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Functional management of ankle sprains: what volume and intensity of walking is undertaken in the first week postinjury

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ABSTRACT

Background Acute ankle sprains are usually managed functionally, with advice to undertake progressive weight-bearing and walking. Mechanical loading is an important modular of tissue repair; therefore, the clinical effectiveness of walking after ankle sprain may be dose dependent. The intensity, magnitude and duration of load associated with current functional treatments for ankle sprain are unclear.

Aim To describe physical activity (PA) in the first week after ankle sprain and to compare results with a healthy control group.

Methods Participants (16–65 years) with an acute ankle sprain were randomised into two groups (standard or exercise). Both groups were advised to apply ice and compression, and walk within the limits of pain. The exercise group undertook additional therapeutic exercises. PA was measured using an activPAL accelerometer, worn for 7 days after injury. Comparisons were made with a non-injured control group.

Results The standard group were significantly less active (1.2 ± 0.4 h activity/day; 5621 ± 2294 steps/day) than the exercise (1.7 ± 0.7 h/day, $p=0.04$; 7886 ± 3075 steps/day, $p=0.03$) and non-injured control groups (1.7 ± 0.4 h/day, $p=0.02$; 8844 ± 2185 steps/day, $p=0.002$). Also, compared with the non-injured control group, the standard and exercise groups spent less time in moderate (38.3 ± 12.7 min/day vs 14.5 ± 11.4 min/day, $p=0.001$ and 22.5 ± 15.9 min/day, $p=0.003$) and high-intensity activity (4.1 ± 6.9 min/day vs 0.1 ± 0.1 min/day, $p=0.001$ and 0.62 ± 1.0 min/day $p=0.005$).

Conclusion PA patterns are reduced in the first week after ankle sprain, which is partly ameliorated with addition of therapeutic exercises. This study represents the first step towards developing evidence-based walking prescription after acute ankle sprain.

INTRODUCTION

Ankle sprains are one of the most common forms of soft tissue injuries¹ and account for a significant number of consultations in accident and emergency (A&E) departments.^{2–3} The incidence of ankle sprains is 1 sprain per 10 000 persons daily,⁴ incurring substantial costs to the individual and society in terms of initial time off work and sport;⁵ and long-term sequelae such as pain, swelling and instability.⁶

A popular approach is to manage ankle sprains 'functionally', which involves progressive weight-bearing and walking.^{7–8} This has been shown to be more effective than passive approaches such as immobilisation and casting for the majority of

ankle sprains.^{9–10} For many clinicians, the underlying principle for promoting walking after an ankle sprain is an early return to function. However, as walking induces a mechanical load on healing ligaments, it could have a number of important physiological effects that may promote tissue recovery. There is evidence from animal models that mechanically loading injured soft tissue prompts a range of cellular responses that promote tissue structural change and recovery.¹¹ These responses include an upregulation of mRNA expression for key proteins associated with soft tissue healing,^{12–14} and enhanced strength and morphological characteristics of collagenous tissue.^{12–13}

We have recently suggested that 'optimal loading' is an important component of soft tissue management.¹⁵ After an ankle sprain, this should involve an exercise programme which maximises the physiological and therapeutic effects of mechanical loading, while avoiding excessive forces, rebleeding and further damage. Central to this is advice on when walking should be initiated, for how long and at what intensity. Human studies have not objectively examined walking patterns after soft tissue injury. A popular clinical approach after ankle sprain is to encourage walking within the limits of pain. Determining patients' compliance with this advice, and examining the nature of the resultant walking patterns, are fundamental clinical questions.

Accelerometer technology objectively records physical activity (PA) patterns including: walking bout length and frequency, intensity and step cadence.^{16–17} The aim of this study was to use accelerometers to describe walking activity in the first week after ankle sprain using a subgroup of participants recruited into a larger randomised controlled study of functional recovery, and to compare results with a non-injured control group.

METHODS

Recruitment

Participants were recruited as part of a larger randomised controlled trial of the effects of functional treatment of ankle sprain.^{18–19} Participants who met the inclusion/exclusion criteria (table 1) were recruited to the main trial from the A&E department of the Royal Victoria Hospital, Belfast and the Sports Injury Clinic, University of Ulster. After initial assessment by a health professional, individuals were given a brief verbal explanation of the study with an information sheet and consent to participate sought. Following baseline

Table 1 Inclusion/exclusion criteria

Inclusion	Exclusion
<ul style="list-style-type: none"> ▶ Acute (<7 days) Grade I or Grade II ankle sprain ▶ Aged 16–65 years 	<ul style="list-style-type: none"> ▶ Complete (Grade III) ankle ligament rupture (mechanical instability diagnosed by a positive anterior drawer or inversion stress test) ▶ Bony ankle injury (indicated by Ottawa ankle rules or plain x-ray) ▶ Multiple injuries (eg, other joint injury or fracture) ▶ Contraindication to cryotherapy ▶ Non-English speaking ▶ Under the influence of drugs/alcohol ▶ Insufficient address for follow-up

measurements, individuals were randomly allocated to a group receiving standard functional treatment (standard group) or additional early therapeutic exercises (exercise group), using computer-generated random numbers by the physiotherapist who then carried out the appropriate treatment. Stratified randomisation was employed according to whether participants were from an athletic or non-athletic population.

Physical activity monitoring

A subset of individuals recruited in the main study^{18 19} were sequentially allocated to wear an activPAL uniaxial accelerometer (PAL Technologies, Glasgow, UK) to record levels of free-living PA. Reported intraclass correlation coefficients (ICCs) for interdevice reliability range from 0.79 to 0.99.^{20 21} The activPAL accelerometer was attached directly to the anterior aspect of the thigh on the injured leg using PAL stickies (double-sided hypo-allergenic hydrogel adhesive pads). Participants were asked to wear the monitor continuously for 7 consecutive days. They were instructed to wear the monitor at all times, except for water-based activities (eg, showering and bathing) and were instructed on how to remove and replace the monitors. After 7 days, accelerometers were removed during their follow-up appointment, and the data were uploaded to a computer and analysed, and classified using PAL Technologies proprietary software. Additional data processing was conducted using the custom-made analysis program, developed by Dr Philippa Dall and Professor Malcolm Granat, School of Health, Glasgow Caledonian University, which is not commercially available.

Function and pain

Subjective ankle function was also assessed using the Lower Extremity Functional Scale.²² This is an 80-point scale that has excellent test-retest reliability (ICC=0.94, 95% CI lower limit=0.89). The scale has a potential error of ± 5.3 points, with a minimal detectable change and minimal clinically important difference of nine points (both 90% CI). Pain at rest and with activity was assessed using 100-mm visual analogue scales, where a higher score represents a higher level of pain.²³

Standardised interventions

All participants recruited into the study^{18 19} were provided with basic advice on applying ice and compression for the week.²⁴ At baseline, they were each encouraged to weight-bear and walk within the limits of pain for the first week after injury. Activities of daily living were encouraged. Crutches, bandages or other forms of external support were not provided.

Exercise group

One of the groups (exercise group) undertook additional rehabilitation exercises (repeated three times per day for 1 week). These were non-weight-bearing exercises which focused on

improving range of movement and strength; full details can be found in the published study protocol.¹⁸ Exercises were provided as standardised verbal and written instructions, and a DVD demonstrating each of the exercises.^{18 19}

Non-injured controls

A non-injured control group was recruited using adverts and emails to the staff and students of the University of Ulster. The inclusion criteria were aged 18–64 years, ability to walk independently around the house and outside without appliances, physically healthy and free from medical conditions which may limit their day-to-day PA levels (eg, heart disease, hypertension, hypotension and low back pain) and a body mass index (BMI) of 20.0–24.9 (kg/m²). As the two injured groups were of normal weight, we compared them with a normal-weight control group. Individuals in the non-injured control group also wore an activPAL uniaxial accelerometer (PAL Technologies, Glasgow, UK) to record levels of free-living PA over a 7-day period, as described above. They were asked to maintain their normal activities of daily living throughout their involvement in the study.

Data handling

Individual records were included if they contained at least 5 days data, of which at least one was a weekend day.²⁵ A day was defined as a calendar day with evidence of a minimum of 10 h of activity. Levels of free-living PA were reported as the average number of steps, time spent sitting, standing and walking, the number of times each individual stood up and sat down and energy expenditure per day. Time spent in light, moderate and high-intensity exercise was calculated using time spent at predefined walking speed.²⁶

Patterns on PA were measured as the number of bouts of short (<20 continuous steps), moderate (20–100 continuous steps), long (>100 continuous steps) and extra-long walks (>500 continuous steps)^{27–29} and the average number of steps and cadence of each.

Statistical analysis

It was estimated that a sample size of 16 in each group would allow detection of a difference of 0.7 h of time spent walking between the groups with an α of 0.05, and 90% power. This was based on the results from a previous study in chronic low back pain compared with healthy non-injured controls.²⁹

Data were analysed using SPSS v17.0. Differences between groups were compared using analysis of variance and pairwise posthoc testing with Tukey's posthoc test. Non-normally distributed data were compared using its non-parametric equivalent (Kruskal–Wallis test).

RESULTS

All participants returned a usable dataset and none were excluded. There were no differences between the groups in terms of age, gender composition between all three groups, or between the two injured groups in self-reported function or time since injury ($p>0.05$) (Table 2). A small but statistically significant difference in BMI was observed. Post hoc testing revealed this was between the standard and non-injured control group ($p=0.005$), but not between the two injured groups ($p=0.16$) or the exercise and non-injured control group ($p=0.32$).

In the first week after an ankle sprain, the standard group spent significantly less time walking and took fewer steps per day compared to both the exercise group ($p=0.04$ and $0=0.03$) and the non-injured control group ($p=0.02$ and $p=0.002$ respectively). The standard group also spent significantly more time

Table 2 Comparison of groups

	Standard (n=16)	Exercise (n=18)	Non-injured control (n=18)	p Value
Gender	10M:6F	10M:8F	9M:9F	0.68
Age (years)	24.1±8.61 (19.47, 28.65)	26.1±10.19 (21.04, 31.18)	21.9±1.6 (21.07, 22.69)	0.55
BMI (kg/m ²)	25.9±3.7 (23.9, 27.9)	24.1±3.1 (22.5, 25.6)	22.7±0.9 (22.2, 23.2)	0.08*
Number of days recording (days)	5.8±0.9 (5.3, 6.2)	6.2±1.1 (5.7, 6.8)	6.1±0.5 (5.9, 6.4)	0.27
Time since injury (h)	37.2±30.1 (20.59, 53.88)	50.9±32.2 (34.38, 67.5)	-	0.23
Function at baseline (LEFS)	35.31±16.56 (26.49, 44.13)	38.22±19.81 (28.37, 48.07)	-	0.65
Function at week 1 (LEFS)	54.00±12.61 (47.28, 60.72)	61.63±13.05 (54.67, 68.58)	-	0.10
Pain at rest at baseline (mm)	26.5 (23.3) (14.1, 38.9)	19.6 (17.5) (10.9, 28.2)	-	0.33
Pain at rest week 1 (mm)	7.1±7.5 (2.9, 11.2)	3.3±4.4 (1.1, 5.5)	-	0.98
Pain with activity at baseline (mm)	53.06±27.7 (38.4, 67.8)	53.3±22.7 (42.0, 64.6)	-	0.08
Pain with activity week 1 (mm)	34.3±22.9 (21.6, 46.9)	25.7±22.1 (14.2, 36.2)	-	0.26

Values are presented as mean±SD (95% CI).

*Posthoc testing (Tukey) showed significant difference between standard and non-injured control group (p=0.005).

BMI, body mass index; LEFS, Lower Extremity Functional Scale.

Table 3 Comparison of physical activity between groups

	Standard (n=16)	Exercise (n=18)	Non-injured control (n=18)	p Value
Time spent sitting per day (h)	19.8±1.4 (19.0, 20.5)	18.8±1.5 (18.1, 19.6)	18.5±1.2 (17.9, 19.1)	0.02*
Time spent standing per day (h)	3.1±1.1 (2.46, 3.64)	3.3±0.9 (2.9, 3.8)	3.8±0.9 (3.3, 4.2)	0.09
Time spent walking per day (h)	1.2±0.4 (1.0, 1.5)	1.7±0.7 (1.3, 2.0)	1.7±0.4 (1.5, 1.9)	0.02*‡
Number of steps per day (steps)	5621±2294 (4399, 6844)	7886±3075 (6357, 9416)	8845±2185 (7758, 9931)	0.002*‡
Postural transitions per day	46±13 (40, 53)	53±10 (48, 58)	56±14 (49, 63)	0.08
Average energy expenditure per day (MET.h/day)	32.7±1.02 (32.1, 33.23)	33.37±1.77 (32.49, 34.25)	34.02±0.92 (33.56, 34.47)	0.02*
Time spent at light intensity activity per day (min)	53.4±16.8 (44.5, 62.4)	76.2±36.4 (57.93, 94.4)	54.5±17.5 (45.8, 63.2)	0.08
Time spent at moderate intensity activity per day (min)	14.5±11.4 (8.4, 20.5)	22.5±15.9 (14.6, 30.4)	38.3±12.7 (40.0, 44.6)	0.001††
Time spent at high-intensity activity per day (min)	0.1±0.1 (0.0, 0.1)	0.6±1.0 (0.1, 1.1)	4.1±6.9 (0.7, 7.6)	0.001*†

Values are presented as mean±SD (95% CI).

*Significant difference between standard and non-injured control groups (p<0.05).

†Significant difference between exercise and non-injured control groups (p<0.05).

‡Significant difference between standard and exercise groups (p<0.05).

MET, metabolic equivalent.

sitting (p=0.02) and had a lower daily energy expenditure (p=0.01) than the non-injured control group (table 2).

Compared to the non-injured control group, both the standard and exercise groups spent less time in moderate (p=0.001 and p=0.003 respectively) and high intensity (p=0.001 and p=0.005 respectively) activity per day (table 3).

The average walking bout of the standard group was shorter in duration than the non-injured control group in terms of time (p=0.02), cadence (p=0.007) and number of steps (p=0.005) (table 4), but the only difference between the exercise group and non-injured control groups was in the average cadence (p=0.006).

Further examination of these bouts confirmed the differences between the standard and the non-injured control group. They took significantly less steps in long (p=0.001) and extra-long bouts (p=0.001) but more in moderate bouts (p=0.03). They also undertook the long bouts at a lower cadence (p=0.01) and took less extra-long bouts (p=0.001). Compared to the exercise group, they took fewer (p=0.02) and less steps (p=0.04) in long bouts (table 4). The differences between the exercise group and control group were not as pronounced. The only differences were in the quantity (p=0.02) and number of steps taken (p=0.003) in extra-long bouts of walking (table 4).

From a more detailed analysis of cadence (figure 1), the standard group took significantly less steps at higher speeds than

the non-injured control group (110–120 steps/min, p=0.001; 120–130 steps/min, p=0.001; 150–160 steps/min, p=0.001; 160–170 steps/min, p=0.001; 170–180 steps/min, p=0.01) and the exercise group (120–130 steps/min, p=0.03; 150–160 steps/min, p=0.002; 160–170 steps/min, p=0.04). There were also differences between the exercise group and the non-injured control group (90–100 steps/min, p=0.02; 120–130 steps/min, p=0.04; 160–170 steps/min, p=0.02).

DISCUSSION

Many clinicians use a functional treatment approach after ankle sprains. This usually involves a short period of protection and unloading, followed by progressive walking. There is no evidence specifying what an optimal functional treatment should entail; consequently, clinicians rarely specify when walking should start, for how long and how often.⁸ A popular approach is to encourage walking within the boundaries of pain. This was the basis for advice provided in this study. Surprisingly, we found that this approach resulted in participants undertaking considerable volumes of walking during the first week after ankle sprain. Although values were not as high as the healthy control group, injured participants took an average 5500–7800 steps per day. It may be important to consider that participants were not provided with any external supports or walking aids. Previous research

Table 4 Comparison of bouts of activity

		Standard (n=16)	Exercise (n=18)	Non-injured control (n=18)	p Value
Average number of walking bouts per day		276.6±123.2 (217.2, 335.9)	321.9±116.6 (257.4, 386.5)	300.1±82.3 (259.2, 341.1)	0.09
Average duration of activity bout (s)		16.5±3.4 (14.9, 18.2)	18.0±3.8 (15.8, 20.1)	20.0±4.1 (18.0, 22.1)	0.03*
Average number steps per bout (steps)		21±6 (18, 24)	24±7 (20, 28)	29±8 (25, 33)	0.005*
Average cadence (steps/min)		77.4±10.6 (72.3, 82.5)	76.7±7.6 (72.4, 80.9)	86.4±6.7 (83.1, 89.8)	0.002*†
Short bouts (<20 steps)	Number of bouts	210.4±100.6 (161.9, 258.9)	241.1±87.2 (192.8, 289.4)	233.3±67.0 (200.0, 266.6)	0.13
	Number of steps (steps)	1321±632 (1016, 1625)	1507±540 (1207, 1806)	1425±404 (1224, 1625)	0.12
	Cadence (steps/min)	63.1±5.5 (60.2, 66.1)	63.6±5.7 (60.8, 66.4)	63.2±3.0 (61.7, 64.7)	0.96
Moderate bouts (20–100 steps)	Number of bouts	57.2±24.4 (45.5, 69.0)	67.1±26.9 (52.19, 82.0)	53.9±18.4 (44.8, 63.1)	0.4
	Number of steps (steps)	2900±1402 (2225, 3576)	3807±2240 (2567, 5048)	2724±1044 (2204, 3243)	0.02*
	Cadence (steps/min)	76.3±7.0 (72.5, 80.0)	78.5±5.9 (75.6, 81.5)	80.1±4.3 (77.9, 82.2)	0.17
Long bouts (>100 steps)	Number of bouts	8.7±5.6 (6.0, 11.41)	13.5±8.9 (8.5, 18.4)	12.7±3.0 (11.2, 14.2)	0.02‡
	Number of steps (steps)	2245±1408 (1567, 2924)	3674±2200 (2456, 4893)	4966±1915 (4014, 5918)	0.01**
	Cadence (steps/min)	92.6±11.3 (86.5, 98.6)	96.2±11.53 (90.5, 102.0)	102.7±5.7 (99.9, 105.6)	0.01*
Extra-long bouts (>500 steps)	Number of bouts	0.7±0.7 (0.4, 1.1)	1.4±1.1 (0.7, 2.0)	2.2±1.1 (1.6, 2.8)	0.001*†
	Number of steps (steps)	678±607 (386, 971)	1173±1198 (510, 1836)	2696±1916 (1743, 3648)	0.001*†
	Cadence (steps/min)	105.8±12.2 (97.5, 114.0)	105.5±9.5 (100.6, 110.3)	111.9±6.3 (108.8, 115.0)	0.09

Values are presented as mean±SD (95% CI).

*Significant difference between standard and non-injured control group ($p<0.05$).

†Significant difference between exercise and non-injured control group ($p<0.05$).

‡Significant difference between standard and exercise groups ($p<0.05$).

has questioned the cost-effectiveness of such adjunctive supports.³⁰ Future research should determine whether the provision of crutches with or without external supports affect walking patterns.

Therapeutic exercise

One of our functional treatment interventions (exercise group) incorporated therapeutic exercises during the first week of recovery. The rationale for using additional therapeutic exercise was to improve muscle strength, range of movement and sensorimotor control, which are commonly impaired after ankle sprain.^{31–34} The most notable between-group differences were that incorporating additional exercise into a functional treatment may allow for a higher volume, and faster speed of walking. It is not clear whether this represents a more optimal loading strategy. An interesting postulation is that therapeutic exercises may improve the quality of movement patterns during gait; however, further research is required. Of note, the results of the main study reported no between-group differences in terms of subjective function and re-injury rate based on 4 months follow-up.¹⁹

Mechano-transduction and optimal loading

For many clinicians, the underlying principle for early walking is to ensure an early return to function. We found that patients complied with advice and remained mobile throughout the first week of recovery. However, other important physiological principles exist, which may justify more tailored and detailed advice on walking. Mechano-transduction is the physiological process where cells sense and respond to mechanical loads.¹¹ Animal studies have shown great potential for mechano-transduction to promote healing after tendon and ligament injury. In vivo effects include: upregulation mRNA expression for key proteins associated with soft tissue healing,^{12–14} accelerated fibroblast proliferation, fibrillogenesis and matrix remodelling,³⁵ improved scar morphology and better tensile strength.^{35–38}

Ligaments are mechano-sensitive structures which adapt to mechanical loads incurred during walking or other forms of exercise.³⁹ Mechano-transduction should therefore be exploited by clinicians, to increase protein synthesis and improve healing after ankle sprain. The therapeutic effect is likely to depend on the 'dose' of mechanical load incurred. In the early phases after injury, parameters such as the magnitude, speed and duration of walking are therefore important.

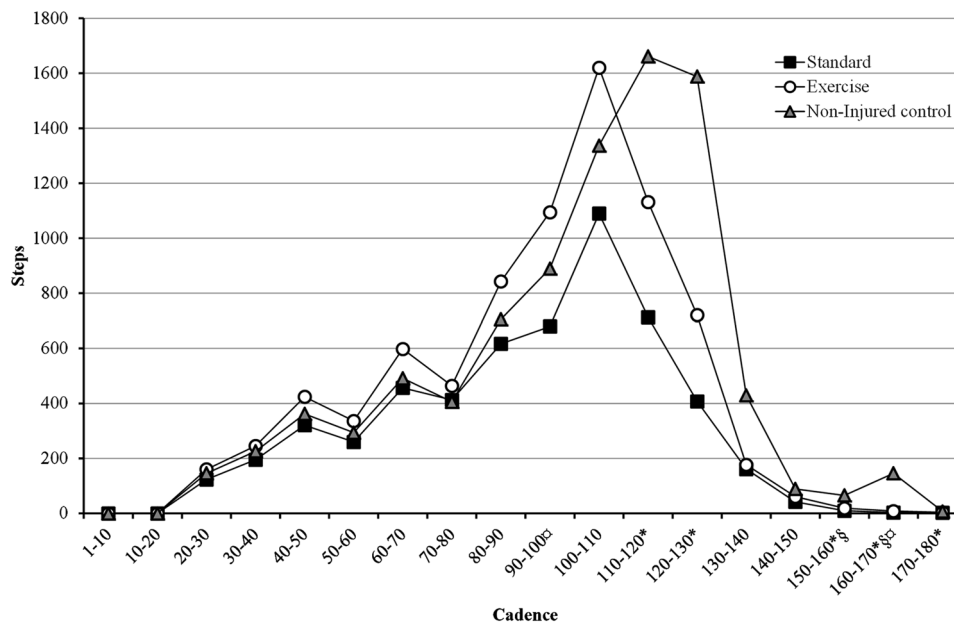


Figure 1 Number of steps by cadence.

*Significant difference between functional and non-injured controls ($p < 0.05$).

‡Significant difference between accelerated functional and non-injured controls ($p < 0.05$).

§Significant difference between functional and accelerated functional groups ($p < 0.05$).

It is not clear if the walking patterns reported in this present study represent an optimal loading strategy. It is interesting that in both of the injured groups, participants' tended to undertake shorter bouts of activity, cumulating load throughout the day. Animal models suggest that tendon tissues have a 'memory' for loading,⁴⁰ which can last several hours. This suggests that one short bout of exercise is the best approach, and multiple or prolonged bouts of loading could offer little additional therapeutic effect or may even be detrimental.

Optimal loading

Ankle sprains incur a high risk of poor recovery.⁶ One reason may be that it is difficult to adequately restore ligaments' morphological and viscoelastic properties after injury. This can result in an unstable or malaligned ankle joint which risks long-term sequelae such as instability, recurrent injury and ultimately post-traumatic arthritis. Animal models suggest that through mechano-transduction, mechanical loading is an important modulator of tissue repair. Underpinning this should be a loading strategy which reflects the histological and mechanical properties of the affected tissue. Ankle ligaments are usually subjected to cyclic loads at particular rates and angles, and therefore have unique viscoelastic properties.³⁹ Based on the current evidence we would suggest that walking is a pragmatic and effective way of introducing loading in the early stages after ankle ligament injury. However, it is not clear whether walking within the limits of pain is the best approach, and we cannot yet suggest an optimal 'walking dose'.

Study limitations

There are a small number of limitations in this study that should be addressed in further research. The cross-sectional design of the study means that it is not possible to determine if PA is a result of treatment, or if increases in PA speed up the healing process. Therefore, there is a need for further study involving repeated measurements over time to further

understand the relationship between recovery from acute musculoskeletal injury and PA. Also, within this study it was not possible to match individual injured participants with an age, gender, weight matched control, which in addition to the relatively small sample size, suggests that further research is required to elicit the generalisability of the findings.

The statistically significant difference in BMI between the standard and non-injured control group could explain some of the differences found between groups. However, this may be the result of a type I error due to the small sample size, and given the absolute difference in the means is not great (3.2 kg/m^2) and that all groups are within the normal-weight range, it is unlikely to have affected the outcome. Also, the main conclusion of this study, that PA levels are reduced in the first week after an ankle sprain, is not affected by this finding.

Finally, although in many medical and A&E departments it is considered the best practice to target the restoration of normal gait patterns with a walking aid, this is not the standard practice where this study was conducted. Therefore, the findings need to be confirmed in patients who use these aids following an acute ankle injury.

CONCLUSIONS

This is the first study to objectively examine walking patterns during the acute functional management of ankle sprain. Our results confirm that walking levels in the first week after ankle sprain are reduced compared with a non-injured control group. Injured participants undertook on average between 5600 and 7900 steps each day, during the first week of recovery. This was generally accumulated through a series of short walking bouts, at low step cadence. Longer walking bouts and more steps per day were observed when additional therapeutic exercises were incorporated.

These data provide an indication of typical mechanical loads associated with walking in early stages after ankle sprain. This represents the first step towards developing

What this study adds

- ▶ When advised to walk after an acute ankle sprain, participants undertook a reasonable amount of walking, and only slightly less than they might be normally be expected to do.
- ▶ Participants undertaking additional therapeutic exercises accumulated higher walking loads.
- ▶ It is not clear whether the walking patterns described maximise the physiological effects of mechanical loading.
- ▶ This study represents the first step towards developing evidence-based walking prescription after acute ankle sprain.

evidence-based walking prescription after acute ankle sprain. Additional research is required to refine exercise prescription so that it maximises the effects of mechano-transduction during recovery from soft tissue injury. Available technologies such as activity monitors, GPS (global positioning systems), gyroscopes and in-sole pressure devices should have particular application in this area of research.

Contributors MAT helped develop the protocol and was responsible for data handling during the trial and data analysis. CMB wrote the original protocol, secured funding, assisted in the treatment intervention during the trial and co-wrote the final manuscript. MAT and CMB co-wrote the final manuscript. SRO'C helped develop the protocol and was responsible for recruitment and treatment during the trial. SMD wrote the original protocol and secured funding. MAT, CMB, SRO'C and SMD assisted with the interpretation of results. All authors contributed to and approved the final version of this manuscript.

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Functional management of ankle sprains: what volume and intensity of walking is undertaken in the first week postinjury

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