Recognition of veneer restorations by dentists and beautician students

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Summary Three types of veneer restorations (VRs) were evaluated for recognition by two groups of observers to study the aesthetic result. The different types of VRs were: porcelain, direct resin composite and indirect resin composite. One month after insertion of the VRs, colour transparencies were made of smiling patients randomly selected from a group of 112 patients participating in a clinical trial. The slides were evaluated by five dentists who were not familiar with the patients and by 25 beautician students (BS). Dentists were asked to locate the VRs which were present in the patients and to specify the type of VR. BS were only asked to locate the VRs. To trace a possible relationship between the aesthetic result of the treatment and a number of variables, ANOVA was applied to evaluate the variables: ‘discolouration of the teeth’ before treatment, ‘type of VR’ and ‘number of VRs’. Agreements in judgement were expressed in Cohen-Kappa coefficients. The results showed that the dentists could locate the VRs quite well (Kappa coefficient 0.64 ± 0.28) but for BS this was lower (Kappa coefficient 0.43 ± 0.27). The more VRs were made in one patient, the more difficult it was to locate them correctly. The other variables had no significant effect on the recognition of the VRs. It was not possible for the dentist observers to differentiate between the types of VRs.

Introduction

In recent years the aesthetics of the dentition have become increasingly important and influenced modern restorative dentistry.

What is ‘aesthetic’ and ‘unaesthetic’? The connotation according to Lombardi (1973) is that ‘something is seen which is pleasant or unpleasant’. Pilkingon (1936) described the term ‘aesthetics’ as synonymous with a natural and harmonious appearance. In reality, the relation of aesthetics and cosmetics to oral health, and more particularly to dental health behaviour, is extremely complex and involves many social, cultural and psychological dimensions that are not clearly understood. What is considered ‘beautiful’ in one culture or person, may be ‘ugly’ in another. For example, grinding of teeth to short points as practised in some primitive cultures is considered beautiful only in those specific cultures. Every day patients are overloaded with information through television programmes, films and magazines and in this way a certain aesthetic standard is developed. Their concept of beauty is being moulded constantly.

A number of studies have documented the salutary effects of attractiveness on interpersonal relationships (DeWitt, 1980; Graber & Lucker, 1980; Shaw et al., 1985). The conclusion of these studies is that appearance is a key element in social interaction and success. Apparently, people such as Shakespeare’s Richard III are believed to have personalities as unattractive as their bodies. The consistency in human awareness of, and agreement on, attractiveness across age, social status
RECOGNITION OF VENEER RESTORATIONS

and sex is remarkable. In females the face correlated most highly with judgment of overall attractiveness by both male and female subjects. With respect to the face, the majority of studies identify two key features: the eyes and the mouth (Goldstein & Mackenber, 1966; Friedman, Reed & Carterette, 1971; Terry & Davis, 1976; DeWitt, 1980).

In many cases untrained observers can identify a denture as a result of monotonous tooth positions, contours and shades. Until now prosthodontic techniques required the maxillary occlusion rim to be contoured and adjusted to determine the proposed length of the maxillary incisors. Vig & Brundo (1978) studied the relationship between lips and teeth in persons of all ages with natural dentitions and recorded the changes that occur with ageing. They found a gradual reduction in the amount of maxillary central incisors exposure with an increase in age accompanied by a gradual increase in the mandibular teeth exposure.

The most important factors which may influence the aesthetic appearance of teeth are the visibility, colour, shape and position. The amount of exposure of maxillary anterior teeth differs between individuals and has a range from a so-called ‘high smile’ or ‘gummy smile’ which shows a contiguous zone of gingiva, to a ‘low smile’ which displays less than 75% of the anterior teeth (Tjan, Miller & The, 1984). Amongst others, factors such as age, gender and lip lengths have influence on the visibility of the anterior teeth (Vig & Brundo, 1978; Chrispin & Watson, 1981). The visibility of teeth has been studied by different investigators and is not the subject of this report (Vig & Brundo, 1978; Chrispin & Watson, 1981; Tjan et al., 1984; Wichmann, 1990). The other three factors mentioned are clinically related to the teeth and may be altered by restorations such as a veneer restoration (VR).

The porcelain veneer is a popular technique worldwide. Porcelain has always been the material of choice when aesthetics was of importance as the translucent characteristic of the porcelain is ideal to mimic tooth structure. Porcelain restorations have also been studied by different investigators and is not the subject of this report (Vig & Brundo, 1978; Chrispin & Watson, 1981; Tjan et al., 1984; Wichmann, 1990). The other three factors mentioned are clinically related to the teeth and may be altered by restorations such as a veneer restoration (VR).

application of a different polymerization technique which will result in a higher degree of cure. Some of the physical characteristics may be improved.

A good aesthetic result is achieved when the restoration cannot be distinguished from untreated neighbouring teeth. In these cases the colour, structure and shape look natural. The aims of the present study were to assess whether veneer restorations can be distinguished from natural teeth by a panel of dentists and one of beauticians; the panel of dentists could distinguish between three types of veneer restorations; and if there was a difference between the recognition of veneers placed on discoloured teeth and veneers made for other reasons.

Materials and methods

This study is part of a clinical trial which was designed to compare three types of veneer restorations: (1) porcelain veneer restoration (P)*; (2) direct resin composite veneer restoration (DC)+; and (3) indirect resin composite veneer restoration (IC)†.

In total, 263 veneer restorations were placed in 112 patients under clinically controlled conditions. From this group 180 veneers were included in the clinical trial (Meijering et al., 1995). Each patient received only one type of VR, independently from the number (1–6 VRs per person). From each patient a maximum of two veneers made on upper incisors were included in the clinical trial. Before treatment, the teeth were assigned to three possible reasons for treatment: 62% of the teeth were assigned to the treatment reason of deviation of colour (discolouration), 14% to deviation of shape, and 24% to deviation of position. This diagnosis was undertaken by the principle investigator.

One month after insertion of the VR(s), colour transparencies were made of the smiling patient (Minolta X-700; Kodak ektachrome 200). Slides of smiling patients were used as this showed most of the teeth under normal conditions. A number of patients were randomly selected for this part of study. This resulted in a sample of 99 patients. The majority of the selected patients were female (77%) and the mean age of the group was 32 years. The slides were evaluated by two groups. Group A consisted of five dentists who

*Flexoceram®, Elephant Ceramics, Hoorn, the Netherlands.
†Silux Plus®, 3M Co, St Paul, MN, U.S.A.
‡Dentacolor®, Heraeus Kulzer GmbH, Wehrheim, Germany.
were neither familiar to the patients nor did they participate in the clinical trial as operators who made the VR. Group B consisted of 25 women who were studying to be beauticians. Beautician students were chosen to form the laypersons panel since they were expected to have eye for details in the appearance of people without having an exact idea of deviations in the appearance of the dentition. The panel of beauticians was chosen to be larger than the dentist panel because a much wider variety in data was expected in this group. Group A evaluated 99 patients and for practical reasons group B evaluated 42 patients, being a representative select sample from the 99 patients of group A. The evaluators were asked to locate the veneer restoration(s) which were present on one or more maxillary anterior teeth. They did not know the exact number of restorations made in the particular patients. The slides were shown to the dentists for 10 s after which they could write down their findings while the beautician students could look for 15 s at the slides. To measure the intra-agreement in the dentist group, 11 patients were shown twice. In group B, six patients were shown a second time. Second, the dentists were asked to specify the type of VR which was pointed out by the investigator. This time the dentists had 15 s to specify the material of the restoration(s). Teeth with crowns in their upper anterior region were excluded from the analysis.

**Statistical methods**

A Cohen-Kappa coefficient (C-coef.) was measured for each slide. If, for instance, a slide was recorded as 011000, where 1 is the presence of a VR and 0 is the absence of a VR, while the correct answer should be 010000, then the C-coef. was 0.57 for that slide. In this way the coefficient gives an indication of the agreement in judgment between the observer and the correct answer, and is adjusted for agreement expected by chance (Schouten, 1982). The C-coefs. were used for further analysis.

Agreements in judgment (correlation coefficient) between different observers (one by one) is expressed by the Pearson Correlation Coefficient (P-coef.). If two observers are in full agreement the P-coef. is +1, if they are in full disagreement it is −1. With the P-coef. it was possible to determine if observers gave the same judgment to the slides.

The reliability of the observers was expressed in

| Table 1. Average Cohen–Kappa coefficient values on the recognition of VRs for the dentist observers and beautician student observers (BS) |
|---|---|---|---|---|
| Group | n | Number of patients | Range | Mean | Standard deviations |
| Dentists | 5 | 99 | 0.57–0.68 | 0.64 | 0.28 |
| BS | 25 | 42 | 0.27–0.72 | 0.43 | 0.27 |

| Table 2. Classes of Pearson Correlation Coefficient (R) of the dentists observers and beautician students (BS) |
|---|---|---|
| Pearson score | % of dentists | % of BS |
| R ≤ 0.0 | 4 | 0 |
| 0.0 < R ≤ 0.2 | 30 | 19 |
| 0.2 < R ≤ 0.4 | 10 | 41 |
| 0.4 < R ≤ 0.6 | 30 | 31 |
| R > 0.6 | 30 | 5 |

Cronbach Alpha Coefficient (CA-coef.) and indicates if the Cohen–Kappa is a good sealing measure for recognition of veneer restorations. An analysis of variance (ANOVA) was applied to evaluate the difference of recognition between the dentists and the beautician students and to evaluate the influence on visibility of the following variables: (1) number of veneer restorations (1–6); (2) type of veneer restoration (P, DC, IC); and (3) discoloration of the teeth before treatment (yes/no).

**Results**

The average Cohen–Kappa values per dentist observer varied from 0.57 to 0.68 with a mean of 0.64 ± 0.28 as showed in Table 1. These values for C-coef. mean that the ability of the dentist observers to distinguish veneered teeth from natural teeth was moderate to substantial. The average C-coef. values per BS observer varied from 0.27 to 0.72 with a mean of 0.43 ± 0.27. This means that the ability of the beautician students to recognize VR was moderate.

The Pearson Correlation Coefficients (P-coef.) of the dentists varied from 0.04 to 0.65 and that of the beautician students from 0.18 to 0.80 (Table 2). To elucidate the wide variety in the beautician students group Table 2 presents the P-coef. of the beauty specialist students and dentists in classes. The reliability of the dentist observations was found to be almost perfect.

The Cronbach's Alpha coefficient was 0.86 for the dentists and 0.93 for the beautician students. A high CA-coef. indicates that the C-coef. is a good measurement for visibility of VRs. However, the wide variety of the P-coef. shows that the agreement between observers is not always high. In an ANOVA model the difference between the two groups was tested. The dentists recognized the VRs significantly better than the beautician students (P < 0.001). Because of possible interactions between the groups and explanatory variables, for each of the groups the effect of ‘number of VR’, ‘type’ and ‘discolouration’ was tested in a three-way ANOVA model without interactions.

Table 3 shows that the presence of discolouration of the teeth before treatment had no significant effect on the recognition of the veneer restoration by dentists and beautician students. Also, the type of VR(s) had no significant effect for both groups of observers. The effect of the number of veneer restorations was found to be highly significant (P < 0.001) in the dentists group and not in the beautician students group.

A number of slides were shown in duplicate to measure the intra-observer agreement. This was 85% for the dentists and 77% for the beautician students. The results of the second part of this study (recognition of type VR) revealed that the recognition of type of VR was equal to the recognition expected by chance. Duplicate measurements showed that the intra-observer agreement was 47%. It is concluded that the dentist observers were not able to recognize the different materials that were used for the veneers.

Discussion

The use of colour slides for aesthetic evaluation has been studied by Glass (1978). He found a close relationship between judgment of the appearance of adults made from live stimuli and those made from colour photographs of the same project. He also showed a close relationship between judgments made from colour photographs and from projected colour slides.

In several studies dealing with aesthetics in dentistry, Ryge criteria (Ryge & Snyder, 1973; Ryge, 1980) were used as the evaluation method. This rating system, based on an operational approach, has been developed for quality assessment of dental restorations. With this method the restoration is examined for three characteristics: surface and colour; anatomic form; and marginal integrity. The examining dentist uses specific criteria that lead to the rating (by specifying a key word) in order to assign the restoration to a category. The use of keywords in addition to the rating is a shorthand method for recording the specific reason for rating the restoration. Although these factors are related to the aesthetic appearance, they do not offer an index for aesthetic appearance. For this reason we consider the Ryge criteria unsuitable for aesthetic judgment.

Several studies of facial or dental attractiveness as well as aesthetic indices have been published in the literature (Albino, 1981; Tedesco et al., 1983a,b; Howells & Shaw, 1985; Evans & Shaw, 1987; Cons et al., 1989; Lobb et al., 1994). The concept of facial aesthetics has been of primary interest and concern to orthodontists. Above and beyond their obvious goal of rectifying malocclusion, orthodontists are also interested in profile correction (DeWitt, 1980). Many of the studies of facial or dental attractiveness have an orthodontic background. The factors which were measured were, for example, position of the teeth, diastema and relation between the maxilla and mandible. In some studies a panel gave a judgment about the aesthetics of a face or the teeth in terms of acceptability (Howells & Shaw, 1985; Kerr & O'Donnell, 1990). These indexes are also considered unsuitable for aesthetic evaluation of restorations.

The reason for the lack of research material on dental aesthetics is not the lack of interest in the subject but the difficulty of measuring precisely what ‘dental aesthetics’ means. How does one measure aesthetics? Aesthetics is a judgment commodity, and the assumed variability in individual judgments, “beauty is in the eye of the beholder”, makes it difficult to make generalized statements (Graber & Lucker, 1980). In our society ‘beauty’ is related to recognition. If a good crown is placed in a mouth with irregular and/or discoloured
teeth, the crown will be recognized and the restored dentition will not be seen as nice or acceptable.

In this study we tried to give an objective judgment on the aesthetic appearance of restored teeth by asking panels to locate the veneer restoration(s) instead of asking for an opinion on the aesthetic appearance or to judge only the colour or shape. Every act of seeing is a judgment and the different factors cannot be examined individually (Lombardi, 1973). As a result, the mind is constantly interpreting the relationships of objects to each other. The assumed superiority of the aesthetic properties of porcelain was not confirmed in this study. Perhaps, in the long term, differences can be found between the aesthetic appearance of the materials. The ages of the restorations studied might be too short as fatigue-related effects were not included in this study.

Conclusions
The results of this study showed that there were no differences in aesthetic appearance between the three different types of veneer restorations at the baseline of this study. However, the recognition amongst the dentist observers in case of one or two veneer restorations was relatively high. The more veneer restorations were inserted in one patient, the more difficult it was to locate them correctly. In view of the significantly different level of recognition between the dentists and the beautician students, we concluded that the knowledge of the observers is a rather important factor. Other investigators also found a difference between the results of laypersons and professional persons (Prahl-Anderson et al., 1979; Brisman, 1980). We consider that ‘recognition’ is a useful indicator for an aesthetic appearance, since this method gives information about deviations from the normal.

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References
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RECOGNITION OF VENEER RESTORATIONS


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