Effects of patella taping on patella position and perceived pain

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ABSTRACT

BOCKRATH, K., C. WOODEN, T. WORRELL, C. D. INGERSOLL, and J. Farr. Effects of patella taping on patella position and perceived pain. *Med. Sci. Sports Exerc.*, Vol. 25, No. 9, pp. 989–992, 1993. Anterior knee pain syndrome (AKPS) represents a significant challenge for the sports medicine clinician. One proposed etiological factor for AKPS is poor vastus medialis obliquus (VMO) control, resulting in lateral glide of the patella. Patella taping has been advocated to increase VMO control. The purpose of this study was to determine the effects of patella taping on patella position and perceived pain. Twelve subjects (age = 29 ± 9 yr; weight= 70.9 kg ± 17.8; height = 174.0 cm ± 8.1) with AKPS currently using patella taping procedures with a decrease in their symptoms participated. Each subject had Merchant's view x-rays taken pre- and posttaping while performing an isometric quadriceps contraction to determine patella rotation and patella congruency angles. Subjects also completed a visual analog pain scale after performing a 0.2 m (8") step-down both pre- and posttaping. Paired *t*-tests revealed no significant change in patellofemoral congruency ($P = 0.98$) and patella rotation angles ($P = 0.80$). Significant reduction (50%) in subject pain level was revealed by the visual analog scale ($t(15) = 4.99$; $P < 0.0005$). Results demonstrate that patella taping significantly reduced the perceived pain levels during a 0.2-m step-down; however, this reduction in pain was not associated with patella position changes.

PATELLA ROTATION, PATELLA CONGRUENCY ANGLES, ANTERIOR KNEE PAIN SYNDROME

Anterior knee pain syndrome (AKPS) is a common problem for the athlete. The specific etiology of AKPS has not been determined (1,3,5,7). One proposed etiological factor for AKPS is poor vastus medialis oblique (VMO) control (1,3–7,11,12). The VMO is a dynamic medial stabilizer that prevents lateral deviation of the patella (1,6,7,11,12). Several authors have demonstrated that patients with AKPS demonstrate lower VMO:VL EMG activity in their symptomatic leg when compared with their asymptomatic leg (12) and changes in reflex time (13). Therefore, selective VMO recruitment and VMO motor control are appropriate goals for the clinician and patient.

Several strategies have been developed to facilitate VMO recruitment (3,5,7). McConnell (7) proposes that patella position (medial/lateral tilt, glide, rotation, and anteroposterior tilt) can be changed by taping the patella. This taping technique is based on the theory that proper alignment of the patella in the patellofemoral groove will decrease pain with activity, allowing the patient to train or facilitate recruitment of the VMO. She reports an increase in VMO EMG activity during a maximal isometric quadriceps contraction in standing after patella taping (7). The effect of McConnell taping on patellar position as determined by roentgenography has not been reported.

The purpose of this study was to determine the effects of patella taping on patella position and perceived pain.

METHODS

Subjects. Twelve patients with AKPS who were currently using McConnell taping procedure with a decrease in their symptoms participated. Four subjects had bilateral AKPS ($N = 16$). The subjects included five men and seven women (age = 29 ± 9 yr, weight = 70.91 kg ± 17.8, height = 174.0 cm ± 8.1). Patients signed an informed consent that was approved by a University Human Review Board prior to participation in this study. Any subject who was or may have been pregnant was omitted from the study.

Patella taping. McConnell's patella taping techniques incorporates the use of 2- and 4-inch coverall tape (Willis Medical Co., Inc., Richardson, TX) admin-

0195-9131/93/2509-0989$3.00/0
MEDICINE AND SCIENCE IN SPORTS AND EXERCISE

Submitted for publication June 1992.
Accepted for publication March 1993.

istered to the patella. Patients taped their knees based on their specific patella position as assessed by a physical therapist. Each patient was receiving patella taping as part of their rehabilitation program. Therefore, no instruction or assessment was provided in patella taping during the testing procedures.

Reliability study. A test-retest reliability study was performed prior to the experimental study. One researcher (CDI) determined sulcus, patella rotation, and congruence angles by digitization ($N = 25$).

Instrumentation. Merchant views of pre- and posttaping were taken with a Picker Starlite G325S x-ray machine. The knee was held at 45° by an Axial Viewer (Orthopaedic Consultants, Mountain View, CA). The cathode tube was set 101.6 cm from the patella with a field size of 15.2 × 27.9–30.5 cm. The cross-hair illumination by the lamp was set on the anterior-most aspect of the patella. Exposure variables were 100 mA 0.05s and 70 kV. One exposure was taken pre- and posttaping with the quadriceps contracted. The subjects performed an isometric contraction against a 1.36-kg weight without allowing their heel to lose contact with the table during both x-rays. The x-rays were taken by a certified x-ray technician. The x-ray set up is demonstrated in Figure 1.

Congruence, patella rotation, and sulcus angles were determined by digitization using a Numonics Model Electronic Digitizer (no. 1224, Numonics Corporation, Lansdale, PA) interfaced to a IBM personal computer. Six points were located on each x-ray as described by Ingersoll and Knight (3): the highest point on the medial condyle (M), the highest point on the lateral condyle (L), the lowest point of the patellofemoral groove (O), the posterior-most point of the thickest aspect of the patella (P), the medial-most point of the patella (μ), and the lateral-most point of the patella (τ).

The sulcus angle (MOL) is the angle from the highest point on the medial and lateral condyles to the lowest point of the intracondylar sulcus. This angle represents the depth of the patellofemoral groove.

The patellofemoral congruence angle (PFC) is obtained by bisecting the sulcus angle to establish a zero reference line. The PFC angle is formed by this zero reference line and line OP. This angle quantifies the position of the patella in the patellofemoral groove (Fig. 2A).

The patella rotation angle (PR) is formed by lines M and L (Fig. 2B). This angle represents rotation in a transverse plane. When the lateral aspect of the patella is positioned posteriorly, it is presumably a result of a laxity of the medial structures and/or tightness of the lateral structures (3).

Pain assessment. The visual analogue scale (VAS) was used to assess changes in pain during a 0.2-m (8″) step down with and without patella taping. The VAS has showed to be reliable and valid for assessing intensity of pain (10). A 150-mm line marked "no sensation of soreness" on the left and "worst sensation of soreness imaginable" on the right was used.

Testing procedure. Each subject performed a forward 0.2-m step down without patella taping and rated his or her intensity of pain on the VAS. Then, a pretaping Merchant view was taken with the subject performing an isometric quadriceps contraction against a 1.36-kg weight. Subjects then applied the tape to their patella as previously taught by a physical therapist trained in McConnell taping. After the tape was applied, the subject repeated the step down and rated his or her pain on the VAS posttaping. A second Merchant view was taken after taping.

RESULTS

Data analysis. Paired t-tests were used to compare pre- and posttest measurements for patella rotation,

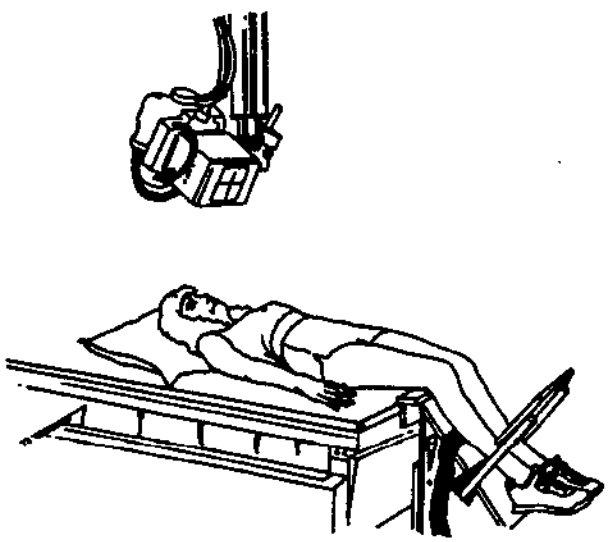

Figure 1—Merchant's view x-ray set up.

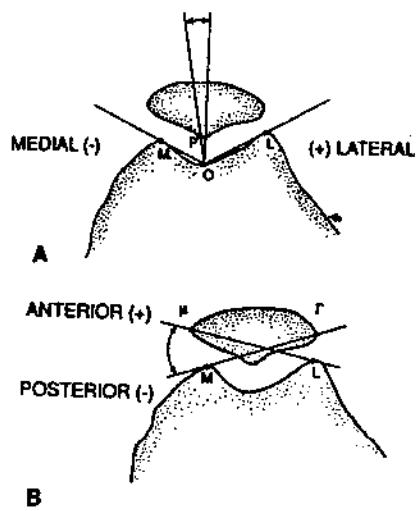

Figure 2—A. Patellofemoral congruency angle. B. Patella rotation angle.

patellofemoral congruency angles, and VAS pain data. The alpha level was adjusted (0.05/3 = 0.017). Data from the reliability study were analyzed using intraclass correlation coefficient. The sulcus, congruence, and rotation angles were determined to have a high reliability (0.97–1.0). No significant change was found in patellofemoral congruency angle ($P = 0.98$) and patella rotation ($P = 0.80$)(Table 1). There was a significant reduction in pain as revealed by the VAS ($t(15) = 4.99$; $P < 0.0005$).

DISCUSSION

Recently, the use of terms such as AKPS have been criticized as vague (2). For the purpose of this paper AKPS is a descriptive term for patients who have anterior knee pain resulting from abnormal patella alignment exacerbated by: increased Q-angle, lateral retinaculum tightness, VMO weakness, and a pronated foot. Common symptoms include reflex-relaxation of the quadriceps and locking ("catching") that can be actively unlocked (3,5,7). Several strategies have been developed to facilitate VMO recruitment however, limited scientific literature exists to support or refute the effects of patella taping. McConnell (7) demonstrated an increase in VMO EMG activity during a maximal isometric quadriceps contaction in standing after patella taping, however, this was a preliminary investigation in two subjects. McConnell (7,8) also reported a preliminary study with four subjects (three experimental and one control) that showed a 15% increase in isokinetic concentric strength and a 5% increase in eccentric strength after patella taping. A 96% success rate was reported when using her techniques of patella taping and VMO strengthening. We have been unable to locate literature that supports this high success rate.

Our results demonstrated that patella taping significantly reduced subject's perceived pain during a 0.2-m step-down. This reduction in pain was not a result of patella position changes since no change occurred between pre- and postpatellar taping. We assessed patella position at 45° of knee flexion during an isometric contraction. Therefore, the effects of patella taping on patella position at other arcs of motion cannot be determined. Limitations exist in static assessment of patella position. Obviously, dynamic imaging or series scanning in larger arcs of motion is needed.

TABLE 1. Patella characteristics with quadriceps contracted and VAS pre and post taping (mean ± SD).

	PFC (°)	PR (°)	VAS (mm)
Pretaping	−15.86 ± 19.96	42.56 ± 27.72	43.75 ± 37.26
Posttaping	−15.67 ± 18.41	40.45 ± 17.20	20.25 ± 28.60
Difference	−0.19 ± 12.70	2.11 ± 13.20	23.50 ± 18.83

PFC = patellofemoral congruency angle; PR = patella rotation angle; VAS = visual analog scale.

We specifically selected patients that were performing patella taping and receiving pain reduction because we wanted to determine if the reduction in pain was related to a change in patella position as theorized by McConnell (7). A 50% reduction in perceived pain was achieved (pretaping VAS = 43.8 vs posttaping VAS = 20.3). This reduction of pain represents important finding that supports McConnell's results and our clinical observations. However, the mechanism for pain reduction remains unclear and is difficult to explain. Theoretically, the tape may provide neural inhibition via large fiber input to the anterior knee. Because large fiber input sensory signals are transmitted faster to the brain than pain signals, the large fiber input from the tape may override the pain signals (9). Therefore, the patient may experience a decrease in perceived pain. Obviously, this is speculative and further study is needed to determine the effect of patella taping on neural inhibition (e.g., Hoffman reflex).

Ingersoll and Knight (3) demonstrated that selective EMG VMO recruitment was possible while maintaining VL EMG activity. They measured patellofemoral congruency angle (PFC) and patella rotation (PR) of a group of asymptomatic subjects before and after nine sessions of biofeedback training and found a significant reduction in PR ($P = 0.03$) and PFC ($P = 0.004$). This decrease in PR and PFC indicates the patella has assumed a more medial position. They also reported that nine sessions of quadriceps progressive resistive exercise increased PR and PFC values and the patella assumed a more lateral position. The results of this study demonstrate that patella position can be altered by clinical intervention. The fact that biofeedback positions the patella medially and that nonspecific quadriceps progressive resistive exercise positioned the patella laterally indicated a strengthening program in patients with AKPS must be selective to the VMO. Because Ingersoll and Knight (3) demonstrated significant changes occurred in PFC and PR angles with biofeedback training at 45° of knee extension, we do not believe that patella position changes occurred in this study. However, we did not review patella position in the last −20° to of −30° knee extension. Therefore, we cannot exclude the possibilty that changes in patella position occurred in other arcs of motion. AKPS patients often experience pain in the −20° to −30° arc of motion. This position is the most unstable position.

The possibility also exists that changes in patella position occurred during the initial taping phase prior to participation in this study. We believe that such changes did not occur because the patients still had pain without patella taping during the step down. Obviously further research is needed.

Further research. Further research is needed to address the following questions: 1) What effect would patella taping have at angles other than 45°? 2) Does

patella taping increase VMO EMG activity? 3) Would magnetic resonance imaging methods provide more accurate data to access patella position? 4) What is the mechanism of pain relief with McConnell taping?

CONCLUSION

Patella taping as used in this study reduced perceived pain in AKPS patients approximately 50% on a VAS during a 0.2-m step down procedure. No significant change occured in patella rotation, patellofemoral congruency, or sulcus angles. We hypothesize that this reduction in pain may be related to sensory input from the tape. Further research is needed to explain this reduction in pain.

This study was supported by a grant from Specialty Centers for Orthopaedic and Rehabilitative Excellence. We would like to express our thanks to Debbie Nelson, R.T,. for her expert assistance during the radiological procedures. In addition we would like to thank Connie Buell, M.S.P.T., A.T.C., and Mark Reinking, P.T., A.T.C., from Saint Francis Sports Medicine for assistance in patient recruitment.

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