

Lay summary: Biomechanics of Quadriceps Strains

Quadriceps strains affect the muscles at the front of the thigh and are the fourth most common injury in the AFL, extracting a heavy toll on a club's injury list. Although it was previously understood that quadriceps strains have been related to kicking and occur on the kicking leg side, the exact mechanism during kicking has not been understood.

This study has found that it is very likely that a quadriceps strain during a running kick is related to a deceleration movement performed by the kicking leg in the final step before the backswing, and *not* due to contact with the ball during the kick. The evidence suggesting that this is the case includes the following:

1. The risk of a quadriceps strain for a type of kick is proportional to the running speed of the approach, rather than the distance kicked. A long kick from a standing start (such as from a free kick, or a kick out from goal) is far less likely to cause a quadriceps strain than a short, fast running kick. Similarly a running pass kick in soccer is a greater risk than a standing punt kick in American football or a kick for goal in rugby. This study has shown that stretch of the quadriceps is greater in a running kick than a standing kick or in regular sprinting, which makes a strain injury more likely.
2. Quadriceps strains may occur during running when the player is trying to slow down, and video analysis of these injuries reveals that the mechanics of the leg movement during slowing down movements are very similar to the final step before kicking a running drop punt in which an injury has occurred.
3. The study has shown that impact forces to the leg from the ball mainly depend on how wet the ball is. Impact forces from ball contact are therefore greater on wet days. However, injury survey data reveals that quadriceps strains are more likely in dry weather. This strongly suggests that ground conditions, more than ball conditions, affect the risk of quadriceps strain. Furthermore, there was no relation shown between measured ball pressures and risk of quadriceps injury.

Other risks for quadriceps strains include that they are more common in players with a past history of quadriceps strain, players returning from a hamstring strain and in shorter players (who presumably are more likely to make fast, running kicks than long kicks from a stoppage). Quadriceps strains are also more common in teams based out

of Melbourne, although like many other injuries that are more common in warmer climates, there is a poor correlation with Penetrometer readings. This suggests that ground traction is more of a risk than hardness. In contrast to most other injuries quadriceps strains are almost as likely during training sessions as they are in matches. There is some evidence that fatigue and overuse may be implicated in causing quadriceps strains.

The findings of this study pinpoint a set of circumstances in which a quadriceps strain is highly likely. Long training sessions on dry grounds where repetitive running kicks are performed under pressure, particularly by players with a history of hamstring or quadriceps injury, are the most likely circumstances to result in a quadriceps strain. These circumstances should be avoided by teams in their efforts to prevent injury.