

Letter to the Editor

Dear Editor:

I read with great interest the recent report by Fredberg et al focusing on the potential preventive effects of a training program among Danish elite soccer players ("Prophylactic Training in Asymptomatic Soccer Players With Ultrasonographic Abnormalities in Achilles and Patellar Tendons. The Danish Super League Study," March 2008, pages 451-460). Given the impact of soccer-related overuse injuries both from the health perspective of the professional soccer player as well as for the club, from a financial perspective, injury prevention appears a reasonable goal to achieve. I appreciate reading the study and would like to comment on some issues raised by the authors.

Fredberg et al reported the successful use of conventional gray-scale serial ultrasound examinations of the Achilles and the patellar tendon with a 7.5-Hz linear transducer. The classification of a healthy, in contrast to a sonographically abnormal, tendon was achieved by measuring the tendon diameter as well as by detection of structural abnormalities such as hypoechogenic texture. However, at least I could not identify the tendon diameter cutoff level used in this study by Fredberg and coworkers. Since there is accumulating evidence that an Achilles tendon diameter >6 mm might be abnormal,^{2,4} I would appreciate if the authors could elaborate on this issue. However, one has to take into account that mere tendon diameter itself does not necessarily correlate with the development of tendon symptoms in the course. Power Doppler sonography with identification of potential neovascularization in the tendon area might be one further surrogate; however, the current published correlation data to pain at rest are not conclusive.³ In a study by Richards et al,⁶ morphologically abnormal adult Achilles tendons were larger than 5.9 mm, and Power Doppler flow was only seen in Achilles tendons above 6.5 mm. However, they found no significant linear Pearson's correlation between the number of microvessels on Power Doppler and the duration of symptoms in Achilles tendinopathy ($r = 0.25$, $P = .11$) for symptomatic tendons among 52 patients with 55 symptomatic tendons. Given the fact that Dynamic ultrasound and color Doppler examination have shown that the flow in the neovessels stops during dorsiflexion in the ankle joint, the use of additional Doppler to assess, for example, the effect of eccentric training, cannot be underestimated in my personal view.

Fredberg et al reported that among "players with major injuries that necessitated rest for more than 28 days, reinjuries were responsible in only 14% of the players with Achilles tendinopathy and 7% of players with jumper's knee." However, there is currently no mention of the specific tendon therapy applied in either Achilles or patellar tendinopathy among the professional soccer players

other than rest. I would thank the authors for being more specific in terms of therapeutic applications performed for those soccer players.

An important question raised by the paper is why the applied preventive program failed. Fredberg and colleagues pointed out that they took care to provide a "short training program (less than 10 minutes) throughout the season 3 times weekly." I agree that every further training intervention, especially in soccer players, needs convincing arguments for both the players and the team coach, and time is a critical factor in this regard, which holds true for proprioceptive training as well. Fredberg et al presented a modified training program. The Achilles tendon is loaded eccentrically 25 times with bent leg and 25 times with straight leg on each side. Three times weekly were scheduled, which related to 150 scheduled repetitions per leg each week. As pointed out in the discussion, the soccer players were not able to follow these instructions, although reasonable information was provided, so compliance is an issue in this regard. A total of 2.25 times per week was the realistic number the eccentric training was performed. Given this limitation, 113 repetitions per week were performed during 42 weeks, if I follow the timetable of events correctly, which relates to 4746 repetitions during the season.

Hakan Alfredson reported his patients were instructed to do their eccentric exercises with bent and straight leg with 3×15 repetitions each, 2 times daily, 7 days per week, for 12 weeks.¹ This correlates to 1260 repetitions per leg per week and 15 120 for 12 weeks, which is the usual time frame. Given the fact that ankle dorsiflexion limits the blood flow in the neovessels,⁵ it is tempted to speculate that the reasonably good results of eccentric training in midportion Achilles tendinopathy might be at least mediated or influenced by the intermittent disruption of the blood flow in the tiny neovessels. Taking this into account, the number of repetitions per day resulting in a temporal disruption of the blood flow might well be correlated to the effectiveness of any eccentric training intervention. Comparing the total number of repetitions in Fredberg et al's study (4746 repetitions per leg for 42 weeks) with Alfredson et al's original data (15 120 repetitions per leg for 12 weeks), the discrepancy of the effectiveness of the eccentric training at the Achilles tendon level might be suggested. In other words, the dosage of the eccentric training intervention in Fredberg et al's study might be too low for the 42 weeks; a more intense training might have led to more favorable results in a clinical setting. I would appreciate if the authors could comment on this idea in much more detail as well as for the discrepancy of the effects of their program on the patella versus the Achilles tendon level.

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Authors' Response: Thank you, Dr Knobloch, for your interest in our study and your constructive questions.

There is a great variation in tendon diameter between individuals, and I agree that mere tendon diameter itself does not necessarily correlate with development of tendon symptoms. Therefore, the categorization in this study of abnormal contra normal tendons was not based on a cross-section cut of the tendon thickness.

Achilles tendons with *spindle-shaped* ultrasonographic thickening of more than 1 mm in relation to the normal distal part of the tendon in the longitudinal scan plane, and patellar tendons with thickening and a *hypoechoic region* ("granulom") more than 2 mm in the transverse scan plane, were classified as "severely abnormal." Hypoechoic Achilles tendons with ultrasonographically detected *spindle-shaped* tendon thickening between 0.5 and 1 mm and patellar tendons with *hypoechoic regions* between 1 and 2 mm were classified as "slightly abnormal."

A reinjury was defined as an injury of the same type and at the same site as the index injury, and occurring after a player's return to full participation after the index injury. The primary injury arose in a previous season, and we do not know which kind of treatment the players had in the intervening period between the previous injury and the season in which the study took place.

I also agree that one of the explanations for the difference in the result of the eccentric training in this study as opposed to the study of Alfredson et al's could be the difference in intensity. However, the prophylactic training quantities were suitably intense to increase the symptoms in players with a hypoechoic region in the patellar tendon, and the prophylactic training quantities were the maximum that the trainers and the players could be motivated to carry out.

Why eccentric training in several studies seems to have reasonably good results is unknown. One hypothesis is that the results of eccentric training in midportion Achilles tendinopathy might be at least mediated by the intermittent disruption of the blood flow in the tiny neovessels by the eccentric training. However, in my opinion, it seems unlikely that the 15 120 repetitions (each of 2 seconds' duration) for 12 weeks corresponding to 8 hours (15 120 × 2 seconds) of the 2016 hours for the 12 weeks, that is, less than 0.5% of the time, will have any influence on the results.

I cannot give an explanation as to why the eccentric training increases symptoms in players with asymptomatic hypoechoic regions in the patellar tendon but not in players with asymptomatic ultrasonographic Achilles abnormalities. Neither can I explain why the eccentric training seems to reduce the frequency of developing hypoechoic regions in the patellar tendons but has no effect in the Achilles tendons. Larger randomized studies are needed before we can establish the effect of eccentric training.

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