The Use of Sprint Tests for Assessment of Speed Qualities of Elite Australian Rules Footballers

Warren Young, Andrew Russell, Peter Burge, Alex Clarke, Stuart Cormack, and Glenn Stewart

Purpose: The purpose of this study was to determine the relationships between split times within sprint tests over 30 m and 40 m in elite Australian Rules footballers.

Methods: Data were analyzed from two Australian Football League (AFL) clubs. The first club (n = 35) conducted a 40-m sprint test and recorded split times at 10 m and 20 m. The second club (n = 30) conducted a 30-m sprint test and recorded splits at 10 m and 20 m. Analyses included calculation of Pearson correlations and common variances between all the split times as well as “flying” times (20–40 m for the first club and 20 to 30 m for the second club). Results: There was a high correlation (r = 0.94) between 10-m time and 20-m time within each club, indicating these measures assessed very similar speed qualities. The correlations between 10-m time and times to 30 m and 40 m decreased, but still produced common variances of 79% and 66% respectively. However when the “flying” times (20–40 m and 20–30 m) were correlated to 10-m time, the common variances decreased substantially to 25% and 42% respectively, indicating uniqueness. Conclusions: It was concluded that 10-m time is a good reflection of acceleration capabilities and either 20 to 40 m in a 40-m sprint test or 20 to 30 m in a 30-m sprint test can be used to estimate maximum speed capabilities. It was suggested that sprint tests over 30 m or 40 m can be conducted indoors to provide useful information about independent speed qualities in athletes.

Keywords: sprint, football, testing, acceleration, maximum speed
ment can be conducted in an indoor facility such as a single or double basketball court. This is an appealing choice because environmental conditions, floor surface, and wind influences can be controlled or eliminated, compared with an outdoor field setting. This is an important consideration if the sprint performances are to be reliable and sensitive to potential changes from interventions such as training programs. Although footballers are required to perform sprints in games on variable grass surfaces while wearing boots, conducting sprint tests indoors can be justified by the benefits of achieving consistent and controlled conditions as discussed above. Further, there is no evidence that testing indoors would alter the relative performances of players within a team.

The time taken to sprint from a stationary start over a relatively short distance such as 10 m is considered to be a reflection of acceleration capability, whereas longer sprints (eg, 50 m) may be considered to also reflect maximum speed. Since short and longer sprints are somewhat different with respect to biomechanical (eg, the amount of forward lean) muscle activation and strength requirements, they may reflect independent qualities. Indeed, the specificity of acceleration and maximum speed sprinting has been supported by Delecluse et al who reported that the time to 10 m was statistically independent from the time run between 12 and 34 m. Little and Williams reported a common variance of only 39% between 10-m time and maximum speed, as measured by a flying 20-m sprint. Further support comes from training studies that have reported power training to produce significant gains in sprint performance over short distances such as 10 to 20 m, but much smaller improvements in maximum running velocity.

Time-motion analyses of field sports have shown typical sprints to be rarely more than 3 seconds in duration or 20 m in length in rugby union, soccer, field hockey, and Australian Rules football. The performance of relatively short sprints in matches in field sports has been used to argue that maximum running speed is not commonly achieved in games. However, this reasoning is based on the performance of sprints from a stationary start, such as in track and field sprint events. Approximately 40 m was required to reach maximum speed from a standing start in Victorian Football League (VFL) footballers and physical education students. However, when a maximum effort sprint was commenced from a “fast stride” (7 m/s), maximum speed was reached in only 28.7 m. In a similar analysis of rugby union players, backs took on average 5.9 seconds to reach maximum speed from a standing start. This was significantly reduced by 1.9 seconds when the sprint was commenced from a “striding” start. Since the majority of sprints analyzed in games were found to commence from walking or running starts rather than from a standing start, it was estimated that approximately 50% of sprints reached 90% to 99% of maximum running speed. The researchers concluded that maximum or near maximum speeds are often reached in games, and therefore maximum speed should be developed in training as well as assessed in fitness testing. In elite Australian Rules footballers, preseason performances of both 10-m time and maximum speed were shown to be significantly faster in players who were subsequently selected to play the first game of the season. This supports the importance or relevance of both of these speed qualities.

The purpose of this study was to determine the relationships between split times within sprint tests over 30 m and 40 m in elite Australian Rules footballers to provide insights into the best method of interpreting such tests. For example we were interested to evaluate the use of 30-m and 40-m sprint tests as well as
investigating the effect of using “flying” split times. For the purposes of this study, a sprint is defined as a run over any distance performed with maximum effort.

**Methods**

**Subjects**

Participants were players from two Australian Football League (AFL) clubs. The two data sets were kept separate because the two clubs used slightly different sprint test protocols. Club A (n = 35) used a 40-m sprint performed indoors on a wooden floor surface, whereas club B (n = 30) used a 30-m sprint performed indoors on a synthetic running track. All players wore running shoes without spikes. Both clubs conducted their respective sprint tests during the preseason, and all AFL-listed players who were free of injury and illness at that time were tested. All players volunteered participation as part of their club’s regular fitness testing procedures, which conform to the ethical guidelines of the Helsinki Declaration.

**Sprint Test Procedures**

Both clubs used their usual warm-up that was conducted by the respective fitness coaches. Both sprint tests involved a stationary start with the player initiating the sprint in their own time, that is, with no requirement to react to a starting signal. For Club A, players positioned the toe of the front foot on the start line, whereas club B required the foot to be 50 cm behind the start line. The sprint was required to be commenced from a stationary position so that a “rolling” start was not allowed. Both clubs allowed two maximum sprints, with the best split times being retained for analysis. Players were encouraged to wait until they felt completely recovered before performing the second sprint trial, which typically took 2 to 3 minutes.

For club A, light gates with electronic timing (Swift timing, Lismore Australia) were positioned at the start line and at 10 m, 20 m, and 40 m. For club B, timing gates (KMS, Fitness Technologies, Adelaide, Australia) were positioned at the start line as well as at 10 m, 20 m, and 30 m. For this test, 30 m was considered the maximum distance that could be used in the indoor facility to allow enough space to safely decelerate after the finish line. Although the test protocols were slightly different for the two clubs, the purpose was not to compare the absolute times but the relationships between the various split times within each group.

**Statistical Analysis**

The final split time (20-40 m for club A, 20 to 30 m for club B) was calculated because this time interval represents the fastest running periods for each test. The rationale for isolating this time interval is that because it represents a “flying” time, it may be less influenced by the early acceleration phase.

All times were analyzed with Pearson correlations as well as the coefficient of determination ($r^2$). The common variance between any 2 variables was then expressed as a percentage according to $r^2 \times 100$. When a correlation coefficient is less than 0.71, the common or shared variance between 2 test variables is less than 50%, and these variables can be said to possess somewhat unique characteristics.
Results

The means ± standard deviations (SD) are shown for each club in Table 1 and the correlation matrices are shown for each club in Table 2. The correlation coefficients were high between 10-m time and 40-m time for club A ($r = 0.81$) and 10-m time and 30-m time for club B ($r = 0.89$). However, when the 10-m time was correlated with the 20 to 40 m time and 20 to 30 m time, the coefficients decreased to 0.50 and 0.65 respectively.

Discussion

The correlations between 10-m and 20-m times for both data sets were high ($r = 0.94$) with common variances of 88%. This high commonality indicates that 20-m time reflects a speed quality that is very similar to the 10-m time, which can be considered as acceleration. The time to 10 m would be expected to influence the time at 20 m. This suggests that a test over 20 m does not assess any more than the

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Means ± Standard Deviations (SD) for Each Split for Both Clubs</th>
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<tbody>
<tr>
<td></td>
<td>Club A (n = 35)</td>
</tr>
<tr>
<td>10 m time (s)</td>
<td>1.89 ± 0.07</td>
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<tr>
<td>20 m time (s)</td>
<td>3.13 ± 0.10</td>
</tr>
<tr>
<td>30 m time (s)</td>
<td>4.10 ± 0.12</td>
</tr>
<tr>
<td>40 m time (s)</td>
<td>5.40 ± 0.17</td>
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<tr>
<td>Flying 20 m (20–40 m time; s)</td>
<td>2.28 ± 0.08</td>
</tr>
<tr>
<td>Flying 10 m (20–30 m time; s)</td>
<td>1.16 ± 0.04</td>
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<tr>
<th>Table 2</th>
<th>Correlations for Split Times with Percent Common Variance in Parentheses</th>
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<tr>
<td></td>
<td>Club A</td>
</tr>
<tr>
<td></td>
<td>20 m</td>
</tr>
<tr>
<td>10 m</td>
<td>0.94 (88)</td>
</tr>
<tr>
<td>20 m</td>
<td>0.93 (86)</td>
</tr>
</tbody>
</table>

|         | Club B                                                                 |
|         | 20 m | 30 m | Flying 10 m (20–30 m) |
| 10 m    | 0.94 (88) | 0.89 (79) | 0.65 (42) |
| 20 m    | 0.98 (96) |       | 0.77 (59) |

All correlation coefficients are statistically significant ($P < .01$).
ability to accelerate. As the distance of the test increased, the correlation with 10-m time decreased slightly to $r = 0.89$ for 30 m (club B) and $r = 0.81$ for 40 m (club A). Even with the 40-m sprint test time, the correlation with 10-m time was 0.81 (66% common variance), indicating that 10-m and 40-m times still have much in common and are not measures of unique speed qualities.

However, when the flying 10-m time was used (20–30 m time for club B), the correlation between it and 10-m time dropped to 0.65 (42% common variance). In the case of club A, the correlation for 10-m time and flying 20 m (20–40 m time) decreased even further to 0.50 (25% common variance), clearly indicating uniqueness between these two measures. These results indicate that using split times, such as in the current study, the measures become more unique compared with the acceleration performance represented by the 10-m time. We suggest that the 20 to 30 m and 20 to 40 m times are more influenced by maximum speed capabilities. This is likely because the 20 to 30 m and 20 to 40 m flying times are recorded when the athlete is moving at greater running speeds and the influence of the early acceleration (0–20 m) can be reduced. Our suggestion is supported by data of 12 VFL footballers who had their speed recorded every 5 m over a maximum effort 60-m sprint from a standing start. After 10 m, the mean percentage of maximum speed was 82%, indicating a large increase in velocity had occurred. By 20 m, the players had achieved 93.1% of maximum speed and at 30 m, the corresponding value increased to 99.0%. Maximum speed was reached at 40 m, which indicates that the split from 30 to 40 m did not produce further significant increases in running speed. If similar velocity profiles occurred in the AFL players tested in the current study, running speeds between 20 to 30 m could be expected to be close to maximum, with at least 40 m required to assess the true maximum speed. Although AFL players are unlikely to reach maximum speed in a 30-m sprint test, the near maximum speeds achieved would allow the 20 to 30 m split to be strongly influenced by maximum speed capabilities.

The only way to truly isolate maximum speed is by recording running velocity instantaneously over a long enough time and distance to observe a plateau in peak velocity. One method to achieve this would be with a radar or laser device that continuously measures running speed directly. Another method is the use of global positioning systems (GPS), which would be suitable for recording maximum speed sprints, providing the sampling rate is high enough (e.g., 5 Hz or greater). An alternative method that is only an estimate of peak speed is to place several sets of timing gates on a track at short intervals, such as every 10 m. The smallest time would allow an estimate of peak speed to be determined (speed = distance/time), but it would still represent an average rather than true maximum value. Nevertheless, these methods of assessing maximum speed are not as convenient and cost effective as using a timing light system that requires only 3 timing gates, as was conducted by the AFL clubs in the current study. Another disadvantage of testing maximum speed with relatively long sprint tests (greater than 50 m) is the difficulty in locating a convenient indoor venue to accommodate that distance. The results of the present analysis suggest that 30- or 40-m sprints are long enough distances to separate early acceleration and an estimate of maximum speed qualities, providing flying split times are used such as 20 to 30 m or 20 to 40 m. This enhances the likelihood of testers being able to conduct sprint analysis in an indoor venue.
Practical Applications

Time to 20 m in a 20-m sprint test is largely determined by acceleration capability. Therefore if space permits, a useful sprint test appears to be a 40-m sprint conducted indoors with 10-m time and 20 to 40 m or 30 to 40 m time used to represent acceleration and estimated maximum speed, respectively. Although the 30 to 40 m split was not recorded, it may be preferable to use this split rather than 20 to 30 m to better represent maximum speed. If space only allows the use of a 30-m sprint, the 10-m time and 20 to 30 m times should also be useful. When using multiple trials, these times should come from the same trial.

When a correlation between two measures or tests is only moderate (e.g., $r = 0.5$), the relationship suggests that some individuals may be relatively good at one test but not the other. One of the reasons for conducting tests of independent or unique speed qualities is to identify individual player strengths and weaknesses. Figure 1 shows the scatter plot for the 10-m time and flying 20-m time for club A, where the correlation coefficient was 0.50. Because the mean scores for each test are indicated by the dotted lines, it can be seen that each player can be classified as having above or below average results for each test, and can be placed into one of four categories (Figure 1).

**Figure 1** — Scatter plot for 10-m time and flying 20-m time for club A (correlation coefficient = 0.5). The mean 10-m time and 20 to 40 m times are 1.89 seconds and 2.28 seconds respectively.
Sprint Testing in Footballers

Assuming that the means are representative of the AFL population, an above average result may be interpreted as a strength, whereas a below average result may be interpreted as a weakness that requires more emphasis in training. While all players may be given sprint training to develop all speed qualities, this process can help to individualize training. For example, the player represented by the circled data point in quadrant one was ranked 30 out of 35 for the flying 20-m time, and may benefit by emphasizing maximum speed training (Figure 1). Conversely the individual highlighted in quadrant 4 achieved one of the best flying 20-m times, but was only ranked 24th in the group for 10-m time, and may therefore be advised to place more emphasis in training on developing acceleration.

Conclusions

The results of this study indicate that 20-, 30-, and 40-m times assess similar speed qualities to 10-m time. This is likely to be because all these times are significantly influenced by acceleration capabilities. However, the commonality was significantly reduced when 10-m time was correlated to 20 to 30 m time in the 30-m sprint or 20 to 40 m in the 40-m sprint. We suggested that these flying times are more representative of maximum speed capabilities and therefore can be used to profile acceleration and estimated maximum speed of athletes. This hypothesis should be examined by future research designed to determine if these flying times are strong predictors of the true value of maximum speed, as measured during longer sprints of at least 60 m.

References


