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Effects of The Trusox on Agility and Athletic Performance.

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**Introduction**

Football is a high intensity intermittent team sport; eleven per cent of the game is played at top speed with players performing maximal sprints every 90-seconds, high intensity activity every 30-seconds, up to 250 brief intense actions and over 700-changes of direction (Reilly et al., 2000; Mohr et al., 2003; McMillan et al., 2005; Bangsbo, Mohr & Krustrup, 2006; Bloomfield, Polman & O’Donoghue, 2007a).

Agility is the ability to change direction quickly and easily at high speed using total body movements (Young & Farrow, 2006). In game situations, agility is used to both evade and pursue an opponent and improving this performance is one of the key components of elite football (Sporis et al., 2010). Importantly, explosive agility movements have been shown to determine the playing standard and level of performance (Reilly et al. 2000b; Baker et al., 2008; Kaplan et al., 2009; Bradley et al. 2010) with coaches constantly striving to improve such unpredictable, acyclic and intermittent attributes within athletes (Inklaar, 1994; Nicholas et al., 2000; Wragg et al., 2000; McMillan et al., 2005; Bloomfield et al., 2007).

Currently many athletes, including English Premier League footballers are wearing the Trusox product, which anecdotally is suggested by players to enhance the level of stability between the foot/boot complex to stop slippage and potentially aid energy transfer from such agility movements during training, competitive games and rehabilitation following injury. However, to date no studies have been conducted to quantify any physical performance benefits to back up such claims.

The primary outcome of this study is to explore if any relationship exists between wearing Trusox product and agility performance. Secondly the study will assess if any potential performance benefits are gained from the Trusox during a 20-metre sprint (with 10-metre acceleration phase).

Whilst, no gold standard exists to measure agility, several researchers have investigated the modified T –Test (Sassie et al., 2009), 505 (Draper & Lancaster, 1985), L- run (Gabbett, 2006) and Zig- zag test (Sporis et al., 2011). However, uni or bi-planar movements employed are unrealistic to football. Furthermore, time to completion ranges from 2-10 seconds (s), potentially failing to induce a fatigued state, necessary within professional football. (Wilk, Reinold & Hooks, 2003). Requiring greater completion times the T-Test (Appendix-1) has gathered interest (Munro and Herrington, 2011). However the measure is asymmetrical and requires many side-shuffle movements more reflective of court based sports (Cronin & Templeton, 2008). Comparatively, requiring maximal sprints and symmetrical multi-angled movements for longer durations (15-20s) the Illinois Agility Test (IAT) is considered most replicable to football (Khorasani et al., 2010), with excellent reliability levels (r=0.96) (Hachana et al., 2013).

Methodology

Thirteen, active, full time medical and sport science staff from the English Premier League, volunteered to participate in the study, following presentation of the procedures. All subjects signed informed consent, where over the age of 18 years and free from injury.

*Mean values from subjects*

|  |  |
| --- | --- |
| Subjects | 13 |
| Age (yrs.) | 24.9 |
| Height (m) | 178.6 |
| Weight (kg) | 78.4 |

Following a 12-minute warm up conducted by the clubs Head of Rehabilitation practioner (standard mobility, pulse raiser and muscle activation), a single IAT was performed by all subjects at 50% pace to serve as familiarity to the test. Subjects were randomly assigned a number between 1-13 and in consecutive order performed two sets of three trials interspersed by 3-minutes rest to allow full recovery and 5-minutes rest between sets. Each individual trial from each set was performed with Trusox (TS), Modified Trusox (MT) and standard Football Socks (FS), respectively. A team kit match sock, was utilised as the FS to standardise the control and represent the normal sock/foot interface used during competitive games. The MT was presented to the author as a potential new product for our athletes. All testing were performed within an indoor gymnasium to reduce extrinsic environmental variables (weather, temperature, humidity). All subjects were instructed not to perform any strenuous activity 48 hours prior to testing.

***Illinois Agility Test***

Subjects were instructed to perform all IAT tests maximally from a standing position, one metre behind the start line. The prone lying position was not utilised, due to its unrealistic nature to professional football. Timing gates (Brower Timing Systems) were set up at the start and finish line to reduce human error, likely from stopwatch measurement. All times were recorded to .01 of a second.

*20-Metre Sprint Test*

Following 5- minutes rest, 20-metre straight sprint tests were initiated. Timing gates were set up at the start, 10-metres and 20-metres positions within the gymnasium. Subjects within numbered order (1-13), performed three trials of the sprint for one set interspersed with 3-minutes recovery between trials. Two trials was excluded, due to potential increase of accumulative fatigue from testing. Starting 0.5 metres behind the first timing gates from a standing position, subjects on the command “go”, sprinted maximally to a 25-metre position as to reduce the potential of speed decrease upon approaching the 20-metre timing gates, which could affect the results. All times were recorded to .01 of a second.

Results

The individual IAT test times for all subjects are provided in table 2.

*Table 2: Individual times across all trials of the IAT*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subject | Trial | Trusox (TS) | Modified Trusox (MT) | Football Sock(FS) |
| 1 | 1 | 16.41 | 17.79 | 19.51 |
|  | 2 | 16.48 | 17.39 | 18.39 |
| 2 | 1 | 16.66 | 17.09 | 18.71 |
|  | 2 | 16.68 | 17.01 | 17.75 |
| 3 | 1 | 16.45 | 17.21 | 19.82 |
|  | 2 | 16.88 | 18.16 | 18.88 |
| 4 | 1 | 16.59 | 17.01 | 18.90 |
|  | 2 | 16.57 | 17.08 | 19.18 |
| 5 | 1 | 15.67 | 16.65 | 18.88 |
|  | 2 | 16.00 | 16.70 | 18.24 |
| 6 | 1 | 16.07 | 16.76 | 18.99 |
|  | 2 | 16.05 | 16.70 | 18.06 |
| 7 | 1 | 17.27 | 17.62 | 19.32 |
|  | 2 | 16.82 | 17.35 | 19.63 |
| 8 | 1 | 16.14 | 17.17 | 19.06 |
|  | 2 | 16.23 | 17.20 | 18.63 |
| 9 | 1 | 16.67 | 16.69 | 19.39 |
|  | 2 | 16.94 | 17.07 | 19.08 |
| 10 | 1 | 15.98 | 16.75 | 18.58 |
|  | 2 | 16.23 | 16.47 | 18.06 |
| 11 | 1 | 16.69 | 17.09 | 19.59 |
|  | 2 | 16.72 | 17.22 | 19.25 |
| 12 | 1 | 16.89 | 16.87 | 18.83 |
|  | 2 | 16.85 | 17.02 | 18.02 |
| 13 | 1 | 16.46 | 17.86 | 19.28 |
|  | 2 | 16.87 | 17.40 | 18.38 |

*Graph 1: Total Time across all subjects for two trials of TS, MT and FS*

Graph 1, clearly shows the total time for thirteen subjects over the two trials with the Football Sock having the highest total time and overall worst performance across the testing. The Modified Trusox outperformed the Football sock, but the least total time was generated when participating in the test with subjects wearing the Trusox.

To further investigate the results, average time across the two trials for all products were compared in graph 2.

*Graph 2: Average Time Over Two Trials for TS, MT and FS*

The average time (total time / 13 subjects) shows the Trusox (33.02 secs) and modified Trusox average (34.26 secs) is significantly reduced compared to the Football sock (37.72 secs). The Trusox out perfomed the Football sock by an *average 4.7 secs per trial and percentage improvement of 12.5%.*

The combination of the two trials for each subject is calculated as to reduce potential data noise and reduce the effects of a single performance being due to chance. It is possible however, overall average for each product shown in graph 2, could be affected by random scores within the three groups which could have a significant impact on the data. In order to assess the cross subjects scores, Graph 3 below shows the combined total scores over two trials for each subject.

*Graph 3: Total Times For Each Subject During All Agility Testing.*

Graph 3 shows, across all subjects, agility testing when undertaken in the Trusox, recorded the least times for all testing. Equally the modified Trusox in all tests outperformed the Football sock.

Across all trials the Trusox outperformed the Football sock by various margins. Graph 4, below highlights the degree of each percentage improvement of the Trusox compared to Football socks.

*Graph 4: Percentage Improvement of Agility performance for each subject in the Trusox, compared with the Football Sock.*

Graph 4 shows a range improvement of the Trusox against the Football Sock of 16.8 -30.9%, *with an average time (s) improvement of 25.5%.*

It was not initially the aim of this study to investigate factors that contribute to such potential degree of percentage improvements in the Trusox for each subject (graph 4). However, it is apparent that when each individual trial (26 trials) for the Trusox is ranked quickest to slowest from Table 2 and separated into two groups with group 1 incorporating the first 1-13 fastest times and group 2 incorporating the slowest times across all tests, from 14-16, there is a general trend that has immerged.

*Graph 5: Percentage improvement of Trusox performance compared to the Football Sock, when each trial is ranked and split into two groups (group 1 fastest times, group 2 slowest times).*

Graph 5, shows when the subjects individual trials are ranked 1-26 whilst wearing the Trusox the fastest half of the group (represented by the blue line) shows a significant general increased percentage improvement, compared to the slowest group (red line).

*Graph 6: Trusox total percentage improvement compared to Football socks.*

Graph 6 shows the total cumulative percentage improvement increase across the two groups. The average percentage improvement for a single trial compared to Football socks in group 1 is *14.3%* and group 2 *11.2%.* .

Graph 5 and 6, demonstrate that individuals who have the ability to perform agility movements in a more explosive fashion, may actually show a greater level of percentage improvement in Trusox compared to Football Socks. Whilst all subjects showed a percentage increase in performance with the Trusox compared to the Football sock, it is likely faster more mobile subjects show the greatest performance increase.

Given elite athletes are considered to perform such agility movements with more efficiency than non-professional subjects, it is feasible to suggest such athletes would gain the greatest degree of improvement from the Trusox and perhaps explains the large uptake within the English Premier League.

***Sprint Testing:***

*Table 3: 20-metre Sprint Times Across All Subjects*

|  |  |  |  |
| --- | --- | --- | --- |
| Subject | Trusox | Modified Trusox | Football Sock |
| 1 | 3.33 | 3.37 | 3.52 |
| 2 | 3.19 | 3.30 | 3.28 |
| 3 | 3.11 | 3.40 | 3.42 |
| 4 | 3.14 | 3.18 | 3.36 |
| 5 | 3.02 | 3.11 | 3.26 |
| 6 | 3.00 | 3.12 | 3.27 |
| 7 | 3.32 | 3.38 | 3.51 |
| 8 | 3.25 | 3.34 | 3.48 |
| 9 | 3.18 | 3.17 | 3.41 |
| 10 | 3.19 | 3.27 | 3.37 |
| 11 | 3.19 | 3.20 | 3.38 |
| 12 | 3.36 | 3.45 | 3.47 |
| 13 | 3.05 | 3.21 | 3.32 |

*Graph 7: Total Times: 20-Metre Sprint*

Graph 7, shows during the 20-metre sprints across all subjects, for total time the Trusox and Modified Trusox out perfom the Football sock.

*Graph 8: Average 20 metre sprint time for Trusox, Modified Trusox and Football Sock*

Graph 8 shows the average 20-metre sprint time (total time / 13 subjects) is decreased with both a Trusox and Modified Trusox, compared to a Football sock. Trusox had 0.47 second average improvement over 20-metres, in relation to a Football sock. *This equates to a 12.9% relative improvement.*

*Graph 9: Differences in 20-Metre Sprint Time For Each Subject During all Three Tests.*

Graph 9 shows the relative trend of each test for each product during the sprint test over 20-metres. Increased performance is indicated by a decreased time on the test in seconds. Both the Trusox and Modified Trusox show relative decreased times in comparison to the Football Sock, when performed by the same subjects. The graph also shows that in general all three products followed a similar relative trend of performance across all testing, albeit at greater degrees of ability. For instance subject 7 showed a greater score on all testing for all products and subject 6 showed a decreased score for all tests compared to all subjects. This would suggest the Trusox works by enhancing the subjects own potential, when compared to football socks in all the majority of the testing.

*Acceleration (10-Metre) Sprint*

*Table 4: Acceleration Times across all subjects for all Three Products*

|  |  |  |  |
| --- | --- | --- | --- |
| Subject | Trusox | Modified Trusox | Football Sock |
| 1 | 1.36 | 1.44 | 1.95 |
| 2 | 1.33 | 1.37 | 1.90 |
| 3 | 1.34 | 1.39 | 1.83 |
| 4 | 1.31 | 1.38 | 1.35 |
| 5 | 1.33 | 1.36 | 1.76 |
| 6 | 1.31 | 1.39 | 1.74 |
| 7 | 1.40 | 1.49 | 1.92 |
| 8 | 1.38 | 1.43 | 1.95 |
| 9 | 1.30 | 1.39 | 1.89 |
| 10 | 1.36 | 1.40 | 1.85 |
| 11 | 1.32 | 1.38 | 1.90 |
| 12 | 1.44 | 1.40 | 1.98 |
| 13 | 1.79 | 1.95 | 1.41 |

*Graph 10: Total Acceleration Times Across All Three Products*

Graph 10, shows for calculation of total time the Trusox and Modified Trusox outperformed the Football Sock within the same subjects over 10-metres acceleration.

*Graph 11: Average Acceleration Across All Products.*

Graph 11, highlights the Football Sock having the largest average (total time / 13 subjects) acceleration time compared to the Modified Trusox and Trusox. On average the Trusox outperformed the Football Sock by 0.42 seconds over 10-metres. *This equates to 23.3% improvement within the same subjects.*

*Graph 12: Differences in 10-Metre Acceleration Times In All Subjects Across The Three Products.*

Graph 12, shows in general the Trusox and Modified Trusox out performed the Football Sock for the majority of the subjects. Additionally, the graph also shows the Trusox largely outperformed the Modified Trusox in the majority of the testing, albeit marginally.

**Conclusion**

This study for its primary purpose, showed that during a test of agility (IAT) using the same subjects with repeated testing under the same conditions the Trusox showed an average improvement against a traditional team kit Football sock, by 12.5%. Additionally all subjects recorded a greater performance wearing the Trusox than a Football Sock, with a greater degree of potential improvement corresponding to the subjects ability to perform the test. This would have large implications upon professional football players, who feasibly would have greater agility performances. Of great concern is the potential slippage and performance deficit that is possible within the standard team kit sock, when arguably the athlete is required to execute repetitive explosive movements during games. Such slippage at intense speeds may also lead to a greater risk of injury, but is behind the scope of this paper.

In relation to the secondary aim of this study, both 20-metre and 10-metre acceleration times are drastically decreased when performed using the same subjects wearing Trusox compared to Football socks. In conclusion the Trusox product does appear to enhance athletic performance and further research should explore such potential benefits within a sporting elite population, where the search for such physical marginal gains are of significant importance.

**Appendix-1**

Schematic diagram of the protocol for the Illinois agility test : The athlete sprints from point A to B, Turns sprints to the start of the middle section, weaves in and out and back, then sprints upto point C, turns and sprints to point D to finish.

Direction of run

Cone

D

C

B

A

5m

10m