

BIOMECHANICS IN TESTING THE LEGALITY OF A BOWLING ACTION IN CRICKET

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Movement analysis in sport and leisure is clearly the domain of the sports biomechanist. Technique modifications to improve performance or reduce the incidence of injury are currently administered. However, the analysis of sporting movements, from a legal perspective, is a more recent development. This paper discusses the procedures used in testing the legality of actions used in bowling in cricket.

KEY WORDS: motion analysis, cricket, Vicon

INTRODUCTION:

The current **no ball** law in cricket with reference to throwing states:

“the arm should not be straightened in the part of the delivery that immediately precedes ball release”

The sport biomechanist in assessing the legality of a bowling action must first decide on the design of the analysis protocol. Questions that need to be answered before deciding on this protocol are:

- Is movement analysed in a laboratory setting representative of what occurs in the game environment? Also, are athletes capable of changing their action to comply with regulations when being filmed in a laboratory environment?
- Does the lack of accuracy in determining joint centres under baggy clothing worn in match conditions, lead to uncertainty about the error in the collected data?

The laws of the game must also be read from both a “spirit of the game” and a biomechanical perspective. In fast bowling the phrase “immediately before delivery” must be interpreted from both those perspectives.

This paper will show how the Sri Lankan spin bowler Muttiah Muralitharan on being “called for throwing” was analysed within the biomechanics laboratory of the Department of Human Movement and Exercise Science. After this the proposed procedures to be used to assess the action of the Pakistan fast bowler Shoaib Akhtar will also be presented.

1. Muttiah Muralitharan

Muttiah was originally “called for throwing” in the 1995-1996 Australian season. In 1996 we used three-dimensional cinematography to show that Muralitharan did NOT extend his elbow during his bowling delivery. Extension at the elbow was considered to be one of the key characteristics of a throwing action, compared to an action where the upper arm and forearm remain in a relatively constant relationship as is required in the bowling action. Unfortunately, Muralitharan was again “called for throwing” in the Australian Summer of 1998/9.

An analysis was structured that included motion analysis and anthropometric assessment as it was evident from observing video and on preliminary interviews with the bowler that he had an upper limb structural abnormality that could not be changed during his bowling action. An extremely accurate motion analysis system (Vicon opto-electronic system), specifically developed software and anthropometry were therefore used to further assess Muralitharan’s bowling actions under controlled laboratory conditions. The bowling run-up and wicket were set-up in an indoor to outdoor facility, in a way that allowed him to use his full run-up during the bowling action. Fourteen markers were placed strategically on the upper limb so that the segments could be statically calibrated using Vicon software. This enabled movements of each segment to be studied with respect to the adjoining segment in three dimensions. Seven of these reflective markers were left on the upper limb, during 4 trials of each of three

(off-break, topspin and leg-break) deliveries. Bodybuilder software (Bodybuilder for Biomechanics, Oxford Metric Ltd., 1997) was used to analyse marker movement, so that three-dimensional joint angles could be calculated throughout the bowling action.

A. ANTHROPOMETRY REPORT

Standard measures were recorded by a qualified (criterion level 4) anthropologist. It is obvious from measurements of Muralitharan's bowling arm (Table 1, Figure 1) that he has a structural abnormality. Muralitharan has an elbow joint that is fixed in a flexed (37° of flexion when arm fully extended) and abducted position (forearm and upper arm are not in a straight line: 18° out of line - Figure 1). This will give the impression that he has adopted a "throwing position" during his bowling action, particularly when the viewing direction of his arm changes through the delivery.

Table 1 Anthropometric Measurements

	Muralitharan	Normal
Elbow Angle		
Flexion	147°	Normal
Extension	-37°	0°
Forearm deviation (carry angle) (Figure 1)		
Wrist Angle		
Flexion	90°	Normal
Extension	62°	Normal
Ulnar deviation	31°	Normal
Radial deviation	21°	Normal

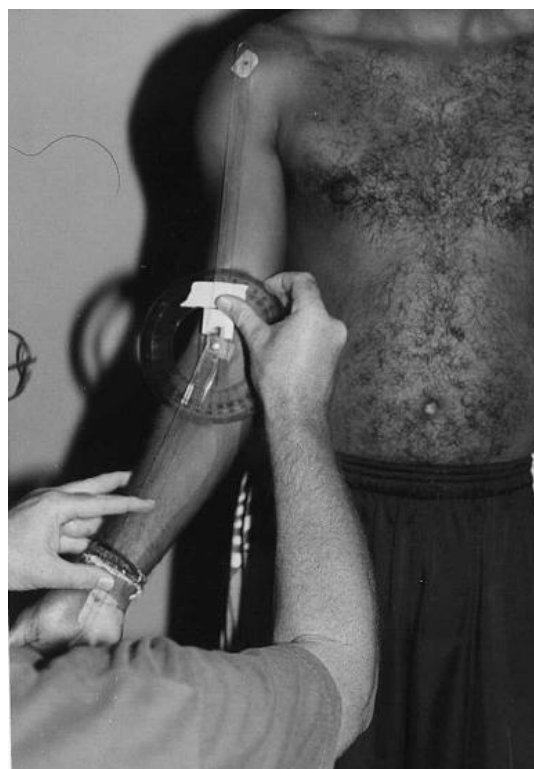


Figure 1 - Upper Limb "Carry Angle"

B. BOWLING ACTION

The Vicon Motion Analysis System recorded three-dimensional changes in the elbow angle during the bowling action. This paper concentrates on flexion-extension of the elbow joint, as the action a cricket umpire focuses on in assessing if a throwing action has occurred (greater change in extension at the elbow, the more a throwing action is evident). In evaluating the range of elbow joint extension in the period before and immediately after release, it must be stated that: marker movement would be responsible for very minor changes in this angle ($\approx 2^\circ$), and any spin bowler would expect to record small changes in elbow angle during the delivery phase of the action.

Table 2 Mean Flexion-Extension Angle Change while Extending and Flexing for Three Trials of each Delivery Action in the Periods Surrounding Ball Release (°)

Period	Angular change while Extending			Angular change while Flexing		
	Offspin	Topspin	Legspin	Offspin	Topspin	Legspin
Upper arm vertical downward to upper arm horizontal	-3.0	-0.7	-3.0	0.5	0.2	2.3
Upper arm horizontal to ball release	-0.1	-0.3	0.0	3.4	3.6	5.6
0.06 s to ball release	0.0	-0.3	0.0	2.0	1.3	4.0
0.02 s to ball release	0.0	-0.3	0.0	0.5	0.3	2.3
Ball release to 0.04 s post-release	-0.4	-0.7	0.0	0.3	0.1	3.8

The range of recorded movements (Table 2) clearly shows that Mr Muralitharan did NOT adopt a throwing action for any of the deliveries recorded during this video session. The changes in angle are entirely within acceptable margins of measurement for a person who does not generate ball speed by a “throwing-action” as defined in cricket laws. In fact, in many of the deliveries the elbow angle is very slightly REDUCING in size, a clear sign that throwing has not occurred.

While the angle at the elbow obviously changes during the preparatory movements during the 0.06 s period before and immediately after release the elbow angle is relatively stable. The part of the “no-ball law” that states the arm should not be straightened immediately before delivery must be related to aspects of technique that can be observed by an umpire (e.g. from when the arm is vertically downward or horizontal to release)

This report, which was sent to the Sri Lankan cricket board, was also forwarded to the International Cricket Council (ICC) together with videos of Muttiah’s bowling action.

2. Shoaib Akhtar

Shoaib Akhtar was called for throwing during the 1999-2000 Australian season. Subsequently, the ICC, on advice from one of its technical committees, suspended him. He was then cleared to play in one-day fixtures as it was considered he only transgressed when bowling a bouncer (not permitted in one-day cricket).

The proposal structured for Akhtar was that a period of coaching would precede any analysis work. This coaching involved technique (video), anthropometry and strength assessments. A three-dimensional video (Peak system) on-field assessment with the bowler appropriately dressed or a laboratory-based three-dimensional Vicon assessment was then planned. A split-screen video was proposed, where deliveries from perspectives commonly viewed by an umpire could be compared with previous footage taken after the period of training.

CONCLUSION: The governing body of the sport in question must decide on the type of data needed to convince the board of the legibility of a bowling action. If this is not available then the research team must make value judgements on providing the best possible data for evaluation.

At times this will mean laboratory-collected data, although on-field analysis may, in other circumstances, be better. Muttiah Muralitharan, a spin bowler with an upper limb constraint, was best analysed using anthropometry and laboratory assessment. However, Shoaib Akhtar, a fast bowler, would be best assessed under structured outdoor or match conditions