

# Variations in Powder/Liquid Ratio of a Restorative and Luting Glass Ionomer Cement in Dental Clinics

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## ABSTRACT

A survey was conducted to ascertain the variations practiced in powder/liquid (P/L) ratio of Glass Ionomer Cement (GIC) used as restorative and luting material in dental clinics of Karachi. It has been observed that in the use of GIC brands, 33% (Fuji 2) and 36% (Gold Label 2) of the dentists, did not follow the recommended P/L ratios for restorative purposes. Similarly, 67% (Fuji 1) and 29% (Gold Label 1) did not follow the recommended ratios for luting purposes. The wide variations practiced in P/L mixing ratios against the recommended ratio for restorative purpose (~1:2) and that for luting purpose (~1:1 to 2:1) may affect the performance characteristics of the material.

**Key words:** Glass ionomer cement. Brand survey. Restorative material. Luting material. Powder/liquid ratio.

Glass Ionomer Cements (GICs) are widely used as restorative and luting material in dentistry. The merits of GIC include physicochemical bonding to the tooth structure, release of fluoride, and a better expansion coefficient.<sup>1-2</sup> The usage of glass ionomer as luting material has increased because of its adhesive property. Recent developments in the field include resin-modified GIC (RMGIC) and compomers. Conventional GIC and its derivatives all contain fluoroaluminosilicate glass and polyalkenoic acids, which undergo an acid-base reaction to form a cement, water being an essential component in this reaction.<sup>3</sup> An improper ratio of powder/liquid or powder/water affects the setting process of GIC, which may result in undesirable mechanical properties. Change in powder/liquid (P/L) ratio affects the compressive, tensile and flexural strengths of the restorative material.<sup>4</sup> The object of the present study was to conduct a survey of the use of different brands of GIC by dentists practicing in Karachi and to assess any deviations in practice from the manufacturers recommended P/L and powder/water (P/W) dispensing ratios.

A questionnaire was sent to 200 of the randomly selected dental practitioner in various localities of the Karachi. The queries on Glass Ionomer Cement (GIC) pertained to different brands application by the practitioners for restorative and luting purposes. The questionnaire required to record the specified brands

used along with their compliance to the recommended powder/liquid (P/L) and powder/water (P/W) ratios or otherwise.

Out of the 200 questionnaires distributed, 70% of the dentists responded. The most commonly used form of dispensing Fuji type 2 and Gold Label type 2 GICs for restorative purpose is powder/liquid (P/L). Among the dentists using the Fuji type 2, 75% used the P/L form, 18% powder/water (P/W) form and 7% encapsulated form. Among the dentists who preferred using Gold Label type 2, 84% used P/L form and 8% each P/W and encapsulated form, respectively, for restoration. The proportion of dentists using the manufacturers' recommended ratio to that of the dentists using their own ratios of P/L dispensing for Fuji 2 and Gold Label 2 was approximately 2:1 on the basis of use by 67% and 33%, 64% and 36% dentists respectively (Table I).

The most commonly used dispensing for Fuji type 1 and Gold Label type 1 is P/L form. Among the dentists using Fuji 1, 76% used the P/L form, 17% P/W form and 7% encapsulated form. Out of the practitioners, who preferred Gold Label 1, 62% used P/L form, 30% used P/W form and 8% encapsulated form. The proportion of dentists using manufacturers' recommended ratio to that of the dentists using their own ratios for P/L form of Fuji 1 and Gold Label 1 is approximately 1:2 and 2.5:1, respectively (Table I).

In view of the development of GICs as new restorative and luting agents, the practitioners need to be aware of the effect of any change in P/L ratio on their physical and biological properties. This may be used to evaluate the clinical performance of these materials.

According to the survey for GIC restorative preparations, 67% of dentists followed the manufacturers' recommended ratios, whereas 33% preferred using their own P/L ratios in case of the Fuji 2, whereas for luting

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Received October 24, 2008; accepted June 9, 2009.

**Table I:** Dispensing and proportion used for Fuji and Gold Label GICs for restorative purpose.

Purpose/brand type	Percentage of dentists using P/L form	Percentage of dentists using P/W form	Percentage of dentists using encapsulated form	Manufacturers' recommended ratio for P/L	Percentage of dentists using manufacturers' recommended ratio	Percentage of dentists using their own mixing ratio
Restorative						
Fuji 2	75	18	7	1:1	67	33
Gold label 2	84	8	8	1:1	64	36
Luting						
Fuji 1	76	17	7	1:2	33	67
Gold label 1	62	30	8	1:2	72	29

procedures, 33% of dentists followed manufacturers' recommended ratios and 67% used their own ratios in the case of Fuji 1. The situation is different in the case of Gold Label. Protection of glass ionomer restorations depends on giving particular attention to the recommended procedures related to proper manipulation of cement components and following the manufacturers' recommended ratio. Glass ionomer luting cements may cause prolonged hypersensitivity, varying from mild to severe. Micro-leakage has been suggested as an explanation. The mechanical properties are affected as the P/L ratio decreases.

GIC is the most popular luting cement among all the luting materials used in dentistry. All the factors regarding the adhesive and mechanical properties of the cement are dependent on the mixing ratio. If the ratio is not properly maintained then one would not be able to manipulate the materials accordingly and will not achieve the proper results. Similar studies of variation in the ratios and their effect on flexural strength and other physical characteristics of the applied materials have shown that the higher powder content does not significantly affect the flexural strength, whereas increasing liquid content reduces the flexural strength.<sup>5</sup> In the present study, the dentists using variable P/L ratio have made qualitative observations on the adhesive strength of the material. This, however, needs to be confirmed by proper physical measurement. Studies conducted by other workers have shown that decreasing the powder content of the three hand-mixed GIC restoratives for a constant weight of liquid from that recommended by the manufacturer resulted in a progressive deterioration of the mean compressive strengths and the mean elastic modulus.<sup>6</sup> The other findings include the study of GIC manipulation to a P/L and P/W mixing consistency below the manufacturers' recommend ratio, for a constant volume of liquid, which resulted in reduction in the porosity levels of the cement mass, thus extending working and setting time.<sup>4</sup> The present observations are indicative of the unsatisfactory performance of the material, if not used according to the manufacturers' recommendations.

**Dental survey form**

Dentist's/Dental assistant's name:

Working location:

Glass Ionomer Cement (GIC)

● Restorative purpose

a. Brand's name:

Fuji 2    Gold Label 2    Other

b. Manufacturers' recommendation followed:

Yes    No

c. Dentist using own ratio:

Ratio (filling):

Dispensing: P/W    P/L    Encapsulated    Other

● Luting purpose

a. Brand's name:

Fuji 1    Gold Label 1    Other

b. Manufacturers' recommendation ratio followed:

Yes    No

c. Dentist using own ratio:

Ratio (luting):

Dispensing: P/W    P/L    Encapsulated    Other

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