THE EFFECT OF PULSED ULTRASOUND THERAPY ON THE IMPROVEMENT OF JOINT FRICTION IN HEMARTHROSIS MODEL

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SUMMARY
The purpose of the present study was to evaluate the effect of pulsed ultrasound, PUS, on joint friction after experimental hemarthrosis in the rabbit knee joint. Twenty rabbit's Lt Knee joints were injected with 1 mL of fresh autologous blood 2 times per week for 4 consecutive weeks. In 10 animals, pulsed ultrasound was applied with a duty cycle of 1/9, frequency of 1 MHz, and power of 0.4 W/cm2. Friction test was performed immediately after the joint resection by a pendulum friction tester. The number of pendulum oscillations increased and coefficient of friction, COF, decreased after PUS therapy (p <0.05). We concluded that PUS is effective to reduce joint friction after experimental hemarthrosis.

INTRODUCTION
Animal models of experimental haemarthrosis have the potential to reproduce any changes in synovial joints similar to what happens in haemophilia. Our previous study was shown the increase of COF in rabbit knee joint after blood injection [1]. Safran et al. investigated the effect of blood injection on joint stiffness in the ankle of rabbits. A single blood injection increased the ankle joint stiffness after 10 days, and this effect resolved after 28 days [2]. Ultrasound have been recommended and widely used in acute and chronic phases of hemarthrosis. For tissues in an inflammatory reaction, the benefit of US is to promote the resolution of the inflammatory problem [3]. As hemarthrosis affects the whole synovial joint, biotribological study can provide important knowledge to understand joint health and disease characteristics and hence can help develop or evaluate therapeutic intervention. Therefore, the purpose of this study was to assess the effects of PUS on the joint friction parameters in the experimental model of rabbit hemarthrosis.

METHODS
Twenty male albino rabbits, weighing 1.5-2 kg were used in this experiment. The study was approved by the Ethics Commission of Tarbiat Modares University.

Animals were anesthetized subcutaneously with Xylazine 2% (60 mg.kg-1) and Ketamine 10% (50 mg.kg-1) injection. They received an injection of 1 mL fresh autologous blood directly obtained from the animal's heart into the left knee joint via parapatellar portal. Blood was injected two times per week for 4 consecutive weeks. Animals randomly divided in PUS (n=10) and sham US (n=10) groups. Pulsed ultrasound treatment was applied by using ultrasound equipment (Enraf Nonius, Sonopuls, model no.434, Holland) with a 0.8 cm² applicator head and 1 MHz frequency. The animals received US at 0.4 W/cm², 1/9 duty cycle (spatial average temporal average, SATA of 0.049 W/cm2) for 150 sec. Each animal received PUS every 24 hours for a total of 5 consecutive treatment sessions. Animals in control group received sham ultrasound. One day after treatment sessions was considered for stabilizing the results and then all the animals were euthanized by overdose of the anaesthetic drugs. The knee joint was removed from the middle of the tibia/fibula and femur shafts. Friction test was performed immediately after the joint resection by a pendulum friction tester [1]. The mean numbers of oscillations of the pendulum to reach equilibrium position, coefficient of friction of the knee joints (by Stanton’s equation), the mean of exponential and linear curve fitting damping slope were measured by designed software.

RESULTS AND DISCUSSION
The mean numbers of pendulum oscillations to reach equilibrium position were 37.50±15.5 and 29.25±9.9 in PUS and sham US groups respectively. COF derived from Stanton’s equation in PUS group was significantly lower than sham US group (p=0.03). The mean of exponential and linear curve fitting damping slope in PUS group also were lower than those in sham US group (Figure 1). The lower coefficient of friction (COF) was in agreement with higher oscillation numbers in PUS group. Release of some inflammatory factors such as IL-1β, IL-6, and TNF-α was reported in patients with hemophilia. These inflammatory mediators can impair lubrication, cause cartilage damage through increased friction and destruct the cartilage matrix. The impaired structure, lubrication and elevated joint friction may be caused more inflammation in the joint. The effectiveness of US in decreasing inflammatory process was suggested in osteoarthritis. Furthermore the effect of PUS in decreasing joint friction could be ascribed to further secretion of boundary and fluid film lubricants like lubricin and hyaluronic acid [4]. In addition to better lubricant secretion, compensating normal protein content could be another possible mechanism of the COF decrease after PUS therapy.
**CONCLUSIONS**

We concluded that PUS therapy is effective to reduce joint friction after experimental haemarthrosis. As the cartilage destruction was severe in an experimental hemarthrosis model, PUS might be useful to reduce joint friction and return the cartilage structure with substantial inability of repair process to normal condition during 5 treatment sessions.

**REFERENCES**