An Adjustable Splint for Forearm Supination

Mary Schuler Murphy

Key Words: arm splints • equipment design

This paper describes the construction of an adjustable splint for forearm supination. At Union Memorial Hospital in Baltimore, Maryland, the splint has been a successful adjunct to mobilization treatment for the restoration of supination in selected patients who have lost active supination due to elbow, forearm, or wrist fractures or radial head resections with interosseous membrane shortening.

Since its original design in 1984, the adjustable supination splint has undergone several changes. The major design difference is the addition of an adjustable strap, which the patient can manipulate to increase the tension of the splint.

Certain traumatic injuries to the elbow, forearm, and wrist can result in a significant loss of supination. According to Kapandji (1981), tolerance to the malunion of fractures is reduced “because any alteration in the shape of the bones can and does affect the delicate mechanism of pronosupination” (p. 94). Pronosupination enables the use of the hand for feeding, personal hygiene, various types of work, and various gestures. Kapandji observed that, although shoulder abduction and elbow flexion can compensate for the loss of pronation, nothing can compensate for the loss of supination.

Before a splinting regimen is begun, the stability of the fracture and associated structures, including vascular and neurological impairment and ligamentous injuries, must be considered. A possible complication of a radial head resection is instability at the elbow with subluxation of the distal radioulnar joint. Deficits may include ulnar nerve symptoms, wrist pain, or both (Swanson, Jaeger, & Rochelle, 1981). The therapist must be aware of all of these symptoms and use the supination splint only after consultation with and approval by the physician. After a radial head resection, bone growth at the radial head, which results in decreased forearm movement, cannot be improved through the use of a splint. X rays can assist in the identification of a bony block, which requires surgical intervention. According to Matthews, Kaufer, Garver, and Sonstegard (1982), “[Residual forearm angulation] deformities of 20 degrees or more must be corrected if normal or nearly normal rotation of the forearm is to be expected” (p. 17). In cases where surgical intervention is necessary, the supination splint is contraindicated prior to surgery.

The splint presented in this paper, which pulls the forearm into supination and flexion, provides a basic design that can be modified to the needs of the patient. Serial adjustments can be made by the patient or therapist as range of motion and wearing tolerance increase. An elbow flexion block may be incorporated at 90° if elbow extension is also a goal of treatment. If the patient has difficulty donning and doffing the forearm portion of the splint, the splint can be cut so...
that it is not completely circumferential, thus allowing greater ease of use.

**Splint Construction**

The materials used to make the splint are low-temperature thermoplastic material, closed cell foam padding, touch fasteners (1-in. or 2-in., depending on arm size), D-rings, and large rivets.

For the forearm portion of the splint, a wrist gauntlet is constructed (see Figure 1) to mold a circumferential splint with the radial edge overlapping the ulnar edge by approximately ½ to 1 in. on the dorsal surface of the forearm. Then the splint length is extended by two thirds up the forearm and the touch-fastener straps are attached.

For the humeral portion of the splint, the pattern shown in Figure 2 can be used to construct a circumferential splint with the edges overlapping along the medial border of the humerus by approximately ½ to 1 in. The splint’s proximal border should be extended to just below the humeral head and distally approximately 2 in. above the epicondyles. After the patient is fitted with the splint, the distal portion should be trimmed back anteriorly to allow for elbow flexion. The touch-fastener straps are then attached, as shown in Figure 3. D-rings are attached with loop touch fasteners and rivets to the forearm and humeral portions of the splint, as follows:

1. On the volar surface of the forearm portion, the A-1 D-ring is attached just proximal to the wrist along the ulnar border. The D-ring must be on a diagonal, with the top facing toward the A-2 D-ring. The B-1 D-ring is attached in a direct vertical line with the A-1 D-ring, approximately 2 in. from the distal end of the splint, with the top of the D-ring facing up toward the B-2 D-ring.
2. On the lateral-posterior border of the humeral portion of the splint, the A-2 D-ring is attached approximately 2 in. from the top of the splint on a diagonal, with the top of the D-ring facing toward the A-1 D-ring. The B-2 D-ring is attached approximately 2 in. from the bottom of the splint, with the top of the D-ring facing toward the B-1 D-ring.

To make the straps (see Figure 3), the patient’s forearm is positioned in maximum passive supination. The length of the A-1 to A-2 (loop touch fastener) strap is determined by measurement of the distance between the A-1 and A-2 D-rings. This is then added to the circumference of the patient’s forearm, and another 3 to 4 in. are added. Note that the strap must wrap posteriorly across the dorsum of the wrist to provide maximal pull into supination. The length of the B-1 to B-2 strap is determined in the same manner, with only 1 to 2 in. added to the total of forearm circumference and distance between rings. Approximately ½ in. of hook touch fastener should be added to the loop touch fastener strapping at either end. Finally, the straps are connected, starting with the forearm, as shown in Figure 3. The strap is
wrapped around the forearm before it is attached to the humeral portion of the splint.

Splint Application

Case 1

R.C., a 13-year-old right-hand-dominant girl, sustained a left Colles fracture in a fall and was placed in a short arm cast for 6 weeks. After the cast was removed, she was referred for treatment to increase forearm and wrist active range of motion. Measurements taken at that time were as follows: active supination, $0^\circ$; passive supination, $10^\circ$; active pronation, $45^\circ$; and passive pronation, $60^\circ$.

Treatment involved the use of moist heat, mobilization, and range of motion exercises three times a week. After six treatment sessions, R.C. gained $5^\circ$ of passive supination. Because such little progress was made in the first 2 weeks of treatment, I fabricated the adjustable supination splint (see Figure 4). R.C.'s passive supination improved to $25^\circ$, a $15^\circ$ gain, within 1 day of wearing the splint. After 1 week of wear, her range of motion was $45^\circ$ passive supination and $35^\circ$ active supination. Wearing time was initiated for 5 to 10 min approximately five times a day during waking hours; within 2 days, wearing time increased to 20 min at a time. R.C. was able to tolerate the splint for 2 to 3 hr a day at ½- to 1-hr intervals by the end of the first week. She was instructed to perform active range of motion exercises after the splint was removed and to wear the splint before attending therapy. Her treatment regimen of moist heat, mobilization, and range of motion exercises remained the same. R.C. was treated twice a week for 2 months, with periodic splint adjustments as indicated. The splint was found to be a useful adjunct to treatment and, after 2 months, R.C. was discharged with $80^\circ$ of active supination and full active pronation.

Case 2

E.L., a 47-year-old right-hand-dominant woman, sustained a right radial head fracture, and the radial head was removed 4 weeks postinjury. After surgery, she was placed in a long arm cast, which was removed in 9 days. Treatment, which consisted of mobilization, moist heat, and range of motion exercises, was initiated on the 10th day and was carried out three times a week. Active range of motion measurements taken at that time were as follows: supination, $10^\circ$; pronation, $70^\circ$; elbow flexion, $100^\circ$; and elbow extension, $-85^\circ$.

An occupational therapist constructed a static night elbow extension splint and a dynamic supination splint the first week of therapy. E.L. was able to tolerate wearing the supination splint four to five times a day for 15 min each time. After 3 weeks, her active range of motion measurements were as follows: supination, $45^\circ$; pronation, $70^\circ$; elbow flexion, $105^\circ$; and elbow extension, $-30^\circ$. At that time, a dynamic elbow flexion component was added to the supination splint to be used intermittently with the supination component.

Three weeks later, E.L.'s active range of motion measurements were as follows: supination, $72^\circ$; pronation, $70^\circ$; elbow flexion, $112^\circ$; and elbow extension, $-22^\circ$.

E.L. was discharged 1 month later with the following active range of motion measurements: supination, $90^\circ$; pronation, $70^\circ$; elbow flexion, $120^\circ$; and elbow extension, $-18^\circ$.

This splint has been used in the treatment of postradial head resections with variable success, depending on how early in the patient's treatment regi-
men it was implemented and on the patient’s com-
pliance. The best results occurred with early use and
with patients who concurred with the treatment pro-
gram. Patients who had subsequent surgery to remove
a bony block had considerably poorer results, with
little or no functional gains in supination.

For patients with elbow, forearm, or Colles frac-
tures, for whom traditional mobilization therapy had
not produced adequate improvement, variable results
were found with the supination splint. Younger, com-
pliant patients with less serious injuries had better
results.

Splint wearing time varied among patients, de-
pending on each patient’s tolerance, need to function
without a brace (i.e., ability to wear the splint at
work), and response to splinting. The splinting pro-
gram usually lasted from 3 weeks to 2 months and was
discontinued when range of motion plateaued.

Summary

The adjustable supination splint is used in select cases
in which traditional mobilization therapy is not pro-
ductive in supination gains. The success of the splint
varies depending on many factors, including the type
and severity of the injury; the timing of the interven-
tion; the patient’s age; and the patient’s tolerance of
and compliance with the treatment program. The
therapist must consult with the physician and have
his or her approval before initiating the treatment
regimen.

Splint use is contraindicated in patients with un-
stable fractures or with injuries that require surgical
intervention before splinting. Therapists should
watch for edema, pain, and neurological changes.
Depending on the severity of these symptoms, the
splint may need to be discontinued or the wearing
time and tension adjusted.

In our experience at Union Memorial Hospital
and in our weighing of the above considerations, we
have found favorable results in the use of the adjust-
able supination splint, with gains in range of motion
and function in select patients. ▲

Acknowledgments

I sincerely thank Marlene Riley, director of rehabili-
tation services at Union Memorial Hospital, Baltimore, Maryland,
for encouragement and editorial assistance; David Motta
for the medical illustrations; and Peter Andrews for
photography.

This splint design was first presented at the 1987 An-
nual Conference of the Maryland Occupational Therapy As-
Association, Timonium, Maryland.

References

Kapandji, I. A. (1981). The upper limb as logistical
support for the hand. In R. Tubiana (Ed.), The hand (Vol. 1,

Matthews, L. S., Kaufer, H., Garver, D., & Sonstegard,
D. A. (1982). The effect on supination-pronation of angular
malalignment of fractures of both bones of the forearm.

Comminuted fractures of the radial head. Journal of Bone
and Joint Surgery, 63A, 1039–1041.