

**Development of new hybrid indirect composite resin for crown-TWiNY (Part 5) Durability** / Kato T, Yamada B, Nagai M, Yamamoto S (Yamamoto Precious Metal Co., Ltd.): This study deals with the impact resistance and toothbrush abrasion properties of a newly developed indirect composite resin (TWiNY) and of four commercially available indirect composite resins, in order to evaluate their durability. TWiNY showed the highest impact resistance among the resins examined and the equivalent abrasion property. These results indicate that TWiNY, which exhibits higher or equivalent durability in comparison to the commercially available indirect composite resins, is suitable for use on the molar.

[Abstract]

Among the many demands indirect composite resins face, achieving sufficient durability to withstand potential problems (such as abrasion and chipping) within the oral cavity is particularly vital. Chipping is considered to be caused by factors such as mastication impact and impact forces from opposing teeth acting on the molar inlay and jacket crown<sup>1)</sup>. Toothbrush abrasion and tooth attrition from opposing teeth have also been identified as contributory factors<sup>2)</sup>. In this investigation, the newly developed indirect composite resin<sup>3)</sup> is compared with four major commercially available indirect composite resins. Through repeated impact and abrasion tests, the impact and abrasion resistance of each of the resins is ascertained and compared.

[Materials and Methods]

1. Test specimens

In this investigation, the newly developed indirect composite resin DA3 (TWiNY (TW)) and four commercially available indirect composite resins DA3 (A, B, C and D) were used. Samples of each resin were loaded into a metal mold 15 mm in diameter and 1 mm thick. Each sample underwent polymerization curing according to the manufacturer's stipulated instructions. The sample surfaces were polished using water-resistant sandpaper (#2000) and then polished to a mirror finish using diamond paste, achieving a disk-shaped test specimen.

2. Measurement Method

For repeated impact tests, a collision abrasion testing apparatus (K655, manufactured by Tokyo Giken Co., Ltd.) was used. A stainless steel rod (diameter 4 mm) with a hemispherical tip was repeatedly dropped onto each test specimen affixed to the metal mold, applying an impact force of 6kg at the hemispherical tip to the test specimen. The number of times the impact force was applied until cracks appeared on the test specimen was confirmed visually. The toothbrush abrasion test was carried out in conformance with the ISO 14569-1 standard; surface abrasion was measured in Ra, using a surface abrasion measurement apparatus (SV-600, manufactured by Mitutoyo). Surface abrasion was applied at a loading weight of 2.0 N for a set number of brush strokes.

[Results and Discussion]

Figure 1 shows the number of times the impact force was applied until cracks appeared on the test specimen. The order in which cracks appeared on the resins under impact was A < D < C < B < TW. TW therefore displayed the most outstanding durability among the test samples compared in this investigation. It is therefore apparent that TW is the least likely of the resins tested to display crack formation under impact, and is the resin most suitable for use in contexts subject to repetitive compressive load, such as the molar. It is thought that the impact resistance values of TW and the other commercially available tested resins is influenced by their respective flexural strengths and fracture energy limits, which have already been compared and analyzed.

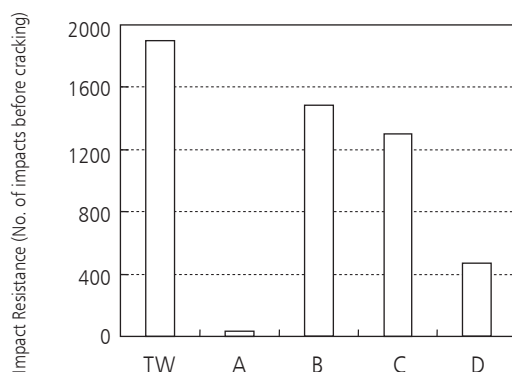


Figure 1: Number of Times Repetitive Compressive Load was Applied until Crack Formation

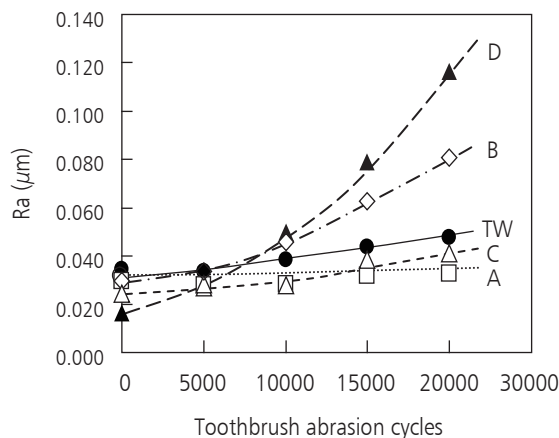


Figure 2: Surface Roughness by Toothbrush Abrasion Cycles

Figure 2 shows surface roughness by toothbrush abrasion cycles. No differences are apparent up to 10,000 cycles, but after 20,000 cycles, surface roughness was apparent in the order  $A < C < TW < B < D$ . The abrasion resistance displayed by TW was similar to that of A and C, and surface roughness increased only moderately as the number of abrasion cycles was increased, thus demonstrating adequate anti-abrasion characteristics. Differences by resin in toothbrush abrasion are thought to be influenced by differences in the resin hardness and filler particle diameter.

[Conclusion]

The newly developed indirect composite resin (TWiNY) displayed high impact resistance as compared with the other four commercially available products, while the comparison results for toothbrush abrasion for TWiNY were in line with most of the commercially available products. This demonstrates that TWiNY displays durability equivalent to or higher than that of the commercially available products, and that it is suitable for use on the molar.

[Reference]

- 1) A Hthag et al.: Journal of the Japanese Society for Dental Materials and Devices, 14(25), 90-91, 1995.
- 2) Kawahara et al.: Journal of the Japanese Society for Dental Materials and Devices, 6(6), 88-794, 1987.
- 3) Hoshikawa , Miyazaki, Kato, Anraku, Yamamoto: Japanese Patent Number: 4502673