BJSM Online First, published on August 17, 2015 as 10.1136/bjsports-2015-094935

Early functional rehabilitation or cast immobilisation for the postoperative management of acute Achilles tendon rupture? A meta-analysis of randomised controlled trials

R McCormack, J Bovard

Department of Orthopedic Surgery, University of British Columbia, New Westminster, British Columbia, Canada

Correspondence to
Dr Robert G McCormack, Department of Orthopedic Surgery, University of British Columbia, Suite 102-65 Richmond Street, New Westminster, BC, Canada V3L5P5; drbobmccormack@me.com

Accepted 17 July 2015

ABSTRACT

Objective To determine which postoperative rehabilitation regime is superior following surgical repair of acute Achilles tendon rupture. The primary outcomes were patient safety and satisfaction.

Design Intervention meta-analysis.

Data sources The MEDLINE and CINAHL electronic databases were searched from their date of inception until June 2015 using keywords related to acute Achilles tendon rupture, surgical repair and rehabilitation. The electronic database search was supplemented with forward citation tracking using the Web of Science.

Eligibility criteria Randomised controlled trials comparing clinical and/or patient-reported outcomes between patients receiving early functional postoperative ankle motion and weight bearing (bracing group), and traditional ankle immobilisation with a non-weight bearing rigid cast (cast group) were eligible for inclusion. Fourteen articles were identified as potentially eligible; 10 sufficient-quality randomised controlled trials involving 570 patients were included for meta-analysis.

Main results A high proportion of patients were able to return to prior employment and sporting activity in both groups. Five of the six trials measuring the time interval showed a faster return to prior sporting level in the bracing group. Subjective patient outcomes were significantly better in the bracing group (for good and excellent results, p=0.01; OR, 3.13; 95% CI 1.30 to 7.53). There was no difference in major complications between the two groups (p=0.21; RD, −0.03; 95% CI −0.06 to 0.01). Dynamometry and anthropometry measurements favoured functional rehabilitation at 6–12 weeks postoperation; however, by 6 months postoperative, the differences were negligible.

Conclusions Compared to traditional ankle immobilisation, with a non-weight bearing cast following surgical repair of acute Achilles tendon rupture, early dynamic functional rehabilitation is as safe with higher patient satisfaction.

Acute Achilles tendon rupture is a common injury, most frequently occurring during sporting activity and in males in their fourth and fifth decades.[1–5] The reported incidence ranges from 3 to 17 ruptures per 100 000 people per year, and this appears to be increasing.[2–9] Achilles tendon rupture can be managed conservatively or surgically, followed by 3–6 months of rehabilitation. Postoperative rehabilitation of must balance the risk of complications resulting from prolonged immobilisation (eg, adhesions and muscle atrophy) with the risk of tendon rerupture, due to early mobilisation and tendon loading.

Surgical management of acute Achilles tendon rupture has traditionally involved operative repair followed by a prolonged period of ankle immobilisation in a rigid cast, similar to closed treatment of fractures.[10 11] However, initial reports of early postoperative ankle motion and functional rehabilitation after acute Achilles tendon rupture repair did not demonstrate an increase in the rate of rerupture.[12 13] Subsequently, a number of randomised controlled trials (RCTs) have been performed comparing immobilisation to functional postoperative rehabilitation across a wide range of patient outcomes. Several studies found functional bracing produced favourable outcomes in terms of motor performance, anthropometrics and patient satisfaction.[14–24]

We present the results of a meta-analysis of RCTs comparing the two rehabilitation regimens following surgical repair of acute Achilles tendon rupture. The primary objective was to determine which is superior for postoperative management: early, functional mobilisation with weight bearing in a brace, or non-weight bearing immobilisation in a rigid cast? Outcomes considered were return to normal function, patient-reported outcomes, complication rates, muscle strength and anthropometrics.

METHODS

Data sources

A systematic literature search of peer-reviewed articles was performed to identify all RCTs comparing cast immobilisation and functional rehabilitation for the postoperative management of acute Achilles tendon rupture. Databases searched were CINAHL and MEDLINE (Ovid), which included EMBASE, BIOSIS, Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts and Reviews of Effects (DARE), the Cochrane Controlled Trials Register (CCTR) and the American College of Physicians (ACP) Journal Club. The keywords Achilles and ruptur* and surg* or operat* and mobili* or immobili* or cast* or rehab* or weight bearing were combined and results were limited to human RCTs, controlled clinical trials or clinical trials published in the English language (table 1). All databases were searched from their date of inception until June 2015, producing 113 articles from MEDLINE and 9 from CINAHL for a total of 114 unique articles. EndNote was used to combine results from different search engines, and cited reference searches of eligible RCTs were

To cite: McCormack R, Bovard J. *Br J Sports Med* Published Online First: [*please include* Day Month Year] doi:10.1136/bjsports-2015-094935

Table 1 Search queries and number of hits for each step

Search #	Query	MEDLINE	CINAHL
1	Achilles	27 350	2960
2	ruptur	319 135	12 456
3	surg	5 253 953	371 089
4	operat	2 411 237	91 666
5	3 or 4	6 576 349	414 642
6	1 and 2 and 5	3644	608
7	mobili	568 519	26 561
8	immobili	21	0
9	cast	67 152	7947
10	rehab	3056	125 715
11	weight-bearing	57 078	6188
12	7 or 8 or 9 or 10 or 11	687 415	160 037
13	6 and 12	878	190
14	Limit 13 to randomized controlled trials or controlled clinical trials or clinical trials	187	–
15	Limit 13 to Randomized controlled trials	–	10
16	Limit 14 and 15 to English language	165	10
17	Limit 16 to human trials	161	9
18	Removes duplicates from 17	113	–

performed using ISI Web of Science (figure 1). After removal of duplicates, both authors evaluated potentially eligible articles utilising the criteria outlined in the eligibility section below. Differences and grading were discussed and resolved by consensus. Data were extracted by two independent reviewers and reviewed by the senior author.

Eligibility criteria

Studies included were RCTs comparing rehabilitation regimes for patients with surgically repaired acute Achilles tendon rupture. Studies were excluded if they were non-Achilles tendon rupture; editorial, commentary, observation or non-randomised studies; trials comparing non-operative treatments; trials comparing operative techniques; trials comparing operative and non-operative treatments; trials not comparing immobilisation versus functional rehabilitation; or meta-analyses.

Two independent reviewers assessed the risk of bias in the included studies using Downs and Black's validated 27-item checklist.[25] This checklist assesses study quality, internal and external validity as well as bias. Studies had to meet a minimum total score of 19 for inclusion in the current meta-analysis.[25] Masking of trial findings was not possible, as this scale includes appraisal of statistical methods and adjustments. Individual authors were contacted for data clarification and further information when necessary.

Outcomes

Return to employment and sport activities, subjective patient satisfaction, and rate of major complications were evaluated using pooled statistical analysis. At both early and late follow-ups, muscle strength and anthropometrics were also evaluated in terms of ankle strength, muscle atrophy, ankle range of motion (ROM) and tendon elongation. These measurements were excluded from meta-analysis due to differences in trial methodology and data presentation.

Statistical analysis

Pooled statistical analysis was conducted using ReviewManager 5.3 (The Cochrane Collaboration),[26] and comparisons were made between patients who received early functional rehabilitation (bracing group) and patients who received immobilisation in a cast (casting group). Statistical heterogeneity was assessed using the I^2 statistic.[27] The statistical method, analysis model and summary statistics were determined by the type of data, amount of heterogeneity and number of events.[28] Dichotomous data were statistically analysed using the Mantel-Haenszel (M-H) method and continuous data with the inverse variance (IV) method. A fixed-effects model was used when heterogeneity was minimal or moderate (I^2=0–50%), whereas the random effects was used when there was substantial or considerable heterogeneity (I^2=50–100%).[28] The risk difference (RD) was reported when the number of events was low; otherwise, the OR was used. Mean difference (MD) was calculated for continuous data. The level of statistical significance taken was p=0.05 in each individual trial and in the present analysis. When SD was not available from published data or communication with authors, it was estimated from the range.[29] A normal distribution was assumed unless otherwise stated, and given median values were estimated as mean values.

RESULTS

Description of included studies

In total, 10 RCTs (11 articles) involving a total of 570 patients were included in the meta-analysis (table 2). The bracing group comprised 281 patients and the casting group, 289 patients. Two RCTs were excluded from the meta-analysis because they did not address the outcomes specified for the review.[30 31] Another RCT was excluded because the length of intervention in the functional rehabilitation group was 2 weeks.[32] Two similar trials by Maffulli *et al*[19 20] with overlapping inclusion dates were included, as the author confirmed that they involved separate patient populations. The same patient population from one RCT was analysed in two separate articles, and data from these patients were only included once in the meta-analysis.[18 22] No other potential sources of bias (including differing patient types, recruitment periods, patient compliance, or follow-up) between the groups were identified.

Included patients were at least 17 years of age and had a complete Achilles tendon rupture, while exclusion criteria were use of immunosuppressive therapy, reruptures and history of Achilles tendonitis. Within each trial, the proportions of men and women, and affected side were similar between the bracing and casting groups. The majority of injuries leading to the Achilles tendon rupture were sports-related, most frequently soccer or racquet sports.

All operations were performed within 14 days of the initial injury, and patients were allocated to bracing (weight-bearing and protected range of motion) or casting (immobilisation and non-weight bearing) using random envelope selections,[18 24] computer randomisation,[15 17 23] or day of presentation to services.[16 19 20] Tendon repairs were carried out using Kessler sutures, modified Kessler sutures, Bunnel sutures or an alternate 4-string suture technique. In three trials, dressings were applied on the day of[14 18] or the day following[17 21] surgery. A temporary rigid cast was applied to both groups in five trials for 7[15 16 24] and 14[19 20 23] days before start of functional movement in the bracing group.

The postoperative rehabilitation of patients who received bracing involved early mobilisation and weight bearing between 24 h and 2 weeks of surgery, either in a dynamic brace, rigid dorsal splint, removable cast boot or semirigid wrap. Patients who received casting were treated with a traditional non-weight bearing rigid cast or cast boot, and immobilised for 6 to 8 weeks postoperatively. All patients completed a course of physiotherapy following cast or brace removal.

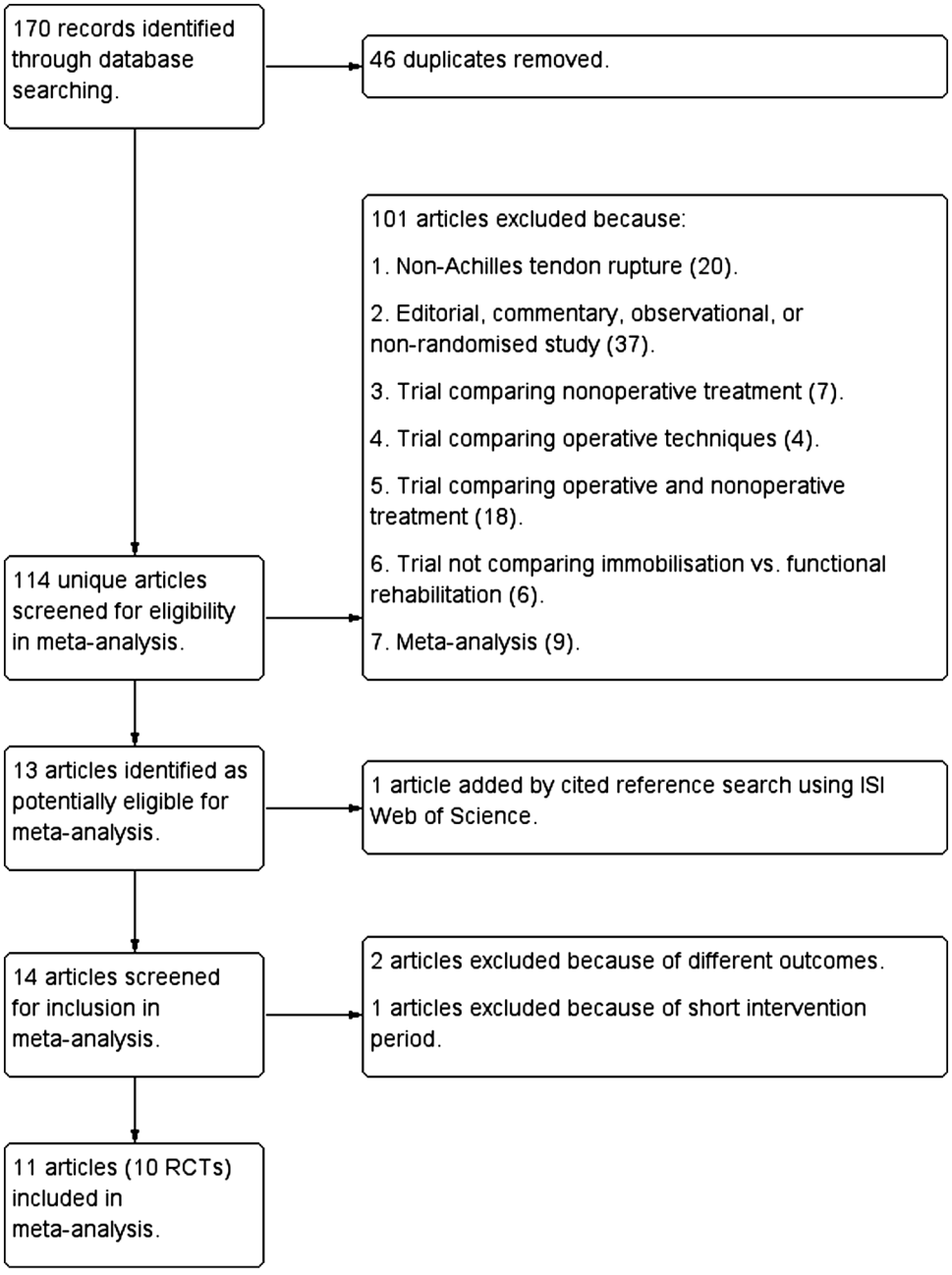

Figure 1 Literature search flow diagram.

Follow-up was defined as early (6 to 12 weeks postoperatively) and late (greater than 6 months). A total of 22 patients (3.9%) had incomplete follow-up data across all trials, and two patients were lost to follow-up before 12 weeks. In all trials, losses were stated to be equally representative of bracing and casting groups.

Return to employment and sport activities

Based on the results of six trials, pooled analysis (figures 2 and 3) demonstrated that almost all patients were able to return to normal employment duties during the follow-up period, with no difference between the two treatment groups (p=0.33; OR, 4.62; 95% CI 0.21 to 101.15). There was also no difference in the rate of return to prior sporting activity (p=0.44; OR, 1.23; 95% CI 0.73 to 2.06).

For time to resumption, the mean difference was 1.5 weeks shorter for return to prior employment and 2.4 weeks for prior sporting level; although these results were not statistically significant (p=0.23; MD, −1.53; 95% CI −4.02 to 0.95 and p=0.48; MD, −2.38; 95% CI −8.95 to 4.19, respectively). Moreover, differences in patient demographics and employment protocols generated considerable heterogeneity across the studies (I^2>80%). When analysing the studies individually, five of the six trials showed a faster return in the bracing group. Only the trial by Costa *et al*[21] did not favour bracing, although this may be explained by a higher proportion of manual jobs in the early motion group. The time to resume walking and stair climbing, which are unaffected by occupation, were also reported by Costa *et al*[21] and the bracing group had a significantly faster return to normal function (p=0.027 and p=0.023, respectively).

Patient-reported outcomes

Patient satisfaction was assessed in six trials using questionnaire results or multiple factor scoring systems (figure 4). The pooled

Table 2 Characteristics of each study

Primary author	Year	Demographics	Bracing	n	Casting	n	Follow-up (months)
Cetti[14]	1994	Mean 37 years (20–60) 50 M, 10 W	WB dorsal splint	30	NWB rigid cast	30	3, 6, 12
Mortensen[15]	1999	Median 39 years (20–73) 51 M, 20 F	WB dynamic brace	36	NWB rigid cast	35	1, 3, 4, 16*
Kerkhoffs[16]	2002	Mean 37 years (22–52) 32 M, 7 F	WB semi rigid wrap	16	NWB rigid cast	23	6.7 yrs*
Costa[17]	2003	Mean 41 years 24 M, 4 F	WB dynamic brace	13	NWB rigid equinus cast	13	1.5, 3, 6, 12
Kangas[18 22]	2003 2007	Mean 36 years (21–55) 46 M, 4 F	WB dorsal splint	25	NWB rigid cast	25	1, 2, 3, 6, 14*
Maffulli (a)[19]	2003	Mean 44 years (30–69) 45 M, 8 F	WB dorsal splint	26	NWB rigid equinus cast	27	1, 2, 3, 6
Maffulli (b)[20]	2003	Mean 44 years (30–69) 45 M, 8 F	WB neutral cast	25	NWB rigid equinus cast	28	3, 6
Costa[21]	2006	Mean 42 years (28–69) 40 M, 7 F	WB dynamic brace	23	NWB rigid cast	25	3, 6, 12
Suchak[23]	2008	Mean 39 years (SD 9) 93 M, 17 F	WB cast boot	55	NWB cast boot	55	1.5, 3, 6.5
Groetelaers[24]	2014	Median 43 years (19–65) 46 M, 14 F	WB dynamic brace	32	NWB fiberglass cast	28	1.5, 3, 6, 12

Number of patients is shown after exclusion of losses to follow-up. (WB, weight-bearing, NWB, non-weight-bearing).
*Median time of most recent follow-up.

results demonstrated that the bracing group had three times the odds of rating their satisfaction as 'good' or 'excellent' compared to the casting group (p=0.01; OR, 3.13; 95% CI 1.30 to 7.53).

In one trial, the RAND-36, was used to measure health-related quality of life at all follow-up visits.[23] At 6 weeks follow-up, the bracing group reported significantly better scores for the physical functioning, social functioning, vitality and role-emotional domains than the casting group. Fewer limitations in daily activities were reported by the bracing group at 6 weeks compared to the casting group.

Complications

Complications during the follow-up period were documented in all 10 trials, and were categorised as minor or major complications based on the criteria in table 3. There was no difference in the incidence of major complications (figure 5) between the two groups (p=0.21; RD, −0.03; 95% CI −0.06 to 0.01). Rerupture was an infrequent complication, occurring in fewer than 3% of patients in both groups. There was no difference in the number of reruptures between bracing (n=6) and casting (n=6) (p=0.98). Statistical analysis of minor complications was omitted due to disparities in the level of detail available in each article.

Dynamometry and anthropometrics

Nine trials included some form of serial anthropometric and dynamometry measurements during the follow-up period.[14 15 17–21 23 24] The methods of measurement,

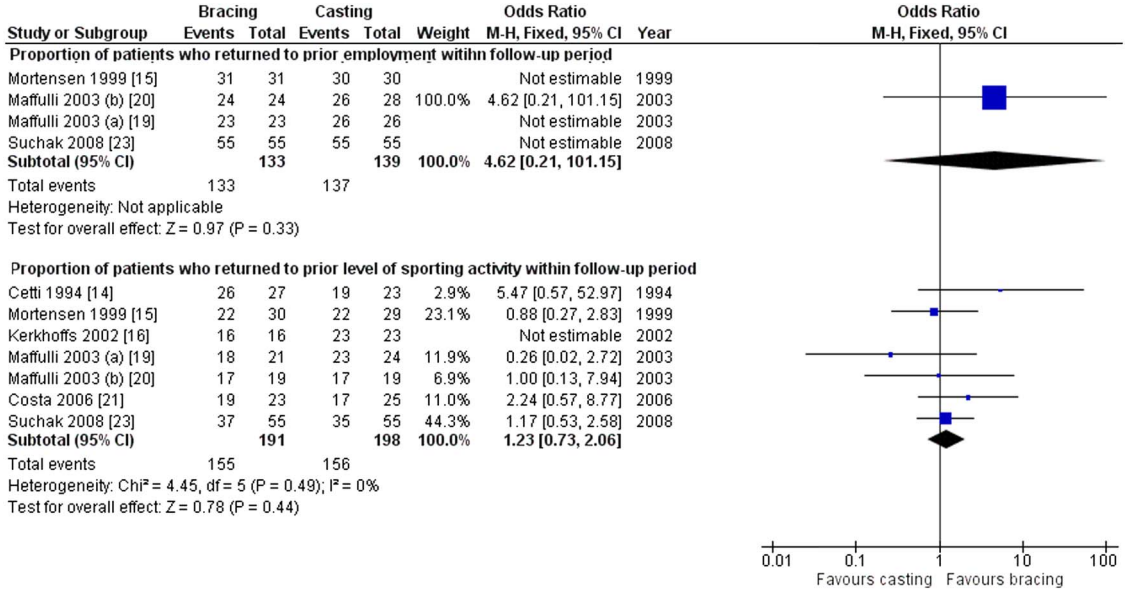

Figure 2 Annotated forest plot of fixed effects model showing the proportion of patients who resumed normal function during the follow-up period in terms of prior employment and sporting activity.

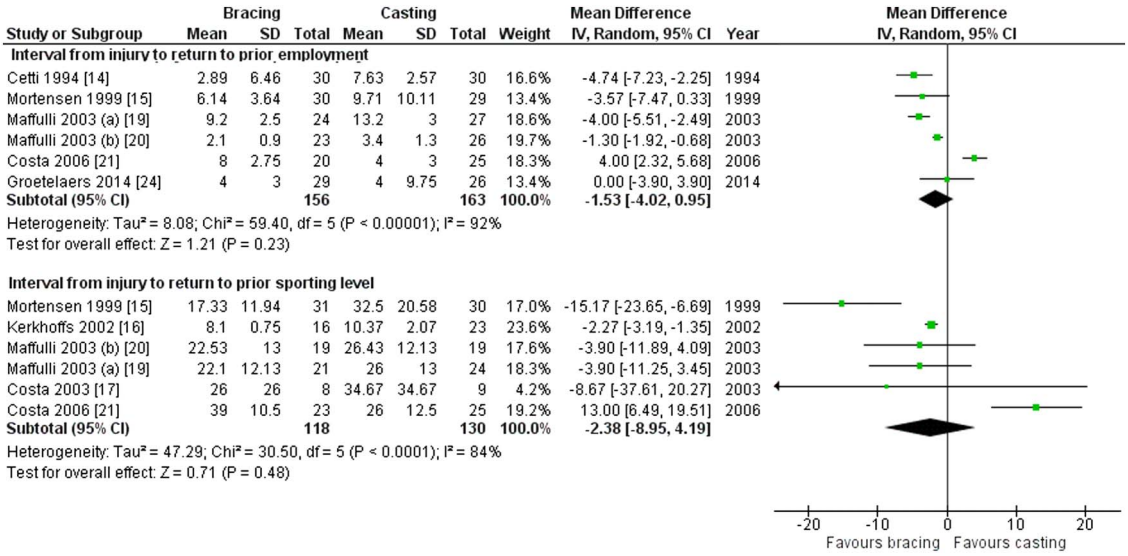

Figure 3 Annotated forest plot of random effects model showing the duration of rehabilitation in terms of interval to resumption of occupational and recreational activity.

comparisons and interval from injury to assessment were not standardised sufficiently for pooled analysis. The parameters measured included plantarflexion and dorsiflexion strength, degree of calf atrophy, ankle ROM and tendon length.

Strength Ankle plantarflexion and dorsiflexion strength was assessed by nine authors.[14 15 17–21 23 24] At early follow-up, ankle strength in the injured leg tended to be closer to normal for the bracing group than for patients in the casting group. Over time this difference diminished, and the overall mean deficit in strength was approximately equal in both groups by 6 months. Regarding late follow-up, Cetti *et al*[14] found that the mean deficit was significantly different between the injured and uninjured legs in both groups at 1 year, suggesting that a return to preinjury level of ankle strength does not occur within 1 year for patients in either group.

Calf atrophy: Six articles reported on the level of calf atrophy, and all noted a significant loss of muscle mass in the injured leg compared with the uninjured leg. Although there was little or no difference between the bracing and casting groups.[14 15 17 19–21]

Ankle range of motion: Five articles measured ROM either in terms of median loss of ROM or regaining normal ROM.[14 15 17 21 22] Similar to the change in strength over time, the between-group difference in ROM tended to favour bracing within the first year and diminished over time.

Tendon elongation: Tendon elongation was measured radiographically using intratendinous markers in three articles.[14 15 22] Radiopaque markers were implanted into the tendons of all patients at operation, and the distance separating these markers was measured successively using calibrated radiographs during the follow-up period. Mortensen *et al*[15] reported slightly more tendon elongation with early mobilisation after 12 weeks (p=0.20). However, Cetti *et al*[14] cited less elongation in the bracing group at all follow-ups and significantly lower tendon elongation after 1 year (p=0.0033). Long-term follow-up by Kangas *et al*[22] also found less tendon elongation in the bracing group at 60 weeks postoperative (p=0.054), and noted a significant correlation between less tendon elongation and a better clinical outcome (p=0.017). Although these trials could not be pooled statistically because of inconsistent data presentation, they provide no support for increased tendon elongation with early mobilisation.

DISCUSSION

We systematically reviewed two types of postsurgical rehabilitation of patients with acute Achilles tendon rupture. Studies were carefully assessed for methodological quality before inclusion. Randomisation methods used in three trials were suboptimal, but given the limited number and small size of available trials, we included otherwise high-quality trials that had low-quality

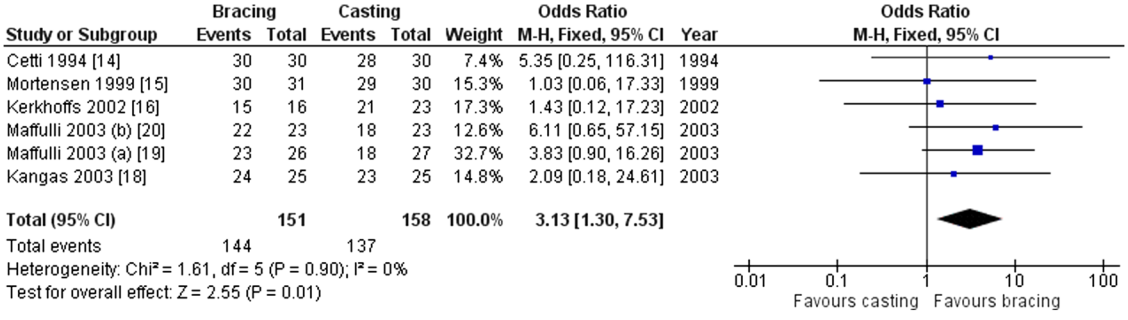

Figure 4 Annotated forest plot of fixed effects model to show the number of patients whose level of satisfaction at follow-up was good or excellent.

Table 3 Criteria used in the definition of major and minor complications

Major complications	Minor complications
Tendon rerupture	Muscle atrophy
Deep infection	Superficial infection
Tendon adhesions	Abnormal wound healing (eg, keloid)
Persistent functional/neurological deficit	Weakness/limited ROM
Thrombophlebitis/compartment syndrome	Minor (symptomatic) oedema
Wound slough	Scar adhesions

ROM, range of motion.

methods of randomisation.[16 19 20] All studies uses similar methods of perioperative care, time of randomisation and follow-up investigation. Trial populations were generally well matched for patient characteristics and presentation.

Five outcomes—including time to return to play, complications and patient satisfaction

All but one trial that assessed return to the preinjury level of function favoured bracing. Pooled analysis revealed no difference in time to return to preinjury employment (1.5 weeks) and sporting level (2.4 weeks) in the bracing group. We were not able to assess the impact of the duration, or type, of formal therapy on the patient activity. This is an important consideration that merits further research, particularly for high demand individuals.

In both groups, a high proportion of patients returned to their preinjury employment and sporting level during the follow-up period. Therefore, a more sensitive measure of the difference between the treatments may be the time taken to return. Another option would be to measure the time to resumption of normal walking. These may be a more valid measures of patient function, as they are unaffected by prior level of activity. Unfortunately, these measurements could not be adequately assessed in this review as many study protocols directed patients when to commence walking.

Muscle strength could not be evaluated by met-analysis as because of the considerable heterogeneity of methods used to assess it. Nevertheless, muscle strength, range of motion and tendon elongation all improved more rapidly in the group that used the brace postoperatively. Early tendon loading promotes collagen deposition and strengthens the healing tendon. This benefit appears to outweigh the theoretic disadvantage of greater strain placed on the Achilles tendon with early loading.[33] This tendon benefit was seen in the first year postoperatively. Over the long-term, the strength and anthropometric outcomes in both groups were similar. For all outcomes, the injured leg remained deficient compared to the uninjured leg during the follow-up period.

We report a trend towards a lower rate of major complications in the bracing group. There was no difference in the rerupture rate (both groups had six reruptures).These findings counter the concern about overloading the healing tendon which provided the rationale for postoperative cast immobilisation is.[9 34]

Patient satisfaction levels were higher for the bracing group in all trials assessing this outcome. This is arguably the most important outcome which likely integrates all of the outcomes reported above. Such higher level of patient satisfaction with early mobilisation regimes were surprising, as dynamic braces are lightweight and some models are removable. Moreover, early mobilisation protocols encouraged early weight-bearing, minimising patient disability. A validated, patient-oriented outcome measure confirmed a significantly higher health-related quality of life with early weight bearing.

Strengths and limitations

Compared to previous meta-analyses, the current analysis benefits from a greater pooled population and longer follow-up.[9 34] In addition, outcome measures such as time to return to normal activities have not been evaluated previously. Nevertheless, the quality of evidence from any meta-analysis is dependent on the quality of the component trials. Although the trials available to date included low follow-up losses and long follow-up periods, they featured small patient populations and non-standardised rehabilitation protocols. Nevertheless, we believe the results are generalisable. The Downs and Black assessment of study quality focuses on this issue and there are no identifiable sources of significant bias.

Summary

The benefits and convenience of bracing, without increased complication rates, has led to bracing for Achilles tendon rupture being a popular choice among both patients and physicians. Pooled analysis of randomised controlled trials shows higher patient satisfaction with no increase in complications. Thus, dynamic functional bracing may contribute to evidenced-based practice in the postoperative rehabilitation of acute Achilles tendon rupture.

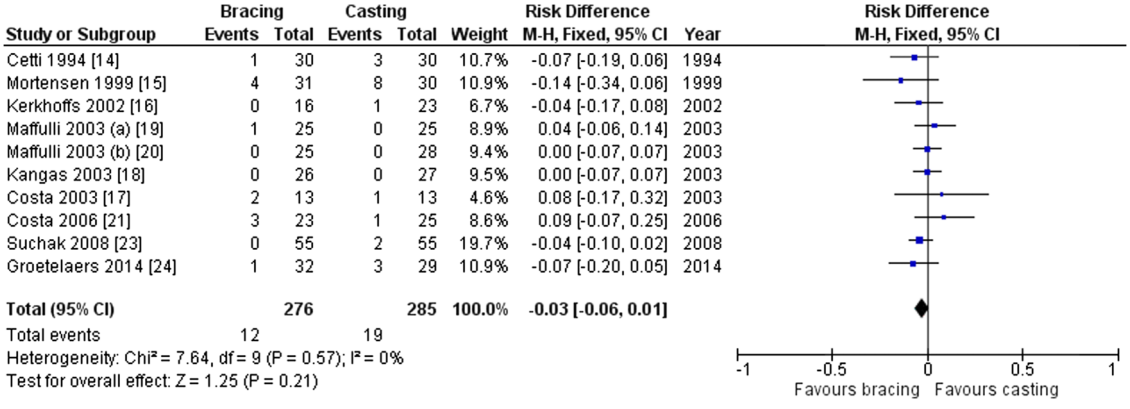

Figure 5 Annotated forest plot of fixed effects model to show the incidence of major complications occurring in patients from each intervention group during the follow-up period.

What are the new findings?

Compared to cast immobilisation, early functional rehabilitation after Achilles tendon repair

- is safe.
- results in higher patient satisfaction.
- leads to earlier return to function.

How might it impact clinical practice?

- It is safe to start functional rehabilitation early following Achilles tendon repair.
- Early functional rehabilitation can improve patient satisfaction and facilitate earlier return to activity following Achilles tendon repair.
- Postoperative immobilisation is not necessary or helpful.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Kujala UM, Sarna S, Kaprio J. Cumulative incidence of Achilles tendon rupture and tendinopathy in male former elite athletes. *Clin J Sport Med* 2005;15:133–5.
2 Houshian S, Tscherning T, Riegels-Nielsen P. The epidemiology of Achilles tendon rupture in a Danish county. *Injury* 1998;29:651–4.
3 Leppilahti J, Puranen J, Orava S. Incidence of Achilles tendon rupture. *Acta Orthop Scand* 1996;67:277–9.
4 Maffulli N, Waterston SW, Squair J, *et al*. Changing incidence of Achilles tendon rupture in Scotland, a 15-year study. *Clin J Sport Med* 1999;9:157–60.
5 Moller A, Astrom M, Westlin NE. Increasing incidence of Achilles tendon rupture. *Acta Orthop Scand* 1996;67:479–81.
6 Jarvinen M. Epidemiology of tendon injuries in sports. *Clin Sports Med* 1992;11:493–504.
7 Levi N. The incidence of Achilles tendon rupture in Copenhagen. *Injury* 1997;28:311–13.
8 Nyyssonen T, Luthje P. Achilles tendon ruptures in South-East Finland between 1986–1996, with special reference to epidemiology, complications of surgery and hospital costs. *Ann Chir Gynaecol* 2000;89:53–7.
9 Suchak AA, Bostick G, Reid D, *et al*. The incidence of Achilles tendon ruptures in Edmonton, Canada. *Foot Ankle Int* 2005;26:932–6.
10 Gulati V, Jaggard M, Al-Nammari SS, *et al*. Management of achilles tendon injury: a current concepts systematic review. *World J Orthop* 2015;6:380–6.
11 Lantto I, Heikkinen J, Flinkkila T, *et al*. Epidemiology of Achilles tendon ruptures: increasing incidence over a 33-year period. *Scan J Med Sci Sports* 2015;25:E133–8.
12 Solveborn SA, Moberg A. Immediate free ankle motion after surgical repair of acute Achilles tendon ruptures. *Am J Sports Med* 1994;22:607–10.
13 Troop RL, Losse GM, Lane JG, *et al*. Early motion after repair of Achilles tendon ruptures. *Foot Ankle Int* 1995;16:705–9.
14 Cetti R, Henriksen LO, Jacobsen KS. A new treatment of ruptured Achilles tendons: a prospective randomized study. *Clin Orthop Relat Res* 1994(308):155–65.
15 Mortensen NHM, Skov O, Jensen PE. Early motion of the ankle after operative treatment of a rupture of the Achilles tendon: a prospective, randomized clinical and radiographic study. *J Bone Joint Surg Am* 1999;81:983–90.
16 Kerkhoffs GMMJ, Struijs PAA, Raaymakers ELFB, *et al*. Functional treatment after surgical repair of acute Achilles tendon rupture: wrap vs walking cast. *Arch Orthop Trauma Surg* 2002;122:102–5.
17 Costa ML, Shepstone L, Darrah C, *et al*. Immediate full-weight-bearing mobilisation for repaired Achilles tendon ruptures: a pilot study. *Injury* 2003;34:874–6.
18 Kangas J, Pajala A, Siira P, *et al*. Early functional treatment versus early immobilization in tension of the musculotendinous unit after Achilles rupture repair: a prospective, randomized, clinical study. *J Trauma* 2003;54:1171–80.
19 Maffulli N, Tallon C, Wong J, *et al*. Early weightbearing and ankle mobilization after open repair of acute midsubstance tears of the Achilles tendon. *Am J Sports Med* 2003;31:692–700.
20 Maffulli N, Tallon C, Wong J, *et al*. No adverse effect of early weight bearing following open repair of acute tears of the Achilles tendon. *J Sports Med Phys Fitness* 2003;43:367–79.
21 Costa ML, MacMillan K, Halliday D, *et al*. Randomised controlled trials of immediate weight-bearing mobilisation for rupture of the tendo Achillis. *J Bone Joint Surg Br* 2006;88:69–77.
22 Kangas J, Pajala A, Ohtonen P, *et al*. Achilles tendon elongation after rupture repair: a randomized comparison of 2 postoperative regimens. *Am J Sports Med* 2007;35:59–64.
23 Suchak AA, Bostick GP, Beaupre LA, *et al*. The influence of early weight-bearing compared with non-weight-bearing after surgical repair of the Achilles tendon. *J Bone Joint Surg* 2008;90:1876–83.
24 Groetelaers RPTGC, Janssen L, Van Der Velden J, *et al*. Functional treatment or cast immobilization after minimally invasive repair of an acute Achilles tendon rupture: prospective, randomized trial. *Foot Ankle Int* 2014;35:771–8.
25 Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health* 1998;52:377–84.
26 Review Manager (RevMan) [Computer program]. Version 5.3. Copenhagen: The Nordic Cochrance Centre, The Cochrane Collaboration, 2014.
27 Higgins JPT, Thompson SG, Deeks JJ, *et al*. Measuring inconsistency in meta-analyses. *Br Med J* 2003;327:557–60.
28 Higgins JPT, Green S, eds. *Cochrane handbook for systematic reviews of interventions Version 5.1.0 [updated March 2011]*. The Cochrane Collaboration, 2011. http://www.cochrane-handbook.org
29 Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med Res Methodol* 2005;5:13.
30 Kauranen K, Kangas J, Leppilahti J. Recovering motor performance of the foot after Achilles rupture repair: a randomized clinical study about early functional treatment vs. early immobilization of Achilles tendon in tension. *Foot Ankle Int* 2002;23:600–5.
31 McNair P, Nordez A, Olds M, *et al*. Biomechanical properties of the plantar flexor muscle-tendon complex 6 months post-rupture of the Achilles tendon. *J Orthop Res* 2013;31:1469–74.
32 Saleh M, Marshall PD, Senior R, *et al*. The Sheffield splint for controlled early mobilisation after rupture of the calcaneal tendon. A propsective, randomised comparison with plaster treatment. *J Bone Joint Surg Br* 1992;74:206–9.
33 Stehno-Bittel L, Reddy GK, Gum S, *et al*. Biochemistry and biomechanics of healing tendon: part I. effects of rigid plaster casts and functional casts. *Med Sci Sports Exerc* 1998;30:788–93.
34 Khan RJK, Fick D, Keogh A, *et al*. Treatment of acute Achilles tendon ruptures: a meta-analysis of randomized, controlled trials. *J Bone Joint Surg Am* 2005;87:2202–10.

Early functional rehabilitation or cast immobilisation for the postoperative management of acute Achilles tendon rupture? A meta-analysis of randomised controlled trials

R McCormack and J Bovard

Br J Sports Med published online August 17, 2015