Six-week biofeedback gait retraining programme in people with knee osteoarthritis: a randomised controlled trial

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Summary

Gait retraining using a combination of foot angle, step width and step length in the form of real-time gait pattern feedback has greater effect in reducing knee loading in people with knee osteoarthritis, when compared with knee loading feedback and a no feedback group. This technology could enhance the impact of research on clinical practice in knee osteoarthritis.

Introduction

Knee osteoarthritis (KOA) is an irreversible musculoskeletal disease which may contribute to decline in physical function and quality of life, especially in older generations [1]. As increased knee loading has a strong correlation with disease progression [2], gait retraining has become a popular non-invasive strategy to slow down disease progression [3]. To enhance it, biofeedback has been employed to provide real-time body information, either directly (i.e. knee loading feedback) or indirectly (i.e. gait pattern feedback). However, it is unknown which type of feedback is more effective in daily activities. Therefore, this study aims to explore these questions in a multi-group gait retraining programme.

Methods

The detailed protocol was described in the published paper [4]. Fifty KOA patients were randomly allocated into a knee moment feedback group (n=20, 61±6 years, 170±11cm, 78±13kg), gait pattern feedback group (n=20, 62±5 years, 170±13cm, 83±17kg), and control group (n =10, 58±6 years, 170±10cm, 86±15kg), with four participants dropping out from the knee moment group. Supervised gait training sessions with real-time biofeedback were carried out weekly for six continuous weeks, using marker-based motion capture system and an instrumented treadmill. Baseline, post-intervention and one-month follow-up assessments were performed overground to measure knee loading and gait pattern parameters, knee pain (NRS) and functional ability during daily activities (WOMAC). Motion and force data were low-pass filtered and knee adduction moment (KAM) was calculated using inverse dynamics approach in Visual 3D. All outcomes were statistically analysed using intention-to-treat approach by generalised linear mixed-effect modelling.

Results and Discussion

Figure 1 demonstrates that after the six-week training, the gait pattern group had significant improvements in 1st peak KAM ($p = 0.006$), knee pain during walking ($p = 0.002$), and WOMAC score ($p < 0.001$), while the other two groups only had improvement in pain reduction and functional ability ($p \leq 0.034$) but no significant change in knee loading reduction ($p \geq 0.152$). Strong retention effects were found in WOMAC score and knee pain for both intervention groups at one-month follow up ($p < 0.004$), and the significant KAM change was retained in the gait pattern group ($p = 0.003$).

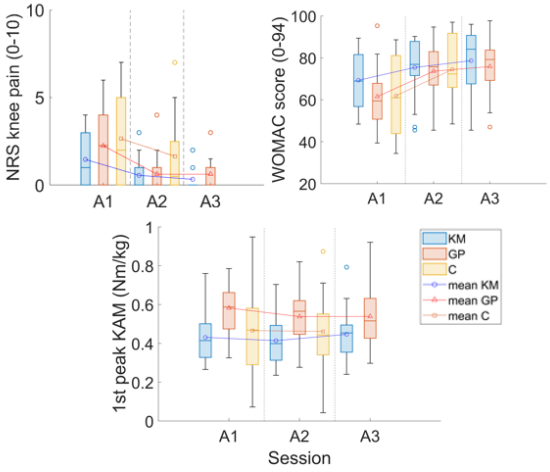

Figure 1: Boxplots of the 1st peak KAM (Nm/kg), knee pain during walking and WOMAC score at baseline (A1), post-training (A2) and one-month follow-up (A3) assessment session. KM = knee moment, GP = gait pattern, C = control.

Gait pattern feedback gait retraining appears to be more effective in reducing the KAM, compared to knee moment feedback and purely walking exercise. The reduction on peak KAM was mainly achieved by more toe-in foot progression angle, wider step width and shorter step lengths.

Conclusions

Short-term pain relief and functional improvement may be achieved by simple walking exercise, as all groups had improved pain and functional ability scores. However, knee loading reduction appears to only be possible when performing gait retraining with gait pattern feedback, which could lead to long-term improvement in disease progression.

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