	84.919	28	3.033		
Total	1555.285	34			

Table 11: Multiple Scheffe Comparison Between The Translucency Of Non-Translucent Brackets For Inter Group Comparison.

(I) Brackets	(J) Brackets	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
CL AD	CLYSL	2.58000	1.10142	.499	-1.6388	6.7988
	GEMINI	-2.80000	1.10142	.400	-7.0188	1.4188
	EMPOWER	-7.96000*	1.10142	.000	-12.1788	-3.7412
	VIRAGE	2.95000	1.10142	.337	-1.2688	7.1688
	ELEG	-14.08600*	1.10142	.000	-18.3048	-9.8672
	ENVISION	5.90000*	1.10142	.002	1.6812	10.1188
CLYSL	CL AD	-2.58000	1.10142	.499	-6.7988	1.6388
	GEMINI	-5.38000*	1.10142	.005	-9.5988	-1.1612
	EMPOWER	-10.54000*	1.10142	.000	-14.7588	-6.3212
	VIRAGE	.37000	1.10142	1.000	-3.8488	4.5888
	ELEG	-16.66600*	1.10142	.000	-20.8848	-12.4472
	ENVISION	3.32000	1.10142	.210	-.8988	7.5388
GEMINI	CL AD	2.80000	1.10142	.400	-1.4188	7.0188
	CLYSL	5.38000*	1.10142	.005	1.1612	9.5988
	EMPOWER	-5.16000*	1.10142	.008	-9.3788	-.9412
	VIRAGE	5.75000*	1.10142	.002	1.5312	9.9688
	ELEG	-11.28600*	1.10142	.000	-15.5048	-7.0672
	ENVISION	8.70000*	1.10142	.000	4.4812	12.9188
EMPOWER	CL AD	7.96000*	1.10142	.000	3.7412	12.1788
	CLYSL	10.54000*	1.10142	.000	6.3212	14.7588
	GEMINI	5.16000*	1.10142	.008	.9412	9.3788
	VIRAGE	10.91000*	1.10142	.000	6.6912	15.1288
	ELEG	-6.12600*	1.10142	.001	-10.3448	-1.9072
	ENVISION	13.86000*	1.10142	.000	9.6412	18.0788
VIRAGE	CL AD	-2.95000	1.10142	.337	-7.1688	1.2688
	CLYSL	-.37000	1.10142	1.000	-4.5888	3.8488
	GEMINI	-5.75000*	1.10142	.002	-9.9688	-1.5312
	EMPOWER	-10.91000*	1.10142	.000	-15.1288	-6.6912
	ELEG	-17.03600*	1.10142	.000	-21.2548	-12.8172
	ENVISION	2.95000	1.10142	.337	-1.2688	7.1688
ELEG	CL AD	14.08600*	1.10142	.000	9.8672	18.3048
	CLYSL	16.66600*	1.10142	.000	12.4472	20.8848
	GEMINI	11.28600*	1.10142	.000	7.0672	15.5048
	EMPOWER	6.12600*	1.10142	.001	1.9072	10.3448
	VIRAGE	17.03600*	1.10142	.000	12.8172	21.2548
	ENVISION	19.98600*	1.10142	.000	15.7672	24.2048
ENVISION	CL AD	-5.90000*	1.10142	.002	-10.1188	-1.6812
	CLYSL	-3.32000	1.10142	.210	-7.5388	.8988
	GEMINI	-8.70000*	1.10142	.000	-12.9188	-4.4812
	EMPOWER	-13.86000*	1.10142	.000	-18.0788	-9.6412
	VIRAGE	-2.95000	1.10142	.337	-7.1688	1.2688
	ELEG	-19.98600*	1.10142	.000	-24.2048	-15.7672

*. The mean difference is significant at the .05 level.

Table 12: Mcnemar Test To Find Significance In Fluorescence Of All The Brackets.

Chi-squared test	5.11
P-value	0.023
Odds ratio	0.7

Fig. 1: Spectrophotometer in Position to Read the Colour Parameter L* A* and B* Of Non-Translucent Brackets-In Vitro

Fig 2: Spectrophotometer In Position To Read The Colour Parameter L*, A* And B* Of 25 Patients Maxillary First Premolar- In Vivo

Fig 3: Diffuse Reflectance Spectrometry- To Measure the Percentage (T %) Of Transmittance from the Percentage of Reflectance of All Brackets.

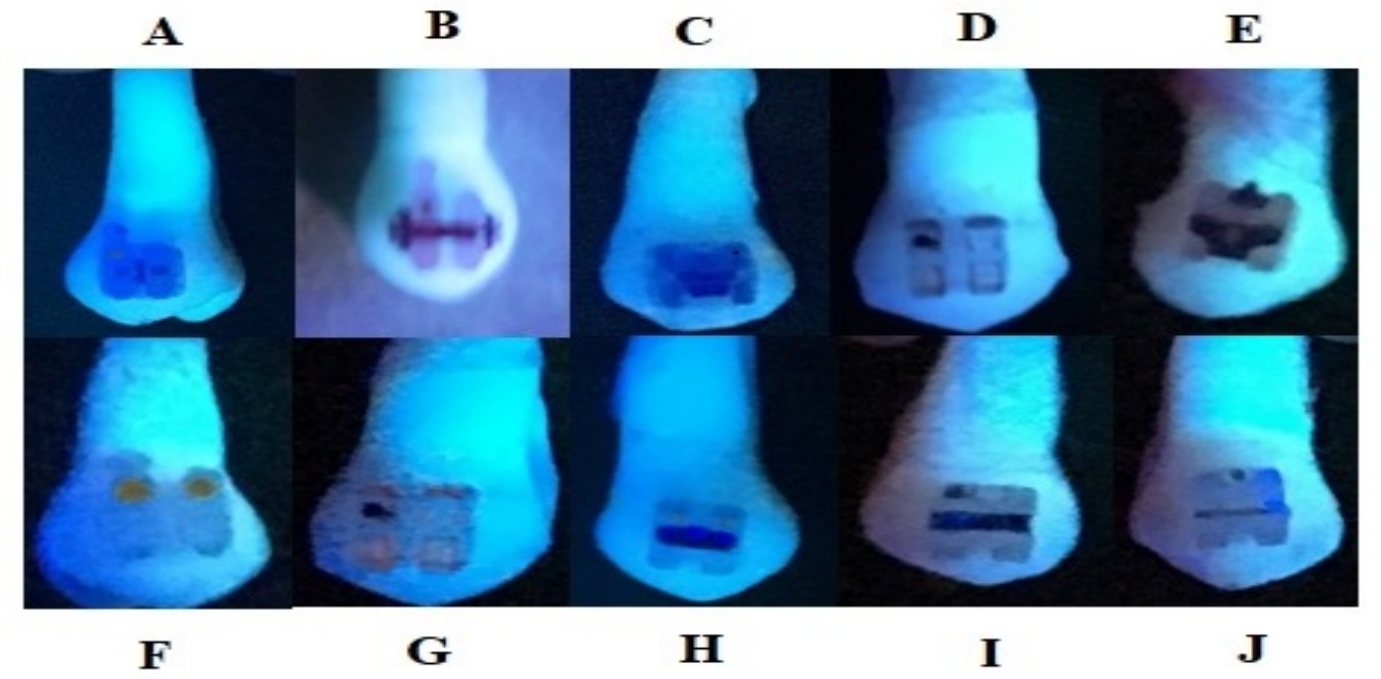


Fig 4: Visual Behavior Of Teeth With Brackets When Irradiated With Ultra-Violet Light. A- Clarity Advanced, B- Clarity Sl, C- Quicklear, D- Radiance Plus, E- Empower Clear, F- Gemini Clear, G- Inspire Ice, H- Elegance, I- Envision And J- Virage.