Comparing the Loss of Reduction Rate between Synthetic Fiberglass and Plaster of Paris Casts in Pediatric Distal Forearm Fractures: a Narrative Review of the Literature

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Distal forearm fractures are one of the most common traumatic injuries experienced by children. For adequate reduction, many of these require manipulation under anesthesia and proper casting[1]. For over 100 years, Plaster of Paris (POP) has been the quintessential splinting material for fracture treatment. The material is known for its low cost and excellent molding properties. However, despite these favorable features, POP has several disadvantages such as its weight, extended drying period and messy application process[2]. In order to overcome the downside of POP, synthetic fiberglass (FG) casting was created. Introduced in the 1970s, FG provided patients with a light-weight and water-resistant cast that still maintained strong fixation. In addition, the fiberglass cast was more radiolucent and able to set at a lower temperature than POP, making it easier to use for the physician and more comfortable for the patient[3]. Despite the fact that FG casting has been in existence for nearly 50 years, minimal research exists comparing FG to POP in reduction of distal forearm fracture efficacy among the pediatric population.

To our knowledge, only one article to date examines the complication rates between POP and FG casts in the treatment of pediatric forearm fractures. Inglis et al conducted a randomized control trial in which patients were included in the study if they presented to the emergency department with a displaced fracture of the forearm (radius, ulna, or both) that required closed reduction and immobilization. After being assigned to either the FG or POP group, the patients were casted and underwent routine follow-up protocol at one and six weeks post casting. The primary outcomes measured were patient satisfaction and complications from casting[4]. After the conclusion of the study, it was determined that patient satisfaction was higher with FG casts due to a more comfortable fit, ease of use with activities of daily living, and lightweight durability[4-5]. Despite these findings, the data for loss of reduction differences between the two casts is limited. Out of the 198 patients enrolled in the study, 5 patients experienced a loss of reduction in POP casts (89 total), while 4 patients experienced a loss of reduction in FG cast (109 total)[4].

In addition to type of casting, there are several factors which contribute to optimal maintenance of reduction. One of the methods used is the Casting Index (CI). The CI is the ratio of sagittal to coronal width measured from the inside edges of the cast at the site of fracture. The optimal CI ratio is <0.8 which would result in an oval shaped cast (slightly longer coronal width than sagittal). In a study comparing CI ratios among pediatric distal forearm fractures using POP casting, a CI ratio >0.8 had a significantly higher rate of re-displacement at the 2 week follow-up[1].

Another factor that contributes to lower complication rate is cast durability. More specifically, in the study by Inglis et al, they noted lower complication rates in FG casting[4]. Unlike POP, FG casting is also water-resistant which becomes especially useful when treating the pediatric population. In a study by Cheng et al, it was found that the highest incidence of pediatric fractures was in the summer[6]. During the summer, the likelihood of sweat and participation in aquatic activities could contribute to more complications with the water intolerant POP casts.

Additionally, one of the important elements in the ability of the cast to maintain reduction is the mold-ability of the material so that a precise fit can be obtained. Proper molding is critical because if there is significant soft tissue swelling from the fracture, the cast will loosen substantially as the swelling resolves[7]. Daines et al compared POP, FG, and soft casts against each other in four different casting scenarios (clubfoot, developmental dysplasia of the hip, forearm fracture, and femur fracture) to try to identify which form of casting had the greatest mold-ability. They found that in the majority of the casting scenarios, POP was more precise than FG, and that FG was more precise than soft casts. However, the molding characteristics of the three casting materials was not significantly different for the forearm testing that they conducted[3].

In conclusion, there is a need for more data comparing POP and FG and, more specifically, the loss of reduction rates and possible contributing variables such as padding index, casting

index, three-point molding index, and degree of angulation. These additional studies could help identify scenarios where one type of casting may be preferred over another for clinical use.

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