The Colles' fracture, originally described by Abraham Colles as a transverse fracture of the radius 1.5 in. proximal to the radiocarpal joint, usually results from a fall on the outstretched hand (Naunton, 1988). Today, the term Colles' fracture is used to describe any fracture involving the distal radius (Frykman & Nelson, 1990).

Treatment of Colles' fracture depends on the severity of the injury. Closed reduction is the treatment of choice, followed by immobilization using methods such as long-arm casts, short-arm casts, sugar-tong splints, fracture bracing, external fixation, and open reduction with external fixation (Naunton, 1988).

When signs of bone consolidation have occurred and the immobilizing device is removed, limitations in range of motion or function are often evident. In the wrist, tightness of the extensor tendons can limit full flexion, tightness of the flexor tendons can limit extension, and tightness of the interosseous membrane surrounding the radius and ulna of the supinators and pronators themselves can greatly limit supination and pronation. These limitations may trigger a referral to occupational therapy (Naunton, 1988).

The main focus of therapy for Colles' fracture is to return mobility to the wrist and forearm. Standard treatment programs may include activities that encourage active and passive range of motion, graded resisted exercises, muscle strengthening, work hardening, functional activities of daily living, and splinting (Naunton, 1998). Because some patients who had Colles' fracture with limitations in supination and pronation did not respond to the standard methods of therapy of active exercises, mobilization, and activities of daily living (ADLs) in my outpatient clinic, I searched for a dynamic supinator-pronator splint to augment the standard therapy program. I found several of these splints, including those by Bunnell (Bunnell, 1949, 1956), Murphy (1990), and Collelo-Abraham (1990) as well as those commercially available (Smith & Nephew Rolyan). However, they looked bulky and had many parts, which might have made them difficult to apply at home. Before purchasing the splints, I decided to assess their potential benefit to the program.

Rationale for Assessment Tool

My assessment criteria required a tool that would be easy to use, require minimal time, and be accessible within the occupational therapy department. Furthermore, the tool had to allow motion in the forearm to take place equally in the lower and upper radial-ulna joints (Fess & Phillips, 1987) with the axis of rotation the length of the forearm. In addition, I wanted a tool that would eliminate all wrist

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This article was accepted for publication March 30, 1994.

1Manufactured by Smith & Nephew Rolyan, 2100 52nd Avenue, Lachute, Quebec, Canada, or One Quality Drive, PO Box 578, Germantown, Wisconsin 53022.
movement. Extending the splint distal to the wrist crease left less chance of compression problems occurring at the volar wrist crease. Short-arm air bag splints, such as those provided by Urias and Jobst, allowed use to meet all these requirements, but the Urias air bag splints were selected because they had been purchased by my department for other treatment purposes and therefore were readily available. My air bag splint method is an adaptation of the Collelo-Abraham method of splinting for limited active and passive range of motion in supination and pronation.

Fabrication

The air bag splint method uses a commercially available short-arm air bag splint, a foam wedge for arm placement, and three pieces of self-gripping strappings to position the arm in passive supination and pronation. Three 1-in. pieces of pressure-sensitive hook tape are attached to the bottom of the air bag and matched with three pieces of pressure-sensitive loop tape on top of the foam wedge (see Figure 1). This arrangement stabilizes the splint onto the wedge. A foam wedge covered with vinyl is used to support the arm while it is in the splint. As an alternative, the foam elevating arm support commercially available from Fred Sammons may be used. Three 1-in. pieces of pressure-sensitive hook tape are also attached to the top surface of the air bag splint to allow for the attachment of pressure-sensitive loop tape straps. The opposite end of these straps are attached to the bottom of the foam wedge (see Figure 2). A 2-in. elastic strap is applied to the proximal end of the wedge to further immobilize the arm proximal to the splint (see Figure 1). To gain the desired passive range of motion (supination or pronation), the long loop straps are attached to the face-up surface of the inflated air bag and pulled in either direction, perpendicular to the splint and to the forearm and wrist. Direction of pull depends on whether passive supination or supination is required.

Application

Splint wear is limited to 15 min to avoid undue discomfort or compression problems because overall treatment time in the clinic is limited and because other treatment modalities and exercises are part of the treatment program of patients with Colles' fracture.

The splint is worn in the chosen position (supination or pronation) for 5 min, building up in 5-min increments as tolerated to a total of 15 min. Changes in skin color, which indicate compression problems, are noted. The patient is told to report any sensory changes in the hand. If changes are detected, pressure is decreased or splint use is discontinued.

Immediately after the splint is removed, active range of motion activities are performed in the same direction of force as was applied by the splint. Active exercises after splint wear prolong the stretch to soft tissue structures stretched by the splint (Rusk, 1977). Manual passive ROM exercises for a few seconds and within the patient's pain tolerance are also done. In addition to these clinic efforts, patients with Colles' fracture maintain an active home therapy program consisting of active range of motion exercises, passive stretches, and resisted activities. When full range of motion in supination and pronation is attained or when no further changes have been evident after three or four applications of the splint, the air bag splints are discontinued.

Figure 1. Air bag splint is inflated and placed on foam wedge. Strap is proximal to splint.

Figure 2. Strapping arrangement from air bag splint to wedge pulls hand and wrist into supination. Arrows indicate direction of pull. Pronation is achieved with arm in pronated direction and strapping pulling in the same direction.
Discussion

The air bag splint was initially used in the outpatient clinic for those Colles' fracture cases in which traditional therapy was not resulting in supination or pronation gains; for example, those showing less than 50% of full supination or pronation after two to three therapy sessions. In the past year I have used the splint on 21 patients with Colles' fractures. These patients made gains great enough for me to believe that application of the air bag splint is a useful treatment modality. In one patient, active range of motion in supination changed from 5° to 25° after only one application. After the second application, active supination increased to 32°. Before use of the air bag splint, this patient had gained only 5° of active supination after three treatment sessions. Traditional therapy sessions for patients with Colles' fracture consisted of active and passive range of motion exercises for supination and pronation, mobilization and stretches to soft tissue structures by the physical therapist, ADL and functional activities involving supination and pronation of the wrist and forearm, and management of edema and wound care if applicable. These gains were maintained and carried over between each treatment session until full active supination was gained.

Variations

In patients with limitations in both supination and wrist extension, I applied serial wrist cock-up splints in addition to a modified air bag splint to maintain the gains in range of motion (see Figure 3). In patients whose elbow extension was also limited, I applied longer air bag splints to gain passive elbow extension (see Figure 4) and prescribed use of a thermoplastic serial elbow extension splint at night as range of motion increased. For two patients with poor gains in supination and pronation after three to four applications of the air bag splint, or when changes were not maintained between treatment sessions, the patients applied the supinator-pronator splint described by Collelo-Abraham (1990) at home and the therapist monitored its use. These patients were willing to wear an apparatus for more than the 15 min required for the air bag splints. Since then, five additional patients have purchased their own air bag splints and foam wedges for use in their home exercise program to replace the use of the Collelo-Abraham splint.

Conclusion

The success of the air bag splint depends on factors such as the type and severity of injury, the patient's age, and the patient's tolerance of the splint. Patient compliance has not been a problem because the splint is used primarily in the outpatient clinic, applied by the therapist, and applied for short durations. Originally designed to be an assessment tool for determining the potential usefulness of a supinator-pronator splint, air bag splinting has become a technique that I use daily in the outpatient clinic to augment the treatment program of patients with Colles' fracture. These splints are less cumbersome and bulky than similar splints and are easier for the patient to apply and use at home for extended periods. Because commercial air bag splints are used as part of our method, fabrication time is speedy. ▲

Figure 3. Wrist air bag splint (double chamber) applies pressure separately on dorsal and volar aspects of hand, therefore totally immobilizing and splinting hand. Bag is applied at wrist crease, and a strap is placed proximal to wrist crease for appropriate leverage and positioning. Passive extension to the wrist is achieved by immobilizing the forearm proximal to the wrist crease (strap) and distally with the air bag splint.

Figure 4. Half arm (21 in.) air bag splint applied full length of arm and distally to include part or all of hand to gain passive elbow extension.

References


Collelo-Abraham, K. (1990). Dynamic pronation-supina-
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