IT IS OFTEN DIFFICULT to restore range of motion (ROM) to a postoperative joint that has undergone extensive immobilization. Lack of full motion in many cases is caused by a contracted joint capsule and surrounding ligaments and the nonyielding collagenous scar tissue. We have had success in restoring ROM in such cases using a heat and mobilization technique. The following is a case study wherein ultrasound and joint mobilizations were used to restore ROM in a postoperative wrist.

Case Report

An 18-year-old; 6-ft, 3-in.; 180-lb male soccer goalie keeper injured his right wrist in September of 2001. A player on the opposing team kicked a hard shot, which the goalie keeper blocked with the back of his hand, resulting in hyperextension of his wrist. Because of the pain, X-rays were taken of the wrist, but no fracture was found. The athlete returned to competition and his wrist improved somewhat but was still painful. An arthrogram was ordered, the results of which also turned up negative. Feeling that everything was normal, the athlete continued to play soccer for the rest of the season even though it was somewhat painful.

Before the start of the next soccer season, the athlete left college-level play for a period of 2 years to live in Mexico, where he served a mission for his church. He did not play soccer at all during this time, and the pain in his wrist subsided somewhat. After his mission, he returned to college soccer in the fall of 2004, and his wrist pain returned. He had restricted range of motion, pain with bearing weight on the wrist, and pain while throwing.

This time, an arthrogram and MRI showed a non-union proximal-pole scaphoid fracture with associated avascular necrosis. The athlete had surgery on November 23, 2004. Because the scaphoid had some necrosis, a bone graft was performed with bone from the athlete's thumb. The bone was then pinned together. The athlete was in a cast for 8 weeks before the pins were removed, and then a cast was reapplied for 4 more weeks.

When the cast was removed after 12 weeks, the wrist had very little range of motion. The athlete and athletic trainer focused on active and passive stretching during rehabilitation in an attempt to restore ROM. They were successful in regaining most of his wrist flexion and radial deviation, but attempts to restore full wrist extension were not successful. On a follow-up visit with his physician it was found that the athlete still lacked 30° of wrist extension and 10° of ulnar deviation. The physician informed him that this was all the wrist motion that he could recover—that he should not expect any more.

The athletic trainer shared this information with a colleague who had had some previous success in restoring ROM to postoperative wrist patients using a regimen of thermal ultrasound and joint mobilizations. They began treating the athlete the very next day. On initial examination, the athlete could extend his wrist to only 50° (30° from normal; Figure 1). To heat the tissues, treatment consisted of 3-MHz continuous ultrasound at 1–1.5W/cm² (to patient tolerance) for 6 min each to the dorsal and volar sides of the wrist (Figure 2). Immediately after the ultrasound, joint mobilizations were performed for 10–12 min, concentrating on each individual bone in the wrist. The primary action taken to restore extension was palmar glides of the proximal row of the carpal bones on the radius. An ice pack and compression wrap were applied for 30 min to the area immediately after posttreatment ROM was recorded.
During the first treatment the athlete improved to 62° of extension. By the third treatment (every other day), he reached 70° of extension (Figure 3). After subsequent treatments, he reached 76° of extension (probably all that was possible because of the bone graft) and full ulnar deviation.

**Discussion**

**Role of Joint Mobilization**

Many therapists resort to passive stretching exercises in an attempt to regain lost ROM. Unfortunately, passive stretching often falls short because what is tight (the capsule) is not being adequately stressed.\(^1\) Hence, the patient might be able to perform only a slight physiologic movement such as partial extension. Two accessory motions required for full ROM are roll and glide. Passive stretching mainly focuses on the rolling action of one bony surface on another. The action that the bone cannot perform on its own because the capsule is too tight is the accessory motion of glide. Until both the roll and the glide motions are returned, full ROM is impossible. Joint mobilization mainly works on the accessory gliding motion.

**Role of Heat Before Mobilization**

One of the world’s leading experts on joint mobilization\(^1\) recommends using heat before joint mobilizations. Kaltenborn states that heat improves circulation and thereby elevates soft-tissue temperatures, is useful preparation for joint mobilizations, and makes the tissues easier to stretch. Heat is often inadequately used as part of a heat-and-stretch treatment regimen. The joint capsules of the elbow, knee, shoulder, and hip are deeper than what can be penetrated from the superficial heat provided by warm whirlpool or hot packs.\(^2,3\) Ideally, pulsed shortwave diathermy would be used on these joints because it can provide deep heat over a large area.\(^4,5\) The wrist, however, is a small target area of somewhat superficial structures, so hot packs, paraffin, and whirlpools are appropriate to heat it.

Our preferred modality to heat the wrist is 3-MHz ultrasound because of the large increases in temperature that can be achieved from 2 to 3 cm deep without increasing the skin’s temperature.\(^6\) Because ultrasound only heats areas twice the size of the transducer’s faceplate,\(^4,5\) we recommend that both the dorsal and the volar surfaces be targeted before joint mobilizations.
Some therapists might still be under the impression that ultrasound cannot be safely used over metal implants. This is pure speculation. Batavia\(^7\) performed an extensive review of contraindications for ultrasound appearing in the literature from 1992 to 2002. Of the 20 sources cited, only 12 (60\%) listed metal implants as a contraindication for ultrasound. Even more important, however, none of the articles or texts reported any metal-implant-related complications in the literature. We have been performing ultrasound treatments over small metal implants (such as pins or screws) for years and have never had any adverse reaction or overheating of the area.

### Role of Cold After Mobilization

Kaltenborn reports that cooling tissues after stretch mobilization helps preserve mobility gains for a longer period of time, a process known as plastic elongation.\(^8\) Unlike elastic elongation, in which tissues stretch but go back to their shortened position, plastic elongation, or deformation, as it is often referred to, involves tissues being stretched and then maintaining this newly acquired length. The application of ice and compression to the wrist immediately after the mobilization treatment helped cool the tissues in their increased range.\(^8\) When ROM was assessed before subsequent treatments, it was noted that in most cases ROM was maintained or only slightly decreased, lending credence to the theory of plastic deformation. In addition, ice application helps decrease the posttreatment pain that sometimes accompanies joint mobilizations.

### Summary

A regimen of 3-MHz continuous ultrasound (to patient tolerance) and joint mobilizations was effective in restoring the available wrist ROM to a patient with an internal fixation of his scaphoid. The patient gained 12° of extension on his first visit. The athlete is currently in season with soccer and is practicing intensely. His beginning ROM each day fluctuates between 65° and 76° extension (well beyond the 50° that the physician stated was possible).

### References

2. Draper DO, Harris ST, Schultries SS, Ricard MD, Knight KK, Durrant E. Hotpack and 1 MHz ultrasound treatments have an additive effect on muscle temperature increase. \(\textit{J Athl Train.}\) 1998;33:21-24.

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