

FujiFil LC/FujiFil LC Flow - restorative light-cured glass ionomer cement

Adhesion to Tooth Structure and Clinical Application

Toshimoto YAMADA, Jumpei SUGIZAKI,
Toranomon Hospital Department of Dentistry

Progress in dental cements

The development of adhesive dental cement started by D.C. Smith led to the development of glass ionomer cement by Wilson and Kent, changing the landscape for clinical dentistry, which had until then only been able to use zinc phosphate cement for luting and the silicate cement for restorations, opening a path for innovative dental cements that could adhere to hard tooth tissue. In the past 30 years dramatic progress was made in glass ionomer cements by GC, to the extent that the Fuji glass ionomer products have become the brand leader in clinical dentistry around the world. The clinical applications include lining, luting, restorative and fissure protection. About 10 years ago, light-cured resin technology was introduced and Fuji II LC was the first light cured glass ionomer restorative cement providing all the benefits of conventional glass ionomer cements such as tooth adhesion performance

and fluoride release and the added aesthetic advantage of looking very much like natural teeth. More recently, in an attempt to enhance the handling-characteristics of luting cements, easy-to-mix paste-paste products (Fuji CEM) were developed and are widely used in Europe and the USA as well as in Japan.

FujiFil LC/FujiFil LC Flow

GC has now developed a new range of paste-paste restorative cements FujiFil LC and FujiFil LC Flow in order to enhance restorative cement handling characteristics and to improve aesthetics. Characteristics of these new cements include even better aesthetics and translucency. After setting, the restorative material becomes a translucent material closer to enamel than any results with previous glass ionomer restorative cement. In addition a new "self-conditioner" has been newly designed to enhance adhesion to tooth structure.

A flowable glass ionomer has also been developed to make the cement easy to place in small and root surface cavities.

FujiFil LC consists of 2 pastes in a special cartridge pack. Paste A comprises fluoro-alumino-silicate glass, HEMA, dimethacrylate, initiator, and pigment, and Paste B contains polyacrylic acid, water, filler, initiator. FujiFil LC Flow contains similar ingredients but in different proportions. Both products are available in Vita Classic shades A1, A2, A3, A3.5, A4*, as well as CV, and blue (base cement). The self-conditioner consists of 4-MET, HEMA, water, and ethanol, and is applied to the cavity surface for 10 seconds, followed by mild air blowing. When using the self-conditioner the bond strength to the tooth structure is increased up to approximately 15 MPa. Without the self-conditioner, the adhesive strength is similar to that of previous glass ionomer cement.

Restoration using FujiFil LC



1 Maxillary canine cervical caries lesion before operation



2 Cavity preparation completed



3 Self-conditioner treatment (10 seconds), followed by mild air blowing



4 After filling with FujiFil LC cement (shade: A3.5)

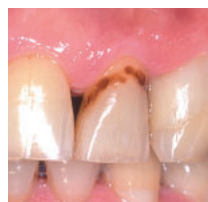


5 Light-cure (20 seconds)

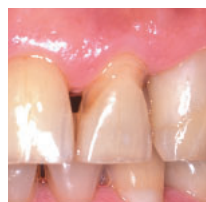


6 Completed restoration that is aesthetically pleasing.

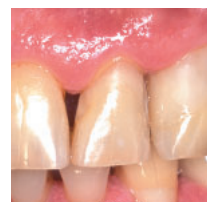
Restoration using FujiFil LC Flow



1 Root surface caries on a narrow part of a maxillary incisor cervical lesion before operation



2 Cavity preparation completed



3 Completed restoration that is aesthetically pleasing (Shade A3.5)

Observation of set cement and interface between set cement and tooth structure

FE-SEM observation of the interface between dentin and the set cement was conducted for these two new cements. All samples were subjected to argon ion beam etching. Figure 1 and Figure 2 show SEM images of FujiFil LC after setting. The observations show a fine cored structure with the fluoro-alumino-silicate glass core and the filler closely

distributed. Figure 3 shows an SEM image of FujiFil LC Flow after setting. The comparatively fine fluoro-alumino-silicate glass core is distributed in a rarefied manner. Figure 4 and Figure 5 shows the interface between FujiFil LC and enamel. The adhesion is very tight, and under higher magnification (x 20,000, Figure 5) and it can be seen that the polymer components of the cement matrix and the apatite crystals of the enamel rods are connecting. Figure 6, Figure 7, and Figure 8 show

the interface between FujiFil LC and dentin. The adhesion is very tight and under high magnification (x 20,000) in Figure 8 the polymer components of the cement matrix and the dentin are connecting, and furthermore, there is a layer less than 0.5 μm thick which can be described as a nanohybrid layer in the superficial layer of dentin. Figure 9 shows the interface between FujiFil LC Flow and dentin. Similarly, the adhesion is very tight.

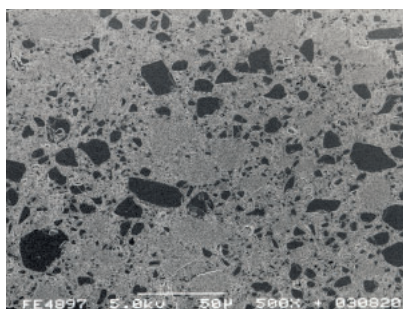


Fig 1. SEM image (x 500) of FujiFil LC after setting. Glass core and filler are distributed closely together in a variety of sizes.

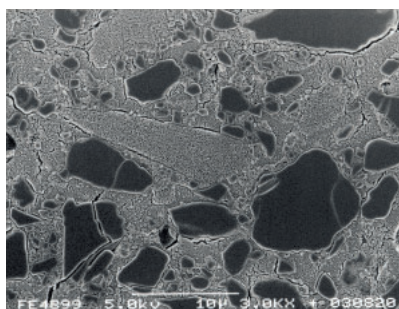


Fig 2. SEM image (x 3000) of FujiFil LC after setting. Glass core and filler can be clearly recognized.

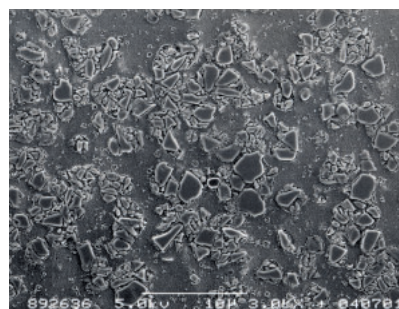


Fig 3. SEM image (x 3000) of FujiFil LC Flow after setting. Relatively fine fluoro-alumino-silicate glass core is distributed sparsely.

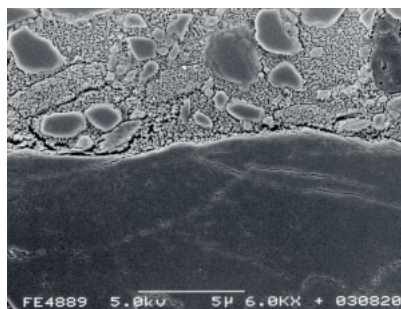


Fig 4. SEM image (x 6000) of the interface between FujiFil LC and enamel. Tight bonding can be seen.

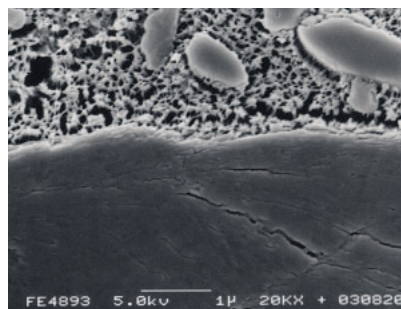


Fig 5. SEM image (x 20000) of the interface between FujiFil LC and enamel. It can be seen that the polymer components of the cement matrix and the apatite crystals of the enamel rods are connecting.

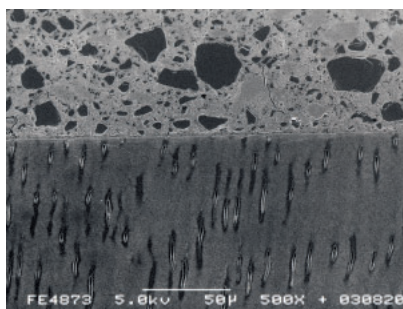


Fig 6. SEM image (x 500) of the interface between FujiFil LC and dentin. Tight bonding can be seen.

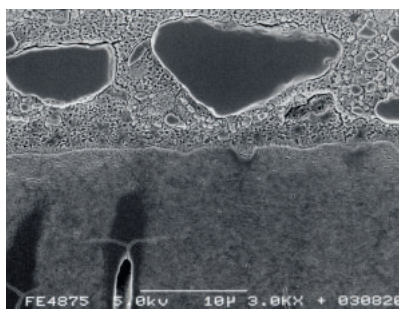


Fig 7. SEM image (x 3000) of the interface between FujiFil LC and dentin. Just above the dentin and with a form that is distinct from the cement matrix, a 2-3 micron layer can be seen that is a mix of primer and cement matrix.

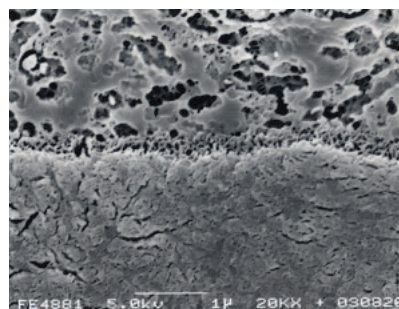


Fig 8. SEM image (x 20000) of the interface between FujiFil LC and dentin. It can be seen that the polymer components of the cement matrix and the dentin are connecting, and that the structure appears to have a layer of less than 0.5 μm thick, a nanohybrid layer in the superficial layer of dentin.

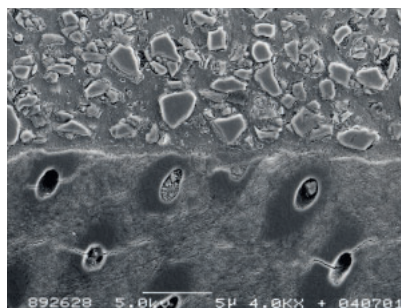


Fig 9. SEM image (x 4000) of the interface between FujiFil LC Flow and dentin. The bond is extremely tight.

Summary

New FujiFil LC and FujiFil LC Flow restorative light-cured glass ionomer cements are available as paste products; an innovative step in the history of dental cement. Their easy mixing and highly aesthetic results are features that make them innovative. The two new cements will bring a worldwide revolution of clinical practice for dental restorations, and contribute to enhancing people's oral health.

* Vita is a trademark of Vita Zahnfabrik Germany