Effect of different bowling surfaces on bowling speed of pace bowlers: A cross-sectional study

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Research Article

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Abstract

Objectives

Cricket is a popular game played across many countries in varied playing conditions ranging from ball, bowling surface, outfield and weather. Speed of bowling is a significant factor that can decide result of any match; and therefore, it always attracts sports professionals to study and analyse it in detail.

Methods

This research presents an original field-based study carried out to understand the effect of different bowling surfaces (natural turf and concrete) on bowling speed of 41 fast and medium pace asymptomatic bowlers having no injuries, especially to the shoulder joint and back, during 3 months before participation in this study. This single occasion cross-sectional design study comprised of Physical profile evaluation and Bowling velocity assessment performed with SRA 3000 Tracer Precision Radar gun.

Results

This research discusses the statistical analysis of the observations with the help of mean value, standard deviation and t-value and concludes that the ball speed decreases less after pitching on the cement-based pitch than natural turf. The data signify that on the concrete-based pitch the post pitching speed remains slightly higher and Pitch pace which is difference at 2 ends of the pitch is decreased.

Conclusion

Potential applications of this field research are also presented, which include development of judgement and accurate bat swing according to ball speed; fair degree of confidence in replacing season cricket ball with a tennis ball for practice sessions from the speed point of view and ascertaining the need of safety equipment.

Background

Cricket is a game widely played across many countries. Despite its popularity, the playing characteristics of the pitch have remained unclear. Bowlers must apply lots of techniques to trick the batsmen in order to take a wicket.[1] One of the most important factors contributing to bowling performance is ball release speed and interaction between ball and pitch.[1–3] Speed of the ball is quite significant for any fast or medium pace bowler in this game. The batsmen needto predict the trajectories of deliveries based on the angle and velocity of deliveries. [4]Interaction between cricket ball and pitch includes pace, bounce and

consistency. Pitch pace is the difference between pre and post pitching speeds. [2]Different surfacestend to have different ball-pitch interaction.Cricket is usually played on a natural grass surface. In the case of club and junior level cricket, the pitch which is used can be flat concrete strips. [2]

The natural turf is a surface on which the match takes place and is prepared over time comprised of closely mown grass on a compacted layer of soil. [5]It is assessed by soil profile tool for moisture content, then watered and rolled to prepare the pitch for matches. Properties of the pitch such as grass type, surface grass content, moisture content, and soil percentage as well as local conditions influence the reflection characteristics of the delivery. [5–8]

Traditional turf behaves unpredictably because of bumpy surface and an attempt to stroke is futile and dangerous to inexperienced and even seasoned players. Concrete provides a permanent solution to the problem along with low maintenance; prevents excessive wear of balls and can't be damaged by playing when wet. [9] A study on natural grass surface has revealed that when the measurements were combined in a simple Newtonian model, good pace predictions were achieved. The study on various pitches of England and Wales suggested that a ball retained 90.2% of its speed before impact on the fastest pitch monitored compared to 87.1% for the slowest pitch.[5]Characteristics of various synthetic pitches have also been studied and it suggested that the speed ratio of traditional synthetic surface falls within the ratio for the natural turf, whilst the value of All-season synthetic surface fall outside the range.[2]

In India, despite the traditional season ball, a hard tennis ball is also popularly used for practice sessions. One of the studies [10] obtained a measurement of ball release speed of balls with different weight. They found that ball speed decreased as the weight of the ball increased.

There is no such study comparing the natural turf characteristics with that of concrete surface. The present study aims to compare the speed ratio (pace of pitch) of the two above mentioned pitches/surfaces which includes the speed at bowling and keeper's end. As there is no evidence of change in ball release speed of different types of balls, the study aims to assess the difference in ball release speed of season and tennis balls.

Methods

Participants:

41 male fast and medium-fast pace bowlers out of which 36 players were Right arm and 5 were left-arm bowlers (having different Age (20.56 ± 4.13); Body Mass (65.62 ± 11.96); Height (1.69 ± 0.07); BMI (22.98 ± 3.34)) from various cricket academies from Amritsar, Punjab, India volunteered to participate in the study. Sample size was calculated with G power software (version 3.1). Sample size 33 was calculated at α error 0.05 with 80% power (1-β err prob). Participants included were asymptomatic and had no injuries, especially to the shoulder joint and back during 3 months before the testing.[11] 32 out of 41 participants had participated in at least state level tournament.

Surface:

Two distinct categories of surface namely natural bowling turf and concrete-based pitch were used to assess the bowling speed.

Different balls:

Two different types of balls were used in the study.

1) SG Club four-piece cricket leather ball (Red, weight- 156 gm) (Sanspareils Greenlandscricket) (Meerut, Uttar Pradesh, India)

2) Sixer hard tennis ball (Red, Weight- 120 gm) (Jalandhar, Punjab, India)

Four new balls (2 of each type mentioned above) were used in this study. [2]

Testing procedure

The study was approved by the institutional medical ethics committee of Guru Nanak Dev University, Amritsar, Punjab, India. Single occasion Cross-sectional design study, which included Physical profile evaluation and Bowling speed assessment, was performed. The bowling speed assessment was performed at various academies of Amritsar, Punjab, India. Physical profile evaluation included Body mass & Stature which was performed at strength analysis lab, Department of sports sciences and medicine, Guru Nanak Dev University, Amritsar. Statistical analysis and other research work were conducted at Human performance lab, Department of sports sciences and medicine, Guru Nanak Dev University, Amritsar. SRA 3000 Tracer Precision Radar gun (Homosassa, Florida, United States) with range up to 60 feet and measuring speed of 10-199 mph was used to assess the bowling speed of players.[12] Morning session (7 to 10 am) was selected for speed evaluation to avoid excessive exertion or fatigue for the bowlers as Amritsar is known for extremely hot weather in this season.

Participants were instructed to perform a warm-up of 15 minutes including running, stretching (static and dynamic stretches) & shadow deliveries.[11,13,14] Bowling facilities were pre-assessed for length, to confirm that each one is having a standard length of 20.12 m (22 yards). The edges of good length deliveries were marked with bowling cones at 3.8 to 5.8 m from Keeper's end.

Participants were required to bowl 24 deliveries [(4 * 6 bowls per over); (2 overs on natural turf, 2 on cement surface* 2 different balls)]. The size of the facility enabled the participants to use their full run-up lengths. Participants were asked to bowl good length deliveries of maximum speed possible. Rest periods given between each delivery was 40-60s.[13] During deliveries front foot placement was monitored by assessor, so the "no-ball" deliveries get excluded as per the cricket bowling rules.[14] Within one over, half of the deliveries measured were at one end of the pitch (Bowling end) and a half at the other (Keeper's end).[2] The order was consistent as Natural turf followed by Concrete-based surface.

At the bowling end, the gun was placed 5 m behind the bowling crease, pointing down a line joining the middle stump at the bowler's end to the middle stump at the Keeper's end.[13] At Keeper's end, the gun was placed 3 m behind the middle stump, pointing towards the ball landed at good length from the middle stump.[2]A protective net was placed between a radar gun and stumps to prevent injury to the tester and radar gun.[3]

The procedure was repeated as two balls were included in the study. The sequence was maintained as bowling with SG season ball followed by Sixer hard tennis ball. Players were given adequate rest so they do not get fatigued. For this, each player was assessed for 2 days, 2 overs per day. Between each delivery 40-60 s rest was given and after each over 10-15 mins active rest was given.

Statistical analysis:

Measures of centrality and spread are presented as mean ± SD. The analysis was performed with all data included for 2 different surfaces. i.e. Natural turf and concrete-based pitch. Separately comparison between two ends of pitch and two different balls was performed.

Independent T-test was used to assess between-group differences. A level of $p \leq 0.05$ was considered significant.[15] Statistical analysis was conducted using SPSS statistics version 23 (IBM, Chicago, IL, USA)

Results

Table 1
Difference between Bowling end and Keeper's end:

Parameters	Mean ± SD	t-value	p-value
Bowling End speed (kmph)	94.04 ± 11.20	3.114	0.002
Keeper End speed (kmph)	91.08 ± 11.25		

The difference at bowling end and keeper's end:

The difference in bowling speed at bowling and keeper's end is shown in Table 1. The results were analysed by calculating an average of 3 deliveries per end with each of the two balls and on 2 different surfaces. It is observed from the table that the mean value of bowling speed was 94.04 and 91.08 and the standard deviation was ±11.20 and ±11.25 at the bowling end and keeper's end respectively. T-value was 3.114 at p-value 0.002. The data indicates that there is a significant difference between the two ends of the pitch. The speed of the ball at the bowling end is higher than at keeper's end. It suggests that the ball speed at keeper's end reduces as the ball pitches on both surfaces.

Table 2: Difference between a season cricket ball and tennis ball:

Parameters	Mean ± SD	t-value	p-value
Season cricket ball speed (kmph)	92.29 ± 11.62	-1.136	0.257
Tennis ball speed (kmph)	93.72 ± 11.11		

The difference in speed with season cricket and tennis ball:

Table 2 shows the difference in ball speed with 2 different balls (Season cricket ball and Tennis ball). All the results were analysed for 12 deliveries with both balls. The table shows that the mean value of bowling speed with a season cricket ball and tennis ball was 92.29 and 93.72 respectively, whereas the standard deviation was 11.62 and 11.11. The value of t was -1.136. at p value of 0.257. The results indicate that there is no significant difference between 2 different balls. The speed does not change with the type of ball either at the bowling end (Ball release speed) or keeper's end (Post pitching speed).

Table 3: Bowling speed at Keeper's end:

	Season cricket ball		
Parameters	**Mean ± SD**	**t-value**	**p-value**
Natural turf speed (kmph)	89.50 ± 11.75	-3.276	0.002
Concrete based pitch speed (kmph)	96.72 ± 7.78		
	Tennis Ball		
Parameters	**Mean ± SD**	**t-value**	**p-value**
Natural turf speed (kmph)	90.06 ± 9.11	-3.325	0.001
Concrete based pitch speed (kmph)	96.89 ± 9.47		

The difference of speed on Natural turf and concrete based pitch:

Table 3 shows the results of bowling speed at keeper's end on different surfaces. With season cricket ball the mean values are 89.50 and 96.72 with a standard deviation of 11.75 and 7.78 at keeper's end of natural turf and concrete-based pitch respectively. With tennis ball on natural turf and cement-based pitch, the mean values are 90.06 and 96.89, whereas the standard deviation is 9.11 and 9.47 respectively. The result shows that there is a significant difference in speed between 2 surfaces with season cricket ball (t value -3.276, p-value 0.002) and tennis ball (t value -3.325, p-value 0.001). This suggests that the ball speed decreases less after pitching on the cement-based pitch than natural turf. The data signifies that on the concrete-based pitch the post pitching speed remains slightly higher and Pitch pace (Difference at 2 ends of the pitch) [2] is decreased.

Discussion

At both surfaces, natural turf and concrete based pitch the bowling speed decreased at keeper's end significantly. At keeper's end, this result may help the batsman to predict the speed of the delivery. For bowlers, these results suggest that they need to bowl at a higher speed to achieve a particularly targeted speed at the Keeper's end.

There was no significant difference between a tennis ball and season ball speed. The ball can be used interchangeably as far as its speed is concerned. However, the bounce and consistency of delivery may vary with different balls. Although most of the players usually practice with a season cricket ball, some use tennis ball frequently. Due to their frequent use, the ball bounce and consistency with different balls remain areas requiring further research. As per a study [10] the ball weight may influence the speed of bowling. The study suggested that by increasing 100 gm of weight there was a decrease in ball speed by 1.1 m/s. They also suggested that a training program that uses balls weighing less than about 80 g might produce an excessive change in the player's bowling action (especially ball release angle) if the player attempts to bowl a good length with this ball. In our study, there was no significant difference in ball weight which can lead to a change in speed. Season cricket ball weighing 156 gm gives slightly decreased speed than tennis ball of 120 gm. Therefore we can conclude that season cricket ball can be replaced with a tennis ball for practise sessions as far as only speed is concerned.

Speed characters of the pitch are helpful especially for junior-level players in India, where the use of concrete based pitch is common. With season cricket ball, the ball speed was comparatively more on the concrete based pitch than natural turf. The difference was more significant at the keeper's end. This suggests that while playing on a concrete based pitch the ball reaching the batsman will be faster. It is also observed that this difference is more significant with a tennis ball. Bowling speed with a tennis ball is higher at both ends, and the speed remains higher after pitching than with a season cricket ball. It is thought that the pace of the pitch is affected by more than just the surface restitution as friction and deformation are also important factors.[5, 7] The pace of the pitch is higher on natural turf than concrete based pitch. Studies have also found playing the character of different synthetic pitches, where all-season synthetic pitch is closely similar to natural turf.

The present study has certain specific limitations. For example, the study was required to be conducted at different sports academies of Amritsar, as bringing all 41 players to a single ground was not possible. This could have resulted into some variation in measurement of speed performed at different pitches. While this was accepted with the objective to have a larger sample size of the bowlers; in further research, this could possibly be solved by conducting entire study at the same place. The present study has also shown that its scope could be further expanded to include other interesting parameters like ball bounce and consistency; that can specify pitch characteristics more clearly.

Knowledge of changing the pace of pitch may help batsmen as well as wicket-keepers to predict the deliveries accurately. Development of judgement and accurate bat swing according to ball speed may be

achieved with this research. Variation in speed on various surfaces represents a potential injury risk if players are not familiar with it. Players are advised to wear safety gadgets including helmets at all times. Further, encouraging players to perform practice drills on regular natural turf is important to avoid speed variations. Also transitions from concrete based pitch to natural turf may be smooth and played along with precautions.

Conclusion

Differences were detected in ball speed of natural turf and concrete based pitch on the keeper's end. There was a significant decrease in speed at the bowling end than the keeper's end. There was more decrease in speed after pitching on natural turf than on the concrete based pitch. There was no difference between season ball and cricket ball regarding ball speed. Ball speed characteristics may be helpful in skill development and injury risk prevention of bowlers, batsman as well as wicketkeeper.

Declarations

Acknowledgment

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Conflict of interest: None

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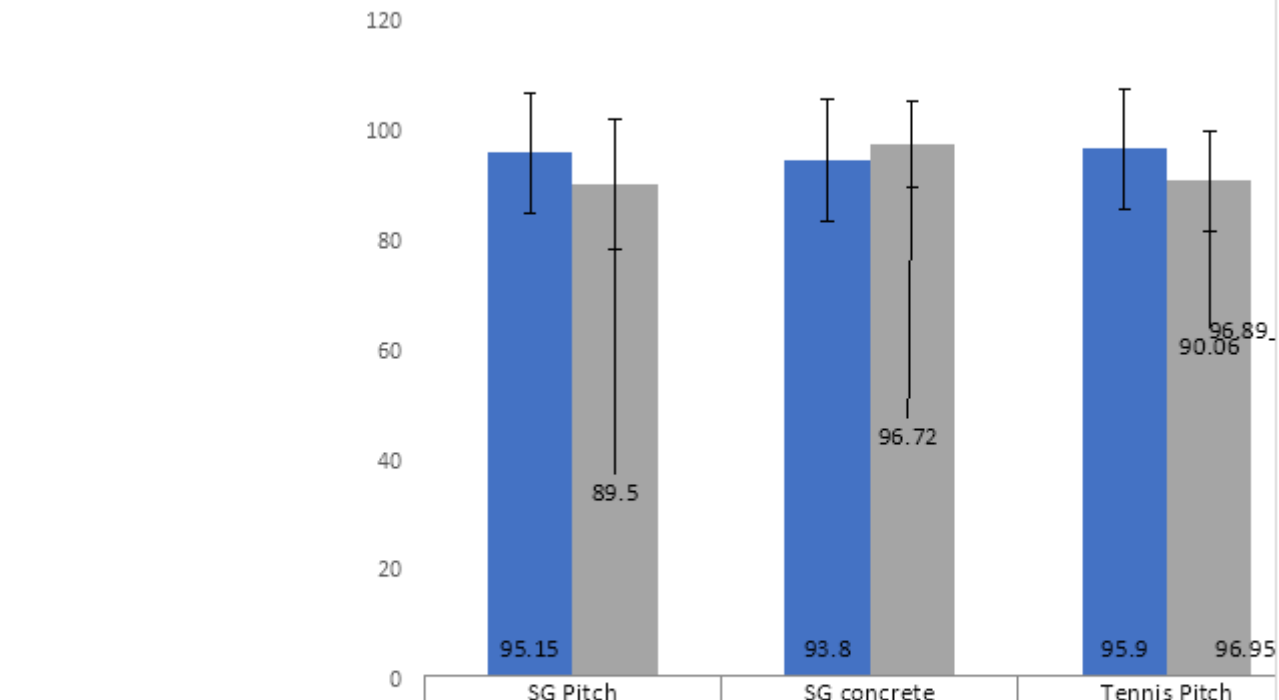
Figures



	SG Pitch	SG concrete	Tennis Pitch
Bowling speed (km/h) at Keeper's end	95.15	93.8	95.9
Bowling speed (Km/h) at Bowling End	89.5	96.72	90.06

Figure 1

Difference of bowling speed between 2 ends. Error bar shows standard deviation values.