Accepted Manuscript

Title: Does Dynamic Tape change the walking biomechanics of women with greater trochanteric pain syndrome? A double-blind randomised controlled crossover trial

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PII: S0966-6362(18)30351-5
DOI: https://doi.org/10.1016/j.gaitpost.2019.02.031
Reference: GAIPOS 6718

To appear in: *Gait & Posture*

Received date: 1 May 2018
Revised date: 27 January 2019
Accepted date: 26 February 2019

Please cite this article as: Robinson N, Spratford W, Welvaert M, Gaida J, Fearon A, Does Dynamic Tape change the walking biomechanics of women with greater trochanteric pain syndrome? A double-blind randomised controlled crossover trial, *Gait and Posture* (2019), https://doi.org/10.1016/j.gaitpost.2019.02.031

Does Dynamic Tape change the walking biomechanics of women with greater trochanteric pain syndrome? A double-blind randomised controlled crossover trial.

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Word count: 2984

Highlights

- Dynamic Tape significantly reduces hip adduction moment, adduction, internal rotation and pelvic obliquity displacement during walking gait.
- Dynamic Tape may provide a small mechanical benefit to women with GTPS.
- Dynamic Tape provides a statistically significant reduction in pain.

INTRODUCTION

Greater trochanteric pain syndrome (GTPS) is common.[1, 2] Affecting women more than men by a ratio of approximately 4:1,[1, 2] GTPS negatively impacts work participation, sleep, activity and quality of life.[3] Previously thought to be trochanteric bursitis,[4] studies using

MRI,[5, 6] ultrasound[7-9] and histopathology[10, 11] show that gluteus medius or minimus tendinopathy is the primary underlying pathology. While corticosteroid injections are an effective short-term treatment[4] they cause harm in the long term[12, 13]. Therefore, finding alternative treatments for GTPS is important.

Compression is thought to contribute to the development and maintenance of tendinopathy[14, 15] by causing pathological tenocyte changes.[16, 17] The iliotibial band (ITB) passes over the greater trochanter,[18] which compresses the gluteal (medius and minimus) tendons. This compression increases significantly with increasing hip adduction.[19]

People with GTPS have reduced abduction strength,[20, 21] increased external hip adduction moment (HAM), hip adduction angle (HAA), trunk lateral flexion and pelvic obliquity during walking gait, compared to a matched asymptomatic group.[22] Due to increased hip adduction angles[22] and therefore increased ITB length,[18] there is likely increased force from the ITB on the greater trochanter,[18] thus compressing the gluteal tendons. Addressing the increased adduction moment and angle by minimising dynamic adduction during gait or reducing ITB tension[18] may be an effective treatment for GTPS. To date, there are no published studies that aim to correct these biomechanical issues.

Sports tape has been used in various populations to manage musculoskeletal conditions.[23] Unlike rigid sports tape which is designed to reduce joint movement,[23] Dynamic Tape (DT) is elasticised with multi-directional rebound. Dynamic Tape may provide an external force, or proprioceptive input, to counteract the increased HAM, pelvic obliquity or trunk lateral flexion seen in people with GTPS. Kinesio Tape (KT) is another form of elastic tape, which is designed to increase circulation by creating lifts in the skin, thus reducing pressure on neurosensory receptors.[23, 24] There is scant published work on the effect of taping for lower limb biomechanics. One published abstract reports DT applied to the hips of volleyball players altered the knee position during a single-leg squat.[25] A comparative study of rigid tape and KT on the knees of adolescent ballet dancers demonstrated that rigid tape reduced shear forces at the hip.[26] However, there is an absence of taping studies in GTPS.

The aim of this study was to determine if DT provided a mechanical benefit to women with GTPS. Our primary research question was, does DT reduce the HAM, HAA, pelvic obliquity and trunk lateral flexion in women with GTPS?[22] Our secondary research question was, does DT provide point-in-time pain relief during gait in this population?

METHODS

This study was a blinded randomised controlled crossover trial.

Participants

Participants were recruited between December 2016 and April 2017. Data were collected in a university setting. Inclusion criteria were: female 18 years or older with a history of lateral hip pain[27]; pain duration of at least three months; pain severity of at least 2/10 on the Numerical Rating Scale (NRS)[28]; pain on palpation of the greater trochanter; reproduction of lateral hip pain with at least one clinical test (single-leg stance (SLS)), FABER (flexion, abduction, external rotation), FADER (flexion, adduction, external rotation), FADER-R (resisted FADER)).[29] Exclusion criteria were: male sex; low back pain of more than 2/10 on the NRS; lumbar radiculopathy; history of lower limb surgery; systemic inflammatory conditions; active cancer; corticosteroid injection within the last three months; known allergy to sports tape; clinical signs or symptoms of hip joint pathology according to Altman et al.[30] or FABER.[27]

Ethical approval was obtained from the University of XXXXXX Human Research Ethical Committee. Written informed consent was obtained from all participants.

Recruitment

Participants were recruited via television, radio, print media, word of mouth and professional networks in the XXXXXX region. Potential participants contacted the investigators via telephone or email. Potential participants were screened via telephone, with likely eligible individuals invited to attend a physical screening appointment.

Physical screening assessments included the clinical tests listed above. These were performed by a physiotherapist with 30 years' experience and specialization in hip conditions (AF). Individuals who met the inclusion criteria for GTPS and did not meet the exclusion criteria were invited to participate in the study.

Descriptive measures

Participants' height (cm), mass (kg) and age (years) were recorded, and body mass index (BMI) (kg/m^2) calculated. Health-related quality of life was measured using the Assessment of Quality of Life 6D (AQoL-6D)[31] and severity of GTPS was measured using the VISA-G score.[32]

Outcome measures

The primary outcome, derived from gait analysis, was HAM during the stance phase of gait, normalised to bodyweight and leg length (Nm/BW.LL). Normalisation to leg length was chosen to better reflect individual stride length differences between participants during the gait specific task. The leg length (cm) was measured from the anterior superior iliac spine to the medial malleolus.[33] Secondary gait outcomes were hip adduction, internal rotation, pelvic obliquity (contralateral pelvic drop), trunk lateral flexion displacements (degrees) as well as pelvic translation (measured as the lateral horizontal pelvic shift, defined as the distance in the frontal plane between the calcaneal marker and the midpoint of the anterior superior iliac spines (ASIS) projected into the ground (mm).[22])

Point-in-time hip pain was measured via the NRS where 0 = no pain and 10 = worst pain.[34]

Gait data collection

Gait data collection was undertaken by an experienced biomechanist (WS). Three-dimensional marker trajectories were captured using a 12-camera Vicon motion capture system sampling at 250 Hz (Oxford Metrics Ltd., Oxford, UK). Ground reaction force data were collected at 1000 Hz using two 400 x 600 mm AMTI force plates (Advanced Mechanical Technologies, MA, USA) contiguously placed flush to the floor.

Gait data were collected using three separate walking trials on a ten-metre walkway under three conditions: baseline (control), Trial 1 (active or sham taping method) and Trial 2 (the alternative taping method). Participants walked laps of the walkway at their normal, comfortable walking pace (barefoot), until six complete affected-foot strikes were recorded on the plates. On average, participants performed 6.93, 6.86 and 5.98 laps for the baseline, active and sham tape conditions respectively.

Twenty four retro-reflective markers were applied to the spine (C7 and T10), manubrium, xiphoid process; the pelvis (ASIS and posterior superior iliac spines); the tibia and lateral thigh (triad of markers on T shaped semi-rigid base); medial and lateral femoral epicondyles and malleoli; calcaneous; first and fifth metatarsal heads consistent with the University of Western Australia's lower body kinematic and kinetic model.[35]

The hip joint centre was estimated using a regression equation.[36] The knee joint centre was functionally calculated using the epicondyle markers placed on the medial and lateral aspects of the knee and five consecutive squats that allowed the shank to flex and extend about the knee.[35] The ankle joint centre was calculated from the midpoint of the lateral and medial malleoli with calcaneus inversion/eversion and foot abduction/adduction measured to assist in defining the anatomical coordinate system.[35]

All data analyses were performed using Vicon Nexus software 1.8.5 (Vicon, Oxford Metrics Ltd., Oxford, UK) with trajectory and analogue data filtered using a fourth-order zero-lag low pass Butterworth filter with a cut-off frequency of 12 Hz after a residual analysis and visual inspection of the data.[37] Joint kinetics were calculated using a standard inverse dynamics approach with segment inertial properties taken from published data.[38] All data was normalised to 101 points for the stance phase using a customised program written with MATLAB software (Mathworks Inc., Natick, USA). The maximum HAMs were determined during 0-50% and 50-100% of the stance phase, representing the first and second peaks as well as the minimum value between the peaks. These discrete points determined the time points used for other gait parameters.[22]

Trials

Participants undertook a baseline and two trial walks. Following the baseline walk, tape for Trial 1 was applied. Trial 1 was completed as per the baseline walk, and then the tape removed. A washout period of approximately 20 minutes (equal to the trial duration) was then observed. This included ascending 28 stairs, sitting for 20 minutes and then descending 28 stairs. Tape for Trial 2 was then applied. Trial 2 was completed as per previous trials.

Trial 1 was randomly allocated to be either the active (heads) or sham (tails) tape application, via a coin toss. All researchers (other than the one responsible for applying the tape) were blinded to the allocation of tape application. The taping applications are described and shown in Figure 1 and 2.

Pain

Participants were asked to rate their pain using the numeric rating scale, an 11 point scale where 0 is no pain and 10 is worst pain[39] at baseline, immediately post Trial 1 and immediately post Trial 2.

Figure 1 Taping positions. The active and sham taping methods were both applied using a double layer of 7.5 cm Dynamic Tape (Dynamic Tape, Port Vila, VU). The tape used for each taping method was identical in appearance, pattern and structure. Active and sham taping methods were applied with the participant in standing. For the active application the hip was in maximum external rotation and abduction (a) achieved by shifting the pelvis laterally. For the sham taping the hip was in 0° to 10° of adduction and slight external

rotation (b) achieved by shifting the pelvis in the opposite direction. The active tape was applied with 30% stretch in length, as per the manufacturer's recommendations; the sham application was applied with no stretch.

Figure 2 Taping of affected hip (left hip). a) Piece one anterior view. b) Piece one lateral view. c) Piece one posterior view. d) Piece two lateral view (with piece one underneath). Two pieces of tape were applied. The first piece, starting from the vastus medialis obliquus, wrapped around the thigh in a supero-lateral direction approaching the posterior thigh, and continued medially to the junction of the proximal and middle third of the thigh. The piece

was then taken supero-laterally to cross the greater trochanter, continuing posteriorly to the contralateral PSIS (a, b, c). The second piece started at the lateral iliac crest and finished at the distal third of the thigh (d).

Statistical analysis

Following assessment for normality, biomechanical data were analysed using mixed models linear regressions. We report mean differences (MD) and a 95% confidence interval. Analyses were undertaken using Statistical Package for the Social Sciences (SPSS), version 23 (International Business Machines Corp., New York, USA). Pain data were not normally distributed and were analysed non-parametrically using Wilcoxon sign rank, with STATA 12.1 (Statacorp, Texas). The level of statistical significance was set at <0.05. Intention to treat analysis was undertaken.

Sample size

The sample size was calculated for the primary outcome of HAM.[22] Using 80% power, an alpha of 0.05, and assuming a conservative mean difference (SD) of 0.4 Nm/BW.Ht (1.0) we calculated 50 participants would be required to detect a difference. Calculations were carried out using STATA 12.1 (Statacorp, Texas, USA).

RESULTS

Participant flow through the study is presented in Figure 3. The researchers were contacted by 205 individuals, with 41 of these making contact after recruitment closed. One hundred and sixty-four individuals underwent phone screening; 98 were excluded. Sixty-six individuals took part in the physical assessment screening process; 16 were excluded. Gait data was obtained from the remaining 50 (Figure 3). Participant characteristics are reported in Table 1.

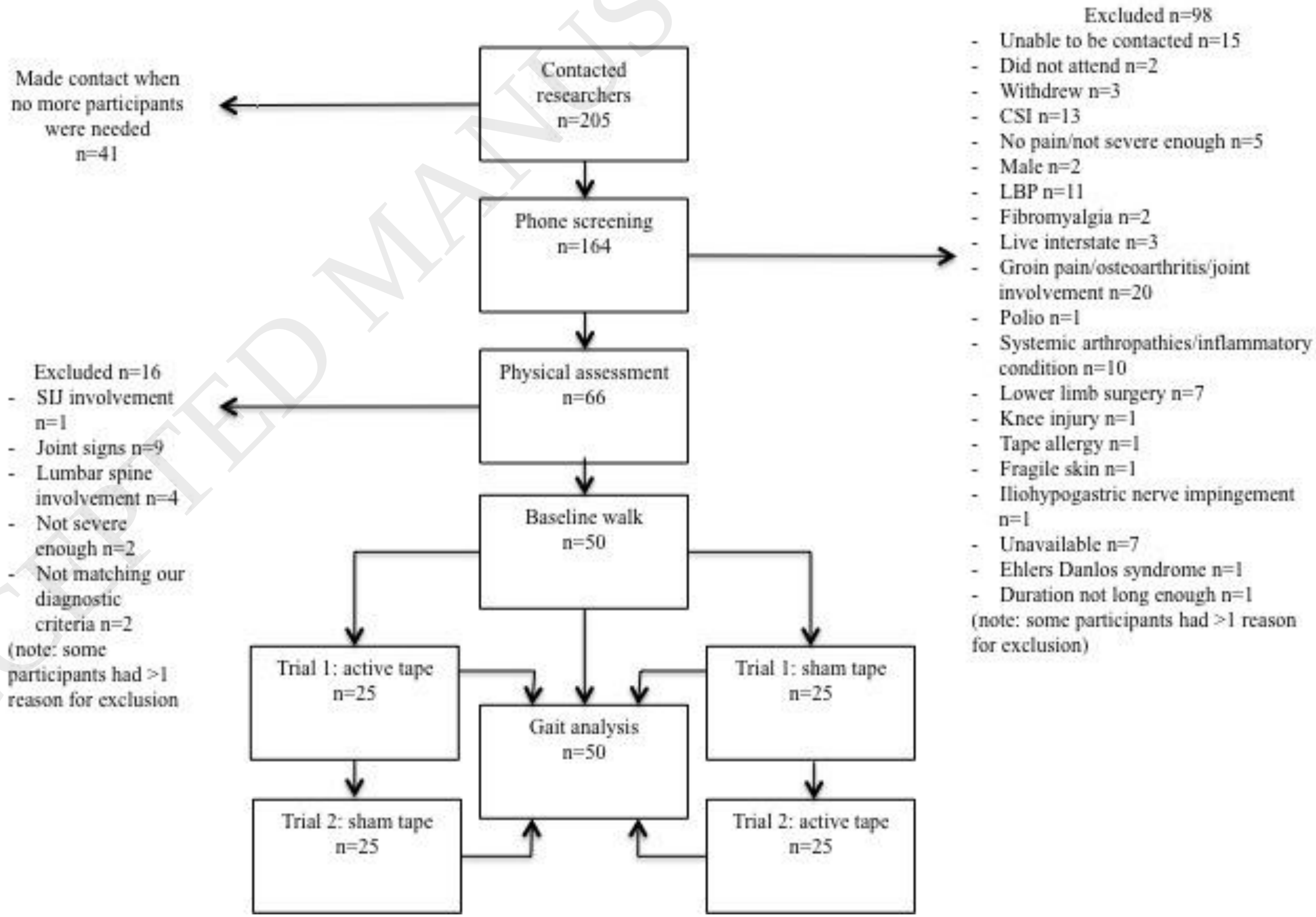

Figure 3 Flow of participants. CSI, corticosteroid injection. LBP, lower back pain. SIJ, sacroiliac joint.

Table 1 Participant characteristics

Characteristic	Mean (SD)
Age (years)	57.4 (13.8)
Height (cm)	163.7 (6.4)
Mass (kg)	74.6 (14.0)
BMI (kg/m^2)	28.0 (5.8)
AQoL-6D	75.3 (8.7)
VISA-G	61.7 (14.4)
Average pain (NRS)	4.5 (2.0)

Data normally distributed.
BMI, Body Mass Index.
AQoL-6D healthy population mean for females aged 55-64 is 82.1, scored 20-99, with lower scores indicating better quality of life.[40]
VISA-G healthy population mean score of 99.8 for asymptomatic people and 47 for symptomatic people, scored out of 100, with lower scores indicating more disability.[32]
NRS, Numerical Rating Scale. “Average” pain recorded.

Changes in hip adduction moment (HAM), our primary outcome measure, were seen at first peak, mid-stance and second peak (Table 2, Figure 4). At first peak, HAM was reduced compared to baseline with both active (0.7 Nm/BW.LL; p<0.001) and sham taping (0.4 Nm/BW.LL; p=0.03), with no between-group difference (active vs sham (-0.3 Nm/BW.LL; p=0.2)). At mid-stance, neither active nor sham taping reduced the HAM when compared to baseline measures (active: 0.2 Nm/BW.LL, p=0.1; sham: -0.1 Nm/BW.LL, p=0.4). At second peak, HAM was reduced compared to baseline with active (0.8 Nm/BW.LL, p<0.001) but not sham taping (0.1 Nm/BW.LL, p=0.4) with a between-group (active vs sham) difference of -0.6 Nm/BW.LL (p<0.001).

Changes in HAA were observed at first peak and mid-stance. At first peak, HAA was reduced with both active (1.5°, p<0.001) and sham taping (0.7°, p=0.03) compared to baseline, with a between-group difference (active vs sham) of -0.8° (p=0.004). At mid-stance, HAA was reduced with the active tape compared to baseline (0.8°, p=0.003), but not with sham taping (-

0.02°, $p=0.9$), with a between-group (active vs sham) difference of 0.8° ($p=0.002$) (Table 2, Figure 4).

Reductions in hip internal rotation were observed at first peak, mid-stance and second peak. At first peak, hip internal rotation was reduced with active (3.5°, $p<0.001$) but not sham taping (1.1°, $p=0.1$) compared to baseline, with a between-group (active vs sham) difference of 2.4° ($p=0.001$). At mid-stance, hip internal rotation was reduced with active (4.3°, $p<0.001$) but not sham taping (0.5°, $p=0.5$) with a between-group (active vs sham) difference of -3.8° ($p<0.001$). At second peak, hip internal rotation was reduced with the active (5.1°, $p<0.001$), but not the sham tape (1.1°, $p=0.1$) compared to baseline, with a between-group (active vs sham) difference of -3.9° ($p<0.001$) (Table 2, Figure 4).

A reduction in pelvic obliquity was observed at first peak, mid-stance and second peak with the active taping only (0.6°, $p=0.02$; 1.0, $p<0.001$; and 0.9°, $p<0.001$ respectively). A between-group difference (active vs sham) was seen at mid-stance (-0.6°, $p=0.03$) (Table 2, Figure 4). No differences were found with pelvic translation or trunk lateral flexion (Table 2, Figure 4).

Table 2 Gait results

Variable	Peak/mid-stance	Mean gait data		Pairwise comparisons				
		Condition	Mean (SE)	Pairwise comparison	Difference	p value	95% confidence interval	
							Lower	Upper
Hip adduction moment (Nm/BW.LL)	First peak	Baseline	9.6 (0.3)	Baseline vs active	0.7	**<0.001**	0.3	1.0
		Active	9.0 (0.3)	Baseline vs sham	0.4	**0.03**	0.05	0.8
		Sham	9.2 (0.3)	Active vs sham	-0.3	0.2	-0.6	0.1
	Mid-stance	Baseline	6.2 (0.3)	Baseline vs active	0.2	0.1	-0.1	0.5
		Active	6.0 (0.3)	Baseline vs sham	-0.1	0.4	-0.4	0.1
		Sham	6.3 (0.3)	Active vs sham	-0.3	**0.02**	-0.6	-0.1
	Second peak	Baseline	9.0 (0.3)	Baseline vs active	0.8	**<0.001**	0.5	1.1
		Active	8.2 (0.3)	Baseline vs sham	0.1	0.4	-0.2	0.4
		Sham	8.9 (0.3)	Active vs sham	-0.6	**<0.001**	-0.9	-0.3
Hip adduction angle (degrees)	First peak	Baseline	7.8 (0.5)	Baseline vs active	1.5	**<0.001**	0.9	2.1
		Active	6.2 (0.5)	Baseline vs sham	0.7	**0.03**	0.1	1.2
		Sham	7.1 (0.5)	Active vs sham	-0.8	**0.004**	-1.4	-0.3
	Mid-stance	Baseline	5.8 (0.6)	Baseline vs active	0.8	**0.003**	0.3	1.2
		Active	5.0 (0.6)	Baseline vs sham	-0.02	0.9	-0.5	0.5
		Sham	5.8 (0.6)	Active vs sham	-0.8	**0.002**	-1.3	-0.3
	Second peak	Baseline	5.5 (0.6)	Baseline vs active	0.3	0.2	-0.2	0.8
		Active	5.2 (0.6)	Baseline vs sham	-0.1	0.8	-0.5	0.4
		Sham	5.2 (0.6)	Active vs sham	-0.4	0.1	-0.8	0.1
Hip internal rotation (degrees)	First peak	Baseline	-10.4 (1.2)	Baseline vs active	3.5	**<0.001**	2.1	4.9

Table 2 Gait results

Variable	Peak/mid-stance	Mean gait data		Pairwise comparisons				
		Condition	Mean (SE)	Pairwise comparison	Difference	p value	95% confidence interval	
							Lower	Upper
		Active	-13.9 (1.2)	Baseline vs sham	1.1	0.1	-0.3	2.4
		Sham	-11.5 (1.2)	Active vs sham	-2.4	**0.001**	-3.8	-1.0
	Mid-stance	Baseline	-5.1 (1.2)	Baseline vs active	4.3	**<0.001**	2.9	5.7
		Active	-9.4 (1.2)	Baseline vs sham	0.5	0.5	-0.9	2.0
		Sham	-5.6 (1.2)	Active vs sham	-3.8	**<0.001**	-5.2	-2.3
	Second peak	Baseline	0.9 (1.2)	Baseline vs active	5.1	**<0.001**	3.7	6.4
		Active	-4.1 (1.2)	Baseline vs sham	1.1	0.1	-0.2	2.5
		Sham	-0.2 (1.12)	Active vs sham	-3.9	**<0.001**	-5.3	-2.6
Pelvic Obliquity (degrees)	First peak	Baseline	3.9 (0.4)	Baseline vs active	0.6	**0.02**	0.1	1.1
		Active	3.3 (0.4)	Baseline vs sham	0.3	0.2	-0.1	0.8
		Sham	3.5 (0.4)	Active vs sham	-0.2	0.3	-0.7	0.3
	Mid-stance	Baseline	0.5 (0.4)	Baseline vs active	1.0	**<0.001**	0.5	1.5
		Active	-0.5 (0.4)	Baseline vs sham	0.4	0.1	-0.1	0.9
		Sham	0.1 (0.4)	Active vs sham	-0.6	**0.03**	-1.1	-0.1
	Second peak	Baseline	-0.1 (0.4)	Baseline vs active	0.9	**<0.001**	0.5	1.4
		Active	-1.0 (0.4)	Baseline vs sham	0.5	0.1	-0.03	1.0
		Sham	-0.5 (0.4)	Active vs sham	-0.5	0.1	-1.0	0.03
Pelvic translation (mm)	First peak	Baseline	29.2 (2.0)	Baseline vs active	-0.7	0.4	-2.4	0.9
		Active	30.0 (2.0)	Baseline vs sham	0.6	0.5	-1.1	2.2

Table 2 Gait results

Variable	Peak/mid-stance	Mean gait data		Pairwise comparisons				
		Condition	Mean (SE)	Pairwise comparison	Difference	p value	95% confidence interval	
							Lower	Upper
		Sham	28.7 (2.0)	Active vs Sham	1.3	0.1	-0.4	3.0
	Mid-stance	Baseline	20.0 (2.0)	Baseline vs active	-0.6	0.5	-2.3	1.2
		Active	20.5 (2.0)	Baseline vs sham	-0.2	0.8	-1.9	1.6
		Sham	20.1 (2.0)	Active vs sham	0.4	0.7	-1.4	2.1
	Second peak	Baseline	14.8 (2.1)	Baseline vs active	-0.8	0.4	-2.8	1.3
		Active	15.6 (2.1)	Baseline vs sham	-0.1	0.9	-2.2	1.9
		Sham	14.9 (2.1)	Active vs sham	0.7	0.5	-1.4	2.7
Trunk lateral flexion (degrees)	First peak	Baseline	2.0 (0.3)	Baseline vs active	0.1	0.5	-0.2	0.5
		Active	1.9 (0.3)	Baseline vs sham	-0.01	0.9	-0.4	0.3
		Sham	2.0 (0.3)	Active vs Sham	-0.1	0.5	-0.5	0.2
	Mid-stance	Baseline	1.6 (0.3)	Baseline vs active	0.1	0.5	-0.2	0.4
		Active	1.5 (0.3)	Baseline vs sham	-0.1	0.8	-0.4	0.3
		Sham	1.7 (0.3)	Active vs sham	-0.2	0.3	-0.5	0.2
	Second peak	Baseline	1.4 (0.3)	Baseline vs active	-0.03	0.9	-0.4	0.3
		Active	1.4 (0.3)	Baseline vs sham	-0.1	0.7	-0.4	0.3
		Sham	1.5 (0.3)	Active vs sham	-0.04	0.8	-0.3	0.3

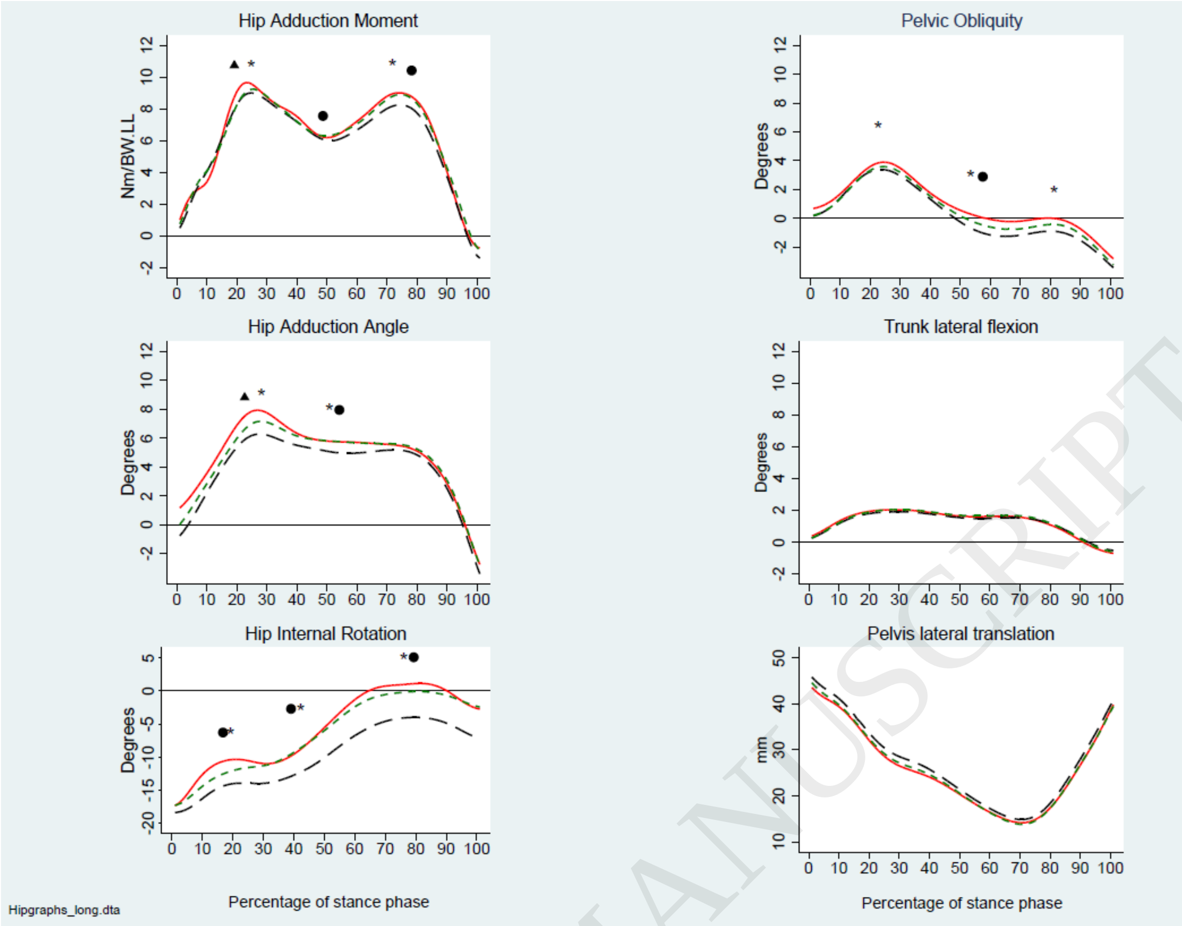

Figure 4 Mean time series data during stance phase for baseline, active and sham gait trials for HAM, HAA, internal rotation, pelvic obliquity, trunk lateral flexion and pelvic translation.
Note: Solid red lines represent baseline trials, dashed black lines represent active trials and dotted green lines represent sham trials.
* = significant difference between baseline and active trials; ▲ = significant difference between baseline and sham trials; ● = significant difference between active and sham trials

Pain outcome

Baseline, post active tape and post sham tape was recorded for 41 participants. Neither active nor sham tape provided a clinically important reduction of 2 points[39] on the NRS (active, mean (range) -1.91 (2 to -5), sham, mean (range) -1.44 (2.5 to -6)). Both active and sham tape produced a statistically significant reduction in pain (active vs baseline: z=-4.74, p=0.000; sham vs baseline; z= -4.19, p= 0.000), with the active tape providing a statistically significantly greater reduction (z=-2.83, p=0.003).

DISCUSSION

This is the first study to examine the mechanical effects of sports tape on people with GTPS. We found the active and sham applications of DT provided a possible mechanical benefit to women with GTPS, with the active having a more profound effect. Active DT reduced the HAM compared to baseline and sham at second peak, and, compared to baseline, reduced the amount of hip adduction, internal rotation and pelvic obliquity during the stance phase of gait. Both active and sham applications of DT provided pain reduction, with the active application approaching a clinically meaningful value.

Dynamic Tape and biomechanics

We have shown that the increased HAM and HAA seen in people with GTPS[22] can be reduced in the short term with the active application of DT, thus likely reducing the compression of the tendons via the ITB,[19, 41] possibly facilitating a recovery process. However, sham DT also reduced the HAM, suggesting a somatosensory or placebo role. Between-group differences for active vs sham, while small, were observed in four gait variables with the active taping resulting in greater changes, suggesting that DT provided a mechanical benefit.

To our knowledge there are no sports tape studies that have differentiated somatosensory input from the placebo effect. The effect of tape on somatosensory input has been briefly examined in other joints, with conflicting results. Simoneau et al.[42] demonstrated that strips of rigid tape on the ankle joints of healthy individuals improve proprioception, however rigid tape on the shoulders of healthy Australian Football players[43] and Kinesio Tape applied to the ankles of healthy individuals[44] showed no proprioception change. Thus, the causes of changes associated with sham taping remain unclear.

The HAA was reduced when wearing active DT. In a study of gait variations in GTPS, there was no difference in HAA when comparing people with GTPS to age-matched controls.[22] However, when comparing single-leg stance from the same group, increased HAA was evident in the GTPS group.[45] This difference may be due to forward momentum, and altered loading with heel strike during gait. Our results demonstrated that the active application of DT reduced the HAA at first peak (heel strike), more than sham taping. This supports the premise that DT has a mechanical effect, as active taping reduced adduction, however additional somatosensory effects cannot be excluded.

Internal rotation was reduced with the active application of DT. The tensor fasciae latae (TFL), a hip internal rotator, inserts into the ITB.[18, 46] When the TFL shortens (with internal rotation), the tightness of the ITB likely increases.[18] The degree of hip rotation may therefore influence ITB tension.[41] The significant reduction of internal rotation may contribute to decompression of the greater trochanter.

The significant reduction in pelvic obliquity with active DT may have contributed to the decreased HAM. Pelvic obliquity is the main contributor to increasing HAMs for people with GTPS, compared to healthy individuals, in which walking velocity is the primary contributor.[22]

We were surprised by the lack of change in trunk lateral flexion as this is linked to pelvic obliquity.[45] However, the changes seen in the GTPS population may be due to altered motor control strategies, rather than muscular strength.[45]

This study was not designed to test if DT would reduce pain. Never-the-less we found both the active and sham taping resulted in immediate statistically significant short-term pain relief, with the active application of DT approaching a clinically important difference.[39] Two studies examining pain relief associated with taping around the elbow[47, 48] have demonstrated short-term pain relief, with a third supporting the hypothesis of deloading contributing to this change.[49] A systematic review of treatments for patellofemoral pain cautiously supported the use of taping in older people.[50] We consider that further work should be done with respect to the role of DT in providing pain relief in people with GTPS as this may prove to be a viable alternative to corticosteroid injection therapy.

Additional research to understand where the mechanical changes are occurring using muscle modelling techniques is recommended. Further, a head-to-head comparison with corticosteroid injections and exercise, and establishing the long-term effects of prolonged intermittent use of DT should be investigated.

Strengths and limitations

The strengths of this this RCT were that participants acted as their own controls, assessors were blind to allocation, and there was no loss to follow-up.

The study had some limitations. Imaging was not used to support our clinical diagnosis, however the combination of clinical tests used in the physical assessment provided >85% probability of having gluteal tendinopathy in 47/50 participants, with the remaining 3/50 having a >70% probability of having gluteal tendinopathy.[29] Further, we did not assess the effectiveness of the blinding, and while motion analysis technology is considered the ‘gold standard’ of movement measurement, the use of skin-mounted markers is prone to noise introduced through skin movement artefact and assumptions are made during the calculation of inverse dynamics. In addition, while some of our findings were statistically significant, many may not be clinically significant as the small absolute difference in change is likely within the margin of error for three-dimensional motion analysis. However, all changes followed a similar pattern, with the largest differences seen consistently between the active and baseline conditions. Finally, some of the participants were pain-free on the day of testing and we were missing some data for the pain scores.

CONCLUSION

Dynamic Tape appears to have a mechanical effect on gait, likely reducing tendon compression and supporting dynamic hip adduction control. It is not clear if this change is due to mechanical, somatosensory or placebo effects. Further, the application of DT may provide a clinically significant short-term reduction in pain, which may then allow exercise interventions to be implemented.

CONFLICT OF INTEREST STATEMENT

Dynamic Tape provided a tutorial on the application of the tape (free of charge) and the tape used during the study free of charge. During data collection there was some correspondence with the company seeking advice in relation to refining the technique (due to skin irritation that occurred for a small portion of participants). Other than that noted above, there has been no correspondence with the company during data collection, analysis and interpretation of the results, or during the preparation of the manuscript. The company agreed to allow the results to be published regardless of the outcomes.

Declaration of interest statement
Dynamic Tape provided a tutorial on the application of the tape (free of charge) and the tape used during the study, free of charge. During data collection there was some correspondence with the company seeking advice in relation to refining the technique (due to skin irritation in a couple of participants). Other than that noted above, there has been no correspondence with

the company during data collection, analysis and interpretation of the results, or during the preparation of the manuscript. The company agreed to allow the results to be published, regardless of the outcomes.

Acknowledgements
We, the authors of this manuscript, would like to acknowledge our co-authors, participants, Nathan De Meillon and Shannon Parnell. Thank you for all your support, time and effort you have put in to helping us complete this research. We would also like to thank Ryan Kendrick of Dynamic Tape® for providing the tape and advice.

Credit

Author	Conceptualisation	Data curation	Formal analysis	Funding acquisition	Investigation	Methods	Project administration	Resources	Software	Supervision	Validation	Visualisation	Roles/Writing – original draft	Writing – review and editing
Robinson		✓	✓		✓		✓				✓		✓	✓
Spratford	✓	✓	✓		✓	✓		✓	✓	✓	✓			✓
Welvaert			✓			✓								✓
Gaida						✓					✓			✓
Fearon	✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓

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CONSORT
TRANSPARENT REPORTING of TRIALS

CONSORT 2010 Flow Diagram