Therapeutic Ultrasound: The Effectiveness Of Ultrasound and the Importance of Parameter Settings

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Abstract

Context: Therapeutic ultrasound is mainly used in order to heat tissue for different musculoskeletal conditions. Research on therapeutic ultrasound has shown mixed results for the overall effectiveness based on the variety of parameters used, machines used, and treatment areas. This study was based on parameters used clinically versus recommended parameters based on textbook information. Objective: The purpose of this study was to determine if the most common parameters from the survey of ultrasound usage by ATs reach the recommended goal of increased intramuscular temperature for specific injuries. Design: Crossover Study. Setting: Athletic Training Research Laboratory-NDSU Patients or Other Participants. Twenty healthy volunteers (11 females, 9 males) Intervention: Thermocouples were inserted 2.5 cm deep into the lateral gastrocnemius. Ultrasound was delivered at the following settings: 3 MHz, 1.0 W/cm² for 5 minutes, 3 MHz, and 1.5 W/cm² for 5 minutes and 1 MHz, 1.5 W/cm² for 5 minutes. All settings were continuous. Main Outcome Measure: Temperature was recorded every 5 seconds for 9 to 7 minutes. Results: Treatment one was the parameters of 3 MHz, 1.0 W/cm² for 5 minutes produced a mean ending temperature of 36.64 ˚C ±1.22 with a mean change in temperature of 60˚C ±.69. Treatment two was the parameters of 3 MHz, 1.5 W/cm² for 7 minutes which produced a mean ending temperature of 36.67˚C±1.08 with a mean change in temperature of 74˚C±.61. Treatment three was the parameters of 1 MHz at 1.5 W/cm² for 5 minutes which produced a mean ending temperature of 36.44˚C±1.90 with a mean change in temperature of 40˚C±.55. Conclusion: Some of the subjects reached a temperature which could be considered therapeutic and only a few subjects reached the goal. This is important for clinicians to note that every patient is different when it comes to tissue heating. There is no doubt that therapeutic US machines increase tissue temperature but at what rate and accuracy they do this is the question clinicians need to keep in mind and should be the basis for future research. Further Research: Further research should incorporate more testing and examination of US machines more closely taking a look a larger look at machine inaccuracy and how prevalent it actually is.

Research Questions

•Experimental Design: A crossover study design was used for this experiment. Treatment conditions depended on the results based on the survey completed by Athletic Trainers and their use of therapeutic US. Three treatment parameters from the survey were included and used as the treatment parameters which include the following: 3 MHz, at 1.0 W/cm² for 5 minutes; 1 MHz at 1.5 W/cm² for 5 minutes; and 1 MHz at 1.5 W/cm² for 7 minutes.

•Procedures:
  • A 20 gauge x 1.16 in. needle catheter was inserted perpendicular to the carpenter’s square and treatment area at a depth of 2.5 cm.
  • The thermocouple was connected to the Iso-Thermex electronic thermometer (Columbus Instruments, Columbus, OH), which measured and recorded intramuscular temperature from the tip of the thermocouple.
  • Each subject received each of the three treatments performed on three different days.
  • There were no more than 7-10 days between each of the testing days for each subject for a total of 3 weeks total.

•Statistical Design:
  • The descriptive statistics of mean and standard deviation temperature change for each of the three settings was calculated. The a priori value was set at p<0.05. Three one-sample T-Tests were run for each treatment and the mean of the change in temperature. All Analyses were conducted using SPSS (20th edition; Pearson Education Inc., Upper Saddle River, NJ).

Results

• Treatment one with the parameters of 3 MHz 1.0 W/cm² for 5 minutes produced a mean ending temperature of 36.64˚C±1.22 with a mean change in temperature of 60˚C±.69.
• Treatment two was the parameters of 1 MHz at 1.5 W/cm² for 7 minutes produced a mean ending temperature of 36.67˚C±1.08 with a mean change in temperature of 74˚C±.61.
• Treatment with the parameters of 1 MHz at 1.5 W/cm² for 5 minutes produced a mean ending temperature of 36.44˚C±1.90 with a mean change in temperature of 60˚C±.55.

Conclusions and Clinical Significance

•Some of the subjects reached a temperature which could be considered therapeutic and only a few subjects reached the temperature goal. This is important for clinicians to note that every patient is different when it comes to tissue heating. Also the issue arises that not every ultrasound machine produces the same result so parameters will differ with each machine.

•There is no doubt that therapeutic US machines increase tissue temperature but at what rate and accuracy they do this is the question clinicians need to keep in mind and should be the basis for future research.

•Further research should incorporate testing US parameters with thermocouples being inserted at different depths and on different parts of the body because of the difference in adipose tissue and other anatomical structures possibly changing the outcome of US treatments.

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