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## Using Augmented Feedback to Decrease Patellafemoral Pain in Runners: A Pilot Study

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**Objective:** Patellofemoral pain (PFP) is a common injury in running. The cause of patellofemoral pain is multifactorial in nature, which results varied treatment approaches for this disorder. Many studies have examined the effect of using strengthening protocols targeted at subjects' hip and quadriceps strength. Although these studies have resulted in a reduction in short-term PFP for runners, many continue to experience PFP after undergoing these treatment strategies. A more recent theory regarding the treatment of PFP in runners involves the use of augmented verbal and visual feedback. This treatment strategy involves giving the runner scheduled visual feedback to adapt their running strategies in hopes of reducing their PFP. Much of this research has been done with experienced runners in the age range of 18-22 years old. The purpose of this study was to examine the effects of augmented verbal and real-time visual feedback on patellofemoral pain. The hypothesis was that training with the use of auditory and visual feedback would improve patellofemoral pain in this runner. In clinical practice, auditory and visual feedback to change hip and knee mechanics while running may be used as a treatment strategy for patellofemoral pain.

**Design and Setting:** The study was conducted in a controlled laboratory setting and was an experimental design including a single-subject.

**Participants:** The subject was a recreational female runner that was 22 years of age. The subject was recruited via a flyer distributed on campus. Once the individual agreed to participate, they were given a date to begin the study. This study was approved by the Institutional Review Board at the institution. When the subject arrived at the first meeting, the

informed consent was reviewed and signed by the subject.

**Intervention:** At the first visit, the subject was given a PFP questionnaire to determine if they were eligible for the study. For this study, the subject was classified as having PFP if they had pre-patellar or retropatellar knee pain while running that was an insidious onset, and knee pain that has lasted for at least three months. The subject also needed these symptoms to occur during two of the following functional activities: ascending/descending stairs, squatting, kneeling, jumping, and long periods of sitting. Subjects were excluded from the study if they exhibited any type of neurological disorder, injury to the lower extremity, previous surgeries involving the lower extremity, rheumatoid arthritis, heart conditions, or any other knee pathologies including patellar instability, patellofemoral dysplasia, meniscal or ligament tears, osteoarthritis, or tendinopathies. Once the subject met the inclusion criteria, they completed a visual analog scale (VAS) and a lower extremity functional scale survey (LEFS) to assess their function. The subject completed 2 training sessions per week for a total of 8 training sessions on a treadmill. During the run, an iPad was used to capture an anterior view of the subject. This image was mirrored to a television monitor to provide the subject with real time visual feedback of their running. For each session, the subject was given a five-minute warm-up at their self-selected running speed and was then asked to move to a speed that they were comfortable with running 25 minutes. This speed was constant throughout the entire study. The augmented verbal and visual feedback was given based on a schedule of "on" times and "off" times. The "on" times for the feedback stayed at a constant one

minute where the “off” times became progressively longer.

**Main Outcome Measurement:** The VAS and the LEFS served as the dependent variables in this study. The subject completed these questionnaires at the first test session and after completion of the training protocol.

**Results:** The subject completed a four-week, eight session, verbal and real-time visual feedback training. The subject demonstrated a small improvement in LEFS scores from a pre-test score of 68 points to a post-test score of 73 points. The subject demonstrated an improvement in VAS scores from 21 millimeters (mm) to 6 mm.

**Conclusion:** The subject’s pre- and post- training VAS scores exceeded the 14 mm minimal clinically important difference (MCID) which is important for determining improvement with PFP. However, although the subject experienced an increase in their LEFS score, this change was below the threshold of the MCID. The results from this case study design support the use of verbal and real-time visual feedback to improve the short-term perceived symptoms from PFP in recreational runners. Further research should be conducted to determine if the effects of this type of training protocol promote long-term relief of PFP, or if the need for “retraining” is necessary. Additionally, including dependent variables that actually measure hip and knee kinematics before and after this type of training may be of interest.

**Key words:** Patellofemoral pain, lower extremity functional scale, visual analog scale, augmented feedback