



Case Study

## The micro-current stimulation of knee acupoints in management of chondromalacia patella: a case report

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**Abstract.** [Purpose] A case report in which we treated injured patellar cartilage using non-invasive electrical stimulation; we also used MRI to document the morphology of the patellar cartilage before and after the treatment. [Participant and Methods] A police officer suffered from right anterior knee pain that noticeably affected his fire-arms marksmanship in kneeling position. After a MRI scan he was diagnosed with grade I chondromalacia patella involving the lateral patellar facet. He received therapeutic electrical stimulation on right knee acupoints for four weeks. [Results] He responded positively to the treatment and his numerical rating scale reduced from 6 to 0 for the right knee pain. The MRI revealed that the signs of grade I chondromalacia patella disappeared. [Conclusion] The patellar cartilage is largely avascular; the chondrocytes in cartilage have a low metabolic rate due to limited nutrient supply. Mild cartilage repair may occur spontaneously but is undoubtedly slow. Although this is a case report, we believe that the micro-current stimulation may help enhance the local metabolism and repair process in the affected cartilage.

**Key words:** Electrical stimulation, Patellofemoral joint, Acupuncture point

(This article was submitted Feb. 27, 2020, and was accepted Aug. 9, 2020)

### INTRODUCTION

Micro-current stimulation (MCS), a type of non-invasive therapeutic electrical stimulation, does not activate muscle contractions or trigger noticeable sensations for a given neurologically intact person<sup>1)</sup>. While animal studies showed that MCS could accelerate cartilage repair in rats or rabbits<sup>2, 3)</sup>, no clinical case has been published to reveal the effects of MCS on the human articular cartilage. The present case illustrated an adult with chondromalacia patella who underwent MCS treatment for four weeks, a comparison of his pre- and post-treatment MRI images of the knee and his subjective reporting of the knee pain.

### PARTICIPANT AND METHODS

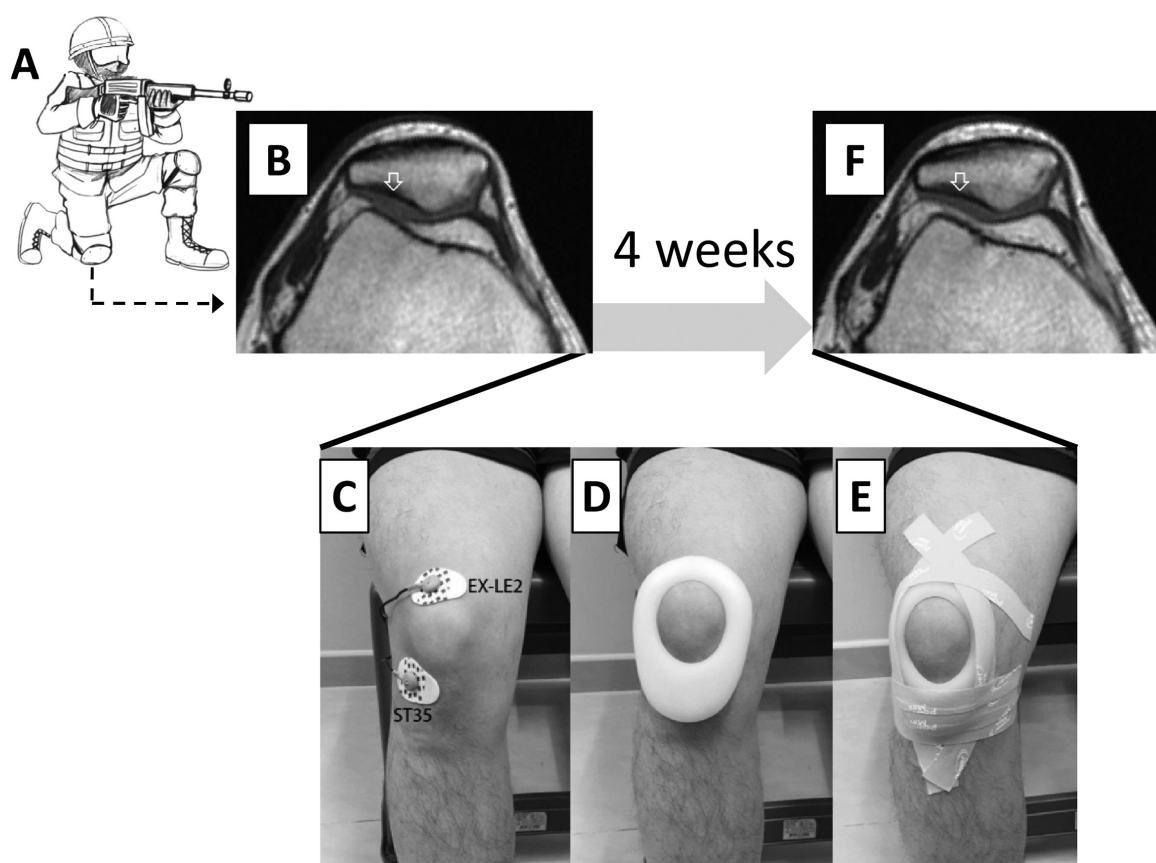
A 35-year-old counter-terrorism policeman had been routinely trained to perform dynamic firearms shooting in which he rapidly changed his positions between standing and kneeling. His dominant hand and kneeling knee were the right (Fig. 1A). He was required to pass the dynamic pistol and rifle shooting tests monthly with 90 out of 100 shots hitting the head area of a human-shape target, otherwise he might be removed from the counter-terrorism team. His main complaint was that he experienced right anterior knee pain during firearms shooting while kneeling. This made it difficult to balance himself firmly in the position and affected his marksmanship. He recalled that two months earlier he had noticed the mild right anterior knee

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**Fig. 1.** A. Rifle shooting with kneeling on the right knee. B. Axial view of right patellofemoral joint before treatment. C. MCS for two acupoints. D. Silicon ring covers peripatellar area. E. The ring secured by elastic taping. F. Axial view of right patellofemoral joint after treatment.

pain after shooting drills or physical exercises that required kneeling or squats. An ice pad applied to the knee for 10 minutes could ease his pain. As the knee pain became more aggravated, he visited his physical therapist.

He had no record of chronic illness or previous surgery, and no history of acute trauma to the right knee. On physical examination, his vital signs and body weight were within normal ranges (BMI=23), and both knees were observed the same. His spinal and lower limb alignments were unremarkable. No tenderness, swelling or increased temperature was found over the right knee region. Anterior/posterior drawer tests for cruciate ligaments and valgus/varus stress tests for collateral ligaments were negative. The right knee extension and flexion strength grading was 5/5. But, his full squat or kneeling with the right knee pressed on the ground elicited dull pain on the anterior right knee. According to the numerical rating scale (NRS), he scored his pain level at 2 out of 10 for the squat and 6 out of 10 for the kneeling (0=no pain, 10=worst pain imaginable).

Based on his medical history and claims, repeated and prolonged kneeling in his shooting training was found to be associated with his current complaint. In order to disclose queried meniscus or retropatellar cartilaginous lesion, a T1-weighted MRI was used to scan the right knee. Eventually, grade I chondromalacia patella of the right knee was diagnosed through a morphological abnormality visualized in axial MRI (Fig. 1B) that showed a swelling of the hyaline cartilage on the lateral facet<sup>4</sup>).

For knee rehabilitation, his physical therapist prescribed MCS for right knee acupoints. Two acupoints, ST35 and EX-LE2, which covered the lateral patella were chosen for his condition based on anatomical consideration rather than classical acupuncture theory (Fig. 1C). MCS was provided using a micro-current stimulator (ES-360, ITO, Japan) with 100 Hz sinusoidal waveform; pulse width: 200  $\mu$ S; electrical current: 400  $\mu$ A; treatment time: 30 minutes with one polarity for 15 minutes and then the opposite polarity for another 15 minutes. The treatment was repeated three times a week for four weeks, twelve treatments in total. He also learned to use a silicon patellar ring with adhesive taping that aimed to reduce weight bearing on his right patellofemoral joint during kneeling firearms training (Fig. 1D, E). The Hong Kong PHAB Association approved this case report in accordance with the ethical standards of the Declaration of Helsinki. The written informed consent was obtained from the participant.

## RESULTS

He responded positively following the four-week treatment. His numerical rating scale for the right knee pain was reduced from 2 to 0 and 6 to 0 for the squat and the kneeling respectively. The post-treatment MRI also revealed that the sign of grade I chondromalacia patella disappeared (Fig. 1F). He still needed to use the silicon patellar ring for preventive purposes. During his six-month follow-up, he did not complain of knee pain or the marksmanship issues.

## DISCUSSION

The counter-terrorism police officers always kneel a great deal in firearms training or a long surveillance. Although knee pads strapped outside their uniform pants can help avoid injury from kneeling on sharp objects, the mechanical stress placed on the patellofemoral joint is substantial. In the present case, the officer had suffered from chondromalacia patella and responded positively to the MCS. The development of cartilage repair depends on various factors such as configurations of cartilage lesion, age and general health conditions. The articular cartilage is largely avascular; the chondrocytes in cartilage have a low metabolic rate due to limited nutrient supply<sup>5</sup>). Therefore, mild cartilage repair may occur spontaneously but is certainly slow. We believed that the use of MCS increased the production of the cell membrane ATP in the injured tissues, in turn, enhancing the local metabolism and repair process in the affected cartilage<sup>6, 7</sup>). It should also be noted that this case report was limited to one articular joint and one modality only; therefore, it may not be possible to extrapolate the findings to other body regions or other modalities.

Previous clinical human studies reported that MCS was an inexpensive, non-addictive and effective means of minimizing delayed-onset muscle soreness and chronic nonspecific back pain; relevant adverse effects were minor consisting of skin irritation at the electrode sites<sup>8, 9</sup>). Based on the above, the MCS may be proposed to be used on a schedule or on an as-needed basis for preventing or treating mechanical-stress related cartilaginous injuries. It could be valuable to disciplined forces such as counter-terrorism police officers who need to maintain a high level of physical fitness and readiness for complex and rapidly-unfolding crises they will experience on their duties.

### *Funding and Conflict of interest*

None.

## ACKNOWLEDGEMENT

Ms. Deborah Wong, executive director of Hong Kong PHAB Association, furnished administrative support to the first author.

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