Extracorporeal Shockwave Therapy Accelerates the Healing of a Meniscal Tear in the Avascular Region in a Rat Model

BACKGROUND: The treatment of meniscal tears in the avascular region remains a clinical challenge. Extracorporeal shock wave therapy (ESWT) is a minimally invasive, safe, and effective therapy for various orthopedic disorders. However, the therapeutic effect of ESWT on meniscal tears has not been reported.

PURPOSE: The purpose of the present study is to evaluate the therapeutic effect of ESWT in the treatment of meniscal tears.

STUDY DESIGN: Controlled laboratory study.

METHODS: Twelve-week-old male Wister rats were divided into three groups (Normal, ESWT [-], and ESWT [+]). We made a full-thickness 2-mm longitudinal tear in the avascular region in the latter 2 groups. At one week after surgery, the ESWT (+) group received 800 impulses of shockwave at 0.22 mJ/mm² energy flux density in a single session. We performed a pathological examination to evaluate meniscal healing (n=10 for each group), and immunohistochemistry to analyze the expression of bromodeoxyuridine (BrdU) and CCN family member 2 (CCN2) at 2, 4, and 8 weeks after ESWT (n=5 for each group). The CCN2, Sry-type high mobility-group box 9 (SOX9), Vascular Endothelial Growth Factor (VEGF-a), Aggrecan, collagen type 1 alpha 2 (Col1a2) and collagen type 2 alpha 1 (Col2a1) levels at the site of the meniscal tear at 4 weeks after ESWT were quantitatively evaluated by a real-time PCR (n=5 for each group).

RESULTS: The meniscus healing scores in the ESWT (+) group were significantly higher than those in the ESWT (-) group at 4 and 8 weeks. The ratio of BrdU-positive cells and CCN2-positive cells were the highest in the ESWT (+) group among the three groups. In the ESWT (+) group, the real-time PCR revealed that the levels of CCN2, SOX9, Aggrecan and Col12a1 were upregulated. All significant data were p <0.05.

CONCLUSION: ESWT promoted the healing of meniscal tears in the avascular area. ESWT stimulated proliferation of meniscus cells and the upregulation of cartilage-repairing factors such as CCN2, with the upregulation of the cartilage-specific extracellular matrix expression.

Clinical Relevance: ESWT may be an effective therapeutic option that promotes meniscal healing in the avascular region.