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Taken from research carried out by Nicholas Dinsdale at Manchester Metropolitan University in 2010

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FOREFOOT VARUS WEDGES ENHANCE CYCLING PERFORMANCE IN CYCLISTS PRESENTING WITH FOREFOOT VARUS

Abstract

Cyclists with bilateral and/or unilateral forefoot varus performed 2 x 30 second Wingate Anaerobic tests on a cycle ergometer, one with and one without Specialized BG varus wedges. Riders demonstrated between 3% and 10% increase in power output when using varus wedges compared without wedges. Unique to this study, we found a strong correlation between power output and cyclists with varying amounts of forefoot varus. Importantly, cyclists presenting with higher levels of forefoot varus (forefoot-rearfoot alignment) potentially have the most to gain.

Introduction

During a 25 mile time trial, a rider may average up to 5,000 pedal revolutions. The smallest amount of malalignment in the lower limb, often associated with forefoot-rearfoot alignment (sometimes referred to as tilt), can lead to knee and pelvic problems, and more importantly, reduced power output. Although many studies report on the use of foot inserts in running, there is limited quantitative evidence of their use in cycling and more specifically, their use to enhance cycling performance.

Forefoot alignment

According to some research, and that used by Specialized when developing their Body Geometry (BG) shoes and BG inserts, approximately 87% of cyclists have a condition called forefoot varus, 9% have forefoot valgus, and only 4% have a neutral forefoot-rearfoot relationship. Yet, conventional pedal systems are designed for the cyclist to be positioned on the pedal flat-footed, and are therefore only ideally suited to the 4% of the cycling population who have a neutral forefoot-rearfoot relationship.

Foot/pedal interface forces

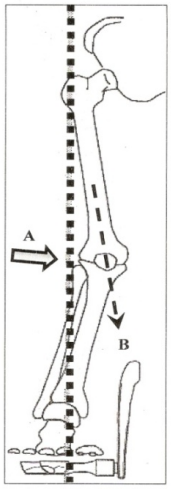

Figure 1a

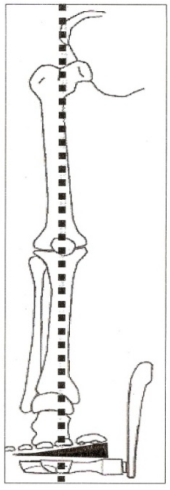

Figure 1b

During the downstroke of pedalling the forces are at their greatest, and in some cases, these forces cause the foot to roll inwards too much (known as excessive pronation). Potentially, this can result in lower-limb malalignment, knee injury, pelvic imbalance and power loss. The forces, found at the foot/pedal interface, can reach 3 times body mass during sprinting (anaerobic) and equal to body mass during steady-state (aerobic) cycling.

Previous research has demonstrated that as power outputs increase (high intensity cycling) so does the amount of foot pronation. Moreover, the condition known as forefoot varus exaggerates the amount of foot pronation, which can lead to greater knee misalignment and potentially greater power loss.

During the downstroke of pedalling, the forefoot tends to collapse allowing the forefoot to become parallel with the pedal (Fig. 1a). Consequently, foot pronation, internal rotation and knee adduction increase (Fig. 1a; arrow A). This causes the applied resultant force to be lower (Fig. 1a; arrow B). Varus wedges support the medial forefoot in cyclists with forefoot varus, thus helps to prevent the foot from collapsing (Figure 1b).

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Study conclusion

This study examined the effect of forefoot varus wedges on cycling performance as measured by anaerobic mean power (MP) output. Cyclists with bilateral and/or unilateral forefoot varus performed 2 x 30 second Wingate Anaerobic tests on a cycle ergometer, one *with* and one *without* wedges. Whilst not statistically significant, the results demonstrated an average increase in MP output of 3.8% in favour of using wedges compared to not using wedges. Unlike previous studies, this study reported forefoot varus measurements for each rider, and the corresponding number of varus wedges used in testing. Unique to this study, we found a strong correlation between power output and cyclists with varying amounts of forefoot varus. Interestingly, those with the highest levels of forefoot varus demonstrated increased MP outputs of ~10%. Considering the high prevalence of forefoot varus (87%) found amongst cyclists, these findings may have implications across the cycling population. In summary, cyclists presenting with higher levels of forefoot varus potentially have the most to gain.

What does this imply to the competitive cyclist?

Although this study suggests that correcting forefoot varus using wedges may improve short-term power, it is also likely that competitive cyclists involved in short to medium distance time trial events (10m – 25m) will also benefit, but to a lesser amount. Many riders with forefoot alignment problems develop pelvic muscle imbalances, pelvic asymmetry, and functional leg length discrepancies – leading to asymmetry – all of which can contribute to injury and/or power loss. Therefore, appropriate biomechanical screening, particularly of the foot and lower limb, should be considered prior to undergoing a cycle-fit and/or setting rider position, or when buying new pedal systems, or cycling shoes. Failure to identify and address any biomechanical problems may result in the problems being taken on to the bike. Consequently, these problems are likely to adversely affect the desired outcome. Finally, while many Health Care professionals offer biomechanical assessments prior to prescribing cycling orthotics / inserts, many of these assessments are still based on rearfoot 'gait analysis' (applicable to running), which are not necessarily applicable and appropriate to competitive cycling.

Although not linked, in anyway, this study represents an extension to the work done by Dr. Andy Pruitt of the Boulder Center for Sports Medicine in the development of the Specialized BG FIT (Body Geometry Fit Integration Technology) products.

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