IMMEDIATE CHANGES OF GAIT PATTERNS IN PATIENTS WITH BILATERAL MEDIAL KNEE OSTEOARTHRITIS AFTER ACUPUNCTURE TREATMENT

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SUMMARY
Acupuncture treatment has been proven to be effective in pain relief and anesthesia, and has been suggested for treating knee OA. However, no study has reported the immediate changes of lower limb mechanics in patients with different degrees of knee OA after acupuncture treatment. This present study aimed to investigate the immediate biomechanical changes of gait patterns in patients with bilateral medial knee OA during level walking after acupuncture treatment. Thirty bilateral medial knee OA patients were recruited and assigned to mild group and severe group. Both groups underwent 30-minute formula electro-acupuncture treatment. The visual analog scales (VAS) and gait analysis were used to evaluate the knee pain and the performance of level walking before and after acupuncture treatment. Paired t-test was used to investigate the before and after changes. The VAS was reduced in both groups after treatment. The temporal-distance variables, joint kinematics, joint kinetics and leg stiffness were also improved in patients with mild knee OA after acupuncture treatment, while no significant improvements were found in severe group. The current results suggest that patients with mild knee OA showed immediate favourable biomechanical changes after acupuncture treatment and that acupuncture stimulation seems to be more effective in patients with mild knee OA.

INTRODUCTION
Osteoarthritis (OA), a slowly progressive degeneration disease, is often seen in people over 50 years old [1,2]. Up to 40% of people over 70 years old suffer osteoarthritis of the knee (knee OA). The pathologic changes in the medial compartment of knee are more than those in the lateral. Most symptoms disturbing patients with knee OA include pain, joint swelling & stiffness, muscle weakness, cracking noise, impaired movement and deformation, which would lead to the abnormal gait of the knee OA patients.

A previous study showed that acupuncture treatment could be effective for knee OA patients [3], including pain reduction, improved joint kinematics & kinetics and gait temporal-distance variables. However, only patients with K/L (Kellgren & Lawrence) grade II and grade III were recruited in that study. Meanwhile, how the control of the whole of the lower limbs may be affected by acupuncture treatment is unclear. Through the mass-spring model of the lower limbs, the modulation of the leg stiffness in controlling the lower limbs could be studied [4]. No study in the literature reported the modulation of the leg stiffness of patients with knee OA after acupuncture treatment during level walking.

The aim of this study was to investigate the changes of leg stiffness, as well as the associated joint kinematics and joint kinetics, in patients with different degrees of bilateral medial knee OA during level walking after acupuncture treatment.

METHODS
Fifteen patients with mild bilateral knee OA and fifteen patients with severe bilateral knee OA were recruited with informed written consent. During the experiment, both groups underwent a 30-minute formula electro-acupuncture stimulation at five acupoints. Each acupoint was acupunctured with a single needle by an experienced acupuncturist (IPW). All patients were evaluated for their knee pain using a 10-cm visual analogue scale (VAS) and for performance of level walking using computerized gait analysis. The kinematic data were collected with a 7-camera motion analysis system (Vicon 512, Oxford Metrics, U.K.) and ground reaction forces (GRF) by two forceplates (AMTI, USA). Joint angles, moments and leg stiffness were calculated using inverse dynamics analysis. All variables at the beginning and end of single stance phase (SSP), as well as the maximum values during swing phase (joint angle only) were obtained and compared between groups. All the variables were compared using paired t-test before and after acupuncture treatment. Significant level was set at α = 0.05.

RESULTS AND DISCUSSION
The current results showed that the VAS of both groups were all reduced after acupuncture treatment (p < 0.05; Fig.1). The temporal-
distance variables, namely the gait velocity and stride length in the mild group were also decreased (p < 0.05), but there was no significant difference in the severe group after treatment. For the mild group, the knee flexion at the beginning of SSP and during swing phase was increased after treatment (p < 0.05) and the hip flexion was also significantly increased during swing phase (p < 0.05). In the severe group, only the peak hip flexion increased at the beginning of SSP after acupuncture treatment (p < 0.05).

The relatively unchanged gait patterns in the severe group suggest that effects of the apparent deformity could not be improved simply with acupuncture treatment.

The hip and knee extensor moments were increased at the beginning of SSP after acupuncture treatment (p < 0.05). Furthermore, the knee abductor moments were also increased at the beginning of SSP in the mild group after treatment (p < 0.05). The leg stiffness was significantly increased in the mild group after acupuncture treatment (p < 0.05, Fig. 2).

Previous studies reported that decreased knee flexion was found on knee OA patients at stance phase [5]. According the current results, increased hip flexion and knee flexion at the beginning of SSP and swing phase suggest that the effect of pain-relief of acupuncture did help improve the gait pattern for the knee OA. Meanwhile, patients with knee OA also showed poor ability of weight-transferring while ambulation. The reduced force at the knee joint led to smaller knee extensor moments, which helped reduce pain. The increased hip extensor and knee extensor moments at the beginning of SSP suggested that mild knee OA patients could take larger impact force during weight acceptation of gait.

The patients recruited in this study were all suffering medial knee OA, which meant larger stress on medial side (knee adduction moment). The knee abductor moments in the mild group were increased after acupuncture treatment, suggesting that patients were able to take more knee adduction stress with less pain [2].

Leg stiffness was estimated in the current study as the ratio of the effective ground reaction force and the total leg length. In other words, changes of the force and leg length would influence the leg stiffness. The joint moments in the mild group were increased (knee extensor and abductor moment) after acupuncture treatment, with increased resultant force. On the other hand, the increased hip and knee flexion angles led to reduced leg length. Therefore, the increased leg stiffness in the mild group indicated that the lower extremities could bear larger force with less pain after acupuncture treatment.

**CONCLUSIONS**

The current results indicate that patients with mild bilateral knee OA changed the leg stiffness, joint angles and joint moments during level walking after acupuncture treatment. They showed increased gait velocity and stride length mainly owing to increased joint angles and joint moments. They also carried larger impact force during level walking as indicated by the increased leg stiffness after acupuncture treatment. On the other hand, acupuncture may not be efficient in more severe OA knee possibly owing to the deformity of the knee which may be too severe to be improved or compensated simply using acupuncture. Therefore, acupuncture treatment seems to be more effective in patients with mild knee OA.

**REFERENCES**