43. The Stretching Window Revealed: Rate of Heat Loss in Human Muscle Following 3 Megahertz Ultrasound

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When therapeutic ultrasound vigorously heats tissues, it can increase extensibility of collagen affected by scar tissue. These findings give credence to the use of continuous thermal ultrasound to heat tissue prior to stretching, exercise, or friction massage in an effort to decrease joint contractures and increase range of motion. Prior to our investigation, it was not known how long following an ultrasound treatment, the tissue will remain at a vigorous heating level (>3°C above baseline). We conducted this study to determine the rate of temperature decay following ultrasound in order to determine the time period of optimal stretching. Twenty subjects had a 23-gauge hypodermic needle microprobe inserted 1.2 cm deep into the medial aspect of their anesthetized triceps surae muscle. Subjects then received a 3MHz ultrasound treatment (Omnisound 3000, Physio Technology Inc, Topeka, KS) at 1.5 W/cm^2 until the tissue temperature was increased at least 5°C. The mean baseline temperature prior to each treatment was 33.8°±1.3°C, and it peaked at 39.1°±1.2°C from the ultrasound. Immediately following the treatment, we recorded the rate at which the temperature dropped at 30-second intervals. We ran a stepwise nonlinear regression analysis to predict temperature decay as a function of time following ultrasound. We found a significant nonlinear relationship between time and temperature decay (r=.99, r^2=.99, SE of estimate=.06). The time that it took for the temperature to drop each degree as expressed in minutes and seconds was: 1°C=1:20; 2°C=3:22; 3°C=5:50; 4°C=9:13; 5°C=14:55; 5.3°C=18:00 (baseline). We measured the temperature change at 1.2 cm depth, since this is about how far below the surface many tendons and ligaments lie, and this is an appropriate target depth for 3 MHz ultrasound. We conclude that under similar circumstances where the tissue temperature is raised 5°C, stretching will be effective, on average, for 3.3 minutes following an ultrasound treatment. To increase this stretching window, we suggest that stretching be applied during and immediately after ultrasound application. Our research has uncovered the critical time period regarding when stretching can occur as a part of ultrasound therapy. This will enable clinicians to effectively increase joint ROM due to adhesive capsulitis, tendinitis, and joint contractures.