

# Eccentric Exercise Protocols for Patella Tendinopathy: Should we Really be Withdrawing Athletes from Sport? A Systematic Review

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**Abstract:** The 2007 review by Visnes and Bahr concluded that athletes with patella tendinopathy should be withdrawn from sport whilst engaging in eccentric exercise (EE) rehabilitation programs. However, deprivation of sport is associated with a number of negative psychological and physiological effects. Withdrawal from sport is therefore a decision that warrants due consideration of the risk/benefit ratio. The aim of this study was to determine whether sufficient evidence exists to warrant withdrawal of athletes from sport during an eccentric exercise rehabilitation program. A systematic review of the literature was performed to identify relevant randomised trials. Data was extracted to determine whether athletes were withdrawn from sport, what evidence was presented to support the chosen strategy and whether this affected the clinical outcome. Seven studies were included. None of these reported high quality evidence to support withdrawal. In addition, three studies were identified in which athletes were not withdrawn from sport and still benefited from EE. This review has demonstrated that there is no high quality evidence to support a strategy of withdrawal from sport in the management of patella tendinopathy.

**Keywords:** Eccentric exercises, jumper's knee, patella, rehabilitation, tendinopathy, sport withdrawal.

## INTRODUCTION

Patella tendinopathy is a common condition that affects athletes in a wide range of sports but is particularly associated with explosive jumping [1-3]. The prevalence is reported to be around 40-50% amongst elite volleyball players [4, 5]. The natural history of the condition is that of chronic pain and reduced function. This can severely limit or end an athletic career. Up to one third of patients will have significant pain and limitation at 6 months following the onset of symptoms and for the majority some level of symptoms will persist for many years [1, 6].

The pathophysiology of chronic tendinopathy is not fully understood. Numerous studies have demonstrated the absence of a significant inflammatory component and a variety of mechanical, vascular and neural theories have been proposed [7]. Cannell *et al.*, [8], suggested that this incomplete understanding of the underlying pathology limits our ability to establish effective treatment options. This is reflected in a wide range of different types of treatment used in the management of tendon disorders (non-steroidal anti-inflammatory medication, shock wave therapy, ultrasound, injection; including corticosteroid, platelet rich plasma, aprotinin and dextrose). Unfortunately, most of these have little evidence to support their use [7-10]. One of the most well studied interventions is the use of eccentric exercises (EE). These were proposed by Curwin and Stanish in 1984

[11]. They have become a popular treatment modality for patella tendinopathy and this is reflected in the number of trials that investigate their efficacy. Although most of these studies suggest that eccentric exercises are beneficial some authors have failed to show a benefit and this has prompted several review articles [12-14].

A review by Woodley *et al.*, [13], concluded that there was a dearth of high quality research in support of the clinical effectiveness of EE over other treatments and that further adequately powered studies that include adequate randomisation procedures, standardised outcome measures and long term follow-up were required. A more recent systematic review by Visnes and Bahr (2007) [12], was more supportive of the use of EE and concluded that most investigators had shown benefit but due to heterogeneity between studies their ability to recommend a specific protocol was limited. Despite this they suggested that based on the results of their review EE should be performed on a decline board, with some level of discomfort and that athletes should be withdrawn from sport.

Most recent studies have used a decline protocol because it has been shown that using a 25 degree decline board allows a greater load through the tendon and smaller knee and hip stop angles compared to standard EE [15]. Only one randomised study has specifically compared concentric and decline protocols and this showed increased benefit associated with the latter [16]. However other areas of ambiguity include whether exercises should be performed quickly or slowly, through pain and how frequently. These

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areas have been the focus of several other studies and are not considered further here [14].

The aim of this study was to determine whether sufficient evidence exists to support the conclusions of the 2007 review by Visnes and Bahr, which advocated withdrawal of athletes from sport during eccentric exercise rehabilitation. Withdrawing an athlete from sport can have significant psychological, physiological and financial implications [17-19]. Withdrawal from sport in order to facilitate rehabilitation for tendinopathy is therefore a decision that warrants due consideration of the risk/benefit ratio for this intervention. In the absence of controlled trials it is important to establish the evidence base for this particular issue by means of systematic review.

## METHODS

Three independent reviewers separately completed a literature search. This was performed twice by each reviewer to ensure accuracy. The initial search was performed on the 10<sup>th</sup> of June 2011, and it was repeated on the 21<sup>st</sup> of June 2011 to ensure accuracy. The search strategy was applied to PubMed, Medline, PEDRO and Cochrane databases. The search terms included “patella tendinopathy”, “jumper’s knee” and “eccentric”. Randomised trials published in the English language investigating the role of eccentric exercises for treatment of symptomatic patella tendinopathy were included.

Studies were appraised by two independent reviewers using the Jadad scale. This is a critical appraisal tool that was designed to allow assessment of the methodological quality of a randomised trial [20]. If there was any disagreement between the authors in assigning a score to each paper appraised, a third independent reviewer made the final decision.

Data were extracted to determine the efficacy of the outcome, the EE protocol used and whether athletes were withdrawn from sport and what evidence was presented to support this philosophy.

## RESULTS

A total of nine eligible RCT’s were identified and included in the study [8, 16, 21-27]. In two of the studies it was not possible to determine if athletes were withdrawn from sport or not as no specific comment was made by the authors regarding this issue [26, 27]. These studies were excluded from further analyses. Basic characteristics of studies including whether athletes were prevented from participating in sports is presented in Table 1. The Jadad score attributed to each study is reported in Table 2.

In three studies athletes were withdrawn from sport [16, 21, 22] Frohm *et al.*, [21], compared bilateral eccentric overload training (Brosman device) with unilateral eccentric body load training using a decline board in a twice weekly 3 month program in 20 athletes with patella tendinopathy. Athletes were withdrawn from participating in sports and other training activities for the first 6 weeks of the intervention. However, no evidence was presented to support this philosophy. When athletes resumed sport in the second 6 weeks this was guided by Thomee’s pain monitoring model in order to keep pain < 5 on a 10 point scale. Both groups

improved significantly at 12 weeks with respect to VISA-P score. This study scored 3 out of 5 on the Jadad Scale.

Bahr *et al.*, [22], compared a decline eccentric training program against surgery in 35 recreational athletes (40 knees). Patients were withdrawn from sports specific training for the first 8 weeks. After 4 weeks they were allowed to cycle and jog on a flat surface if pain free. No evidence was presented to support this rationale but it is likely that such a methodology was chosen to standardize the rehabilitation with those patients in the surgery arm of the trial. Despite withdrawal from sport 5 knees (25%) failed EE and went on to surgery, 7 made a full recovery, and 8 had some improvement but were still symptomatic at 12 months. The authors concluded that there was no advantage of surgery over eccentric exercises and that EE should be tried for 12 weeks prior to surgery.

Jonsson *et al.*, [16], compared EE on a decline board against concentric exercises in 15 recreational athletes (19 knees). They withdrew athletes from sport for the first 6 weeks of treatment. The rationale for this was based on the promising results reported by Purdam *et al.*, [28], who also withdrew athletes from sport. The study by Jonsson *et al.*, [16], showed EE to be beneficial in reducing pain and improving VISA at a mean follow up of 33 months. None of the patients in the concentric group were satisfied and all required additional treatment with injection or surgery. This study scored 2 out of 5 points on the Jadad scale.

Four studies did not withdraw athletes from sport [8, 23-25] three of the studies that did not withdraw athletes from sport showed a benefit of eccentric exercises [8, 23, 24], and only one did not [25].

Kongsgaard *et al.*, [23], compared ultrasound guided peri-tendinous steroid injection (n=13), EE (n=13) and heavy slow resistance exercises (HSR) (n=13) in recreational male athletes with chronic patella tendinopathy. Patients were allowed to continue with participation in sport provided the VAS score remained below 30. The rationale for this was that Silbernagel *et al.*, [29], had demonstrated successful results of EE in Achilles tendinopathy when a leisure time pain threshold of 50 was applied. The VISA-P score improved significantly in all three groups at 12 weeks. At 6 months improvement was maintained in the exercise groups. Although the small numbers precluded comparison between the groups there was a trend towards better outcome in the HSR group compared to the EE group with respect to VISA-P, collagen concentration and patient satisfaction. At 6 months only nine out of 12 subjects in the EE group completed the follow up questionnaires. Of those only two (22% of responders) were satisfied compared to eight (73% of responders) in the HSR group. This study scored 3 out of 5 on the Jadad scale

Young *et al.*, [24], compared EE with a decline board against a traditional EE (non-decline) protocol in 17 elite volleyball players. They did not withdraw athletes from sport, as the purpose of the study was to investigate the efficacy of these treatment modalities during a competitive season. Both groups had a significant improvement in VISA and VAS scores at 12 weeks and 12 months. The authors concluded that clinicians could confidently use these protocols to positively affect pain and the ability to play

**Table 1. Basic Characteristics for Included Studies**

Study ID	Population	Intervention	Withdrawn from Sport	Evidence
<b>Cannell 2001 [8]</b>	Athletes n = 19	EE (drop squats, 3 sets x 20 reps, 5x per week) (n = 10) vs CE (leg curls/extensions, 3 sets x 10 reps, 5x per week) (n = 9) 12 week intervention period	No	No evidence provided
<b>Jonsson 2005 [16]</b>	Recreational Athletes n = 19	EE (decline squats 25°, 3 sets x 15 reps, twice daily) (n = 10) vs CE (decline squats 25°, 3 sets x 15 reps, twice daily) (n = 9) 12 week intervention period	Yes – for first 6 weeks	Decision to withdraw athletes from sport in this study based on results of series published by Purdam <i>et al.</i> , [28]
<b>Visnes 2005 [25]</b>	Elite Athletes n = 29	EE (decline squats 25°, 3 sets x 15 reps, twice daily) (n = 13) vs No intervention (n = 16) 12 week intervention period	No	No evidence provided
<b>Young 2005 [24]</b>	Athletes n = 17	EE (decline squats 25°, 3 sets x 15 reps twice daily) (n = 9) vs EE (onto a step, 3 sets x 15 reps twice daily) (n = 8) 12 week intervention period	No	No evidence provided
<b>Bahr 2006 [22]</b>	Recreational Athletes n = 40	EE (decline squats 25°, 3 sets x 15 reps, twice daily) (n = 20) vs Surgery (wedge excision, rehabilitation) (n = 20) 8 week intervention period	Yes – for first 4 weeks	No evidence provided
<b>Frohm 2007 [21]</b>	Athletes n = 20	EE (Brosman device, 4 sets x 4 reps, twice weekly) (n = 11) vs EE (decline squats 25°, 3 sets x 15 reps, twice daily) (n = 9) 12 week intervention period	Yes – for first 6 weeks	No evidence provided
<b>Kongsgaard 2009 [23]</b>	Recreational Athletes n = 39	Peritendinous corticosteroid injections (n = 13) vs EE (decline squats 25°, 3 sets x 15 reps, twice daily) (n = 13) vs HSR training (4 sets, 6-15 reps, 3x per week) (n = 13) 12 week intervention period	No	Patients allowed to continue sport during EE intervention, based on the study by Silbernagel <i>et al.</i> , [29]. This showed good results in patients with Achilles tendinopathy who continued sport provided VAS score < 50 during activity

EE = Eccentric Exercises, CE = Concentric Exercises, HSR = Heavy slow resistance training.

**Table 2. Jadad Scores**

Study ID	Was the Study Described as Random?	Was the Randomisation Scheme Described and Appropriate?	Was the Study Described as Being Double-Blind?	Were Both the Patient and Assessor Double Blinded?	Description of Dropouts and Withdrawals?	Total Score (1-5/5)
<b>Cannell 2001 [28]</b>	1	1	0	0	1	3
<b>Jonsson 2005 [16]</b>	1	0	0	0	1	2
<b>Visnes 2005 [25]</b>	1	1	0	0	1	3
<b>Young 2005 [24]</b>	1	1	0	0	1	3
<b>Bahr 2006 [22]</b>	1	1	0	0	1	3
<b>Frohm 2007 [21]</b>	1	1	0	0	1	3
<b>Kongsgaard 2009 [23]</b>	1	1	0	0	1	3

sport stating a 94% likelihood of achieving the smallest improvement of 20 points on the VISA scale at 12 months with the decline protocol.

Cannell *et al.*, [8], compared the efficacy of drop squats against leg extensions in 19 athletes. They did not withdraw

athletes from sport but instead allowed them to participate provided their initial symptoms were relieved. Compliance was good and all participants completed at least 55 out of 60 sessions. Both groups were associated with significant pain reduction by 12 weeks. In the EE group nine out of ten

athletes had been able to return to sport by that time. No long-term outcomes were reported.

Visnes *et al.*, [25], investigated the EE protocol versus no special treatment in a group of 31 elite volleyball players. EE were prescribed to be completed twice a day, into pain if necessary (provided it was not disabling). EE were performed to beyond 90 degrees of knee flexion on a 25 degree decline board. Compliance in this group was 8.2+/-4.6 sessions of the 14 per week. The authors found no benefit with respect to the VISA score in either the EE group (pre 71.1, post 70.2) or the control group (76.4, post 75.4) at 6 weeks or 6 months. They concluded that there was no benefit to an EE program without removing the athlete from regular training and competition.

## DISCUSSION

Withdrawing athletes from sport can have serious potential consequences. Several authors have reported that deprivation of sport may result in symptoms of psychological distress including depression, anxiety, confusion, mood disturbance and low self-esteem [17-19]. Withdrawal from sport also results in de-training of physiology and sports specific skills [18]. Furthermore it can have implications for the individual concerned with regards to securing a contract for the following season, team selection and success of the squad as a whole. It is therefore a decision that warrants due consideration of the evidence for the risk/benefit ratio of the intervention.

All of the authors of the studies that withdrew athletes from sport concluded EE to be a useful treatment modality [16, 21, 22]. However, one of the studies only reported outcome up to 12 weeks [21]. This is an important point because withdrawing athletes from sport for this duration could in itself result in some improvement in symptoms and outcomes should have been reassessed following return to normal training and competition. Despite the conclusions of the respective authors stating that EE exercises were useful, there were some failures of treatment. In the study by Bahr *et al.*, [22], only 35% of patients in the EE group made a full recovery and 25% went on to have surgery, with the remainder improving but remaining symptomatic. Only one paper [16] cited a reason for withdrawing athletes from sport and that was based on the work of Purdam *et al.*, [28].

Purdam *et al.*, [28], conducted a study in which they withdrew athletes from their competitive sporting activity for the first 8 weeks of the study period. After 4 weeks they were allowed to perform water based activities, cycling and jogging on a flat surface if these could be performed without sharp pain. They did not present any evidence to support their philosophy of withdrawal from sport and the study did not contain a group which did not withdraw athletes. In addition this was a non-randomised study and therefore subject to allocation bias and confounding. Furthermore, despite withdrawal from sport only seven out of 17 patients were able to return to their chosen activity after treatment. This study therefore provides no good evidence to support withdrawing athletes from sport.

In those studies where athletes were not withdrawn, all except the study by Visnes demonstrated efficacy of EE [8, 23, 24]. Visnes *et al.*, [25], concluded that there was no benefit to an EE program without removing the athlete from

regular training and competition. However, the other three studies all allowed continued competition and still reported a benefit. There are several possible explanations for this. The

first is that compliance varied between the studies and was the lowest in the study by Visnes *et al.*, (Visnes 58%, Cannell 92%, Young 72%, Kongsgaard 89%) [8, 23-25]. It may be that a greater degree of compliance is required to elicit a treatment effect. Another potential explanation is that in the study by Visnes the mean pre-intervention VISA score was 71, whereas in the two studies reporting this outcome measure that did not withdraw athletes the pre-intervention values were lower (Kongsgaard 53, Young 61) [23-25]. It is unsurprising that in less severe cases of patella tendinopathy the benefit seen from treatment is less significant.

Further evidence to support continued participation in sport comes from a study by Silbernagel *et al.*, [29]. This RCT showed that there was no evidence of negative effects on the outcome of treatment with EE from continuing tendon-loading activity, such as running and jumping, with the use of a pain-monitoring model, during treatment. However it should be noted that this study considered the Achilles tendon and further study is therefore required to confirm this finding for patella tendinopathy.

The limitations of this review include the generally low quality of the literature on this topic. None of the included studies had a Jadad score higher than 3 out of 5 [20]. This concurs with comments in previous reviews with respect to poor study design and inadequate reporting of outcome. Additional concerns included short periods of follow up and small study populations. The majority of studies did not present sample size calculations and were undoubtedly underpowered. Furthermore, considerable heterogeneity between studies with respect to inclusion criteria, duration of follow up, EE protocol and outcome measures used precluded any attempt at amalgamation of results and further analyses. However, accepting these limitations does not change the fact that there remains no high quality evidence to support withdrawal from sport.

## CONCLUSIONS

This review has been unable to identify any evidence to support withdrawing athletes from sport when engaging in an EE rehabilitation program in treating patella tendinopathy. Universally good outcome was not reported in those studies that did withdraw athletes. It is likely that the only study that failed to show a benefit associated with EE did so, not because of failure to remove athletes from training and competition, but due to poor compliance and generally milder symptoms with less potential for large increases in the VISA score. In contrast, this review has identified three studies in which athletes continued to participate in sport and benefited from an EE protocol [8, 23, 24]. Furthermore, evidence from an RCT studying Achilles tendinopathy suggests no detriment to the outcome of treatment with EE if athletes continue to participate in sport [29].

We conclude that there is no evidence to support a strategy of withdrawal in the management of patella tendinopathy with an eccentric exercise protocol. Several studies have shown benefit with EE training despite

continued sports participation. Unnecessary withdrawal from sport has recognised significant adverse effects.

### CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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