Efficacy of knee tape in the management of osteoarthritis of the knee: blinded randomised controlled trial

Rana S Hinman, Kay M Crossley, Jenny McConnell, Kim L Bennell

Abstract

Objectives To test the hypotheses that therapeutic taping of the knee improves pain and disability in patients with osteoarthritis of the knee and that benefits remain after stopping treatment.

Design Randomised single blind controlled trial with three intervention arms (therapeutic tape, control tape, and no tape) of three weeks' duration and three week follow up.

Setting Outcome assessment was performed in a university based laboratory. Taping interventions were applied by eight physiotherapists in metropolitan private practice.

Participants 87 patients with symptoms of knee osteoarthritis as defined by the American College of Rheumatology.

Main outcome measures Primary outcome measure was pain as measured by visual analogue scale and participant perceived rating of change. Secondary measures of pain and disability included the Western Ontario and MacMaster Universities osteoarthritis index, knee pain scale, and the SF-36.

Results The therapeutic tape group reported a greater reduction in pain on all primary outcomes than either of the other two groups. A significant association was evident between intervention and change in pain at three weeks (P=0.000), with 73% (21/29) of the therapeutic tape group reporting improvement compared with 49% (14/29) of the control tape group and 10% (3/29) of the no tape group. Significantly greater improvement in pain and disability was observed on most secondary outcomes in the therapeutic tape group compared with the no tape group. Benefits of therapeutic tape were maintained three weeks after stopping treatment.

Conclusions Therapeutic knee taping is an efficacious treatment for the management of pain and disability in patients with knee osteoarthritis.

Introduction

Osteoarthritis is a leading cause of pain and disability in elderly people worldwide and accounts for a large proportion of visits to health professionals each year.[1–4] Since limited progress has been made towards curing the disease, management of symptoms is the mainstay of treatment.[5] Simple, inexpensive treatments that increase the range of options for patients with the disease are warranted.

Physiotherapists tape the knee as short term or intermittent treatment for knee pain. Knee taping is believed to relieve pain by improving alignment of the patellofemoral joint and/or unloading inflamed soft tissues.[6] The American College of Rheumatology recommends knee taping for patients with osteoarthritis, but there is little evidence to justify its use.[5 7] One study of medial patellar tape applied for four days in a small cohort with patellofemoral joint disease showed a 25% reduction in pain.[8] We aimed to establish the effect of therapeutic knee taping on pain and disability in patients with symptoms of knee osteoarthritis and to determine if any benefits could be maintained after stopping treatment.

Centre for Sports Medicine Research and Education, School of Physiotherapy, University of Melbourne, Victoria, 3010, Australia

Rana S Hinman *tutor*

Kay M Crossley *postdoctoral research fellow*

Jenny McConnell *senior fellow*

Kim L Bennell *associate professor*

Correspondence to: R S Hinman ranash@unimelb.edu.au

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Methods

Participants and group assignment

Volunteers from the community responded to advertisements in local papers. Inclusion criteria were based on the clinical and radiological classification criteria of the American College of Rheumatology (presence of osteophytes, age over 50 years, and pain in the knee).[9] Exclusion criteria were allergy to tape or history of joint replacement, symptoms or signs suggestive of another cause of knee pain, physiotherapy for the knee (previous six months), body mass index >38 (owing to difficulties of taping the knee effectively), rheumatoid arthritis, steroid injection or knee surgery (previous six months), history of knee taping, and fragile skin around the knee.

All participants gave written informed consent. They were assigned by block randomisation (blocks of three), stratified according to sex, to receive either therapeutic tape, control tape, or no tape. An independent researcher not involved in outcome assessment was responsible for group allocation, using a computer generated random number table. Immediately after baseline assessment by the blinded assessor, the treating physiotherapist accessed the allocation schedule from a centrally located locked cabinet.

Protocol

The trial comprised a three week intervention period and a three week follow up (fig 1). Participants were assessed before treatment (baseline), after three weeks of treatment (final assessment), and at six weeks (follow up).

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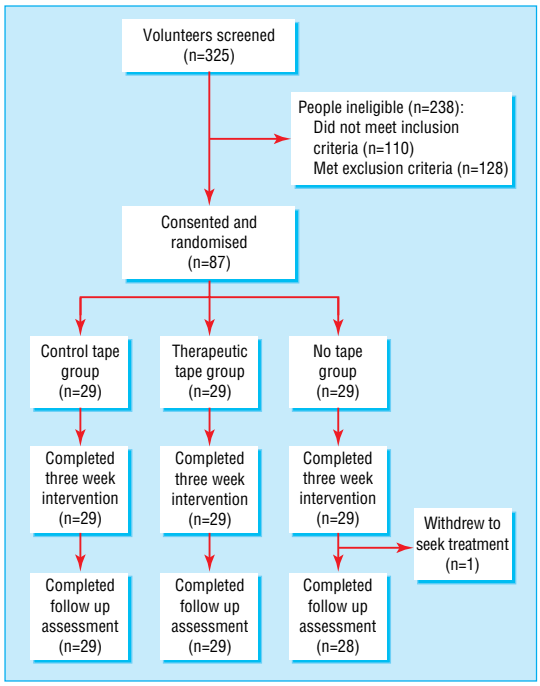

Fig 1 Trial profile

Tape was applied by 12 trained physiotherapists at the university (n=4) and in private practice (n=8) around the metropolitan region. The tape was worn for three weeks and reapplied weekly. Skin was shaved before application.

Therapeutic tape provided medial glide, medial tilt, and anteroposterior tilt to the patella (fig 2). As inflamed soft tissue is aggravated by stretch, tape was also applied to unload either the infrapatellar fat pad or the pes anserinus (determined by clinical assessment to ascertain the most tender).[6] Hypoallergenic undertape (Fixomull stretch; Beiersdorf, North Rhyde, NSW) was applied beneath the rigid tape (Leuko Sportstape Premium Plus; Beiersdorf) to prevent irritation of the skin. Control tape aimed to provide sensory input only. Hypoallergenic tape alone was laid over the same areas of skin as the therapeutic tape. Participants allocated to the no tape group received no intervention. All participants continued current treatments but were instructed to refrain from starting new ones. Analgesic use was recorded in a diary.

Masking

Participants were unaware of which taping technique was considered therapeutic. Assessments were performed by one assessor (RH), who remained blinded to treatment allocation until after statistical analyses. Participants were instructed not to discuss group allocation with the assessor, and the tape was removed by the participant before final assessment.

Outcome measures

Primary outcome

The primary outcome was change in pain, measured on an 11 point, 10 cm horizontal visual analogue scale, numbered in 1 cm increments.[10] Participants rated the average severity of knee pain, over the previous week, on movement and during an aggravating activity nominated by the participant, by selecting an appropriate whole number. Participant perceived rating of change in pain was recorded on a 5 point Likert scale ranging from 1 (much worse) to 5 (much better). Participants with scores of 4 or 5 were considered "improvers."

Secondary outcomes

Secondary measures of pain included the pain subscale of the Western Ontario and MacMaster Universities osteoarthritis index, the knee pain scale, and the bodily pain domain of the SF-36.[11–13] Disability was measured on a visual analogue scale (average restriction of activity), the physical function subscale of the osteoarthritis index, and the physical function and role domains of the SF-36.

Sample size and statistical analysis

A change in pain of 1.75 cm on the visual analogue scale has been recommended as the minimum clinically important difference in trials of knee osteoarthritis.[14] With 81 participants, our study had 80% power to detect a change in pain of 1.75 cm between the therapeutic tape and no tape groups, assuming a change of 1 cm in the control group and a standard deviation of 2 cm with a significance level of 5%. We increased the numbers to 87 to allow for drop outs.

Analyses were performed with SPSS software on an intention to treat basis. Baseline comparability between groups was determined with one way analysis of variance, Kruskal-Wallis tests, or χ^2 tests. For each participant, change in scores from baseline was calculated at three weeks (final assessment) and at six weeks (follow up). Mean difference in change in scores and 95% confidence intervals were calculated between groups at these time points.We analysed participant perceived rating of change with the χ^2 statistic and determined the relative risk of being an improver. The

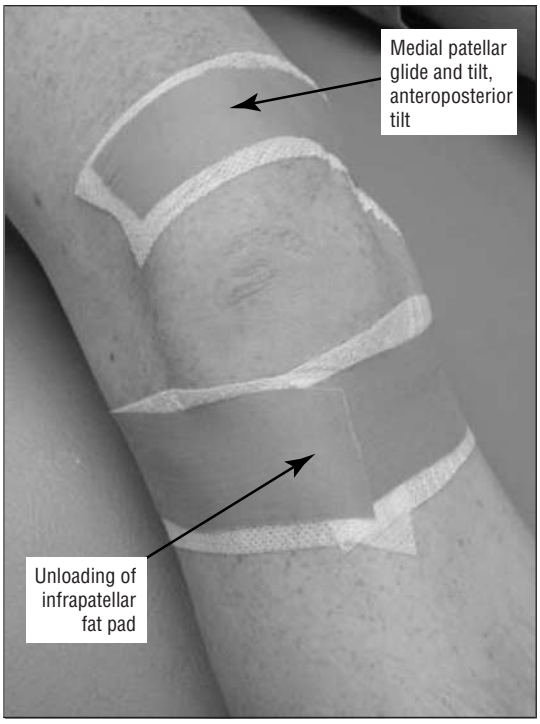

Fig 2 Positioning of therapeutic knee tape

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effect size of therapeutic tape (relative to no tape) was calculated.

Results

Between July 2001 and April 2002, we screened 325 volunteers from the community. Of these, 87 met the selection criteria and were enrolled into our study. Twenty nine participants were randomised to each of the three intervention groups. All participants completed the intervention as allocated. One participant (no tape group) withdrew to seek treatment for the knee and was unable to return for follow up. Groups did not differ significantly at baseline for personal characteristics or outcome measures (tables 1 and 2).

Primary outcome measures

After intervention the therapeutic tape group showed a significantly greater reduction in pain than the control and no tape groups (table 2). Effect sizes were large. A small, although non-significant, benefit of control tape was observed. On most comparisons at six weeks, a significantly greater reduction in pain from baseline was evident in the therapeutic tape group. This indicates a prolonged effect of therapeutic tape three weeks after stopping treatment (fig 3).

An association was evident between group and perceived improvement in pain after three weeks (χ^2 test P=0.000; fig 4), with 21 (73%) participants in the therapeutic tape group reporting improved pain compared with three (10%) in the no tape group (95% confidence interval of difference 42% to 82%), and corresponding to a number needed to treat of 2 (1.8 to 2.2). Compared with no tape group, the therapeutic tape group was seven times more likely to report improved pain (relative risk 7.00, 2.34 to 20.92), and the control tape group was four and a half times more likely (4.67, 1.50 to 14.53).

Secondary outcome measures

The therapeutic tape group experienced a significantly greater reduction in pain and disability on most secondary outcomes than the no tape group. Although control tape achieved small beneficial effects, most differences were not significantly different from no tape. Although therapeutic tape seemed more effective than control tape, differences were small for most outcomes and were not statistically significant. However, at six weeks both tape groups showed significant improvements from baseline compared with the no tape group.

Compliance, cointerventions, and adverse effects

Minor skin irritations affected eight (28%) participants in the therapeutic tape group and one (3%) participant in the control tape group, but all participants continued to wear the tape as prescribed. One participant (no tape group) underwent corticosteroid injection for the knee during the intervention period, and one participant (drop out from no tape group) sought alternative treatment after the intervention period. No differences were found in analgesic use between groups over the intervention period (28% no tape (eight participants), 14% control tape (four), and 31% therapeutic tape (nine), χ^2 test P=0.27).

Table 1 Characteristics of participants allocated one of three interventions for treatment of knee pain caused by osteoarthritis. Values are numbers (percentages) unless stated otherwise

Characteristic	No tape (n=29)	Control tape (n=29)	Therapeutic tape (n=29)
Mean (SD) age (years)	69 (9)	71 (8)	66 (8)
Mean (SD) height (m)	1.64 (0.01)	1.64 (0.09)	1.64 (0.01)
Mean (SD) weight (kg)	81.1 (13.4)	78.8 (16.4)	79.1 (10.8)
Mean (SD) body mass index (kg/m^2)	30.1 (4.0)	29.3 (4.9)	29.3 (4.0)
Mean (SD) duration of symptoms (years)	9 (11)	9 (10)	9 (8)
Men	10 (34)	10 (34)	10 (34)
Women	19 (66)	19 (66)	19 (66)
Radiographic severity*:			
Grade I/II	7 (24)	9 (31)	9 (30)
Grade III/IV	22 (76)	20 (69)	20 (70)
Presence of osteophytes in patellofemoral joint	23 (79)	23 (79)	21 (72)
Narrowing of patellofemoral joint	10 (35)	5 (17)	6 (21)

*Kellgren and Lawrence grading system; higher grade indicates more severe disease.[15]

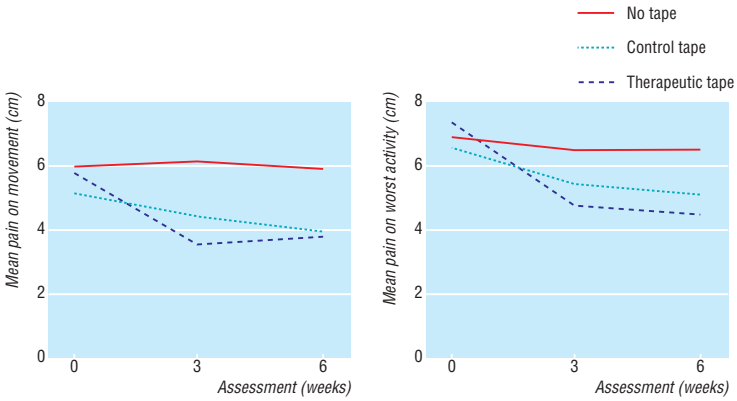

Fig 3 Pain scores on primary outcomes over time by intervention group

Discussion

Therapeutic knee tape reapplied weekly and worn continuously for three weeks significantly improved pain and disability in patients with osteoarthritis of the knee. This effect was greater than that observed with control tape and was of a magnitude considered clinically significant.[14] Furthermore, benefits may be maintained three weeks after stopping treatment.

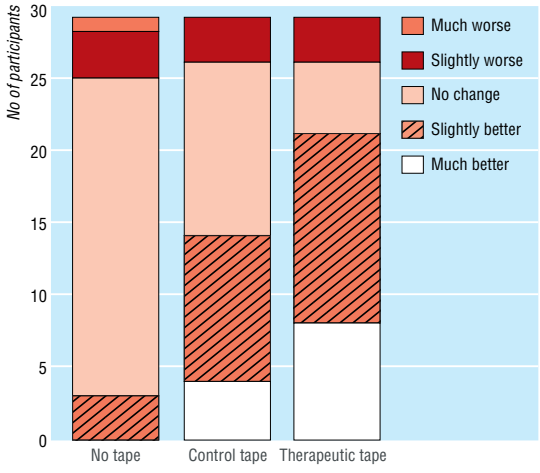

Fig 4 Participant perceived change in pain after intervention period

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Table 2 Change in outcomes from baseline over time in participants allocated no tape, control tape, or therapeutic tape for osteoarthritis of the knee

Outcome measures	Mean score (95% CI)			Mean difference in change (95% CI)			Effect size
	No tape (n=29)	Control tape (n=29)	Therapeutic tape (n=29)	No tape versus control tape	No tape versus therapeutic tape	Control tape versus therapeutic tape	
Primary outcomes							
Pain on movement (cm)*:							
Baseline (0 weeks)	6.0 (5.3 to 6.8)	5.1 (4.4 to 5.9)	5.7 (4.9 to 6.5)	—	—	—	
Final assessment (3 weeks)	6.1 (5.2 to 6.9)	4.4 (3.4 to 5.4)	3.6 (2.9 to 4.3)	0.8 (0.0 to 1.6)	2.1 (1.2 to 3.0)	1.3 (0.3 to 2.4)	1.19
Follow up (6 weeks)	5.9 (5.1 to 6.7)	4.0 (3.1 to 4.9)	3.8 (2.9 to 4.8)	1.0 (0.0 to 2.0)	1.7 (0.6 to 2.8)	0.7 (–0.6 to 1.9)	
Pain on worst activity (cm)*:							
Baseline (0 weeks)	6.9 (6.2 to 7.6)	6.5 (5.7 to 7.2)	7.3 (6.6 to 8.0)	—	—	—	
Final assessment (3 weeks)	6.5 (5.7 to 7.3)	5.4 (4.4 to 6.5)	4.8 (4.0 to 5.6)	0.6 (–0.4 to 1.5)	2.0 (1.0 to 3.1)	1.5 (0.3 to 2.7)	1.00
Follow up (6 weeks)	6.5 (5.7 to 7.3)	5.1 (4.0 to 6.2)	4.5 (3.4 to 5.5)	0.9 (–0.3 to 2.1)	2.4 (1.1 to 3.7)	1.6 (0.1 to 3.0)	
Secondary outcomes							
Restriction of activity (cm)*:							
Baseline (0 weeks)	4.8 (3.9 to 5.6)	4.8 (3.7 to 5.8)	5.0 (4.0 to 6.0)	—	—	—	
Final assessment (3 weeks)	5.0 (4.1 to 5.9)	3.6 (2.6 to 4.5)	4.0 (3.2 to 4.9)	1.6 (0.5 to 2.6)	1.0 (0.2 to 1.9)	–0.5 (–1.6 to 0.6)	0.62
Follow up (6 weeks)	4.9 (3.9 to 6.0)	3.4 (2.5 to 4.4)	3.5 (2.6 to 4.5)	1.9 (0.5 to 3.2)	1.6 (0.3 to 2.9)	–0.2 (–1.7 to 1.2)	
Pain†:							
Baseline (0 weeks)	9.0 (7.8 to 10.1)	7.8 (6.6 to 8.9)	9.0 (7.7 to 10.3)	—	—	—	
Final assessment (3 weeks)	8.9 (7.6 to 10.1)	6.2 (4.9 to 7.4)	7.2 (6.1 to 8.4)	1.3 (0.0 to 2.6)	1.7 (0.6 to 2.9)	0.4 (–1.2 to 2.0)	0.82
Follow up (6 weeks)	9.4 (8.1 to 10.7)	5.8 (4.6 to 7.0)	7.3 (5.8 to 8.8)	2.1 (0.6 to 3.6)	2.1 (0.5 to 3.6)	0.0 (–2.0 to 1.8)	
Physical function†:							
Baseline (0 weeks)	29.6 (25.3 to 33.9)	27.8 (23.5 to 32.1)	29.4 (25.6 to 33.3)	—	—	—	
Final assessment (3 weeks)	31.3 (26.8 to 35.8)	24.7 (19.6 to 29.8)	25.4 (21.9 to 28.9)	3.3 (0.0 to 6.7)	5.1 (1.9 to 8.4)	1.8 (–2.3 to 6.0)	0.83
Follow up (6 weeks)	31.5 (26.7 to 36.3)	21.8 (17.4 to 26.2)	26.0 (21.2 to 30.8)	6.7 (3.1 to 10.3)	4.7 (0.6 to 8.9)	–2.0 (–6.7 to 2.8)	
Severity‡:							
Baseline (0 weeks)	17.4 (15.9 to 19.0)	16.8 (15.3 to 18.3)	17.4 (15.9 to 18.9)	—	—	—	
Final assessment (3 weeks)	17.4 (15.8 to 18.9)	14.9 (13.0 to 16.8)	14.7 (13.2 to 16.2)	1.3 (–0.4 to 3.0)	2.2 (0.4 to 4.0)	0.9 (–1.2 to 3.1)	0.66
Follow up (6 weeks)	17.9 (16.1 to 19.6)	13.9 (12.1 to 15.7)	15.1 (13.6 to 16.5)	3.0 (1.0 to 4.9)	2.6 (0.7 to 4.4)	–0.4 (–2.5 to 1.7)	
Frequency‡:							
Baseline (0 weeks)	23.0 (21.6 to 24.5)	23.8 (22.0 to 25.6)	23.9 (22.5 to 25.2)	—	—	—	
Final assessment (3 weeks)	22.9 (21.4 to 24.3)	21.4 (19.0 to 23.9)	21.3 (19.8 to 22.9)	1.9 (–0.1 to 3.8)	2.1 (1.0 to 3.3)	0.2 (–1.8 to 2.2)	0.97
Follow up (6 weeks)	22.9 (21.6 to 24.2)	20.5 (18.2 to 22.9)	21.2 (19.5 to 22.9)	3.0 (1.0 to 4.9)	2.5 (0.7 to 4.3)	–0.4 (–2.8 to 1.9)	
Bodily pain§:							
Baseline (0 weeks)	50.6 (41.7 to 59.4)	53.8 (44.2 to 63.5)	52.2 (43.0 to 61.4)	—	—	—	
Final assessment (3 weeks)	46.9 (37.9 to 56.0)	59.3 (50.0 to 68.5)	62.2 (52.9 to 71.6)	–6.7 (–16.8 to 3.4)	–10.8 (–20.8 to –0.7)	–4.1 (–12.6 to 4.5)	0.56
Follow up (6 weeks)	48.6 (39.6 to 57.6)	70.3 (61.9 to 78.7)	60.1 (50.8 to 69.4)	–16.6 (–29.5 to –3.7)	–9.0 (–20.1 to 2.2)	7.7 (–3.7 to 19.0)	
Physical function§:							
Baseline (0 weeks)	40.0 (30.6 to 49.4)	43.4 (34.2 to 52.6)	39.8 (31.8 to 47.8)	—	—	—	
Final assessment (3 weeks)	40.0 (31.3 to 48.7)	45.4 (35.8 to 55.0)	41.9 (33.8 to 50.0)	–1.7 (–6.5 to 3.1)	–1.9 (–6.9 to 3.1)	–0.2 (–6.0 to 5.6)	0.20
Follow up (6 weeks)	38.7 (29.5 to 47.8)	47.8 (38.8 to 56.8)	41.9 (33.2 to 50.5)	–4.9 (–11.2 to 1.4)	–3.3 (–8.5 to 1.9)	1.6 (–5.7 to 8.8)	
Physical role§:							
Baseline (0 weeks)	35.6 (21.0 to 50.2)	44.0 (26.8 to 61.2)	38.8 (22.2 to 55.4)	—	—	—	
Final assessment (3 weeks)	38.5 (22.5 to 54.4)	44.0 (26.1 to 61.9)	43.1 (25.5 to 60.7)	9.5 (–8.9 to 27.8)	0.9 (–13.5 to 15.2)	–8.6 (–24.6 to 7.3)	0.03
Follow up (6 weeks)	34.6 (18.4 to 50.8)	57.0 (41.4 to 72.6)	41.4 (24.5 to 58.3)	–7.7 (–26.2 to 10.9)	0.0 (–15.7 to 15.8)	7.8 (–9.4 to 25.0)	

*Visual analogue scale (0, no pain to 10, worst pain possible).
†Western Ontario and MacMaster Universities osteoarthritis index (pain scores 0 to 20 points, physical function scores 0 to 68; higher scores indicate worse pain or physical function).
‡Knee pain scale (severity subscale 0 to 36 points, frequency subscale 0 to 30 points; higher scores indicate more severe or frequent pain).
§Medical outcomes study SF-36 (0 to 100 points; higher scores indicate less pain or disability).

Only one previous study evaluated the effects of knee tape in a population with osteoarthritis.[8] Despite the limitations of that trial (small sample, lack of untaped control group, short intervention period, and limited outcome measures), a 25% reduction in pain was observed in patients with patellofemoral joint disease after taping of the patella medially for four days.[8] We achieved a greater reduction in pain (38-40%) with therapeutic tape, probably because of our different protocol. Our study expands on previous findings by showing improvements in both pain and physical function using a battery of outcome measures. More importantly, we observed beneficial effects of knee taping in people with generalised, non-specific degeneration of the knee joint. Our cohort comprised patients with both varied severity of disease, as shown by radiography, and varied involvement of the patellofemoral joint. Contrary to the previous trial, some of our participants had only tibiofemoral joint disease, highlighting the generalisability of this intervention to the wider population with osteoarthritis.[8] Our study provides the first evidence of the prolonged effects of knee taping in the short term, once treatment has stopped.

Strengths and limitations of study

A strength of our study is the general applicability of the therapeutic taping technique. Numerous physiotherapists, of varying ages and skill level, representative of those working in private practice, applied the intervention. The results suggest that specialist physiotherapists are not required for this intervention to be effective. The effect sizes were generally medium to large for most outcome measures, comparable with those reported for exercise programmes, physiotherapy regimens, and drug therapies.[7 16–18] Patients may be taught to tape their own knee, providing them

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with a self management strategy. Further research is needed to confirm the effectiveness of such management.

The main limitation of our study was its short duration, although in clinical practice taping is viewed as a short term and intermittent treatment strategy, generally used as an adjunct to exercise and drug therapies in knee osteoarthritis. Taping is particularly useful for patients pursuing potentially aggravating activities. Nevertheless, as knee osteoarthritis is a chronic disease, studies evaluating the long term effects of knee taping are also required.

Our cohort comprised volunteers from the community, which explains the large number excluded. Participants had moderately severe osteoarthritis, as assessed by radiography, and reported moderate levels of pain and disability. More women than men were enrolled. We believe that our cohort reflects patients with knee osteoarthritis presenting to health practitioners. Although patients who volunteer for research may be more motivated than those recruited from waiting lists, and thus more likely to report positive outcomes, the lack of significant change in the control tape group suggests that benefits with therapeutic tape were owing to the intervention. We cannot generalise our results to some patient subgroups. These include obese individuals and those with fragile skin or allergies to tape.

It is not known how taping relieves pain. Our three way randomisation protocol represents an advance on previous methods, allowing specific effects of tape to be compared with both the placebo effects of the intervention and the clinical course of knee osteoarthritis. Although a placebo effect was evident on secondary outcomes at six weeks, the superiority of therapeutic tape over control tape on primary outcomes at both time points showed that therapeutic tape has a direct effect on knee pain that cannot be attributed to placebo (attention by physiotherapist, close monitoring, novel treatment) or cutaneous stimulation alone. Subtle changes in patellar position may alter the magnitude or distribution of patellofemoral joint pressures or stress on joint structures.[6] Unloading the fat pad may reduce strain on this often inflamed soft tissue.[19] Changes in proprioceptive acuity, quadriceps strength, and neuromotor control of the knee with taping have been described in other populations.[20–24]

We thank Mike Smith for evaluating the radiographs and the physiotherapists for applying the tape. KMC is a postdoctoral research fellow of the National Health and Medical Research Council Australia.

Contributors: RSH recruited and screened participants, planned and coordinated data collection, analysed data, performed statistical analyses, and wrote the paper. KLB and KMC obtained funding and contributed to the design of the study, supervised the planning, coordination, and collection of data, and provided advice on writing the paper. KLB provided statistical advice and assisted with analysis and interpretation of data. JMcC devised the therapeutic taping intervention and assisted with interpretation of findings. RSH and KLB will act as guarantors for the paper.

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Competing interests: JMcC receives a royalty from sales of Endura-Tape (Sydney, Australia). Endura tape was not used in this study.

Ethical approval: The university human research ethics committee approved the study.

What is already known on this topic

Osteoarthritis of the knee is a common condition

Knee taping is recommended by the American College of Rheumatology to manage the disease

No randomised, controlled trial has evaluated the effects of knee tape in patients with osteoarthritis

What this study adds

Therapeutic knee taping reduces pain and self reported disability in patients with symptoms of knee osteoarthritis

Benefits can be maintained in the short term once treatment has stopped

Knee taping is a simple, inexpensive self management strategy

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