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Clinical Note

# Upper extremity quad splint: indications and technique☆

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ABSTRACT

Patients experiencing high-energy trauma evaluated at level I trauma centers often present with multiple injuries and varying levels of hemodynamic instability. The polytrauma patient requires immediate assessment and stabilization of their orthopedic injuries once the primary trauma survey is complete, and oftentimes, operative fixation of injuries is delayed while patients are resuscitated by general trauma services. The authors describe the application of the upper extremity "quad" splint which includes components of a sugar tong, intrinsic plus, thumb spica, and dorsal extension blocking splint and its indication for patients with multiple upper extremity fractures distal to the humerus. This splint is efficiently applied using minimal material while simultaneously allowing for the stabilizing aspects of 4 splints commonly applied in the emergency setting.



## 1. Introduction

### 1.1. Sugar tong splint

The sugar tong splint is an upper extremity splint used in injuries where excessive pronation and supination may be detrimental to the injury pattern [1]. Specifically, the application of a sugar tong splint has shown to reduce pronation and supination up to 30% [1]. Common indications include acute distal radius fractures, distal ulnar fractures, both bone forearm fractures, and distal radioulnar joint injuries including those of the triangular fibrocartilage complex [2,3]. To apply, appropriately sized splint material (commonly plaster to facilitate molding) is measured from the metacarpophalangeal (MCP) joint dorsally around the elbow to the midpalmar surface volarly. Next, padding is applied with special attention to the bony prominences about the elbow. The splint material is applied, and a 3-point mold is performed to correct any dorsal or volar angulation in the fracture pattern. The sugar tong splint is used in both pediatric and adult populations and has been found to be up to 96% effecting in maintaining reduction of distal forearm fractures [4]. This splint does not block motion at the MCP joints.

### 1.2. Intrinsic plus splint

The intrinsic plus splint is most commonly used for fractures of the metacarpal bones or proximal phalanges with greater than 90% success in maintenance of reduction for nondisplaced fractures [5]. Depending on the affected ray, a radial (second or third ray) or ulnar (fourth or fifth ray) gutter may be used to immobilize the affected portion of the hand. To create an intrinsic plus splint, padding is applied to the appropriate digits, and a plaster gutter is placed either ulnarly (from the mid forearm proximally to the distal phalanx of the fourth and fifth digits distally) or radially (from the mid forearm proximally to the distal phalanx of the second and third digits distally) with the hand in the Edinburgh position [6]. Specifically, the wrist is placed at 0° to 30° of extension, the MCP joints at 70° to 90° of flexion, and the interphalangeal (IP) joints in full extension. The use of this position prevents contractures of the hand by placing tension on the collateral ligaments and has also been found to be useful in maintaining the reduction of metacarpal fractures [5,6].

### 1.3. Thumb spica splint

Thumb spica splinting is often used for injuries of the carpus or thumb where immobilization of the thumb is necessary [7]. These include fractures of the scaphoid, first metacarpal (Bennett and Rolando fractures), ulnar collateral ligament injury of the thumb (Skier's thumb), de Quervain tendinitis, or lunate injuries [7]. To create a thumb spica splint, padding is placed first followed by the application of a plaster strut radially from the forearm proximally to the IP joint distally, circumferentially around the thumb. For scaphoid fractures in particular, limited evidence suggests that a long arm spica extending more proximally on the forearm leads to faster rates of union for proximal scaphoid fractures compared to a short arm spica (9.5% vs 12.7%), although there is less evidence for spica length in the acute setting [8]. Similar to the Edinburgh position, the wrist is placed in 20° to 30° of extension, and the thumb is placed in a neutral position, inline with the radius and index finger.

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### *1.4. Thumb or finger extension blocking splint*

Extension blocking splints are used in the management of dorsal subluxations, dislocations, fracture subluxations, and fracture-dislocations of the proximal and distal interphalangeal (PIP and DIP) joints of the fingers and the IP joint of the thumb [9-11]. Extension blocking splints have also been used to manage volar plate injuries which are usually associated with hyperextension [9,12]. The purpose of an extension blocking splint is to maintain a congruent finger or thumb IP joint reduction while allowing for flexion to help reduce joint stiffness [9,12].

The extension blocking splint is created from a padded material such as an aluminum foam splint or from plaster or fiberglass that is padded with webril [13]. The material should be contoured on the finger to maintain IP joint flexion at 15° to 30° at the desired joint [9]. The splint length shoulder be extended as far as possible proximally and distally without restricting motion of the uninjured adjacent joints [14]. The MCP joint may need to be incorporated into the splint if it needs to be immobilized to maintain reduction of the injured joint [9]. Correct ligamentous stress at each joint incorporated into the splint allows full motion of the uninjured joints [14]. Serial radiographic imaging must be performed to confirm that joint congruence is maintained [9].

## 2. Case presentation

The authors encountered a 60-year-old man involved in a motorcycle accident who sustained multiple upper extremity injuries including a left radial styloid fracture, left ulnar styloid fracture, left first metacarpal fracture, and left thumb IP joint fracture-dislocation (Fig. 1A-C) as well as a pneumothorax and right fifth to seventh rib fractures. The patient underwent closed reduction of his thumb IP joint fracture-dislocation, followed by closed reduction of his first metacarpal fracture and radial styloid fractures. To maintain the fracture and joint alignment that result from closed reductions, the patient was placed in a sugar tong splint that extended to the tips of the fingers both volar and dorsal. A traditional 3 point "C" mold was applied to hold the radial styloid reduced while the metacarpals were flexed to 70° with the PIP and DIP joints of the finger joints were extended to reduce the first metacarpal similar to the intrinsic plus splint. A thumb spica extension was added to the radial aspect of the splint with the thumb metacarpal extended and the thumb IP joint flexed to act as both a thumb spica splint and dorsal extension blocking splint to prevent dislocation of the thumb IP (Fig. 1D-F). Written consent was obtained from the patient for use of his imaging and presentation in this report.

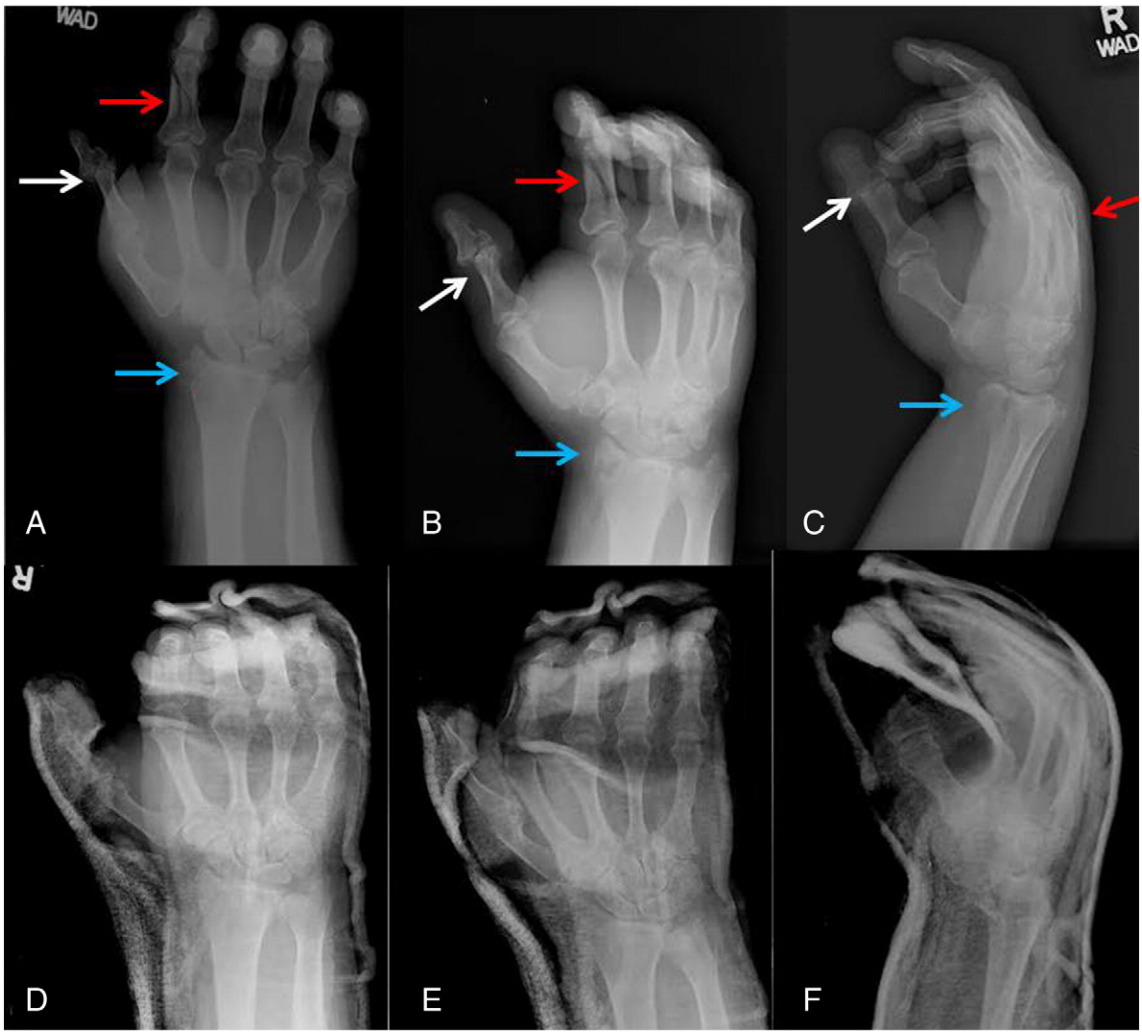


**Fig. 1.** A, Anteroposterior view of the wrist and hand showing thump IP joint dislocation (white arrow), first metacarpal fracture (red arrow), and radial styloid fracture (blue arrow). B, Oblique. C, Lateral. D-F, Postreduction films, anteroposterior, oblique, and lateral after applying the quad splint.