The beneficial therapeutic effects of heat for treatment of musculoskeletal injuries have been thoroughly documented. Heat decreases muscle spasm and pain and increases blood flow and collagen extensibility. The most common mode of heat application for sports injury treatment is a moist heat pack, but this modality raises tissue temperature < 1°C at a depth of 3 cm. For deep heating, ultrasound or diathermy must be used.

When combined with heat application, joint mobilizations can increase collagen extensibility and improve both physiologic and accessory joint movements. Research has demonstrated that joint mobilizations can improve the range of motion (ROM) of stiff joints. An increase in the temperature of the tissues to be mobilized increases patient comfort during the procedure and minimizes posttreatment soreness.

Following a period of immobilization, I have used pulsed short wave diathermy to apply deep heat to joints with decreased ROM. Shortwave diathermy was chosen for these patients because of: (1) the relatively large size of the area and the depth of the tissues that need to be heated; (2) the heating modality application, in conjunction with joint mobilizations, has proven to be an effective treatment regimen for improvement of joint ROM.

Most recent literature pertaining to the use of shortwave diathermy has related to the induction drum method, which is the most readily available type of equipment. Induction coil diathermy involves the use of a cable that is wrapped around the patient’s extremity. The purpose of this report is to present the case of a postoperative ACL patient who did not have full range of motion (ROM) in her knee after 3 months of aggressive stretching. After 4 treatments of induction coil shortwave diathermy (ICSD) and joint mobilizations, she achieved full knee ROM.

Case Background

The day after ACL reconstructive surgery, which utilized an autologous patellar tendon graft, postsurgical rehabilitation was initiated. A straight-leg immobilizer was applied immediately after surgery, and the use of a continuous passive motion was discouraged by the surgeon. At approximately one week postsurgery, she was allowed to apply an elastic wrap for joint compression and subsequently was instructed to wear a functional knee brace for approximately one week. For a period of 15 days following surgery, the patient was either non-weight bearing or partial weight bearing.

The postsurgical rehabilitation program consisted of ROM exercises, including active-assisted hanging knee flexion, wall slides, passive knee flexion, knee extension exercises, prone hangs, and quad sets. ROM was initially limited by quadriceps muscle tightness. Electrical stimulation was applied to the quadriceps muscles in an effort to increase quadriceps extensibility, which improved after just three treatments. The patient was discharged from physical therapy soon after quadriceps tightness was relieved, but full ROM had not been achieved. At 2 months postsurgery, she was lacking 12° of extension and 10° degrees of flexion in comparison to the ROM of her opposite extremity. She followed a regimen of stretching once each day, but no improvement in ROM was realized during the following month.
**Evaluation**

ROM measurements of active knee flexion and extension were obtained from a 360-degree goniometer with telescoping arms that could extend to 114 cm (Lafayette Instrument Co.). The bony landmarks used for extension and flexion measurements were the greater trochanter and lateral epicondyle of the femur proximally and the lateral midline of the fibular head and the lateral malleolus of the fibula distally. The same goniometer was used for all measurements.

**Intervention**

The treatment regimen for restoration of full knee ROM consisted of induction coil diathermy and joint mobilizations. Each treatment session included administration of ICSD (induction coil shortwave diathermy) in a knee garment for 20 minutes at 35 Watts (Figure 1), which was immediately followed by joint mobilizations. To gain knee extension the following joint mobilizations were used:

- anterior tibial glides
- posterior femoral glides
- superior glides of the patella
- posterior glides of the head of the fibula

To gain back knee flexion the following joint mobilizations were used:

- posterior tibial glides
- anterior femoral glides
- inferior glides of the patella
- anterior glides of the head of the fibula

ROM was measured immediately following completion of the joint mobilizations. Cryotherapy was administered for 20 minutes at the end of each treatment session for the following reasons: (a) to suppress inflammation that might have developed from the tissue stress produced by the joint mobilizations and (b) to enhance retention of plastic elongation of the tissues.

The patient received joint mobilizations three times per week for a two-week period. Through this two-week period, she continued to perform a home exercise program that did not include any stretching. The diathermy device was used once per day.

**Results**

Extension improved 12° (full extension) and flexion improved 10° by the fourth treatment session, both of which were maintained through the sixth treatment session. One month later, full ROM was still evident. No discomfort was reported during or after treatment.

**Discussion**

Reconstructive ACL surgery is sometimes associated with difficulty regaining the last 5-10° flexion and extension. Passive stretching does address the sliding component normal knee joint motion. Because deep tissue heating is rapidly dissipated by the vascular system, joint mobilizations were performed immediately following the ICSD treatments.

Diathermy devices differ in terms of wave frequency, energy output, and electromagnetic shielding for directional focus of the wave field. Consequently, they produce differential heat absorption within various types of subcutaneous tissue (e.g., fat and muscle). We exclusively used the ReBound Therapeutic Warming System (ReGear Life Sciences, Inc., Pittsburgh, PA) to administer ICSD at 35 Watts. We have observed similar results from utilization of the Megapulse® II (Reno, NV) for administration of pulsed shortwave diathermy at 48 watts. Experimental research is needed to confirm the effectiveness of the treatment protocol used for management of this case.

**Conclusion**

A positive outcome was realized for this case of postsurgical knee ROM restriction through the combination of ICSD with joint mobilizations.