PATELLOFEMORAL JOINT STRESS DURING STAIR ASCENT AND DESCENT: A COMPARISON OF PERSONS WITH AND WITHOUT PATELLOFEMORAL PAIN

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INTRODUCTION

Patellofemoral pain (PFP) is one of the most common knee disorders encountered in clincical practice. Patients with PFP typically complain of retropatellar pain that is aggravated by activities such as stair ascent and descent, running, and squatting. Although the cause of patellofemoral joint pathology is believed to be related to elevated joint stress (force per unit area), this hypothesis has not been adequately tested. Using an individualized biomechanical model of the patellofemoral joint which takes into consideration the inherent variability in patellofemoral joint contact area between individuals, the purpose of this study was to compare joint kinetics and patellofemoral joint stress (PFJS) in persons with PFP and pain-free controls during stair ascent and descent. It was hypothesized that subjects with PFP would demonstrate increased PFJS compared to a control group.

METHODS

Ten subjects with a diagnosis of PFP and ten pain-free individuals participated in this study. Lower extremity kinematics (Vicon) were obtained as subjects ascended and descended a portable four step staircase at a self-selected velocity. A raised forceplate (AMTI) permitted the collection of ground reaction forces from the first step. Kinematic and kinetic data were collected simultaneously.

Individualized patellofemoral joint contact area was obtained at multiple knee flexion angles using a previoulsy described MRI technique.(Heino et al., 1999) The knee joint angle and knee extensor moment (inverse dynamics approach) obtained during stair ambulation were used as input variables into a biomechanical model, (Heino & Powers, 1999) which was used to derive patellofemoral joint reaction force (PFJRF). PFJS was then calculated as the PFJRF/patellofemoral joint contact area and reported as a function of the stance phase of gait. Independent t-tests using trimmed means were used to compare walking velocity, peak knee extensor moment, peak PFJRF, PFJRF-time integral, peak PFJS, PFJS-time integral, and utilized patellofemoral joint contact area between groups.

RESULTS AND DISCUSSION

During stair ascent and descent, there were no significant differences peak PFJS, stress-time integral, or average utilized contact area between groups (Figs. 1-2). During stair ascent however, the PFP subjects demonstrated significantly lower peak knee extensor moments (0.805 vs. 1.16 Nm /kg; p=.04), peak PFJRF's (24.98 vs. 37.31 N/kg; p=.02; Fig.2), PFJRF-time integral (288.2 vs. 501.9 N/kg; p=.01; Fig. 2) compared to the controls. The same trend was observed during stair descent, however there were no statistically significant differences in these variables.

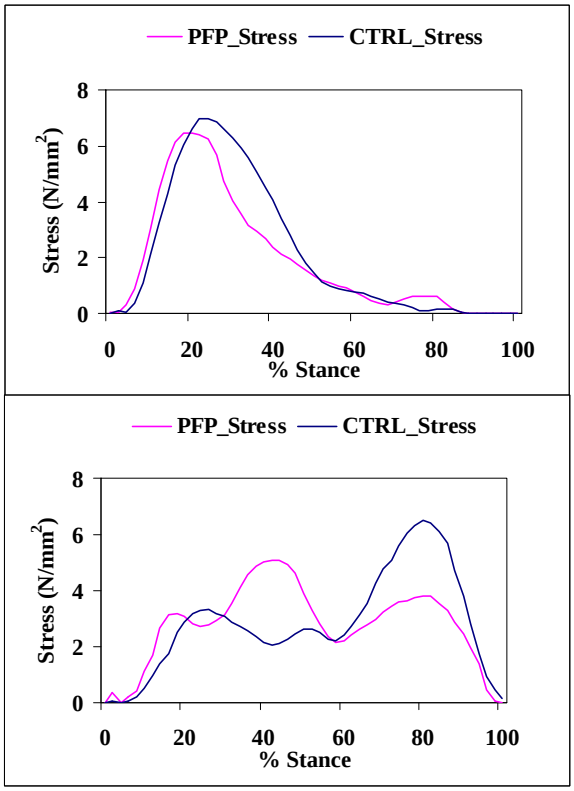

Figure 1. Mean patellofemoral joint stress in subjects with PFP and control subjects during stair ascent (top) and stair descent (bottom).

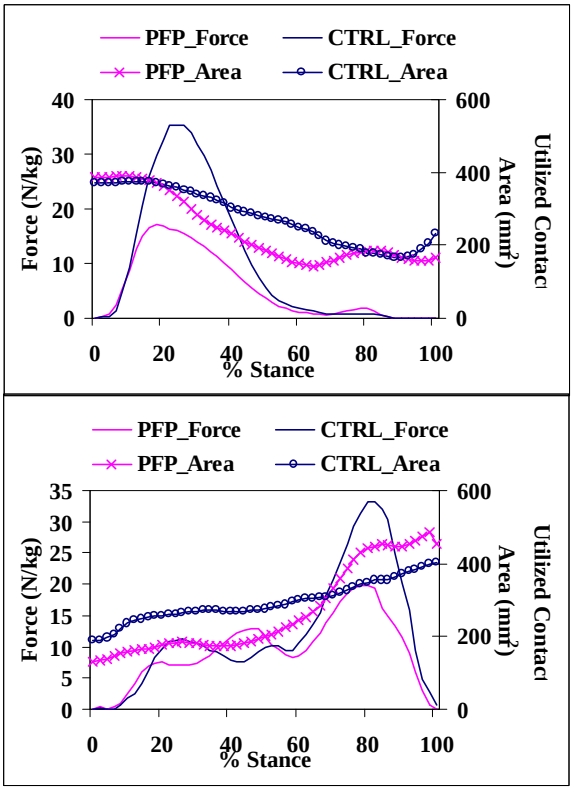

Figure 2. Mean patellofemoral joint reaction force and utilized contact area in subjects with PFP and control subjects during stair ascent (top) and stair descent (bottom).

The results of this study do not support the hypothesis that individuals with PFP exhibit excessive PFJS during stair ambulation. Joint stress in the PFP group appeared to be modulated through a reduction in the knee extensor moment and the PFJRF. The reduction in the knee extensor moment and PFJRF was likely the result of a slower velocity which was evident in the PFP group during both stair ascent (1.48 vs.1.98 m/min; p=.04) and stair descent (1.52 vs. 2.57 m/min; p=.008).

SUMMARY

1. Individuals with PFP did not exhibit excessive PFJS during stair ambulation.
2. The reduction in the knee extensor moments and PFJRF's in the PFP group appeared to be a compensatory strategy aimed at keeping joint stress within acceptable limits. This was accomplished through a reduced walking speed.

REFERENCES

Heino et al.(1999), *Trans ORS.*

Heino & Powers, (1999), *Gait & Posture*, **8**(2).

ACKNOWLEDGEMENTS

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