Opacity of glass-ionomer cements

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The translucency of the first generation of glass-ionomer cements to appear on the market was too low to be cosmetically satisfactory. In the present study the opacity of newer editions of glass-ionomer cements was evaluated and compared with that of a well-known composite resin. Disc-shaped specimens were placed on black and on white backings, the luminous reflectances measured and corrected to a specimen thickness of exactly 1 mm, whereafter the contrast ratio was calculated. The newer glass-ionomer cements were found to be more translucent than the first generation of glass-ionomer cements on the market. However, the opacity still needs to be reduced to reach the level of a composite resin. It was further established that early water contact results in a considerable increase in opacity. □ *Translucency; dental materials; operative dentistry*

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The glass-ionomer cements constitute a group of materials capable of bonding to the hard dental tissues (5, 7). As a consequence, the glass-ionomer cements may be used for the restoration of Class V and cervical erosion cavities without the preparation of retentive undercuts. However, the translucency of the first brand on the market was too low to be cosmetically satisfactory (1, 3). Later, other brands have been marketed. It was the purpose of the present work to evaluate the opacity of various glass-ionomer cements and to compare the results with the opacity of a well-known conventional composite resin.

Materials and methods

The materials listed in Table 1 were investigated.

The contrast ratio was used as a measure of opacity. The contrast ratio was investigated on disc-shaped specimens produced in brass molds ($h = 1$ mm, $d = 15$ mm). The materials were mixed at room temperature in accordance with the directions of the respective manufacturers, placed in a mold, covered with tin foil, clamped between glass plates, and allowed to cure for 10 min in air at 37 ± 1 °C and ambient relative humidity. The glass plates were then removed and the specimens—still covered by tin foil—placed in air at 37 ± 1 °C and 100% relative humidity. Twenty-four hours later the tin foil was peeled off, and the specimens were separated from the molds and stored in water at 37 ± 1 °C for 7 days. Then the specimens were removed from the water and wiped dry with lens paper. Immediately thereafter the luminous reflectance was measured, with the specimens placed on a white and on a black background. Luminous reflectance was measured by means of a Hunterlab D25-A colorimeter (Hunterlab, Fairfax, Va., USA). The luminous reflectance of the white and the black backing was $Y = 0.85$ and $Y = 0.00$, respectively. After the reflectance measurements the thickness of each specimen was measured by means of a micrometer. Using the Kubelka equations as cited by Miyagawa et al. (6), we calculated the luminous reflectance on black and white backgrounds for specimens of a thickness of exactly 1 mm. From these values the contrast ratio was calculated as the ratio between the reflectance on the black and on the white background.

Table 1. List of materials used in the investigation.

Name	Color	Batch no.	Manufacturer
ASPA	1: Very light yellow	Powder: UG6PUH Liquid: UE2UF	Amalgamated Dental, London, England
ASPA	5: Medium greyish yellow	Powder: UA30PUB Liquid: UE2UF	
Fuji II	21: Pale yellow	Powder: FC 8 Liquid: FL 8	G.-C. Corp., Tokyo, Japan
Fuji II	28: Pale grey	Powder: FL 28 Liquid: FL 8	
Fuji II	23: Dark brown	Powder: FC 11 Liquid: FL 8	
ChemFil	2: Light yellow	AF 42 81/07	Amalgamated Dental, London, England
ChemFil	4: Light grey	AF 48 81/07	
ChemFil	5: Yellow	AA 15 P 81/06	
ChemFil	7: Yellow grey	AB 30 P 81/06	
Concise	U: Universal	Paste A: OY 20 Paste B: OX 10	3 M Co., Minnesota, USA

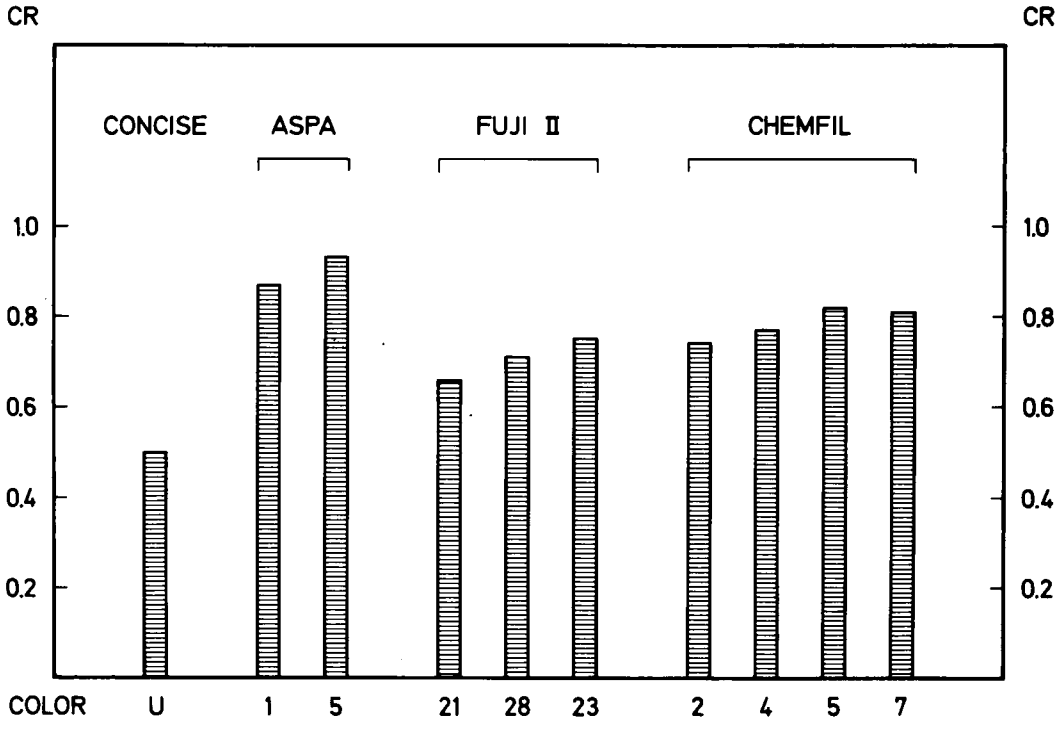

Fig. 1. Contrast ratio (CR) of a composite resin and three brands of glass-ionomer cements. The color designation of the materials is given below the diagram.

For each material the contrast ratio was investigated on three specimens.

In an additional series of measurements using Fuji (color 21) and ChemFil (color 2), the specimens were not placed at 100% relative humidity but stored in water after the 10 min of initial cure. After 7 days in water the contrast ratio was measured as described above.

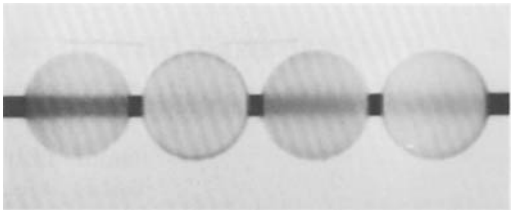

Fig. 2. Illustration of the opacity of four materials. From the left the materials are Concise (color U), ASPA (color 1), Fuji (color 21), and ChemFil (color 2).

Results and discussion

The main results are presented in Fig. 1. For each material the mean value of the three measurements is given. The pooled standard deviation calculated from the ten sets of measurements is $s = 0.02$ with $f = 20$ (4).

It can be seen that ASPA is considerably more opaque than the restorative resin. This is in agreement with the findings of a previous investigation (2). Fuji is less opaque than ASPA, and, although the difference in contrast ratio between Fuji and ChemFil is statistically significant for certain shades, the difference is probably not important from a practical point of view. It further appears from Fig. 1 that the lighter the shade of a given brand of glass-ionomer cement, the less the opacity. Fig. 2 illustrates the opacity of the lightest shade of each of the investigated materials.

From the additional series of measurements it was established that early water contact of a glass-ionomer cement causes an increase in opacity: with Fuji (color 21) the contrast ratio increased from 0.66 to 0.82, and with ChemFil (color 2) the contrast ratio increased from 0.74 to 0.86. In both cases the increase is statistically significant. This finding supports the recommendation of the manufacturers that the fillings be covered with a varnish to prevent early water contact.

It may be concluded that the newer editions of glass-ionomer cements—Fuji and ChemFil—have about the same translucency, which, although higher than that of ASPA, still needs to be improved to reach the translucency of a conventional composite resin.

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References

1. Charbeneau, G. T. & Bozell, R. R. Clinical evaluation of a glass ionomer cement for restoration of cervical erosion. J. Am. Dent. Assoc. 1979, 98, 936–939
2. Crisp, S., Abel, G. & Wilson, A. D. The quantitative measurement of the opacity of aesthetic dental filling materials. J. Dent. Res. 1979, 58, 1585–1596
3. Flynn, M. Clinical evaluation of Cervident and ASPA in restoring teeth with cervical abrasions. Oper. Dent. 1979, 4, 118–120
4. Hald, A. Statistical theory with engineering applications. John Wiley & Sons, Inc., London, 1952, p. 287
5. McCabe, J. F., Jones, P. A. & Wilson, H. J. Some properties of a glass ionomer cement. Br. Dent. J. 1979, 146, 279–281
6. Miyagawa, Y., Powers, J. M. & O'Brien, W. J. Optical properties of direct restorative materials. J. Dent. Res. 1981, 60, 890–894
7. Shalabi, H. S., Asmussen, E. & Jørgensen, K. D. Increased bonding of a glass-ionomer cement to dentin by means of $FeCl_3$. Scand. J. Dent. Res. 1981, 89, 348–353