Comparative evaluation of the effects of lighting conditions on the shade selection of maxillary central incisor using visual methods [version 1; peer review: awaiting peer review]

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Abstract

Background: The selection of shade of a tooth is a routine practice for a dentist, especially a prosthodontist, to make esthetically pleasing prostheses. The phenomenon of colour is a matter of perception by the eye. Every opaque object receives light, absorbs some of it and reflects the rest. A tooth being an opaque object, reflects some amount of light. The dominant wavelength of this reflected light is discerned by us as the colour of the tooth. Light has variable properties that influence our perception. Daylight is regarded as the standard source for the selection of the colour of a tooth. Conversely, the lack of optimal circumstances during different times of the day necessitates using artificial illuminants to select shade of a tooth. This study was carried out to compare the accuracy of a shade-matching light (SMILE LINE) to that of standard daylight.

Methods: This study followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies. The study comprised 125 participants of ages ranging from 20 to 30 years. Five observers from the Department of Prosthodontics, Sharad Pawar Dental College (SPDC), Wardha selected the shade of the maxillary central incisor of 125 subjects under sunlight, dental operatory light, and shade-matching light. The statistical analysis was performed using the SPSS software, and Kappa statistics were used to compare the shades selected by the shade-matching light and dental operatory light with sunlight.

Results: A strong correlation was discovered between the shades of tooth selected under the shade matching light and shades selected under sunlight for four out of five observers.

Conclusions: The shade correcting device gives shades comparable to those selected under sunlight in ideal conditions making it useful as an alternative to sunlight for shade selection.
Keywords
Shade selection, Shade matching light, SMILE LINE, esthetic dentistry, Shade guide

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Introduction
Colour and shade of teeth have gained popularity in cosmetic and esthetic dentistry in the past decades with the increased awareness of the ‘perfect smile’. The advent of the digital age, as well as patient awareness have driven the focus of dentistry to esthetics. Selecting shade is a crucial step for fabricating an aesthetically pleasing prosthesis. Knowledge of colour aids a clinician in this process of selecting a tooth shade. A light source, any object, and the human eye are the factors that interact to create colour.

The average wavelength of ambient light is known as ‘colour temperature’. The temperature of the colour hence associates with the quality of the light source that is expressed in Kelvin (K). As sunlight or daylight is considered the best for selecting tooth colour, we must have a light source similar to daylight. Standard daylight is infrequently available as the dominant wavelength of sunlight depends on climate, season, and time of the day. Compared to the daytime, during early hours and sunset the wavelength of incident sunlight is towards the red spectrum. When the light source or the light reflected off an item changes, the perceived colour of the light changes as well. This necessitates the use of artificial illuminants for selection of tooth colour as the optimal light conditions are available infrequently. The primary consideration in choosing the light source in this study was how closely it could mimic natural daylight.

The shade of a prosthesis may not match in shade with the shade of natural tooth due to metamerism, which is a problematic factor. This phenomenon is due to the spectrophotometric changes of the tooth under different light sources. Two subjects may seem to be of the same colour underneath one light source yet seem to be of varied colour under another light source. Metamerism is attributed to the distribution of spectral energy of a light source. This influences the observer’s perception. Enamel also contains spectrophotometric pigments that differ from the restorative materials used in dentistry.

As the light source has momentous effect on shade selection and there exists a debate as to which light source other that natural sunlight is accurate enough to reproduce a shade. Hence the aim of this study was to evaluate the effect of a light source, which claims to be of the accuracy of sunlight, when compared with sunlight and dental operatory light.

Aim
The aim of this research is to evaluate the effect of different light conditions on shade selection of natural teeth in comparison with daylight.

Objectives
The objectives were to evaluate the effect of sunlight on visual shade matching of natural teeth. The first objective was to evaluate the effect of shade matching light (in this case, we have selected SMILE LINE) on visual shade matching of natural teeth. Our second objective was to evaluate the effect of dental operatory chair light on visual shade matching of natural teeth. Finally, we aimed to complete a comparative evaluation of the efficiency of the shade matching light to dental operatory chair light in comparison with sunlight using visual method on shade selection of natural teeth.

Methods
This in-vivo study was conducted in the Department of Prosthodontics, Sharad Pawar Dental College, Sawangi (Meghe), Wardha, and is reported following the STROBE (The Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational studies (see Extended data).

The study was conducted from January 2021 to January 2022 during which time the participants were recruited for this single-blinded study. The participants were 1st and 2nd year dental undergraduate students of Sharad Pawar Dental College (recruited via telephone; telephone numbers were obtained with permission from the college). Observers in this study were prosthodontists of the department who were recruited on the basis of their visual acuity. The prosthodontists that qualified the colour deficiency tests were chosen for the shade selection of natural teeth. Data for this study was collected when the prosthodontists indicated the shade of the maxillary central incisors of the subjects. The sample size was calculated for this study that was 125. Each prosthodontist selected shade for only 30 participants per day. One of the five prosthodontists, Dr. Aditee Apte (AA) is author in this study. Data collection was done during the selection of shade under the three illuminants. There was no follow up in this study as the shades were selected by each prosthodontist for the same 125 participants under three different light sources.

Ethics statement
Ethical approval for this study was obtained from the Institutional Ethics Committee of Datta Meghe Institute of Higher Education and Research (Previously DMIMS), Deemed to be University (Sawangi, Wardha) with reference number DMIMS (DU)/IEC/2020-21/9393 on 24th December 2020.
Informed written consent was obtained from all the participants and observers for participation in this study and publication of the research data. The permission to use the images of the participants and observers in the presentation of this data was also obtained via a written informed consent.

Study design and sample size calculation
A summary of the study design is presented in Figure 1. The sample size was calculated with formula for difference between two proportions:

\[
N = \frac{(Z_{\alpha} + Z_{\beta})^2 [P_1 (1 - P_1) + P_2 (1 - P_2)]}{(P_1 - P_2)^2}
\]

Where,

\( Z_{\alpha} \) is the level of significance at 5% i.e. 95%

Confidence interval = 1.96

\( Z_{\beta} \) = Power of the test = 80% = 0.84%

\( P_1 = 45.8\% = 0.458 \)

\( P_2 = 28.9\% = 0.289 \)

\[
N = \frac{(1.96 + 0.84)^2 [0.458 (1 - 0.458) + 0.289 (1 - 0.289)]}{(0.458 - 0.289)^2} = 125.54 = 125 \text{ participants}
\]

Participants and eligibility criteria
This study comprised of 125 subjects that were students in Sharad Pawar Dental College (SPDC) with ages ranging from 20-30 years. Participants with healthy, unrestored maxillary central incisors, without discolouration, prosthesis, fracture, malalignment were included in this study. Participants with fractured, restored, discoloured maxillary central incisors and maxillary incisors with crown prosthesis were not considered in this study. Selection of participants was done over telephone. All the subjects underwent shade selection under the three illuminants of this study. The comparison of variation in selected shades under three illuminants was performed when all the participants selected shade of the same subjects under the three light sources.
For the purpose of overcoming the eye fatigue for observers, shade selection was done at the rate of only 30 selections per day. The selection of shade was done first under sunlight by all prosthodontists for all 125 subjects. Afterwards, all the five prosthodontists selected shade of the maxillary central incisors of the same 125 subjects under dental chair light and then the shade matching light. The shades indicated by each prosthodontist at each step was blinded from the other prosthodontists to overcome observer bias.

This study comprised of five experienced prosthodontists as observers from the department and were labelled as observer 1, 2, 3, 4, and 5. One of these observers was author AA. The inclusion criteria for the prosthodontists to be qualified as observers for shade selection was if they passed the Pseudoisochromatic Plates Test (PIP) and Ishihara Tests and were willing to participate in the study. Observers (prosthodontists) that did not pass the PIP and Ishihara tests were excluded from this study. Observers and participants unwilling to participate in this study were excluded.

The observers were tested using Pseudoisochromatic Test and the Ishihara test for red-green deficiency in vision. These tests are efficient in determining the colour deficient individuals that cannot discriminate between the red and green colour.8,9 The tests contained plates with numbers made up of green and red dots of different hue and chroma. The observers were then asked to identify the number made up by the red dots in a green dots containing background.8,10 The significance of carrying out these tests is that the hue of the natural teeth can be reddish-brown, reddish-yellow, grey or greyish red. The red hue is seen for most of these groups and hence testing discrimination of the observers for the red-green colour was essential. The colour blind individuals cannot view the red-green hue and hence cannot select the corresponding shades leading to a mismatch of tooth shade. The colour matching ability of the colour blind individuals is different than that of the normal individuals.11

All observers passed the tests and hence were qualified for this study. The participants were informed about the process of shade selection and that it would be carried out for a period of about three to six months to avoid the observer bias and observer fatigue. The observers also selected shades of only 30 participants for a day to overcome observer fatigue. Data collection was done by author Dr. Rewa Kawade (RK) and was blinded from the prosthodontists (observers in this study) to remove any source of bias.

For the selection of shade of subjects, a semi-open grey box was created by covering the portable hospital curtain with a neutral grey sheet. Figure 2 shows one of our observers seated in semi-open grey box. This setup was then moved near a window. The hospital curtain was then bent to create the semi-open grey box. The three sides of the portable hospital curtain would surround the window on three sides. The subjects who were considered for shade selection were seated in this grey box facing the window.

Figure 2. Semi-open grey box. Permission to use the images of the participants and observers in the presentation of this data was obtained via a written informed consent.
Data collection
Prior to selection of shade, the subjects were asked to remove any makeup. The shade selection under sunlight was carried out during daytime from 11 am to 1 pm. The shade selection was performed on the maxillary central incisors of the subjects using a VITA Classic Shade guide (VITA classical A1-D4 shade guide Prod. no. G027C). The steps of shade selection were explained to the observers as given by Pizzamiglio. This arrangement was done first by selecting the maximum hue of the four groups – A4, B4, C4, and D4. This was to be followed by selecting the chroma and value in the respective selected group. For example, for group A, they were asked to indicate if the chroma was A1, A2, A3, A3.5 or A4. The shade selection by only one illuminant per day was carried out to remove the observer bias. The artificial illuminants used in this study is the SMILE LINE shade matching device (Figure 3) and the dental chair light. The SMILE LINE shade matching device has the temperature of 6500K which is similar to that considered as ideal or near sunlight. Hence this light source was selected to carry out our study which offers an economic option as against the other illuminants. Following protocol was followed when using each illuminant.

Shade selection under sunlight
The observers were to first select shades of the maxillary central incisor under sunlight till they faced observer fatigue. The selection of shade for prolonged periods may lead to fatigue of eyes leading to formation of double images which would affect the results of this study. The subjects were asked to remove any make-up. They were then seated upright on a chair in the semi-open grey box at the eye-level of the observers. They were facing an open window during the shade selection under sunlight. The observers then selected the shade for maxillary central incisors of the subjects (Figure 4). This was carried out during daytime from 11 am to 1 pm. All the data was recorded in the form of an excel sheet.

Shade selection using SMILE LINE shade matching light
The observers selected the shade using the SMILE LINE with the polarizing filter attached to it that was provided in the kit. The shade matching device was kept at a distance of 15 cm as instructed in the manual. The subjects were seated in the grey box with makeup removed. The maxillary central incisor of the subject and the shade tabs were both viewed from the hand-held SMILE LINE shade matching instrument (Figure 5). The shade indicated by the observer for each subject was noted. All the data was recorded in the form of an excel sheet.

Shade selection using dental chair light
The grey box was moved to cover the dental chair on three sides at the back and the open end covering the head end of the dental chair. The dental operatory light was switched on and the light was positioned such that it was at a distance of elbow reach from the operator. The VITA Classic shade guide was then used to select the shade of the maxillary central incisor (Figure 6) and the values were again noted in the excel sheet.
Figure 4. Shade matching under sunlight (a) hue selection (b) chroma and value selection. Permission to use the images of the participants and observers in the presentation of this data was obtained via a written informed consent.

Figure 5. Shade matching under SMILE LINE Shade Matching Light (a) hue selection (b) chroma and value selection. Permission to use the images of the participants and observers in the presentation of this data was obtained via a written informed consent.

Figure 6. Shade matching under Dental chair light (a) hue selection (b) chroma and value selection. Permission to use the images of the participants and observers in the presentation of this data was obtained via a written informed consent.
There were no drop outs in this study as it was carried out in a period of six months. During this period, for all the participants qualified for the study, shade of maxillary central incisor was selected under the three illuminants on different days. The obtained data in the form of a master chart was then analyzed statistically for comparative evaluation of the shade matching device and dental chair light to sunlight.

**Statistical analysis**

Statistical analysis was done in SPSS software using the Kappa (κ) statistics for measuring the intra-observer variation of shade selection under two illuminants. Kappa statistics is the ratio of the number of times there is an agreement between two values. For this case it was the agreement between the shades selected under sunlight and shade selected under shade matching light. The second kappa ratio was for the agreement between the shades selected under sunlight and dental chair light. The agreement of data is complete when the value κ is 1, and no agreement when it is 0. Value more than 0.60 is considered a significant relationship, values less than 0.6 is an indication that the agreement is insufficient.

**Results**

The number participants that participated in this study were 125 for each prosthodontist. The total of 200 students from 1st BDS and 2nd BDS were examined for their eligibility and hence the 125 participants that satisfied the inclusion criteria were selected. The same 125 participants were then followed up in this study. In case if any participant was not present on the particular day of data collection, the participant was followed up by author RK who made sure the participant shade was selected by all five prosthodontists under three illuminants.

**Table 1. Comparison of effects of the two light sources with sunlight for observers 1 to 5.** DCL (Dental chair light), SML (Shade matching light).

<table>
<thead>
<tr>
<th>Observer/Kappa Statistics</th>
<th>Kappa value for DCL vs Sunlight ± Standard error</th>
<th>Kappa value for SML vs Sunlight ± Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer 1</td>
<td>0.162 ± 0.042</td>
<td>0.672 ± 0.062</td>
</tr>
<tr>
<td>Observer 2</td>
<td>0.155 ± 0.041</td>
<td>0.298 ± 0.056</td>
</tr>
<tr>
<td>Observer 3</td>
<td>0.087 ± 0.031</td>
<td>0.630 ± 0.063</td>
</tr>
<tr>
<td>Observer 4</td>
<td>0.261 ± 0.053</td>
<td>0.630 ± 0.063</td>
</tr>
<tr>
<td>Observer 5</td>
<td>0.190 ± 0.049</td>
<td>0.702 ± 0.060</td>
</tr>
</tbody>
</table>

**Figure 7.** Comparison of Kappa values for all observers with the value of significant agreement of relationship of 0.6.
Number of female participants were 95 and number of male participants were 30. The potential confounders in this study were eliminated during the selection process of the participants and observers. The 125 participants underwent the shade selection process by five prosthodontists. Under each prosthodontist, the participants underwent shade selection by three observers. Please see Underlying data for the full results.

Following the statistical analysis, the $k$ value for observers 1, 2, 3, 4, and 5 was found to be 0.162, 0.155, 0.087, 0.261, and 0.190 for the tungsten light of dental chair (Table 1). The $k$ value for the Shade matching device (SMD) for observers were 0.672, 0.298, 0.638, 0.630, and 0.702 calculated for 1, 2, 3, 4, and 5 (Table 1). This $k$ value is significant for four out of five observers with the highest for observer 5 when compared with the value of significant agreement which is 0.6 (Figure 7).

Discussion

The selection of shade is an important step for completion of a restoration as performed by an observer on the subject. In our study, the subjects included were the ones that do not have any abnormality with the maxillary central incisor such as any restoration, crown, fracture or discoloration. Selection of observers was done based on their colour discerning ability tested through the PIP (pseudo-isochromatic test) and Ishihara tests. All observers passed both the PIP test and the Ishihara test and hence were qualified for our study and the above mentioned complication was avoided.

Experience matters in selecting a shade as the ‘eyes’ do not see what the ‘mind’ does not know. The authors Ristic et al., Sellen et al., and Sproull have suggested that the accuracy of selecting a shade improves when the observer is experienced. Dr. Sproull stated that the study of colour and its perception comes with experience and training. A trained individual would understand the phenomenon of colour, the properties of the tooth, and leading to better selection of shade. In the study by Ristic et al. they educated the observers regarding the procedures of shade selection and the appropriate terminologies. This education regarding shade selection proved to be beneficial for the observers as their ability to select shades improved. Nakhaei et al. stated that the experience did not affect the shade selection when the 3D Master shade guide was used as compared to VITA Classic shade guide. The observers in this study were prosthodontists with minimum experience of four years. They were informed about the procedure to be followed for selection of shade.

Perception of the tooth colour is also influenced by the background colour or the colour of the operator. Several studies have suggested numerous colours to be used for background. The colours black, white, blue, pink, and grey have been reportedly used on various occasions. The white background enhances the reflections providing an increase in value and the black increases the contrast. Conversely when we stare at a black background the receptors for back colour will fatigue and a white after image is seen when we look away. The use of pink background was justified for use as it is the combative colour. Use of blue coloured background will then cause the blue receptors to fatigue and the complementary orange colour will be seen in the after images. All these backgrounds in fact, have a disadvantage that they will initiate a change in colour in the retina in their respective complementary shade. This is a property of the eye and colour vision that these complementary colours then cause a distortion of the retinal receptors such that the complementary colour perception is affected. Grey does not have a complementary colour and hence will not cause any change in the perception of other colours. Hence, the use of a grey background, which is a true neutral colour, was selected.

The common mode for selection of a shade is by the means of a shade guide. The VITA 3D Master shade guide and VITA Classic shade guides are popular among dentists. Studies have revealed that the use of VITA Classic shade guide is more reliable, popular, and accurate for selection of shade than 3D Master. Although the studies by Paravina and Ongul et al. support the VITA 3D Master shade guide, due to its consistent and systematic shade variation in the colour spectrum, this shade guide is difficult to use especially if the operators are not well versed with the procedure and steps to use it. According to the study by Dudea et al. the VITA 3D Master shade guide causes fatigue owing to increased number of shade tabs than the VITA Classic shade guide. The time taken to select a shade for any tooth subsequently decreases as the number of shade tabs to choose from decreases. The VITA shade guide was also tested for its reliability when compared to reliability of the 3D Master shade guide by Kim-Pusateri et al and found no difference between the two. Considering the popularity of VITA Classic shade guide it was used for this study. The order of the VITA shade guide was rearranged by the value in the present study as suggested by Pizzamiglio. This arrangement was done first by selecting the maximum hue of the four groups – A4, B4, C4, and D4. This was to be followed by selecting the chroma and value in the respective selected group. This method of shade selection was used for this study.

For the elimination of the subjective errors of visual shade matching, various instruments such as spectrophotometers, spectroradiometers, colourimeter, and photographic methods have been...
used in various studies in literature. However, visual shade selection is the method of choice that is routinely performed by dentists due to its ease as the other methods can be inconsistent. Lagouvardos et al in their article stated that the L*a*b* values and displayed shades by colourimeter and spectrophotometer were different. This concludes that the inter device reliability of the instruments is not sufficient. The study by Kim-Pusateri et al also concluded that the devices have dissimilarity in their shade selection. Hence, the visual method was used for the study.

Effect of the incident light has been studied in the past but these experiments have been carried out comparing the shade tabs of shade guides. The observers in these studies were asked to select a shade of a blinded shade tab with the shade guide. The detriment of this study design is that the shade tabs are inconsistent in their coverage of tooth shades in the population as mentioned by Ahn and Paravina. The shade tabs are made up of ceramics that have different optic nature when compared with the natural teeth. A difference is also found in the perception of the shade of the shade tab and the natural tooth. Incident light on the surface of ceramics produces optical sensation in the eye that is unlike the tooth. Studies conducted on the ceramic shade guides cannot validate the accuracy of shade on natural teeth. Perception of the colour of a tooth is affected largely by metamerism and the surface characteristics of a tooth as well. So natural teeth were used for shade selection in our study.

Digitalization in dentistry has given us a range of instruments that will match shades within seconds with precision. These devices however are costly and can be out of reach of a regular dentist. The visual method of shade selection remains to be the most popular aid for shade selection. The critical appraisal by Paravina justifies the superiority of visual shade matching. The observer’s perception is a major influence on the selected shade as it is ultimately the patient himself who will perceive the colour of the restoration with their eyes.

Illuminant plays an important role in selection of the shade. Sunlight is considered as the gold standard for shade selection. The temperature of sunlight is 5000K which is a quality that we look for in an alternative light source. This study was conducted to evaluate the effect of two illuminants on shade matching of the maxillary central incisor with the help of experienced Prosthodontists. The illuminants selected were dental chair light (DCL), and Shade Matching Light (SML). Light is a major determining factor for shade matching and there have been various studies regarding the ideal source of light for selection of shade of a tooth. The effect of an illuminant on the shade of a natural tooth changes the accuracy of the selected shade. Shade matching under a light source comparable to sunlight is recommended by many authors. Although the D65, D55 sources are ideal near the daylight, considering the cost it maybe unaffordable for some dentists. A light source needs to be easily available, easy to operate and accurate enough to allow their mass usage. The SMILE LINE shade matching device has the temperature of 6500K which is similar to that considered as ideal or near sunlight. Hence this light source was selected to carry out our study which offers an economic option as against the other illuminants.

This study compared the accuracy of dental chair light to that of sunlight which was taken as the standard illuminant. The kappa statistics for the dental chair light were 0.087, 0.155, 0.162, 0.190, and 0.261 that indicated insufficient agreement for similarity for the observers, which can be referred back to the temperature of these lights. The dental chair light is usually a tungsten-based light in the older dental chairs. The newer LED lights have also been incorporated in the dental chairs that overcome the lower temperatures of the tungsten-based lights. The dental chair light and its inefficiency have been established in the literature in previous studies. These studies stated that these lights are either inclined towards red or blue spectrum. The temperature of the tungsten/incandescent light is lower than that of the ideal conditions and hence it causes a mismatch due to variation in the perception. Thus the shade matching light could not attain similar results in the selected shade when compared with sunlight.

The shade matching similarity, as calculated using Kappa statistics, between the Shade matching light (SML) and sunlight was found to be significant for all the 5 observers. The Kappa value was found with strong correlation for observers 1, 3, 4, and 5; whereas the agreement was slight for observer 2. These results are in agreement with the studies performed by Cural, Göke, Jouhar, Berger, and Carsten. The authors concluded that the shade selection performed under the shade correcting devices used in their respective studies was significantly better than the shades selected under sunlight. These studies were conducted on various shade correcting instruments however, the use of the SMILE LINE shade matching light was not mentioned. Hence this shade correcting light was selected for this study. The authors suggested the use of a light correcting device for selecting colour of teeth as the sunlight is inconsistent in nature. This inconsistent nature of sunlight is attributed to place, time of selection, clouds, and pollution.

Although the sunlight is considered as the ideal source of light for selecting shades, there are occasions when adequate amount is not available. The selection of shade itself might not be performed during the day. In such conditions, we can opt for a light correcting device for selecting tooth shades and get results that are esthetically pleasing under sunlight.
Within the constraints of this study the limitations are:

1. The means of visual method for shade selection used in this study can be biased due to the lighting conditions, background colour, mood of the observer, and colour perception of the observer himself.

2. Although VITA Classic shade guide is more user friendly, the VITA 3D Master shade guide has been proved to more vastly cover the spectrum of shades which can be taken up for further evaluation.

3. The use of digital devices can be performed to compare the accuracy of shade selection in further studies.

According to the results obtained in this study, the shade matching light is comparable to that of sunlight and hence can be used as a substitute of sunlight while selecting shade. The results suggest that shades selected under this light had significant similarity, as calculated by Kappa ratio, to the shades selected under sunlight for four out of five observers.

To summarize the findings of this study we can state that there is a strong correlation between the shades selected by the observers under shade matching device and the shades selected under sunlight with the kappa value of 0.5864 (average for the five observers).

**Recommendations**

The selected shade for a tooth using shade correcting light is significantly similar to the shade selected under sunlight. Out of five observers considered for shade selection, four had strong correlation between the shades selected under sunlight and shade corrected light suggestive of the same. The shades selected under dental operatory light showed very less correlation with the shades of the tooth selected under sunlight. As quoted correctly, to disguise the art in nature is the supreme form of art. The ideal conditions for selecting a shade should be created for each case that will lead to perfectly matched restorations and prosthesis. This can be achieved using the a shade correcting device.

**Data availability**

**Underlying data**


This project contains the following underlying data:

- Thesis data.csv (data sheet of the shades selected by five observers under sunlight, dental chair light, and shade matching light).

**Extended data**


This project contains the following extended data:

- STROBE-checklist-v4-cross-sectional.doc.

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

**References**

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