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Static and dynamic balance ability, lumbo-pelvic movement control and injury incidence in cricket pace bowlers

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ABSTRACT

Objectives: This study aimed to establish the difference in lumbo-pelvic movement control, static and dynamic balance at the start and at the end of a cricket season in pace bowlers who sustained an injury during the season and those who did not.
Design: This is a longitudinal, observational study.
Methods: Thirty-two, healthy, injury free, male premier league fast, fast-medium and medium pace bowlers between the ages of 18 and 26 years (mean age 21.8 years, standard deviation 1.8 years) participated in the study. The main outcome measures were injury incidence, lumbo-pelvic movement control, static and dynamic balance ability.
Results: Fifty-three percent of the bowlers ($n = 17$) sustained injuries during the reviewed cricket season. Lumbo-pelvic movement control tests could not discriminate between bowlers who sustained an injury during the cricket season and bowlers who did not. However, performance in the single leg balance test ($p = 0.03$; confidence interval 4.74–29.24) and the star excursion balance test ($p = 0.02$; confidence interval 1.28–11.93) as measured at the start of the season was better in bowlers who did not sustain an injury during the season.
Conclusions: The improvement in the lumbo-pelvic movement control and balance tests suggests that the intensity and type of physical conditioning that happens throughout the season may have been responsible for this improvement. Poor performance in the single leg balance test and the star excursion balance test at the start of the cricket season may be an indication that a bowler is at heightened risk of injury.

1. Introduction

In the game of cricket, players take on specific roles which include batting, wicket keeping, fielding, spin bowling and pace bowling. Each of these roles has its own demands and its own unique set of associated injuries. The cricket pace bowling action is a dynamic, complex sequence of high speed movements that may be repeated between 300 and 600 times each week during a cricket season.[1] During the pace bowling action, substantial forces are placed on the lumbar spine facilitating faster ball release speeds, but at the same time predisposing the bowler to injury.[2] Combined postures of lumbar extension, contralateral side-flexion and ipsilateral rotation during the delivery stride are involved in the pathomechanics of low back injuries.[2–4] Such movements, in combination with other biomechanical aspects of pace bowling, such as increased shoulder counter rotation during the delivery stride,[2] are part of the bowling technique and with insufficient muscular stability and control of movement could lead to injuries including, lumbar soft tissue injuries and stress fractures.[3]

Bowling related injuries have been documented as being the result of the normal strain of the bowling technique, but individual muscle dysfunction might contribute to injury. One example of the effect of muscle dysfunction is the inability of individual muscles to control excessive motion at a specific joint. This may result in local hypermobility, tissue pathology and pain.[5,6] Comerford and Mottram[5,7] have developed a theoretical model which states that functional stability is dependent on integrated local and global muscle function. Poor control of movement is described by Comerford and Mottram[7] as the lack of ability to actively control or prevent a compensatory movement when required or instructed to do so. Specific to cricket pace bowlers, overloading the spine with high load forces during bowling in the presence of uncontrolled movement and muscle imbalance further predispose bowlers to injury.[8] Although extensive research is still needed to develop this

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theoretical model into evidence, it may serve as an explanation of how movement dysfunction can predispose the pace bowler to injury.

Balance is defined as the ability to keep the body's centre of mass within the limits of the base of support.[9] Neuromuscular control and especially superior balance ability is likely to be important during the bowling action due to its high load, dynamic and asymmetrical nature. The importance of optimal balance ability in the bowling action is emphasised by the known relationship between poor balance and a higher incidence of injury, as well as the relationship between highly developed balance ability and the reduced incidence of injuries as was established in other populations.[10,11]

Therefore the aim of this study was to investigate the relationship between static and dynamic balance ability, lumbo-pelvic movement control and injury in cricket pace bowlers at the start and end of the cricket season. This may assist in the development of injury prevention programmes.

2. Methods

Ethical approval was obtained from the Human Research Ethics Committee of the associated tertiary institution. Access to the database of premier league pace bowlers was obtained from the Gauteng Cricket Board. Male, premier league fast, fast-medium and medium pace bowlers were randomly invited to participate in this study. Bowlers were screened for inclusion when they were first contacted telephonically. Bowlers had to be healthy and injury free at the start of the cricket season. Bowlers suffering from any clinical apparent injuries or injuries preventing them from participating in bowling and bowlers who have undergone previous surgery to the spine or limbs were excluded from this study. Written informed consent was granted by all participants. Bowlers completed a self-administered questionnaire enquiring about the length of time they had been a bowler, their bowling position in the bowling order and injuries sustained previously. Content and construct validity was found to be acceptable for this self-developed questionnaire. Each bowler underwent a pre-season testing regimen administered by the first author who was blinded to the injury history of the bowler. The occurrence of injuries was recorded monthly during the cricket season via the completion of self-administered questionnaires. For the purposes of this study an injury was defined as a musculoskeletal condition that resulted in the loss of at least one day of sporting activity or that occurred during a sporting activity that required medical attention and which forced the bowler to quit the activity.[6,12] At the end of the cricket season all bowlers again underwent the same testing regimen as was administered pre-season.

Bowlers underwent single leg balance- (SLBT), star excursion balance- (SEBT) and lumbo-pelvic movement control tests (Table 1). The SLBT were conducted with the bowler's eyes closed standing on a stable surface, eyes open standing on an unstable surface (Airex® balance pad; Fitter International Inc., Calgary), and eyes closed on an unstable surface. The time was recorded when the bowler lost his balance, opened his eyes or when 180 s was reached.[10]

The SEBT was conducted by instructing the bowler to stand on his right leg and reach as far as possible with his left leg in an anterior, postero-lateral and postero-medial direction.[13,14] The bowler had to lightly touch a spot as far as possible in a specific reach direction without transferring his weight onto his reach leg. The bowler then had to return to double leg stance without changing the base of support of the stance leg. The test was abandoned when the bowler removed his hands from his hips, failed to maintain unilateral stance, lifted or moved the stance foot, touched down with the reaching limb, or fail to return to the starting position. The test was repeated with the bowler standing on the other leg.[14]

Leg length was measured from the most distal end of the anterior superior iliac spine (ASIS) to the most distal point of the lateral malleolus. All reach values were then calculated as a percentage of leg length (reach distance in cm/leg length in cm × 100). Combined reach scores were calculated by dividing the sum of the reach distance in the anterior, postero-lateral and postero-medial directions by three times the limb length, then multiplied by 100.[15] The different movement control tests used in this study are itemised and detailed in Table 1.[6,16,17]

The SLBT and SEBT indicated excellent inter- and intra-rater reliability. Only intra-rater reliability was established for all the movement control tests as the same researcher performed these tests. Tests were recorded and video clips were rated one week later to establish intra-rater reliability. The ICC was used for all continuous variables. The weighted kappa coefficients were calculated for the rest of the variables which were all binary. Agreement above 0.75 was described as excellent and below 0.75 as poor.[18] The prone lying active knee flexion (PLKF) to 90° on the right ($k = 0.71$), PLKF to 120° on the left ($k = 0.59$) and the one leg standing (OLS) on the left (ICC = 0.72) and right (ICC = 0.50) showed poor agreement and was as a result not included in the presentation and discussion of results.[16,19] All other movement control tests showed excellent agreement.

Data were analysed using STATA Data Analysis and Statistical Software (version 11.2; TX, USA). Bowlers were divided into two groups: bowlers who sustained a lower quarter (LQ) (low back and lower limb) injury during the cricket season under review are referred to as "LQ injury" and those who did not sustain an injury are referred to as "no LQ injury." All data were assessed for normality before testing and $p < 0.05$ defined statistical significance. Binary data were organised into contingency tables using the Fisher's exact test. Associations were established for continuous data using the independent Student's *t*-test and the Mann–Whitney *U* test (LQ injury vs no LQ injury) as well as the paired Student's *t*-test and the Wilcoxon matched pairs test (pre-season vs post-season).

3. Results

Thirty-two, male, premier league fast, fast-medium and medium pace bowlers, aged 18–26 years (mean age 21.8 years, SD 1.8 years), participated in this study. Most participants were classified as medium pace ($n = 16$; 50%), opening bowlers ($n = 25$; 78%). Seven bowlers (22%) were first change bowlers, 11 (34%) were fast bowlers and 5 (16%) were fast-medium bowlers.

The prevalence and incidence of injuries amongst bowlers are shown in Table 2. Eighty-eight percent ($n = 28$) of bowlers had sustained previous cricket related injuries. Fourteen percent ($n = 4$) of these bowlers injured their lower back. During the season 53% ($n = 17$) sustained injuries. A high number of injuries were sustained during bowling ($n = 16$; 94%).

There was no statistically significant difference between bowlers who sustained an injury and those who did not sustain an injury during the cricket season were found in terms of the following variables: age, type of bowler, handedness, bowling experience and previous injuries sustained ($p = 0.06$–0.68).

Bowlers performed better in the SLBT at the start of the season than at the end of the season (standing on left leg in injured bowlers $p = 0.02$, CI 4.74–29.24; standing on right leg in non-injured bowlers $p = 0.02$, CI 15.95–43.02). At the start of the season, injured bowlers were able to stand for a shorter period of time on an Airex balance pad with their eyes closed when compared to non-injured bowlers ($p = 0.03$, CI 1.13–2.31). The LQ injury group performed worse in the SEBT posterior medial reach direction while standing