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Comparison of multimodal physiotherapy and "R.I.C.E." self-treatment for early management of ankle sprains

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ABSTRACT

Current guidelines advocate the use of R.I.C.E., the acronym for Rest, Ice, Compression and Elevation, for patient self-management of soft tissue injury. The purpose of this study was to investigate the efficacy of R.I.C.E. applied as part of patient self-management compared (R.I.C.E.) to R.I.C.E. incorporated with multimodal physiotherapy management (Physiotherapy). A randomised control trial was carried out in a Physiotherapy Clinic. Twenty eight participants with an acute ankle sprain were randomised into either R.I.C.E. (n=12) or Physiotherapy (n=16) groups. Pain, function and swelling for acute ankle sprain patients were recorded on Days 1, 3, 7, and 11 post injury. Medication usage was also recorded. The main findings of the study were that pain and swelling reduced significantly and function improved significantly in both groups ($p < 0.05$); however, there were no significant differences between the groups ($p > 0.05$). Medication use was less in the physiotherapy group than the R.I.C.E. only group. In the acute setting, patient self management using R.I.C.E. is as effective as multimodal physiotherapy treatment in the management of the ankle sprain. Improvements in function scores and reductions in pain and ankle swelling were similar for both groups. These results are consistent with other studies that have investigated the use of R.I.C.E.

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Key Words: ankle sprain, R.I.C.E., physiotherapy

INTRODUCTION

Injuries to the ankle joint complex are one of the most common musculoskeletal and sporting injuries (Boyce et al 2005, Stasinopoulos 2004, Verhagen et al 2004). These injuries account for approximately 10% of all injuries treated in the casualty department (Accident Compensation Corporation 2003, Frey et al 1996, Lynch and Renstrom 1999). The incidence of ankle ligament sprains in the athletic population ranges from 11% to 20% (Accident Compensation Corporation 2003, Lynch and Renstrom 1999, Safran et al 1999). The lateral ligament is more commonly injured than the medial with inversion of the ankle the most common mechanism of injury. Injuries to the soft tissue structures around the ankle are a major cause of short term disability and pain; they often result in loss of function and can have long term consequences for returning to sport and work if not treated adequately.

The aims of management in the acute phase of treatment are firstly to rule out serious injury such as fracture. If no fractures are present most current guidelines advocate the use of R.I.C.E., the acronym for Rest, Ice, Compression and

Elevation. Rest is encouraged to prevent further tissue damage (Accident Compensation Corporation 2004b). Ice is thought to a) reduce nerve conduction, and/or b) reduce muscle spasm, and/or c) have an antinociceptive effect on the gate control mechanism (Bleakley et al 2006). Ice has also been shown to reduce blood flow, the inflammatory response, oedema production, haemorrhage, and pain sensitivity (Smith 2003). Compression is purported to increase the hydrostatic pressure of the interstitial fluid, counteracting some of the force that causes fluid to move out of the tissue following damage. Compression is hypothesised to stop bleeding, inhibit fluid seepage into underlying tissue spaces and help disperse fluid (oedema) thereby minimising the secondary damage to surrounding tissue that often occurs post injury (Rucinski et al 1991). Elevation of the affected limb utilises the influence of gravity and results in an increase in venous and lymphatic drainage (Tsang et al 2003), reduction in oedema (O'Brien et al 2005) and reduction of local bleeding (Wiger and Stuf 1998). Collectively these four elements are aimed at reducing the significance of the damage to the ligaments and soft tissues around the ankle and improving return to full function. Support for the use of ice comes from

two systematic reviews examining the effect of ice on soft tissue injuries in general and a Cochrane review that examined several treatment modalities for soft tissue injuries to the ankle. These reviews suggested that ice promotes a faster functional recovery (Hubbard et al 2004, Ogilvie-Harris and Gilbert 1995); less persistent pain, less persistent swelling and greater ankle range of motion (Bleakley et al 2004) when used in the acute phase for lateral ligament ankle sprains.

Physiotherapy, whilst utilising R.I.C.E. in the management of ankle sprain also includes a number of other treatment modalities including electrotherapy (ultrasound, Transcutaneous Electrical Nerve Stimulation (TENS), interferential therapy), taping, soft tissue therapies and functional treatments such as proprioception retraining, range of movement and strengthening, and gait re-education. A combination of treatment options (termed multimodal physiotherapy) is often used depending on the diagnoses, severity, clinician experience and patient choice (Larmer et al 2002). A recent Cochrane review of 21 trials involving 2184 participants found that functional treatment of acute ankle sprain in adult participants was of greater benefit than immobilisation of the injured part (Kerkhoffs et al 2002). While there are a number of studies that have investigated the effects of these individual modalities on ankle sprain there has been little research into the effects of R.I.C.E. alone compared to the incorporation of R.I.C.E. with multimodal physiotherapy to improve the functional return to activity following an acute ankle sprain.

The purpose of this study was to investigate the efficacy of R.I.C.E. applied as part of patient self-management compared to R.I.C.E. incorporated with multimodal physiotherapy management in improving function, pain and swelling outcomes up to Day 11 post injury for ankle sprains.

METHODS

Study design

A randomised control study design was used comparing R.I.C.E. versus R.I.C.E. incorporated with multimodal physiotherapy. The variables of interest were patients' ankle swelling, pain and function during the intervention period measured on days 1, 3, 7, and 11. Secondary variables were the amount of medication used and compliance with the programme during the 11 days. Figure 1 depicts the overall structure and randomisation process for the study.

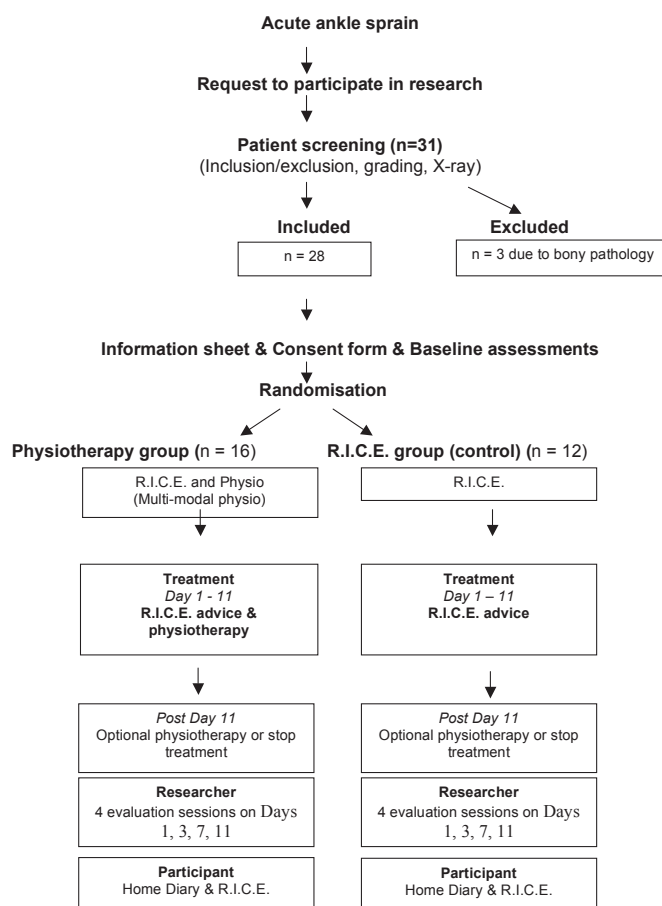
Participants

Male and female participants between the ages of 16 and 40 were recruited via advertisements and brochures placed around the local community. Participants had to have sustained an ankle sprain within the previous 48 hours. Participants also had to be geographically located close to the physiotherapy clinic providing the treatment. Participants were excluded if they had a previous sprain of the same ankle, sustained a fracture or other injury other than a soft tissue ankle injury, could not understand or speak English, withheld consent; or had a systemic disorder that interfered with normal healing timeframes.

Randomisation

A total of thirty one participants met the inclusion criteria and signed written consent forms for participation in the study. Participants were randomly allocated by sealed envelope to one of the two treatment groups: R.I.C.E. or Physiotherapy (See Figure 1).

Figure 1: Flow chart for the study of multimodal physiotherapy and R.I.C.E. (Physio) versus R.I.C.E.



Procedures

On the initial assessment all participants underwent a full subjective assessment and were screened for serious pathologies such as fractures (Stiell et al 1995), Achilles tendon pathology, ankle dislocation, and vascular or neurological damage. An initial grading of the severity of the sprain was given by the treating therapist using an adapted version of the West Point Ankle Grading System (Gerber et al 1998). Grading in the acute setting is difficult and not reliable (van Dijk 1999), therefore a final grading took place on Day 7 to ensure the provisional diagnosis at Day 1 was correct.

If no red flags or fractures were present, participants in both groups received a total of four ankle assessments on Days 1, 3, 7, and 11. At each of these assessments the participants' pain score was recorded, a group of questions regarding functional tasks were completed, and three foot and ankle volumetric measurements were taken. All participants were required to keep a diary and record the compliance with the programme and the amount and type of medication used during the trial. As patients could present at any time within the first 48 hours, post ankle sprain, the description of 'Day 1' refers to the day the participant presented, not necessarily Day 1 post injury. This was deemed the baseline measure once they had presented.

Treatments

The physiotherapy group received up to six treatments until Day 11 while the R.I.C.E. group received only the standard R.I.C.E. advice. After Day 11 both groups could have physiotherapy or stop treatment.

Participants received the same general advice about the R.I.C.E. treatment protocol: a pamphlet called "Managing your Sports Injury" (Accident Compensation Corporation 2002b); a 'Nexcare instant and re-usable' cold pack (3M Health Care, St Paul, USA CAT# 2642); and a crepe 75mm elastic compression bandage. It was recommended that the ice was applied for 10 minutes every two hours for the first 24-48 hours.

The physiotherapy group received 30 minutes of R.I.C.E. incorporated with multimodal physiotherapy treatment which was at the discretion of the treating therapist. This management was in line with the ACC Physiotherapy Profiles (Accident Compensation Corporation May 2000) and the ACC guidelines for the management of soft tissue ankle injuries (Accident Compensation Corporation 2002a). These include a combination of any of the following: palliative techniques (including strapping, therapeutic ultrasound, interferential therapy, TENS, and gentle manual traction of the joint), and functional rehabilitation, such as gait re-education, prescribed weight-bearing/non-weight bearing exercises and proprioceptive exercises.

Outcome measures

The following outcome measures were used:

- Pain was measured using a visual analogue scale (VAS) which has advantages over verbal rating scales and numerical scales in sensitivity to changes in pain intensity (Jamison et al 2002, Wewers and Lowe 1990).
- Functional ability was assessed via a questionnaire for ankle sprains adapted from the Lysholme knee injury questionnaire by de Bie et al. (1997). The five categories (pain, instability, weight bearing, swelling and gait pattern) contained choices the participant could identify that best illustrated their functional ability at the time the questionnaires are completed. Each functional category is allocated points, in such a way to illustrate their overall level of disability. The points are totalled; a score of thirty-five points correlates with the person being able to walk and a score of seventy-five points illustrates that the person can maintain a normal gait pattern in most circumstances. This questionnaire has been reported to have a sensitivity of 97% and a specificity of 100% for discriminating between light (<2 weeks) and severe (>2 weeks) ankle sprains (de Bie et al 1997).
- Swelling was assessed using volumetric measurement undertaken via the water displacement method. In an acute study of this nature the ability to detect changes in swelling is important and the volumetric method has been demonstrated to be valid for measuring the volume of the lower limbs (Brijker et al 2000, Petersen et al 1999, Tierney 1996). A volumetric tank custom made from 6mm thick Plexiglass (Modern signs (NZ) Ltd, Auckland, New Zealand), a recipient container, electronic scales (accuracy 0.01g, VIBRA-CG, Wedderburn scales Ltd, Auckland, New Zealand) and a mercury thermometer were used to measure swelling at the ankle. The accuracy of these materials used for volumetric analysis was quantified in an earlier study (Balasundaram 2006). To minimise diurnal variation of foot and ankle volume the participants were asked to present for five separate volumetric measurements at a similar time of day.
- Compliance to the programme was investigated by examination of the participants' diaries. Compliance was calculated as a percentage of the days they indicated they completed the programme compared to the total number of days in the trial.

- Medication use related to the ankle sprain was examined via participant diaries to see if there was any difference between groups on Day 1 and Day 11, given as a percentage of participants who used medication.

Statistical analyses

The outcome measures were analysed using a variety of methods. The demographics of the participants were analysed via descriptive statistics. Differences between groups on Day 1 and Day 11 were assessed using independent samples t-tests. A one-way within participants ANOVA was conducted with the factor being the days post injury and the dependant variable being the pain scores, or function scores. Repeated measures multivariate or univariate analyses were utilised where appropriate with the test of significance (Mauchly's Test) and the Huynh-Feldt correction procedure used where indicated.

The pain data were analysed using a repeated measures one-way ANOVA. Box's Test of Equality of Covariance Matrices was significant ($p = 0.014$) indicating that a Multivariate analysis was inappropriate, and thus a univariate analysis was used. The function data, analysed using Box's Test of Equality of Covariance Matrices, was non-significant ($p = 0.539$) thus a Multivariate analysis was appropriate. The Statistical Package for Social Sciences (SPSS) software package (version 15, SPSS Institute, Cary, NC, USA) was used and the alpha level was set at 0.05.

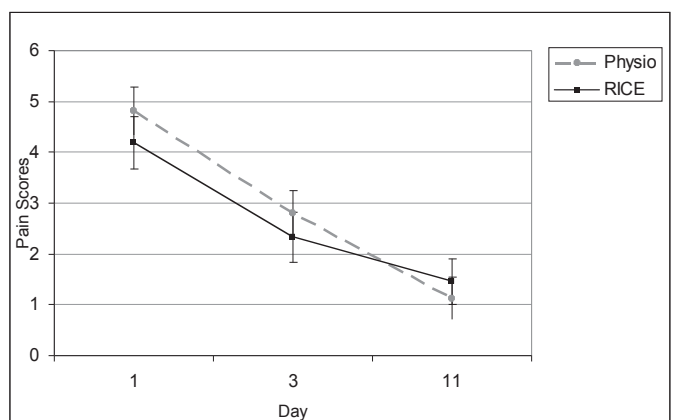
RESULTS

Of the 31 participants that were recruited three were excluded from the study because they were diagnosed with bony pathologies after x-ray screening. Final analysis was therefore conducted on 28 participants (R.I.C.E. $n=12$; Physiotherapy $n=16$).

Baseline characteristics

There were no significant differences between the R.I.C.E. group and Physiotherapy group on Day 1 in terms of perceived pain, swelling, age and time taken to present to physiotherapy (See Figures 2-4 and Table 1). However, the R.I.C.E. group were taking significantly more medication and had significantly higher functional scores at baseline than the physiotherapy group.

Figure 2: Visual Analogue Scale (VAS scores) for R.I.C.E. only and Physiotherapy and R.I.C.E. groups at Days 1, 3 and 11



Pain

Both groups' VAS scores reduced significantly over time ($p < 0.05$). There was no significant difference between the two groups over time (see Figure 2).

Figure 3: Function scores for R.I.C.E. only and Physiotherapy and R.I.C.E. groups at Days 1, 3 and 11.

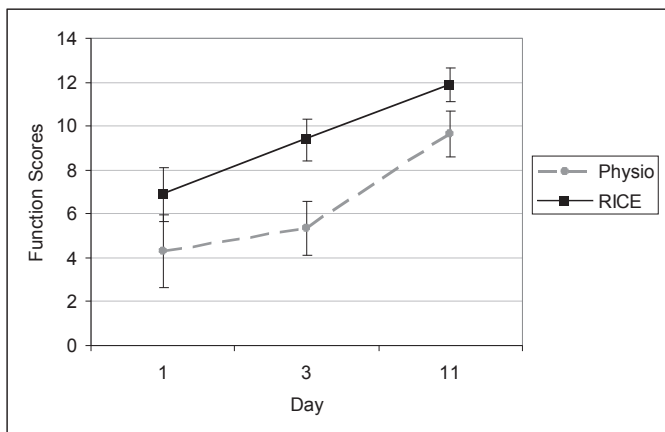
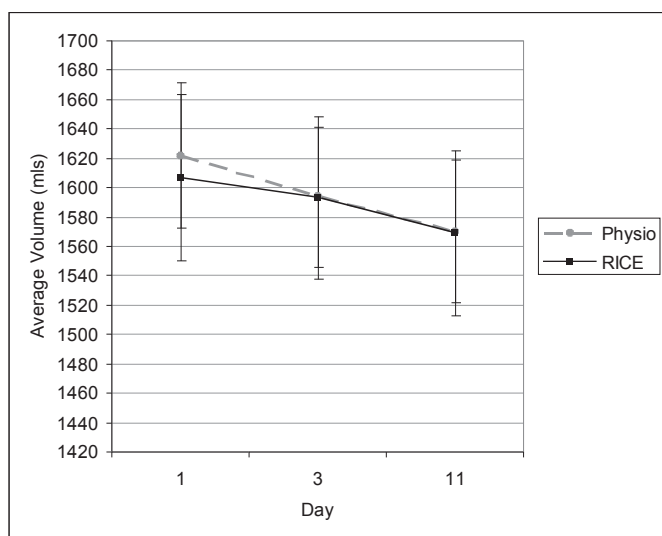


Figure 4: Volumetric measure for R.I.C.E. only and Physiotherapy and R.I.C.E. groups at Days 1, 3 and 11



Function

Both groups significantly improved in function over time ($p = 0.042$) from Day 1 to Day 11 (see Figure 3) with the R.I.C.E group showing significantly greater function at each of Days 1, 3 and 11 than the physiotherapy group. The ANOVA indicated a significant time and group effect ($p < 0.05$).

Swelling

Only 27 of the 28 participants completed all of the volumetric measurements (16 in the physiotherapy group and 11 in the R.I.C.E. group). A multivariate analysis was used to fill in the missing data as suggested by Tabachnick and Fidell (2007) when the missing data were less than the 5%. With respect to the swelling in the ankle, the lowest volume was observed on Day

3 for three participants, on Day 7 for three participants and Day 11 for six participants.

There was a significant effect for time ($p < 0.05$). The average volume of the foot and ankle significantly reduced from Day 1 to Day 11 for both groups ($p < 0.01$). There was no interaction effect observed between the two groups (see Figure 4).

Medication

An analysis of the participants' diaries indicated that all medications used by the participants were self prescribed. The number of participants taking medication reduced from Day 1 to Day 11 for both groups however, there were more participants reporting the use of medication in the R.I.C.E group compared with the physiotherapy group throughout the study. The R.I.C.E group used significantly more medication on Day's 1 and 11 compared to the physiotherapy group however there was no statistically significant difference at Day 3 (see Table 2).

Table 2: Number of participants using medication

Group	Day 1	Day 3	Day 11
R.I.C.E. and Physiotherapy	2	3	0
R.I.C.E. only	5	5	1
P value	0.035	0.222	0.048

Treatment prior to being assessed by physiotherapist

Prior to presenting for assessment and treatment, participants managed their injuries in different ways, from doing nothing (10.7%), to using one or more of the components of R.I.C.E. (85.7%), strapping and medication (see Table 3). Most participants used at least one part of the R.I.C.E. principles prior to seeing a physiotherapist, with 28.6% using all components of R.I.C.E.

X-rays and investigations

X-rays were conducted on nine out of the 28 participants (32.14%) as they presented with signs that suggested an investigation was appropriate using the Ottawa Ankle Rules (see Table 4). Out of the thirty-one participants investigated, three had a positive result for a bony pathology, excluding them from the study.

DISCUSSION

There are very few randomised controlled trials investigating the effectiveness of multimodal physiotherapy, even though this is the way that most physiotherapists manage ankle sprains. The main finding of the current study was that there was no significant difference in outcome 11 days post-acute injury between R.I.C.E. treatment and R.I.C.E. plus physiotherapy multimodal treatment. This is not surprising given the short time frame for the study of only 11 days. This finding is in keeping

Table 1: Means for demographic characteristics and comparison of outcome measures for the R.I.C.E only (R.I.C.E) and Physiotherapy and R.I.C.E. (Physio) groups at Day 1.

	R.I.C.E. (n=12)	Physio (n=16)	R.I.C.E cf Physio. (p value)	ALL participants (n=28)
Age (years)	30.1 (n=12)	25.5 (n=16)	0.65	27.5
Number of hours after injury presenting at clinic	28.3 (n=12)	28.9 (n=16)	0.65	28.6
Medication use (no. participants)	5 (n=12)	2 (n=16)	0.035	25%

Table 3: Treatment undertaken prior to seeing Physiotherapist

Treatment	Frequency (number of patients)	Percent
Compression	2	7.2
Ice	5	17.9
Ice Compression	3	10.7
Ice Elevation	1	3.6
Ice Strapping	1	3.6
Ice Voltaren	1	3.6
Nil	3	10.7
Rest Elevation	1	3.6
Rest Ice	1	3.6
RICE	8	28.6
RICE Crutches	1	3.6
Strapping	1	3.6
Total	28	100

Table 4: Investigations undertaken if appropriate using the Ottawa Ankle Rules

Investigations	Number of participants	Percentage of participants
X-ray	9	32.1
No X-ray	19	67.9
Total	28	100

with the management of other acute musculoskeletal conditions such as acute back pain with respect to early investigations to rule out red flags, the immediate benefits of pain relief and reassurance and resumption of usual activities (Accident Compensation Corporation 2004a).

One finding relevant to this study is the application of R.I.C.E. prior to commencing the study. Twenty nine percent of all participants used all four components of the R.I.C.E. regime and 85.72% of participants used at least one component of the regime prior to the initial assessment. This demonstrates that education of R.I.C.E., as an early management for ankle sprains, by health insurers such as Accident Compensation Corporation, who have endeavored to educate the public about early management of soft tissue injuries, appears to be understood. However this widespread application of the R.I.C.E. regime prior to entering the study may also have contributed to the similarity in results between the groups.

R.I.C.E. treatment

The results of the current study, although not solely an ice only intervention, can be compared to other studies that have investigated the use of ice in the management of ankle sprain (Bleakley et al 2006, Hocutt et al 1982, Laba and Roestenburg 1989). Bleakley et al (2006) conducted a randomised controlled trial comparing an intermittent ice protocol (where ice was applied for ten minutes, taken off for ten minutes, then reapplied for ten minutes), with a constant protocol where the ice was left *in situ* for twenty minutes with 89 subjects with acute ankle sprains. Both options were repeated every two hours for 72 hours post injury. The results indicated that the intermittent method was significantly more effective in reducing pain on activity in the first week than the constant method; however, both groups had improved to the same degree by

the second week. Laba and Roestenburg (1989) compared ice versus no ice in 30 subjects with an acute ankle sprain. Those in the ice group had 20 minutes of ice followed by standard physiotherapy treatment, where as the no ice group only received the physiotherapy treatment. Similar outcomes to the current study were used (pain swelling and return to function). Laba and Rostenburg's (1989) study indicated that by day 10 post-injury both groups had improved to the same degree with respect to key variables. Hocutt et al (1982) compared 15 minutes of ice 1-3 times a day versus a similar prescription of heat, either one hour after injury or 36 hours after injury in 37 subjects with an acute ankle sprain. Ice applied within the first hour was far more effective than the other strategies and allowed subjects to return to full function in 13 days compared to 30 days in the other groups. In summary all of these similar studies, including the current study, have demonstrated ice has a positive effect on both pain and function within the first two weeks of an acute ankle sprain.

Pain

One of the aims of early treatment is to reduce pain. However, there were no significant differences between the two groups over time in reducing pain scores. Mean pain scores for both groups combined were low in this study (Days 1, 3 and 11 respectively were 4.6, 2.6 and 1.3 out of ten), if scoring is based on previous studies where scores of below six out of ten are representative of moderate pain and below three out of ten represents low pain (Bleakley et al 2006).

Function

The significant improvement over time for functional outcomes for both groups was observed and expected due to the short duration of treatment (11 days). However, it is of interest that the R.I.C.E. only group had greater improvement in function than the Physiotherapy group over time. There are a number of possible reasons for this. Firstly, the R.I.C.E. group were functioning at a higher level at baseline than the Physiotherapy group (7.5/14 points versus 4/14 points respectively (see Figure 3) and continued to steadily improve over the 11 days). The Physiotherapy group however, appeared to make a more rapid improvement in function from Day 3 onwards.

Secondly, this result may demonstrate that in the acute setting physiotherapy is not routinely required to ensure functional improvement. This may suggest the question when is the best time to institute physiotherapy? Is treatment best applied from 10 days onwards once the acute effects of the injury have resolved and any residual functional deficits are more easily addressed?

A further explanation may have been that the randomisation process within the study resulted in more people with higher function in the R.I.C.E. group. Thus as these participants were higher functioning anyway they could capitalise on this and continued to improve, whereas the lower functioning participants ended up in the physiotherapy group and their improvement only started catching up 3 days post-injury. A future study to investigate for this effect is warranted.

In this paper we have presented the data up until Day 11 due to a large number of participants in the R.I.C.E. group requesting physiotherapy post this time period despite making good functional improvement. Participants expressed that they felt more treatment was required to get full resolution of the problem. This cross over would have contaminated the sample so the study was stopped at this point.

Swelling or volume change

Although it was expected that the lowest ankle volume would be on Day 11 for all participants, the ankle was at its smallest volume on Day 3 for three participants, one in the physiotherapy group and one in the R.I.C.E. group. There could be a number of reasons for these discrepant results. There has been shown to be a diurnal change in ankle volume, where the ankle is larger as the day progresses, perhaps due to gravity (Brijker et al 2000). Thus, all efforts were made to ensure that the measurements were done at the same time of the day for all five measurements. Secondly the vast majority of participants were sports people who were keen to return to sport. In two cases participants had re-aggravated their sprain slightly by returning to sport. Thirdly, the position and/or activity immediately prior to volumetric measurement can influence the volume of an injured ankle, for example if a participant has been sitting prior to the measurement being taken (Rucinski et al 1991). It has been shown that both elevation and elevation with compression treatment for thirty minutes reduces the ankle volume by $17.3 \text{ ml} \pm 4.1 \text{ ml}$ between the pre treatment measurement and post treatment measurement in participants with acute ankle sprains (Tsang et al 2003).

Medication

One of the interesting findings of this study was medication use. Whilst initially the physiotherapy group had higher mean pain scores, the R.I.C.E. group was taking more medication on Day 1 than the physiotherapy group as illustrated by their lower pain scores and higher functioning scores. Overall, the physiotherapy group required less medication than the R.I.C.E. group over time. It is well supported in the literature that alternative pain relief than medication may be of benefit to the patient in reducing acute pain (Bleakley et al 2008) which may reduce the chance of complications such as gastric intolerance or bleeding related to the use of nonsteroidal anti-inflammatory drugs (NSAIDs) medication (Calligaris et al 1993). Analysis of participants' diaries indicated that the common medications used were either analgesics such as Panadol® or NSAIDs such as Voltaren®. These drugs were either self prescribed or prescribed by a medical practitioner. The highest number of participants using medication was on Day 3 which may correspond to the peak of inflammation.

Ruling out serious pathology

Whilst it has been suggested above that physiotherapy may not be required in the acute setting, one of the benefits of consulting a physiotherapist is to gain an assessment as to the seriousness of the injury, to rule out red flags and provide reassurance about the prognosis. Over one third of the participants in the current study required screening and undertook X-ray examination to rule out a possible fracture. As a consequence of this screening three participants were eliminated from this study with fractures found on X-ray. This demonstrates that the initial screening undertaken by the physiotherapists using the ACC Ankle Guidelines and the Ottawa ankle rules are helpful at determining which patients may require X-ray investigation when presenting with an acute ankle sprain. This supports the use of clinical guidelines in helping health professionals make appropriate clinical decisions in the diagnosis of acute musculoskeletal conditions.

Limitations

As patients could present at any time point within the first 48 hours post ankle sprain, the decision to make 'Day 1' as the

day the participant presented for treatment, not necessarily the actual day the injury occurred, was a potential limitation. Had participants been able to present on the day of injury higher levels of pain and swelling may have been observed. Finally, being a pilot study, the small recruitment numbers within this study must be acknowledged.

CONCLUSION

This study demonstrated that there was no significant difference in outcome between using patient self management R.I.C.E. or R.I.C.E. plus multimodal physiotherapy treatment in the management of the acute ankle sprain. Both groups however had improvements in pain, functional scores and reductions in ankle swelling. The study indicates that those with acute ankle sprains can manage the condition as well as the physiotherapist in the first eleven days. The benefits of further therapy, and the amount and type of intervention required after the second week post injury are unknown and warrant further investigation. The ability to consult a physiotherapist to make the diagnosis, get the appropriate advice and ascertain the need of further investigations such as an X ray, are still useful parts of the initial management.

KEY POINTS

- In the acute setting, patient self management using R.I.C.E. is as effective as a combination of R.I.C.E and physiotherapy management in the treatment of an acute ankle sprain.
- Physiotherapists have an important role to play in the acute management of an ankle sprain by applying clinical guidelines to evaluate and screen for serious injury.
- R.I.C.E. has a positive effect on reducing pain and swelling and improving function in the acute management of an ankle sprain.
- Medication use was less in patients having physiotherapy for an acute ankle sprain indicating that physiotherapy may be useful as alternative form of pain relief.

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