

An Assessment of Shade Taking by Dental Undergraduates

Robert Mc Andrew*, Philip W. L. Chan† and Paul J. Milward‡

Abstract - This study investigated the shade recording abilities of dental students using the traditional methods and that incorporating a colour correcting device to that of a digital shade recording device. Shade matching ability was evaluated between different groups of students at Malmö and Cardiff. The use of the colour correcting device improved a student's ability to match shades when compared to the traditional method under normal lighting conditions. There was no gender difference to match shade amongst the participants. We observed that at one of the test sites the ability to take the correct shade improved as clinical experience was gained.

KEY WORDS: shade taking, colorimeter, colour measuring device, dental undergraduates

INTRODUCTION

The colour and appearance of teeth is a complex phenomenon¹ with the overall colour resulting from the combined effects of intrinsic structure and external influences. Choosing the correct shade of teeth can be challenging with the selection of the incorrect shade leading to poor aesthetics, unsatisfied patients and repeated laboratory fees². It is, therefore, worthwhile ensuring that the shades for laboratory work is correct and that they match the tooth. The most commonly used shade guide to date is the Vita™ Classic³ which distinguishes shades by hue, chroma and value⁴ and it is based on the Munsell system. The visual determination of a tooth's shade is subject to many variables such as experience, age, physiological variables e.g. colour blindness, gender, surrounding environment and external lighting^{5,6}. External lighting, in particular, can have a profound effect on shade selection. It has been suggested that the most ideal lighting conditions for selecting shade is diffuse natural northern light³. In practice this may not always be possible.

The Optilume Trueshade™ (Figure 1) has been released for sale in the UK. It is suggested that the device can provide a spectrum of light very similar to daylight and be used to eliminate some of the variables that have been mentioned as hindrances to correct shade matching.

This study was designed to compare the effectiveness of tooth shade matching by dental students using traditional methods and the Optilume Trueshade™ to that achieved with a digital shade recording device (ShadEye NCC™). In addition the study investigated the variables of gender, experience and place of study.

MATERIALS AND METHODS

This was a two centre study made up of similar groups of dental students from Cardiff, Wales and Malmö, Sweden. Each group of 25 was made up of 8 third year students, 8 fourth year students and 9 fifth year students. Both groups measured and recorded the shades of a natural and un-restored maxillary central incisor on three volunteer patients. All students assessed the teeth with a colorimeter (ShadEye NCC™), traditional methods (VITA™ classic shade guide) and with the assistance of a colour correcting device (Optilume Trueshade™). All students were instructed in the correct use of the methods to measure and record tooth shade. In all instances the tooth's shade was determined within ninety seconds and followed accepted techniques or manufacturer's instructions⁷.

The digital colorimeter was calibrated before each measurement with the measurement being taken at its middle third on the volunteer's tooth. The digital colorimeter recordings were used as the gold standard for shade determination and it was these to which all the other shades recorded were compared.

All the volunteer patient's were dressed in a white dental gown and removed strongly coloured cosmetics to minimise the effect that strong colours would have on the examiners perception of hue⁵. Other than these simple steps no attempt was made to standardise other lighting conditions.

DATA ANALYSIS

The data analysis method was performed using statistical software SPSS™. The non - parametric Paired Wilcoxon test was established as the best statistical test from q-q plots and although not as strong as its equivalent parametric tests it is believed to be most appropriate test for the statistical analysis of relatively small groups of quantitative data. The Friedman test was used to analyse whether there was a difference between the years.

* BDS

† BDS, MscD, PhD, FDS (Rest Dent)RCS, FDS, MRDRCS (Ed), DRD, PGCE, FHEA

‡ MPhil, LCGI, FHEA



Figure 1. Optilume Trueshade™.

RESULTS

The gender and age of the groups of participants were similar with the Cardiff group comprising 13 males and 12 females with mean age of 21.1 years and the Malmö group comprising 12 males and 13 females with mean age 23.6 years.

Table 1 details the digital colorimeter (ShadEye NCC™) determined shades for the patients used in the study. The paired Wilcoxon test revealed that amongst every year group, in both dental schools, there were significant differences between the shades taken by traditional methods under normal lighting conditions (NL) and the gold standard shades taken with the colorimeter (CM) for certain 'patients' (Table 2); out of the 18 shade matching tests carried out there were 9 instances where significant differences were calculated. A comparison between the digital colorimeter and results from using the colour correcting device (Optilume Trueshade™) showed no statistical differences (Table 2). A comparison of the colour corrected device recorded shades (Optilume Trueshade™) and the traditional method of shade taking (Vita™ shade guide method (NL) showed some statistical differences for four of the eighteen patients (Table 2).

When assessing the difference between genders in assessing tooth shade at each centre for the patients examined by the whole group (A and B in Malmo; A and C in Cardiff) when the traditional Vita™ shade method was compared to the results from using the colour correcting device there was only one instance where a gender difference for shade determination was shown in Pt. A. at Malmö (P=0.011) (Table 3).

The data recorded for the patients common to each group (A and B in Malmo; A and C in Cardiff) were also used to determine if any significant differences could be found amongst the three year groups. The Friedmans test revealed that for patients B and C, there were significant differences in shade matches when the traditional and colour corrected methods' results were analysed (Table 4).

A comparison between the two centres displaying the correct number of shade determinations (Table 5) showed that when using traditional methods year 5 in Malmö per-

formed best, however in year 4 both institutes performed the same and Cardiff students performed better in year 3. When using the colour corrected device to record shade it appeared that the Year 3 students in Cardiff performed best. When analysed *in toto* there was a negligible difference in shade taking abilities between Malmö and Cardiff dental students (data not shown).

DISCUSSION

The results showed that when used appropriately the colour correcting device (Optilume Trueshade™) assisted in recording the true shade of the teeth as determined by the digital colorimeter. Whereas in comparison 9 out of 18 tests carried out under normal lighting conditions and using traditional methods showed an incorrect shade to be measured. It is understood that normal lighting conditions can vary considerably at different places of work and at different times of the day and year. However these are variables which are often beyond control (the time of year cannot be changed, tinted windows are often used in buildings) and can be used to illustrate what can happen if the optimal shade taking environment can not be produced. The fact that a simple device such as the Optilume Trueshade™ can have on standardising lighting conditions and shade recording cannot be overemphasised.

The results of this study may have clinical implications in both dental schools. In Malmö the ability to match shades, independent of the surrounding condition, will be particularly useful as the hours of day light during the winter months are greatly limited. In Cardiff, the provision of new tinted windows on each clinic will result in an incomplete spectrum of light that is required to match shades, thus a colour correcting device will be a valuable tool.

The relatively low percentages of colour matches presented in Table 8 agree with previous studies^{8,9} the low percentages demonstrates the variability, and inconsistencies inherent in colour perception between individuals¹⁰. From the results of this study, it can be seen that individuals ability to match the correct shade using the colour correcting device results in a higher percentage of correct matches, and consequently reduces the variability aspect.

Table 5 revealed negligible overall differences between the two centres and no difference was observed between the groups whether or not the Optilume Trueshade™ device was used, but it was noted that more senior students in Malmö were better at taking the correct shade, whereas there was no obvious difference between years in Cardiff. The shade matching courses in both institutions were very similar; with an initial lecture on hue, value and chroma, followed by 2 practical sessions on matching shades. The differences in shade matching abilities could be due to the difference in use of restorative materials; the Swedish government now discourage dentists from using amalgam restorations, mainly replacing its use with composite. Thus the students in Malmö are regularly matching the shades of teeth far more frequently than students in Cardiff.

It is believed that further research could determine the value of correcting devices in clinical practice. This may utilise a similar study design, but incorporating a larger sample size. With a greater sample size one might expect to see higher significant differences between shades

Table 1. Shades for each 'patient' determined by the digital colorimeter (ShadEyeNCC™).

Dental School	Malmö		Cardiff	
Year 5	Pt. A.	A1	Pt. A.	A1
	Pt. B.	A1	Pt. C.	A2
	Pt. D.	A2	Pt. G.	A1
Year 4	Pt. A.	A1	Pt. A.	A1
	Pt. B.	A1	Pt. C.	A2
	Pt. E.	A2	Pt. H.	C1
Year 3	Pt. A.	A1	Pt. A.	A1
	Pt. B.	A1	Pt. C.	A2
	Pt. F.	A1	Pt. I.	A1

Table 3. P values for the difference between male and females when choosing shade under normal lighting conditions and when using the Optilume Truesbade™ (enhanced lighting conditions) in Malmö and Cardiff compared to the digital colorimeter (ShadEye™).

Malmö		Cardiff	
Pt. A (normal lighting)	*P=.011	Pt. A (normal lighting)	P=.380
Pt. A. (enhanced lighting)	P=.104	Pt. A. (enhanced lighting)	P=.281
Pt. B. (normal lighting)	P=.887	Pt. C. (normal lighting)	P=.504
Pt. B. (enhanced lighting)	P=.725	Pt. C. (enhanced lighting)	P=.171

*Highlights significant difference.

Table 4. P values for the difference between year groups when choosing shade under normal lighting conditions and when using the Optilume Truesbade™ (enhanced lighting conditions) in Malmö and Cardiff compared to the digital colorimeter (ShadEye™).

Malmö		Cardiff	
Pt. A (normal lighting)	P=.368	Pt. A (normal lighting)	P=.368
Pt. A. (enhanced lighting)	P=.368	Pt. A. (enhanced lighting)	P=.097
Pt. B. (normal lighting)	*P=.018	Pt. C. (normal lighting)	*P=.021
Pt. B. (enhanced lighting)	*P=.003	Pt. C. (enhanced lighting)	*P=.047

*Highlights significant difference.

Table 5. The percentage of correct shade selections in each year; a comparison between Malmö dental school and the School of Dentistry, Cardiff.

Dental School	Normal Lighting		Optilume Truesbade™	
	Malmö	Cardiff	Malmö	Cardiff
Year 5	40.7%	29.6%	55.6%	40.0%
Year 4	29.2%	29.2%	45.8%	37.5%
Year 3	25%	33.3%	29.2%	54.2%
Combined %	31.6%	30.7%	43.5%	43.9%

Year	Malmö				Cardiff				Malmö				Cardiff					
	Pt. A	Pt. B	Pt. D	Pt. A	Pt. C	Pt. G	Pt. A	Pt. B	Pt. D	Pt. A	Pt. C	Pt. G	Pt. A	Pt. B	Pt. D	Pt. A	Pt. C	Pt. G
Year 5	0.025*	0.041*	1	0.86	0.039*	0.034*	0.705	0.098	0.18	0.206	0.242	0.414	0.102	0.317	0.655	0.18	0.042*	0.026*
	Pt. A	Pt. B	Pt. E	Pt. A	Pt. C	Pt. H	Pt. A	Pt. B	Pt. E	Pt. A	Pt. C	Pt. H	Pt. A	Pt. B	Pt. E	Pt. A	Pt. C	Pt. H
Year 4	0.025*	0.317	0.024*	0.317	0.89	0.026*	0.157	0.102	0.684	0.206	0.461	0.066	0.083	0.317	0.016*	0.317	0.083	0.066
	Pt. A	Pt. B	Pt. F	Pt. A	Pt. C	Pt. I	Pt. A	Pt. B	Pt. F	Pt. A	Pt. C	Pt. I	Pt. A	Pt. B	Pt. F	Pt. A	Pt. C	Pt. I
Year 3	0.102	0.077	0.027*	0.132	0.039*	0.172	1	0.516	0.071	0.48	0.285	0.414	0.059	0.059	0.026*	0.083	0.056	0.0214

*Highlights significant difference.

Table 2. P values obtained from comparisons of different shade measuring sources to the colorimeter and each other.

P values comparing the traditional natural light method with those obtained with the colorimeter

P values comparing the colour corrected light method with those obtained with the colorimeter

P values comparing the traditional natural light method with those obtained with the colour corrected method

matched using the Optilume Trueshade™ compared to traditional normal lighting conditions. It is believed that the use of the Optilume TrueShade™ allows the clinical assessment of shade to remain within the control of the dentist or dental technician, improve overall skills in this area, reduce the likelihood for mistakes and decrease reliance on digital recording instrumentation which requires regular calibration, training in correct use, capital outlay and in reality may not be freely available.

CONCLUSION

Within the limitations of this study, the following conclusions were drawn:

1. The use of the Optilume Trueshade™ colour correcting device, improved a student's ability to match shades compared to using normal lighting.
2. There is no difference between genders for shade matching.
3. The overall shade matching performance between students in the Faculty of Odontology in Malmö, and the School of Dentistry, Cardiff, were the same but the value of colour corrected shade determination cannot be overlooked.

MANUFACTURER'S DETAILS

- Optilume Trueshade™: International Development Centre, Valley Drive, Ilkley, West Yorkshire, LS29 8PB, UK
- Vita™: Vita Zahnfabrik H. Rauter GmbH & Co. KG, Postfach 1338, D-79704 bad Säckingen, Germany
- ShadEye NCC™: Shofu Dental Products Ltd. Duke's Factory, Chiddingstone Causeway, Tonbridge, Kent, TN11 8JU, UK

ADDRESS FOR CORRESPONDENCE

Dr Robert Mc Andrew, School of Dentistry, Cardiff University, Heath Park, Cardiff, CF14 4XY, Wales, UK.. E-mail: Mcandrew@cardiff.ac.uk

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