

# Kinematic MRI Assessment of McConnell Taping Before and After Exercise

Ronald P. Pfeiffer,\*<sup>†</sup> EdD, LAT, ATC, Mark DeBeliso,<sup>†</sup> PhD, Kevin G. Shea,<sup>†‡</sup> MD, Lorrie Kelley,<sup>§</sup> MS, Bobbie Irmischer,<sup>†</sup> MS, and Chad Harris,<sup>†</sup> PhD

From the <sup>†</sup>Center for Orthopaedic and Biomechanics Research, Boise State University, Boise, Idaho, <sup>‡</sup>Intermountain Orthopaedics, Boise, Idaho, and <sup>§</sup>Department of Radiologic Sciences, Boise State University, Boise, Idaho

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**Background:** The authors assessed the effectiveness of McConnell medial glide taping after exercise using an MRI extremity scanner.

**Hypothesis:** McConnell taping would not be effective in maintaining medial glide of the patella after exercise.

**Methods:** Eighteen healthy women (mean age  $22.28 \pm 2.02$  years) participated in the study. The patellofemoral joint was imaged at 4 knee flexion angles (0°, 12°, 24°, and 36°) in 3 conditions (no tape, with McConnell taping–medial glide, and with tape after exercise). Effectiveness was determined by measuring lateral patellar displacement. ANOVA and post hoc paired *t* tests were used to test for changes in lateral patellar displacement at each knee angle and condition.

**Results:** Statistical analysis revealed significant differences in lateral patellar displacement at all test angles, between the tape and no tape and between tape and tape after exercise conditions.

**Conclusions:** McConnell medial glide taping resulted in significant medial glide of the patellofemoral joint at all 4 knee angles before but not after exercise. However, McConnell medial glide taping may be effective under controlled rehabilitation conditions in which exercise is less intense.

**Clinical Relevance:** Beneficial effects of McConnell medial glide taping may be related to factors other than altered patellar alignment.

**Keywords:** exercise; patella; medial glide; McConnell

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McConnell first published the results of her research describing an ensemble of clinical techniques, including specific taping procedures, for the treatment of patellar chondromalacia in 1986.<sup>21</sup> Found to be effective in controlling pain, the McConnell taping techniques continue to be a popular clinical technique applied to patients with persistent patellofemoral pain syndrome (PFPS). Although McConnell reported a 96% success rate in her treatment of PFPS in a mixed-gender symptomatic cohort (N = 35), subsequent publications have been equivocal regarding the effectiveness of the technique to correct patellofemoral incongruence and/or anterior knee pain.<sup>1,5,6,8,10,16,17,27,29,30</sup>

The purpose of the McConnell taping procedures is to correct abnormal patellar tracking to allow the patient to engage in physical therapy exercise pain free. Although there are several variations of the taping procedure recommended, depending on the specific needs of the patient (eg, glide, tilt, and/or rotation), as reported by McConnell, nearly all patients require a medial glide of their patella.<sup>21</sup> Medial glide is accomplished by way of application of specialized adhesive tape (Leukotape P and Cover-Roll stretch underwrap, Beiersdorf AG, Hamburg, Germany) applied across the anterior aspect of the patella, pulling from lateral to medial, to in effect “medialize” the patellofemoral joint (PFJ). Once applied, the patients should experience a reduction in their symptoms associated with PFPS, thus enabling them to engage in physical therapy exercise. As such, the ability of the strapping procedure to maintain the medialized position of the patella is critical for the duration of the physical activity.

A review of MEDLINE literature ([www.medline.com](http://www.medline.com)) identified few published studies that reported radiographic assessment of the effectiveness of the McConnell taping for altering and subsequently controlling patellar posi-

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\*Address correspondence to Ronald P. Pfeiffer, EdD, LAT, ATC, Professor, Department of Kinesiology, K-209, Boise State University, 1910 University Drive, Boise, ID 83725-1710.

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tion.<sup>10,17,30</sup> Gigante et al used CT scans on 16 female subjects suffering from anterior knee pain to assess the ability of McConnell taping to alter both lateral patellar angle (LPA) and lateral patellar displacement (LPD). Scans were obtained at 0° and 15° of knee flexion, both with the quadriceps relaxed and maximally contracted. Their results demonstrated no significant difference in LPA or LPD with muscles relaxed or contracted, as well as untaped or taped.<sup>10</sup> Worrell et al investigated the effect of McConnell taping and bracing on patellofemoral congruence angle as well as on both LPD and LPA. They used MRI and imaged the knees of 12 subjects evaluated with patellofemoral pain. Transaxial images were obtained in 8 discrete knee flexion angles, that is, 10°, 16°, 25°, 30°, 34°, 39°, 41°, and 45°, with the quadriceps relaxed. Results indicated that significant changes in patellofemoral congruence and LPD were present only at the 10° of flexion position in the braced condition. No other significant differences were noted at any other flexion angle between the 3 conditions tested (ie, no tape, taped, and braced).<sup>30</sup> Neither Gigante et al nor Worrell et al evaluated the ability of patellar taping to remain effective after being subjected to a bout of physical exercise. However, Larsen et al did examine the ability of the McConnell medial glide technique to maintain patellar position after exercise.<sup>17</sup> Larsen et al conducted a radiologic assessment, using the modified Merchant view of the PFJ,<sup>23</sup> to determine the effectiveness of the medial glide strapping both before and after a standardized period of exercise.<sup>17</sup> These authors concluded that the tape did not maintain patellar position once it was subjected to the exercise protocol.

The effects of physical activity on the ability of adhesive tape to control and/or restrict range of motion of a joint have been examined previously with respect to ankle strapping. These studies have independently concluded that taped ankles, subjected to various forms of physical activity of 20 to 40 minutes in duration, show a return to pretaped amounts of ankle/foot movement.<sup>12,13,18,20</sup> As such, we endeavored to determine if the medial glide taping procedure, as described by McConnell, would continue to maintain medialization of the patella after a standardized exercise program. However, unlike the previous study by Larsen et al, which imaged using plain film radiography with the knee positioned at 40° of flexion, we chose to image the PFJ at 4 knee flexion angles (0°, 12°, 24°, and 36°) using the MRI method as described by Shellock et al.<sup>28</sup> We believe by assessing PFJ alignment using axial views at 4 discrete knee positions ranging from 0° to 36°, the major limitations associated with using plain film radiography are eliminated. These include problems associated with superimposition of osseous structures within the same image of a large joint such as the knee, as well as inability to view the PFJ at knee flexion positions of less than 30°.<sup>9</sup> For this study, we used a 0.2-T Artoscan dedicated-extremity MRI scanner (Lunar Corp, Madison, Wis) that was located on-site within our Biomechanics Laboratory. The system requires no shielding or special power supply for ease of use in a smaller clinical or university setting. We elected to use the Artoscan MRI as we

had immediate access to the system and were not charged for its use.

Our hypothesis was that the McConnell taping medial glide technique would result in a medialization of the PFJ before exercise; however, after completion of a standardized exercise task, the tape would no longer maintain the medialized position. We chose to image the PFJ using an MRI extremity scanner with the knee being imaged (axial views) in 4 positions of flexion, that is, at 0°, 12°, 24°, and 36°. Furthermore, we used a quantitative measure, LPD, as our indicator of the position of the PFJ within the frontal plane.

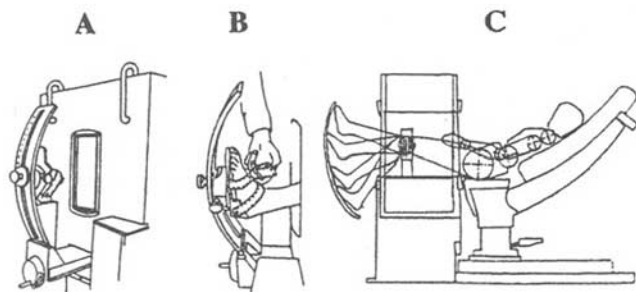
## MATERIALS AND METHODS

The Institutional Review Board of Boise State University approved this study. Eighteen (18) healthy female college students, mean age of  $22.28 \pm 2.02$  years, with no history of PFJ disorders, were recruited from the general student population to participate in the study. Subjects, wearing clothing appropriate for exercise, were scheduled to arrive at the MRI laboratory at Boise State University for imaging of their PFJ; the total time for testing was approximately 90 minutes, including the exercise task. On arrival at the laboratory, subjects were asked to read and sign the informed consent form and were asked a series of questions regarding the medical history of their knees. Inclusion criteria included no history of significant injury to the PFJ in either leg, no history of PFJ surgery, and ability to safely engage in 20 minutes of moderate-intensity exercise.

### Kinematic MRI Procedure

A coin toss was used to determine the leg to be used for the testing, and once determined, the subject was positioned into the MRI system for the first series of MRI images. A permanent magnet of 0.2-T was used in this study. The imaging protocol employed was first introduced by Shellock et al and was the first reported use of the Artoscan extremity MRI system in imaging the PFJ kinematically.<sup>28</sup> Axial images were obtained using a large solenoid radio frequency coil (GE Lunar Artoscan-M, large knee coil #2, Lunar Corp, Madison, Wis) customized for imaging the knee at low field strength. A T1-weighted, turbo-gradient echo pulse sequence was selected that would optimize the inherent chemical shift and susceptibility differences between bone and soft tissue, resulting in a dark border around the edges of bone. This helped define the borders of the femur and patella for ease in making the needed measurements for patellar displacement. An echo pulse sequence with the following parameters was selected: repetition time, 440 ms; echo time, 16 ms; flip angle, 75°; image matrix,  $192 \times 160$ ; slice thickness, 5 mm; interslice gap, 0.5 mm; field of view, 20 cm; number of signal averages, 1. Image acquisition time was 1.13 minutes with 11 images per acquisition.

The subject was placed in a seated position with the test leg placed within the bore of the magnet (approximately

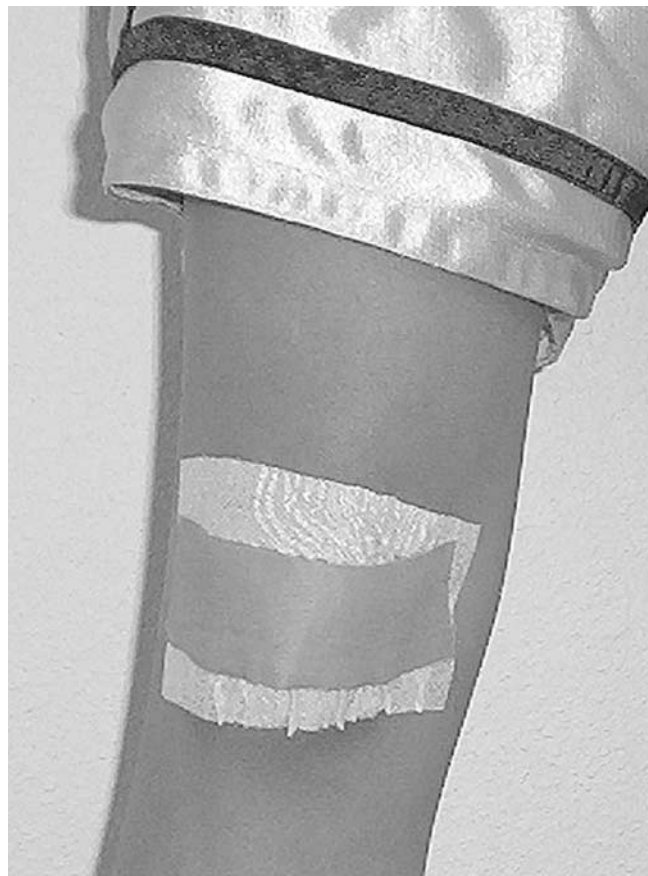


**Figure 1.** Diagram of extremity MR system showing (A) leg locking/movement device, (B) positioning of subject's foot in device in preparation of kinematic MRI procedure, and (C) example of subject placed in MR system showing various positions of the patellofemoral joint from extension to approximately 30° of flexion.

20-in depth), while the nontest leg was positioned alongside the magnet. The seat is attached to the Artoscan and is fully adjustable. Once the optimal position for the subject was achieved, the seat was locked into position, and this position was maintained for all subsequent images for that subject. The leg, foot, and ankle of the test leg exited the bore of the magnet opposite the entrance, thus allowing for the foot to be anchored, via foot straps, to an attached foot/leg-positioning device (Figure 1). This device is adjustable in that it allows for movement along a curvilinear path in a vertical axis. As such, the subject's leg could be placed first in full extension and then adjusted into progressively greater positions of knee flexion to accommodate the requirements of the testing protocol for this study. The foot/leg-positioning device also includes a calibrated degree scale facilitating accurate positioning of the knee relative to the required imaging positions for this study of approximately 0°, 12°, 24°, and 36°, respectively. The order of imaging was with the PFJ of the test leg with no tape (NT) imaged first in full extension (0° of flexion), followed by the same imaging procedure at 12°, 24°, and finally 36°. Subjects were instructed to keep the muscles of their legs relaxed to avoid movement artifact within the MRI images. After all imaging was concluded with the NT condition, the subject's test leg was prepared with aerosol tape adherent, with the medial glide taping technique (Figure 2), as described by McConnell, being applied by a National Athletic Trainers' Association Board of Certification-certified athletic trainer trained in the application of this strapping technique. The subject was then placed back into the MRI with the PFJ of her test leg taped (T) for the second set of axial images at the 4 test positions of the knee. At the conclusion of this phase of the imaging, the subject was removed from the magnet and taken to an indoor gymnasium, located adjacent to the MRI laboratory, for the exercise task component of the study.

### Exercise Protocol

The standardized exercise task used in this study was virtually identical to that employed by Larsen et al<sup>17</sup> and con-

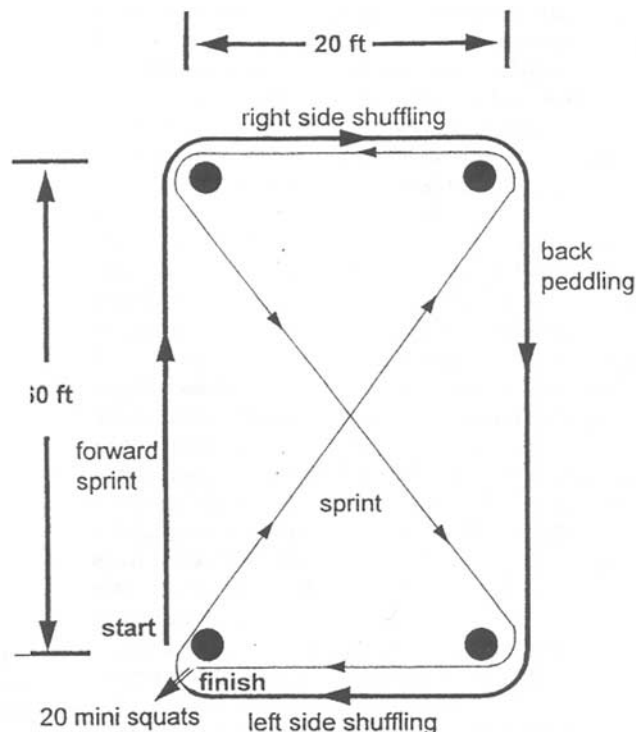


**Figure 2.** McConnell medial glide taping technique (right knee).

sisted of a running/agility task around a rectangular course that was 60 feet in length and 20 feet in width (5 sets of 3 repetitions, each with a 1-minute rest between each set). An orange cone marked each corner of the rectangle, and the subject was given specific instructions as to the exercise task before the start. The exercise task was timed and designed to mimic many typical athletic activities. Specific descriptions of the standardized exercise task along with a graphic of the course are provided in Figure 3. On completion of the standardized exercise task, the subject returned to the MRI laboratory (in the same building), and her test leg was placed into the MRI extremity scanner for the final set of images, that is, taped with exercise (TE).

### Image Analysis

Axial MR images collected on the Artoscan were transferred to a personal computer with MultiView (ACCESS Radiology Corp, Lexington, Mass). MultiView was used to check image quality and to allow the images to be saved as bitmap files. The bitmap images were then retrieved using AutoCAD (AutoDesk, Inc, San Rafael, Calif) software for image analysis. As our interest was in the ability of the McConnell medial glide taping procedure to first medialize the patella and, further, to determine if the patella remained medialized after a standardized exercise task,

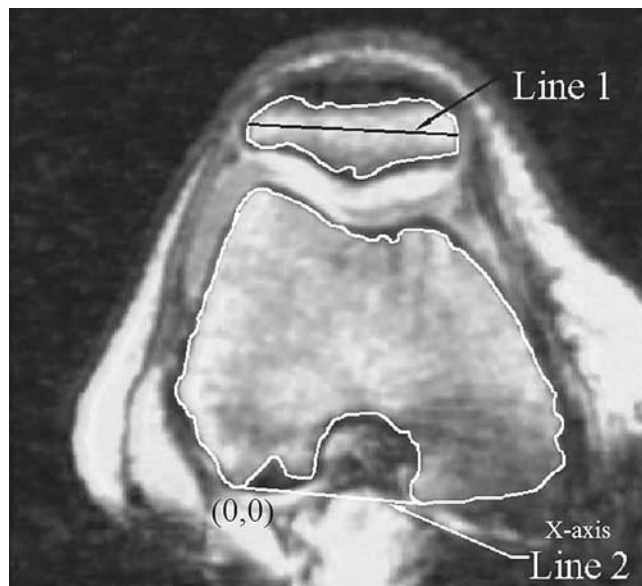


**Figure 3.** The exercise program consisted of the following: each subject began at the start position and forward sprinted, side shuffled to the right, backpedaled, and side shuffled to the left. The subject then immediately began a figure-of-8 pattern and finished with 20 minisquats. This constituted 1 repetition. Each subject performed 5 sets of 3 repetitions, each with a 1-minute rest period between each set.

we chose to use LPD as our measurement of interest. Lateral patellar displacement is recognized as a method of quantifying the position of the patella within the frontal plane, relative to the medial femoral condyle.<sup>30</sup>

The initial step in the analysis procedure involved scaling of the images. A scale embedded in the field of view by Artoscan software provided the conversion factor such that measures collected with AutoCAD were in “real” millimeters. The images for the NT condition for each joint angle were analyzed first with the following process:

- Using the “polyline” function in AutoCAD, a silhouette was sketched around the perimeter of the patellar and femoral condyles (Figure 4).
- A line (line 1) was then placed across the widest bony structure of the patella from medial to lateral (Figure 4). The most medial coordinate of line 1 is considered the medial border of the patella.
- A second line (line 2) was rendered connecting the most posterior surfaces of the medial and lateral femoral condyles (Figure 4).
- A local coordinate system was then established such that the origin was located at the intersection of line 2 with the lateral femoral condyle. Line 2



**Figure 4.** Coordinate system for determination of lateral patellar displacement on the MRI image.

served as the x-axis of the local coordinate system.

- The x coordinates of the medial endpoint of line 1 were used to track changes in position of the patella (LPD) on the subsequent conditions (T, TE).

The images for the T and TE conditions for each joint angle were analyzed with the following process:

- The image sketch (including affixed lines 1 and 2) for the NT condition at each joint angle was copied and superimposed onto subsequent images under different conditions (T and TE). Specifically, the silhouette of the patella for the NT condition was superimposed over the perimeter of the patella for the T and TE conditions. Likewise, the silhouette of the femoral condyles for the NT condition was superimposed over the perimeter of the femoral condyles for the T and TE conditions.
- A local coordinate system was then reestablished such that the origin was located at the intersection of line 2 with the lateral femoral condyle. The coordinate system is situated identically for all conditions at each joint angle.

### Reproducibility

All 216 images (18 subjects, 3 conditions, 4 joint angles) were analyzed by the same author (BI). Twenty images were randomly selected for reanalysis to quantify intraobserver variance or repeatability. Although the observer was not blinded, nearly 1 year had passed between the time of the initial imaging studies and the reanalysis for intraobserver variance. As such, it is unlikely the author (BI) had adequate recall regarding specific aspects of any particular

TABLE 1  
Summary of Mean and SD for  
Knee Angles and Conditions

Joint Position/ Condition <sup>a</sup>	Lateral Patellar Displacement Mean (mm)	SD (mm)
0°		
NT	38.16	8.79
T	39.46	8.24
TE	37.77	8.77
12°		
NT	40.55	5.53
T	41.66	5.74
TE	40.26	6.29
24°		
NT	40.51	7.88
T	41.47	7.71
TE	40.13	7.69
36°		
NT	35.86	14.04
T	37.19	14.31
TE	35.95	14.39

<sup>a</sup> NT, no tape; T, taped; TE, taped with exercise.

image in the set of 216 images to constitute a bias. The correlation between the repeated measures was 0.999, and the mean and SD of the intraobserver difference were 0.00 ± 0.12 mm.<sup>2</sup> All of the intraobserver differences were within ±2 SD of the mean difference.

RESULTS

Data were analyzed using Statistical Processing for the Social Sciences (SPSS Science Inc., Chicago, Ill). A summary of the descriptive statistics for all 4 knee angles and the 3 conditions (NT, T, TE) are shown in Table 1. Repeated measures ANOVA was employed to test for changes in the LPD under all 3 conditions (NT, T, TE) at each of the 4 knee positions tested. Alpha levels less than .05 were required to demonstrate a significant difference. When statistically significant differences were found between conditions, the observed power was ≥ 0.851. ANOVAs indicated significant differences in LPD at all knee angles (Table 2).

To determine where the changes in LPD had occurred at each knee angle, post hoc paired samples *t* tests were conducted and revealed that at all knee angles, the McConnell taping had resulted in significant movement medially (medialization) when comparing the NT and T conditions. At each joint angle, the statistical power was ≥ 0.85. To assess the effectiveness of the McConnell taping to withstand the standardized exercise task (mean time to completion was 19.12 ± 4.04 minutes), paired samples *t* tests were conducted comparing the NT with the TE conditions. These tests revealed that at all knee angles, the McConnell taping had not been effective in maintaining the medialized position of the patella. Paired samples *t* test results for comparisons of all conditions at each joint angle along

TABLE 2  
ANOVA F Scores Indicate Differences in  
Lateral Patellar Displacement Across the 3  
Conditions (NT, T, TE) at Knee Angles Listed<sup>a</sup>

Knee Angle (Lateral Patellar Displacement)	<i>df</i>	F	<i>P</i>	Power
0°	1.41	7.80	<.005	0.85
12°	1.64	12.03	<.000	0.98
24°	1.82	17.96	<.000	0.99
36°	1.80	21.25	<.000	1

<sup>a</sup> NT, no tape; T, taped; TE, taped with exercise.

TABLE 3  
Paired *t* Scores Indicate Differences in Lateral  
Patellar Displacement Across the 3 Conditions  
(NT, T, TE) at Angles Listed<sup>a</sup>

Joint Position/ Pair	95% Confidence Interval of the Difference					
	Mean of Differences (mm)	Lower	Upper	SD	<i>t</i>	<i>P</i>
0°						
NT-T	-1.31	-2.46	-0.16	2.31	-2.34	<.028
NT-TE	0.38	-0.20	0.97	1.18	1.37	<.187
T-TE	1.69	0.68	2.69	2.02	3.54	<.003
12°						
NT-T	-1.10	-1.62	-0.59	1.04	-4.49	<.000
NT-TE	0.30	-0.47	1.06	1.54	0.82	<.426
T-TE	1.40	0.80	1.99	1.20	4.95	<.000
24°						
NT-T	-0.96	-1.43	-0.49	0.95	-4.27	<.001
NT-TE	0.38	-0.17	0.93	1.11	1.46	<.163
T-TE	1.34	0.92	1.76	0.85	6.67	<.000
36°						
NT-T	-1.60	-2.06	-1.14	0.92	-7.36	<.000
NT-TE	-0.21	-0.82	0.40	1.23	-0.73	<.474
T-TE	1.39	0.78	1.99	1.21	4.86	<.000

<sup>a</sup> NT, no tape; T, taped; TE, taped with exercise.

with 95% percent confidence intervals are presented in Table 3. The raw data for each knee are presented in Table 4.

DISCUSSION

The purpose of this study was to test the effectiveness of the McConnell taping medial glide technique in maintaining a medialized patellar position after the subjects completed a standardized exercise task. The results of our study demonstrate that McConnell taping is not effective at maintaining medial patellar position after exercise. Our

TABLE 4  
Lateral Patellar Displacement Measurements in Millimeters Across  
All 3 Conditions (NT, T, TE) at All 4 Joint Positions (0°, 12°, 24°, and 26°)

Subject	0°			12°			24°			36°		
	NT	T	TE	NT	T	TE	NT	T	TE	NT	T	TE
1	48.67	49.33	49.24	47.14	47.05	47.76	49.03	49.34	47.91	60.57	62.5	62.32
2	45.55	47.80	46.2	46.79	49.62	48.91	40.46	41.72	40.79	46.92	50.03	48.71
3	40.54	42.91	41.84	43.83	45.9	44.95	46.2	47.17	44.44	43.72	46.73	44.25
4	21.57	24	21.05	40.30	42.7	41.11	30.85	31.9	31.25	28.13	30.48	27.88
5	39.10	40.47	37.09	36.72	39.05	37.49	38.69	39.80	38.95	36.64	37.66	35
6	40.41	41.99	40.9	43.27	43.41	41.81	40.5	40.83	39.19	48.88	50.27	48.75
7	29.34	30.61	28.92	32.55	33.88	31.75	33.73	34.91	32.11	32.95	35.03	32.86
8	41.41	44.78	43.04	44.07	47.16	46.44	42.16	46.41	44.54	42.75	45.5	42.93
9	29.27	29.65	28.77	32.76	33.37	30.79	30.66	31.82	29.97	28.34	29.29	29.13
10	51.13	44.7	49.2	43.61	44.85	43.53	40.87	41.47	38.86	35.26	36.52	33.79
11	32.82	38.31	33.16	36.28	37.79	33.55	45.99	46.18	46.21	47.35	47.83	48.34
12	34.12	36.97	32.86	40.43	40.40	37.07	47.26	47.41	45.62	37.19	39.98	39.93
13	40.16	41.58	40.51	38.66	39.45	37.17	53.69	54	52.72	53.69	54.79	52.88
14	38.33	38.73	35.86	38.03	38.42	37.90	37.77	38.81	38.16	41.4	43.06	42.1
15	54.53	55.23	52.91	47.01	47.37	47.21	48.69	49.3	48.91	43.56	43.61	43.14
16	42.84	44.57	41.54	50.49	51.06	49.81	47.47	48.02	46.91	42.60	43.55	43.35
17	27.43	27.80	27.02	32.5	32.83	32.62	28.75	30.67	29.18	28.51	29.91	26.52
18	29.54	30.82	29.76	35.51	35.49	34.74	26.44	26.69	26.62	29.65	30.13	30.05

<sup>a</sup> NT, no tape; T, taped; TE, taped with exercise.

study is very similar conceptually to the study by Larsen et al, which also examined the effectiveness of the McConnell medial glide taping technique's ability to withstand the rigors of a standardized exercise task. However, we believe that by using a kinematic MRI technique that allowed imaging at 4 discrete knee flexion angles (0°, 12°, 24°, 36°), we were better able to assess the mechanical effects of the taping than were Larsen et al, who used plain film radiography (Merchant view) with the knee positioned at 40° to image the PFJ.<sup>17</sup> The later technique does not allow for imaging at lower knee flexion angles, and at 45°, the patella is less prone to subluxation as it is supported by the femoral trochlea.

In our study, application of the medial glide taping resulted in measurable medialization of the patella in 68 of 72 trials (94.44%) comparing NT with T conditions. As the purpose of the study was to assess the effectiveness of the McConnell medial glide taping to withstand the rigors of a standardized exercise task, the measure of interest was LPD. The kinematic MRI technique as described by Shellock et al<sup>28</sup> was used because it allows for imaging of the PFJ at knee positions of less than 30° of flexion. This is a significant advantage, since it is well documented that the last 30° of knee extension are the most important relative to patellar tracking.<sup>4,14,15,19,24,25</sup> It is during this portion of knee movement that the patella is located superior to the deepest portion of the trochlear groove and, as such, is more vulnerable to abnormal force vectors resulting from muscle imbalances within the extensor mechanism.

Once the initial imaging was completed with the NT condition at all 4 knee angles, the subjects underwent

McConnell medial glide taping to 1 knee. This was followed by repeat MRI. Our results indicated that with the exception of 4 trials out of 72, the patella was medialized by the application of the McConnell medial glide taping. This finding conflicts with the results of Worrell et al, who found that at 8 different knee flexion angles, between 10° and 45°, LPD was not significantly influenced by patellar taping.<sup>30</sup> The subjects in the present study were all asymptomatic women, whereas Worrell et al studied a mixed-gender cohort of subjects diagnosed with PFJ pain. Worrell et al did not describe the specific McConnell taping procedure (posterior tilt, lateral tilt, "V" tape, etc<sup>22</sup>) applied in their study, and perhaps it was not designed specifically to move the patella in the frontal plane, that is, medial glide. This would help to explain why they found that taping had no effect on LPD at any joint angle tested. In addition, although their subjects were symptomatic, they were classified as having normal patellofemoral alignment based on their assessed congruence angles. As such, it may have been more difficult for the taping to alter the patellar position, as it was already "normal." It is interesting to note, however, that bracing did significantly alter (medialize) the patella in their subjects.

In our study, when the position of the patella was examined, postexercise, and compared to the preexercise, T condition, it was found that at every knee angle, the patella had moved laterally a significant amount. The fact that there were no significant differences between the NT and TE at all 4 knee angles indicates the tape was ineffective after exercise.

Our study is limited by the fact that we did not evaluate patellar tilt or rotation, 2 variables that have been empha-

sized by McConnell. Similar to the study by Larsen et al,<sup>17</sup> we elected to study only the medial glide McConnell technique. We did not evaluate the ability of McConnell taping to control patellar tilt or rotation. As medial glide is required in the majority of patients with PFPS, as indicated by McConnell,<sup>21</sup> we chose to focus on the tape's ability to maintain this position after exposure to a standardized exercise task. Another limitation of our study is that we studied healthy female subjects with no history of PFJ disorder. As our goal was to simply assess the McConnell medial glide procedure's ability to maintain a medialized patellar position, we felt it important to use a relatively homogeneous subject cohort. In addition, our subjects were evaluated in a nonweightbearing position, with their thigh muscles relaxed.

## CONCLUSIONS

The McConnell taping technique continues to be discussed in the literature as a viable clinical technique in the treatment of pain associated with the PFJ, and the effectiveness of this technique has been assumed to be related to the ability of the taping to alter the patellar alignment. Our results demonstrate that the McConnell medial glide technique is effective in moving the patella medially, but the medial displacement is not maintained after exercise. This suggests that the clinical effects of McConnell taping are not related to alteration of patellar alignment.<sup>8,22</sup> The reported effectiveness of the McConnell taping procedure to reduce or eliminate pain associated with a diagnosis of PFPS is likely due to some other mechanism. These effects could include increasing the contact surface area between the patella and the femur,<sup>3,26</sup> improving the function of the knee extensors,<sup>7,11</sup> or other factors that have yet to be identified. Future studies should examine the relationship between McConnell taping procedures and changes in variables such as contact surface area between the patella and the femoral trochlea, as well as EMG patterns of the knee extensors. In addition, this study should be repeated with symptomatic subjects in a weightbearing position, preferably standing, to determine the effectiveness of the tape to both reduce pain and control patellar position. Cine MRI or CT imaging would both have utility in obtaining an analysis of the effects of the medial glide procedure on patellar position. Finally, the authors also recognize that McConnell taping may maintain its ability to control patellar position under controlled rehabilitation conditions in which exercise is less intense than was used in this study.

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