The aim of physical rehabilitation is to reestablish normal function using modalities such as heat and electrical stimulation, mobilization, and therapeutic exercise. Superficial heating agents penetrate soft tissues to a depth of approximately 1 cm. Deep heating agents can elevate tissue temperatures at depths of 2 cm or more. Deep heating agents commonly used include therapeutic ultrasound (US) and diathermy. Although diathermy is an effective deep heating modality, it requires the patient to remain stationary for 15 to 20 minutes and is not practical in dogs. Therapeutic US is considered an effective treatment modality for rehabilitating musculoskeletal conditions such as restricted range of motion (ROM) resulting from joint contracture, pain and muscle spasm, and wound healing. There are advantages and disadvantages of US therapy. Many protocols for the administration of US are based on tradition or extrapolated from basic science research and remain to be tested in controlled clinical trials. This chapter is based on a review of current literature pertaining to the basic research findings (in human and dogs) and the clinical application of US therapy in dogs.

Clinical Conditions Treated with Ultrasound

The main indications for US therapy include the following:

- Soft tissue shortening (e.g., contracture, scarring)
- Subacute and chronic inflammation
- Pain (such as muscle guarding, trigger points)

In human athletes, some experts consider that the most beneficial results from US are in treating tendinitis. In chronic tendinitis, recommended therapy includes heating with US, followed by cross-frictional massage, to eliminate scar tissue and increase ROM. Another indication is the treatment of limited ROM associated with joint contracture, for which patients receive US before passive ROM, stretching, or joint mobilization. A third indication is for pain relief before activity, such as in athletes with tendinitis that is mild enough to allow the person to continue training. The US treatment is administered before activity to assist in the warm-up and provide some pain relief.

In horses, US therapy has been suggested for the treatment of similar conditions. These include tendinitis, desmitis, sprains, joint lesions, lacerations, reduction of scar tissue, edema, exostosis, and myositis.

Tendinitis and Bursitis

Tendinitis and bursitis are treated with US because of the ability to increase blood flow to aid healing, increase tissue temperature to reduce pain, and drive antiinflammatory drugs across the skin by means of phonophoresis. In humans lateral epicondylitis (tennis elbow), subacromial bursitis, and bicipital tendinitis are typical conditions considered for US therapy.

From animal studies it appears that the stage at which US is given in the course of healing is important. Application of US in the early phase of tendon repair could be detrimental.

Joint Contracture and Scar Tissue

Ultrasound is often included in protocols for treating joint contractures and scar tissue.10 Joint contracture typically results from immobilization or trauma. The periarticular connective tissues have high collagen content, and if tissues are not mobilized, they tend to shorten to their resting, immobilized length. The principle of “heat and stretch” can be applied in this situation in an effort to increase ROM. Tissues are heated to approximately 45° C, followed by gentle passive or active stretching. There tends to be a greater residual increase in tissue length with either preheating or simultaneous heating. The effects of heat on ligament extensibility have been studied in humans. Young adults underwent knee joint displacement tests before and after continuous-mode US (1 MHz, 1.5 W/cm2 for 8 minutes). The investigators found small increases (1.3 degrees) in varus/valgus excursion at 0- and 20-degree knee flexion and in recurvatum excursion, but not in anterior-posterior drawer excursion. Their conclusion was that continuous-mode US at commonly used intensities made some knee ligaments only slightly more extensible in normal subjects. Scar tissue is denser than surrounding tissues, so it may be selectively heated by US. However, more research is needed to determine which intensities and durations are most beneficial.

Pain and Muscle Spasm

Pain threshold is usually increased after US. Diathermy and infrared therapy have a similar effect. Although the physiologic mechanism underlying pain reduction remains speculative, the probable mechanism of action is the ability of all three methods to elevate tissue temperature. Heating may elevate the activation threshold of free nerve endings, produce counter-irritation, or activate large-diameter nerve fibers.10 Peripheral nerve conduction velocities are either increased or decreased after US, partially depending on the intensity. Types A, B, and Cmnerve fibers have different sensitivities. With intensities of 1 to 2 W/cm2 US reduces the nerve conduction velocity of pain-carrying C fibers. This may help to reduce muscle spasm and reestablish circulation. Ultrasound also has been used to treat pain associated with neuromas, low-back dysfunction, and skeletal muscle spasm. The mechanism of action for reduction of skeletal muscle spasm may be based on thermal effects that alter the skeletal muscle contractile process, reduce muscle spindle activity, or break the pain-spasm-pain cycle.