Infographic. Running myth: switching to a non-rearfoot strike reduces injury risk and improves running economy

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Endurance running is associated with high rates of injury,[1] with injury causation often complex and multifactorial.[2] Running biomechanics are thought to play a role in the aetiology of running-related injury.[3] Therefore interventions to change running technique may assist in the prevention and management of injuries.[4]

The overwhelming majority of recreational shod distance runners run with a rearfoot strike pattern.[5] Running with a rearfoot strike has been *retrospectively* associated with greater risk of running-related injury,[6] and switching to a non-rearfoot strike pattern has been reported to improve symptoms in runners with anterior lower leg pain and patellofemoral pain.[7 8] As such, changing strike pattern has become a commonly considered and promoted strategy when attempting to prevent and manage injury in endurance runners[9] (see figure 1). Many elite runners tend to use a non-rearfoot strike pattern, which has led some coaches to encourage a non-rearfoot strike pattern in their runners in an attempt to improve performance.[9]

Yet, significant changes in other biomechanical variables result when transitioning to a non-rearfoot strike pattern. While switching to a non-rearfoot strike pattern may reduce load on the knee; the foot, ankle and lower leg will experience a rapid increase in loads.[9] If training loads are not managed appropriately, a runner will experience an elevated risk of a running-related injury during transition.

A recent systematic review and meta-analysis examined 53 studies comparing non-rearfoot strike with rearfoot strike running patterns in relation to injury, running economy and biomechanics.[9] While the authors identified limited retrospective evidence of lower rates of past injury in runners with a non-rearfoot strike pattern, no prospective evidence supported an association of one foot strike pattern with an increased or decreased risk of future injury.[9] Therefore, the claim that running with a non-rearfoot strike pattern will reduce injury risk currently lacks supporting evidence. In regards to running economy, no difference was found between habitual rearfoot and habitual non-rearfoot strike runners, and

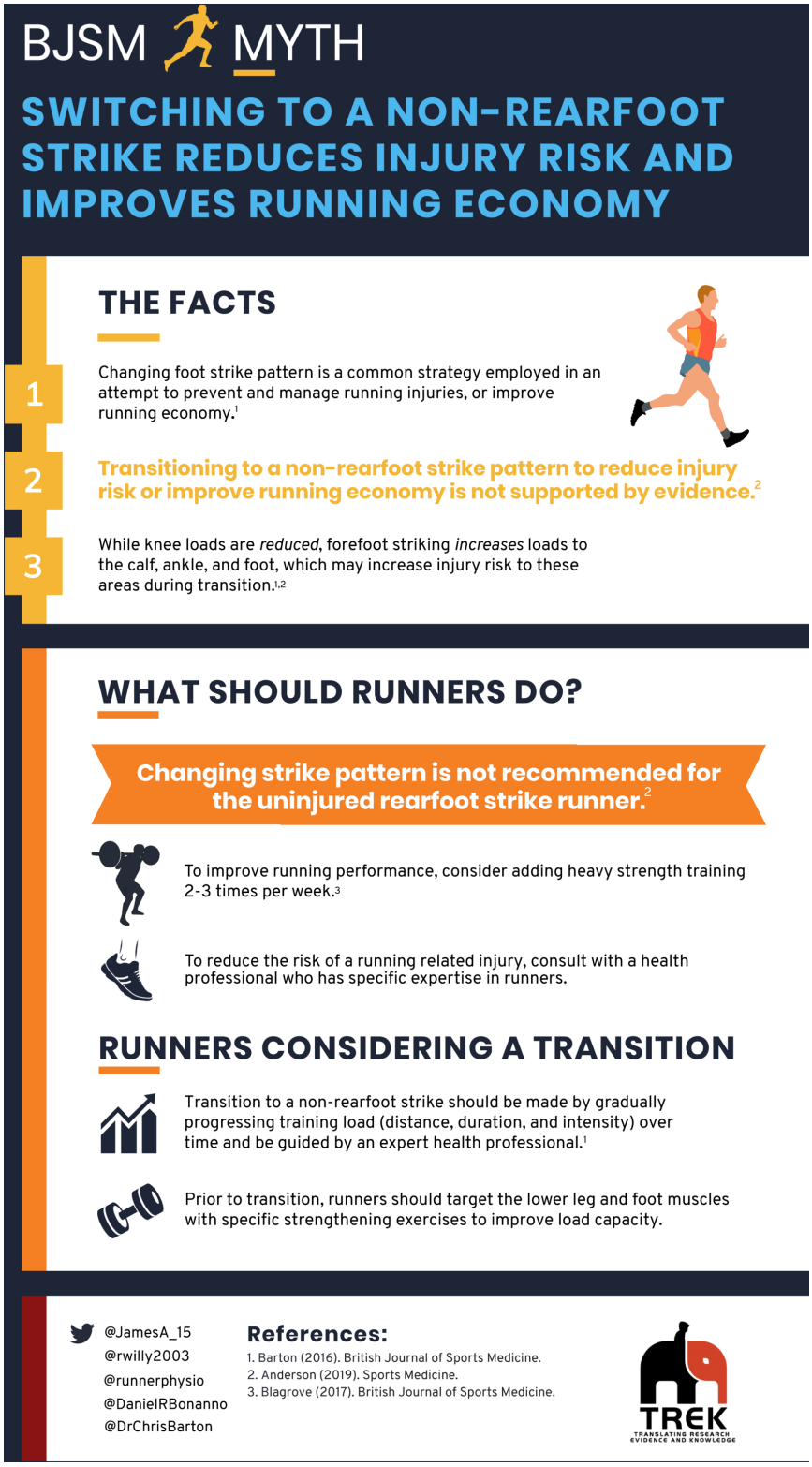

Figure 1

changing foot strike pattern either reduces or has no effect on running economy in the short term.[9 10] The take home message from the Anderson *et al* systematic review was simple: based on a current lack of evidence 'changing foot strike pattern cannot be recommended for an uninjured rearfoot strike runner' and further research is required in this area.[9]

SO, WHAT SHOULD RUNNERS DO?

When considering injury risk and performance, runners should understand that there are safer and more effective interventions than changing foot strike pattern. Using gait retraining in runners to reduce the loading rate of the vertical ground reaction force has positive findings in relation to injury risk[11]. However, further research is required to determine best practices for the use of gait retraining for decreasing injury risk in runners. Furthermore, consistent strength training significantly improves running economy, maximal sprint speed and time trial performance in endurance runners.[12] While heavy strength training reduces the rate of overuse injuries in other athletes,[13] its effectiveness in reducing injury rates in runners has not yet been established. Runners are advised to consult a health professional who has experience working with runners for advice on reducing injury risk specific to their individual circumstances.

Uninjured runners considering a transition from a rearfoot to a non-rearfoot strike pattern should do so with the understanding that neither an injury prevention nor performance benefit may result, and those who proceed may face an initial increased injury risk as their body adapts to the change in loading.[9]

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REFERENCES

1 Kluitenberg B, van Middelkoop M, Diercks R, *et al*. What are the differences in injury proportions between different populations of runners? A systematic review and meta-analysis. *Sports Med* 2015;45:1143–61.
2 Bertelsen ML, Hulme A, Petersen J, *et al*. A framework for the etiology of running-related injuries. *Scand J Med Sci Sports* 2017;27:1170–80.
3 Ceyssens L, Vanelderen R, Barton C, *et al*. Biomechanical risk factors associated with Running-Related injuries: a systematic review. *Sports Med* 2019;49:1095–115.
4 Barton CJ, Bonanno DR, Carr J, *et al*. Running retraining to treat lower limb injuries: a mixed-methods study of current evidence synthesised with expert opinion. *Br J Sports Med* 2016;50:513–26.
5 de Almeida MO, Saragiotto BT, Yamato TP, *et al*. Is the rearfoot pattern the most frequently foot strike pattern among recreational shod distance runners? *Physical Therapy in Sport* 2015;16:29–33.
6 Daoud AI, Geissler GJ, Wang F, *et al*. Foot strike and injury rates in endurance runners: a retrospective study. *Med Sci Sports Exerc* 2012;44:1325–34.
7 Breen DT, Foster J, Falvey E, *et al*. Gait re-training to alleviate the symptoms of anterior exertional lower leg pain: a case series. *Int J Sports Phys Ther* 2015;10:85–94.
8 Roper JL, Harding EM, Doerfler D, *et al*. The effects of gait retraining in runners with patellofemoral pain: a randomized trial. *Clinical Biomechanics* 2016;35:14–22.
9 Anderson LM, Bonanno DR, Hart HF, *et al*. What are the benefits and risks associated with changing foot strike pattern during running? A systematic review and meta-analysis of injury, running economy, and biomechanics. *Sports Medicine* 2019.
10 Roper J, Doerfler D, Kravitz L, *et al*. Gait retraining from rearfoot strike to forefoot strike does not change running economy. *Int J Sports Med* 2017;38:1076–82.
11 Chan ZYS, Zhang JH, Au IPH, *et al*. Gait retraining for the reduction of injury occurrence in novice distance runners: 1-year follow-up of a randomized controlled trial. *Am J Sports Med* 2018;46:388–95.
12 Blagrove RC, Howatson G, Hayes PR. Effects of strength training on the physiological determinants of middle- and long-distance running performance: a systematic review. *Sports Medicine* 2018;48:1117–49.
13 Lauersen JB, Bertelsen DM, Andersen LB. The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials. *Br J Sports Med* 2014;48:871–7.