

## Transcript of report on The University of Western Australia letterhead

### Final Bowling Report - Mr Shoaib Akhtar

University of Western Australia  
Department of Human Movement & Exercise Science  
Perth, Australia

21<sup>st</sup> April 2001

Professor Bruce Elliott  
Dr David Lloyd  
Ms Jacque Alderson  
Mr Daryl Foster

In response to a proposal from Mr Daryl Foster, acting on a request from Pakistan Cricket Board Mr Shoaib Akhtar was referred to the Biomechanics Laboratory of the Department of Human Movement and Exercise Science at the University of Western Australia, for an analysis of his bowling technique. Mr Akhtar arrived in Perth on March 20<sup>th</sup> following New Zealand umpires lodging a suspect bowling action report on February 28<sup>th</sup>.

In response to a proposal from Mr Daryl Foster, acting on a request from Pakistan Cricket Board Mr Shoaib Akhtar was referred to the Biomechanics Laboratory of the Department of Human Movement and Exercise Science at the University of Western Australia, for a analysis of his bowling technique. Mr Akhtar arrived in Perth on March 20<sup>th</sup> following New Zealand umpires lodging a suspect bowling action report on February 28<sup>th</sup>. Mr Akhtar's initial three-dimensional analysis testing session was carried out on March 22<sup>nd</sup>. This analysis comprised of

- an anthropometric assessment of his bowling arm,
- a preliminary three-dimensional analysis of his bowling arm from a position vertical to the ground to ball release. This involved filming Mr Akhtar using two high speed video cameras (200Hz) and Peak motion analysis software for data processing.

A second three-dimensional analysis, following a three-week coaching period, was carried out on the 12<sup>th</sup> April 2001. This involved filming Mr. Akhtar using four high speed video cameras (200 Hz) and Peak Motus and Vicon Bodybuilder software for data processing.

### **Definition of Fair Delivery**

*A ball is fairly delivered in respect of the arm if once the bowlers arm has reached the level of the shoulder in the delivery swing, the elbow joint is not straightened partially or completely from that point until the ball has left the hand. This definition shall not debar a bowler from flexing or rotating the wrist in the delivery swing.*

## Preliminary Results (March 2001)

### 1. Anthropometric Assessment

Mr Akhtar was found to have a carry angle (arm out of alignment) of  $22^{\circ}$  and a hyperextension value of  $18^{\circ}$  (See figures 1 and 2 for pictures of arm abnormalities).

Elbow Angle	Akhtar (Active)	Akhtar (Passive)	Normal
Full flexion	$143^{\circ}$	N/A	$\approx 150^{\circ}$
Full extension	$-6^{\circ}$	$-18^{\circ}$	$\approx 0^{\circ}$
Forearm valgus/abduction deviation ('carry angle')	$22^{\circ}$	N/A	$\approx 5^{\circ}$

### Definition of Terms

**Hyperextension:** The anatomical definition of hyperextension is movement of a joint posterior to the anatomical position (extension past  $0^{\circ}$ ). The clinical definition is "an abnormal, forced extension of a joint beyond its normal range of motion"

**'Carry angle':** When the arm is extended in the anatomical position the longitudinal axis of the upper arm and forearm form a lateral (valgus/abducted) angle at the elbow joint known as the 'carry angle'. The angle therefore between the alignment of the upper arm and forearm.

**Active:** The measurement achieved by an individual without assistance.

**Passive:** The measurement achieved by an individual with assistance.



Figure 1: Active elbow joint hyperextension & rotation

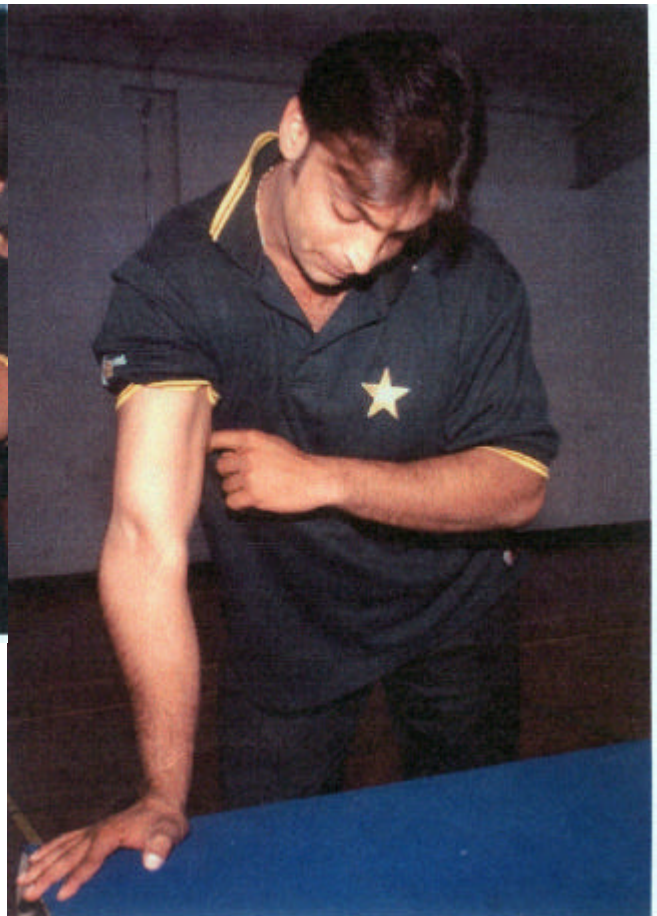


Figure 2: Passive elbow joint hyperextension & rotation

## 2. Preliminary Bowling Assessment

High speed videography (2 cameras, 200Hz) was utilised to film four trials of three different delivery types. The fastest delivery from each of the; express deliveries (over wicket), bouncers and express deliveries (around wicket) were selected for analysis. The radar gun was used to monitor ball speed and the motivate Mr Akhtar to produce high speed deliveries (greater than 140 km/h) across the testing session. The velocity of the three deliveries selected for analysis were:

- Express delivery (over wicket): 149.7 km/h
- Bouncer: 146.5 km/h
- Express delivery (around wicket): 146.5 km/h

To check the reliability of the fastest express delivery as being representative of all his express deliveries the two highest speed deliveries from each delivery type were superimposed to check the consistency in angle change over the bowling delivery. Figure 3 of the two highest speed deliveries (over the wicket) clearly shows this consistency.

Figure 3: Elbow angle consistency across 2 trials

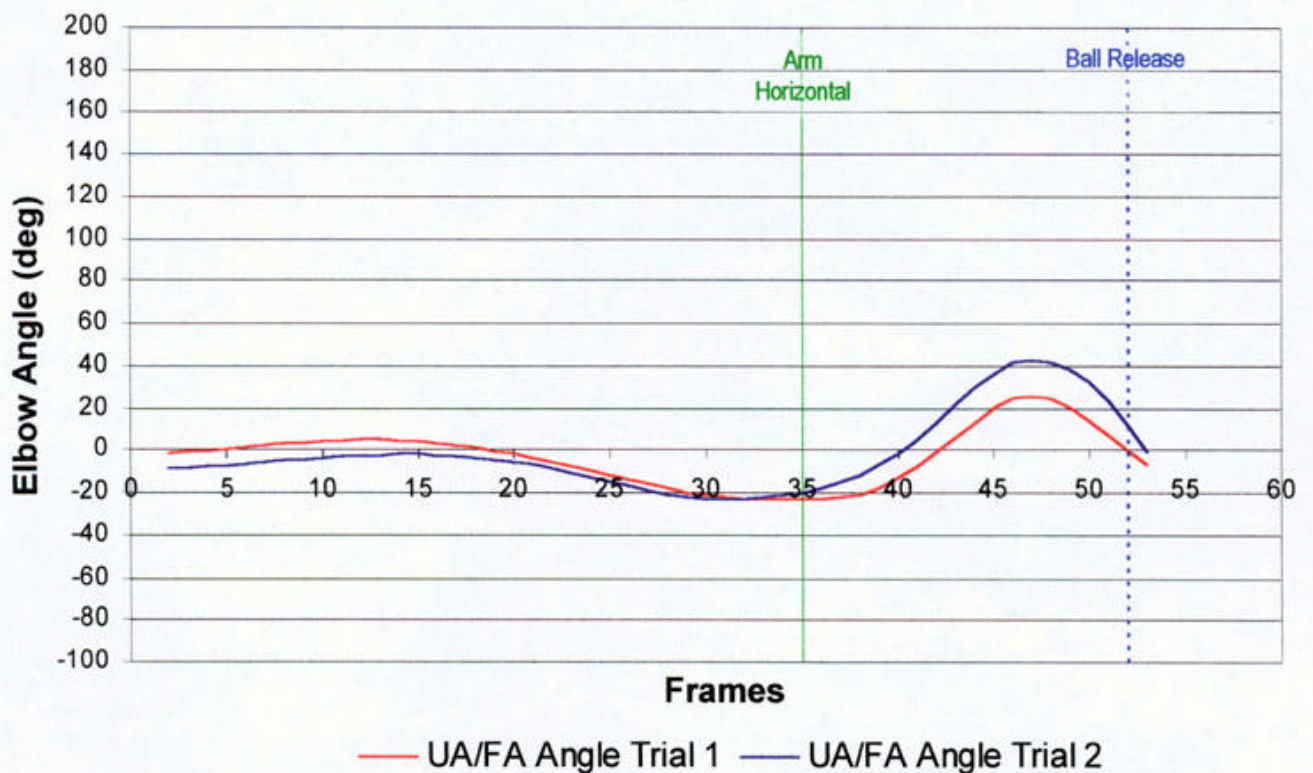
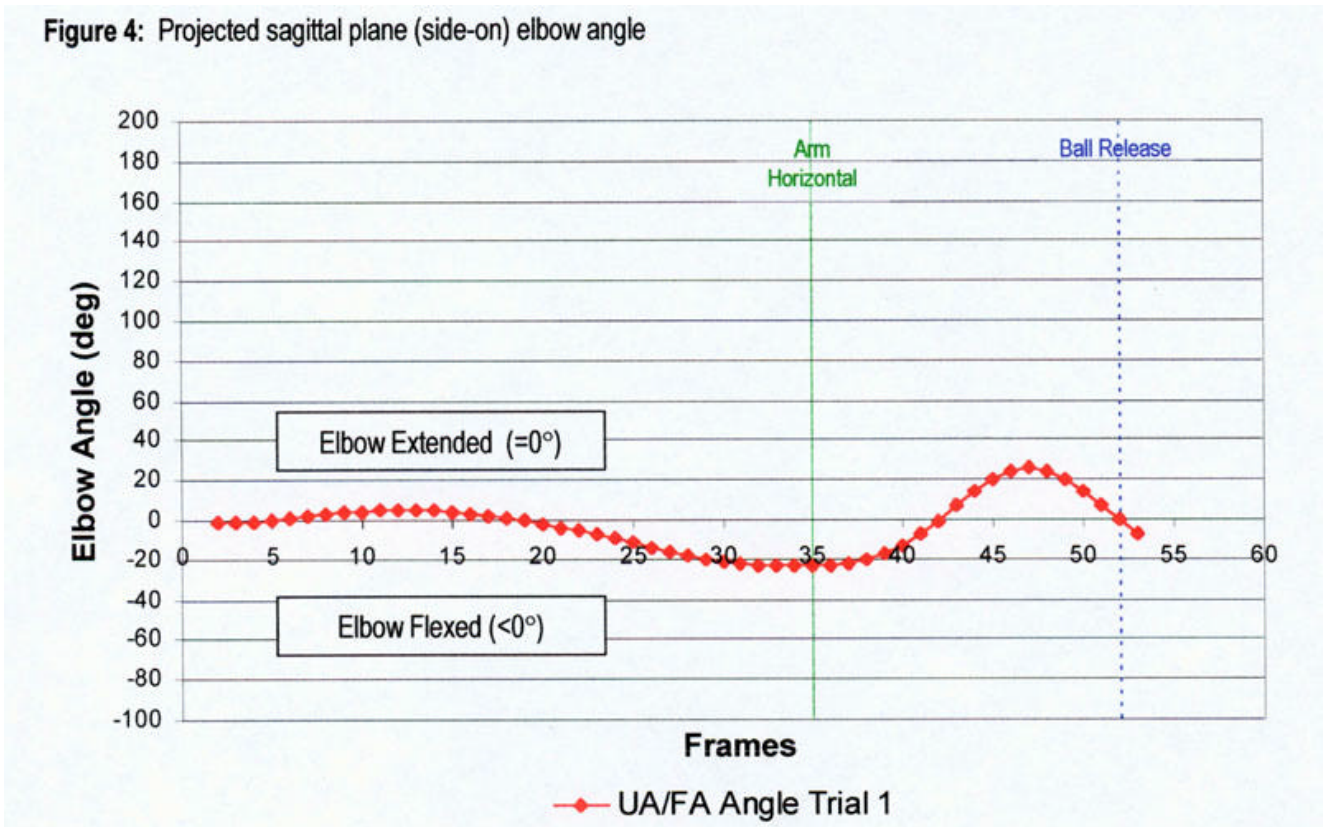


Figure 4 represents the two-dimensional elbow angle profile (as viewed by an umpire) of the fastest delivery from the time the arm is vertical to the ground until ball release. Pictures at relevant stages of the action have been printed directly from the video to further clarify angle changes over the delivery action.

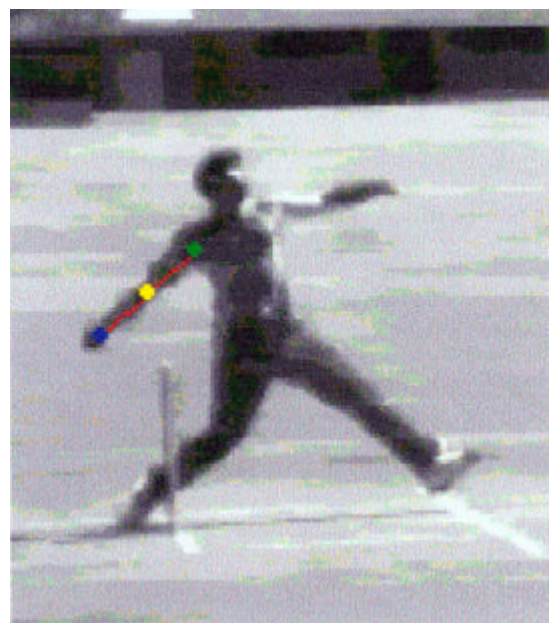


**Delivery Preparation**

In the time period from when the arm is vertical to the ground until almost the horizontal position (the first 20 frames of figure 4) Mr Akhtar clearly has an extended bowling arm with relatively no change in elbow angle (figures 5 & 6).



**Figure 5**



**Figure 6**

## Delivery Phase

The position of the arm when horizontal to the ground is the position that may concern umpires. The carry angle at the elbow ( $22^{\circ}$ ) presents the illusion of a flexed elbow joint. As Mr Akhtar drives the bowling shoulder forward this forces the shoulder into an externally rotated position and the elbow into a fully abducted<sup>1</sup> position (figures 7 & 8). The abnormal movement possible at the elbow caused by his carry angle results in this elbow position. In a fast bowler with a normal elbow joint carry angle this abduction is not possible (in other words the arm would remain relatively straight).



Figure 7

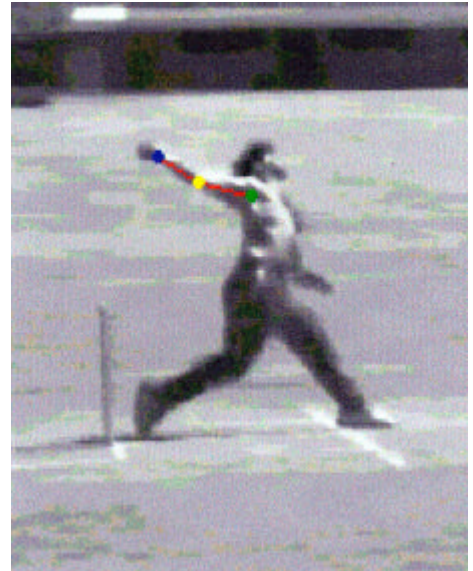


Figure 8

<sup>1</sup> This abducted position relates to his ability to abnormally align his forearm and upper arm – his excessive carry angle.

## Ball Release

At release the arm is again straight (Figure 10). The movement from hyperextension (Figure 9) to extension is one of flexion is **NOT** against the spirit or the law of bowling.



Figure 9



Figure 10

## Final Results (April 2001)

### 1. Introduction and Review

Following Mr Shoaib Akhtar's initial 3D analysis on March 22 a discussion was held to review his bowling action. The legitimacy of his technique was discussed and a Preliminary Report (March, 2001) was forwarded to the Pakistan Cricket Board.

Present at this review were Professor Bruce Elliott, Dr David Lloyd, Ms Jacque Alderson, Dennis Lillee; Daryl Foster and Shoaib Akhtar. All present agreed that Shoaib's fast bowling technique, which he has used in New Zealand and throughout his career was not biomechanically sound particularly from an injury reduction perspective. Mr Lillee and Foster, from a coaching perspective, also suggested areas where improvement could occur. The main thrust of this meeting was to improve his technique in a manner that would reduce the potential for injury, while at the same time pass the scrutiny of all first class umpires from a technical perspective.

Mr Akhtar then worked with Mr Lillee and Foster over a 3-week period. The biomechanics team videoed Shoaib from side-on and from behind midway through the program. This was at Dennis Lillee's request as he wished to view the same ball videoed simultaneously from the lateral and rear view. The changes recommended were designed to simplify his technique by emphasising all aspect of his bowling action being in a straight line while at the same time satisfying the ICC's requirements on his bowling action. Listed below are some of the technique changes advocated to help satisfy "normal bowling requirements"

1. *Run-up:* Approach in a straight line using the same length and speed of run-up. Slow down only over the last few strides such that it will be easier to jump and land in a near side-on position
2. *Back-foot landing:* Attain a slight backward lean of the body and a 45° back-foot placement.
3. *Alignment of feet:* Attempt to attain a straight the line (some margin of error with respect to placement to the leg-side)
4. *Front-arm:* The arm must be moved straight up so that the batsman can be viewed "outside" this arm. It must be brought down vigorously to the left-hip prior to following through beyond the body.
5. *Bowling arm:* This must be a circular path in a vertical alignment. The action should start at face-height and pull straight down close to the side.
6. *Follow through:* This should continue after ball release down beyond the left thigh.

The proposed changes meant:

- he would be less susceptible to injury, which would increase his longevity in the game
- he would be a "better" bowler and just as fast by coordinating his body segments more efficiently rather than just relying on horizontal shoulder movement to create pace.
- his accuracy would increase and he would be in a better position to swing the ball.

In fairness to Shoaib it must be pointed out that his unique physical characteristics pertaining to the high flexibility of his shoulder and elbow joints, will still be present whatever technique he uses. This means Mr Akhtar will always bowl with a

hyper-extended and abducted (carry angle) forearm, which when viewed will always look different to the technique used by a fast bowler with normal ranges of motion of shoulder and elbow joints.

Mr Akhtar, as a result of this lengthy review meeting, decided to make the changes to his technique and bowled every day for the next 3-weeks with constant assistance from both Lillee and Foster.

## **2. Bowling Assessment**

The final bowling assessment was undertaken to see if the coaching had modified Mr Akhtar's bowling arm action and to clarify the movement at the elbow during the delivery phase. In the first assessment figure 4 was included to best represent the angle an umpire would observe (two dimensional side-on view). In this assessment, elbow angle changes will be quantified with reference to the physical abnormalities evident in Mr Akhtar's arm. Specifically comments will be made on how the elbow hyperextension and forearm abduction (carry angle) interact with the bowling arm movement. This necessitated use of more camera's (4) and a different analysis procedure than occurred in the preliminary assessment.

At the final bowling assessment Mr Akhtar, following a warm-up bowled 4 express deliveries over the wicket and a further 2 quick-bouncers. From these, the 2 quickest express deliveries (142 and 143 km/hr) were selected for analysis.

### **Elbow angle changes in the delivery action.**

Figure 11 represents the section of the delivery from when the arm is horizontal to the ground until ball release as this is the phase that is specifically controlled by the laws of bowling.

At the time the arm was horizontal the elbow is in approximately 20° hyperextension (Figure 11). This is different to that recorded in the preliminary testing (figure 4) and better reflects the elbow angle changes in three-dimensions. In the two-dimensional projection the abducted arms (carry angle) gives the impression of elbow flexion.

It is his hyperextension and carry angle (figures 13 & 14) which is of concern to umpires. However, it is equally clear that Mr Akhtar has no control over his arm moving into both hyperextension and abduction (carry angle) when rotating the arm at the level required to bowl in excess of 140km/hr. Figure 12 clearly shows the changes in hyperextension from a two-dimensional perspective over the relevant section of the delivery phase.

Figure 11: Elbow angle changes from a representative delivery

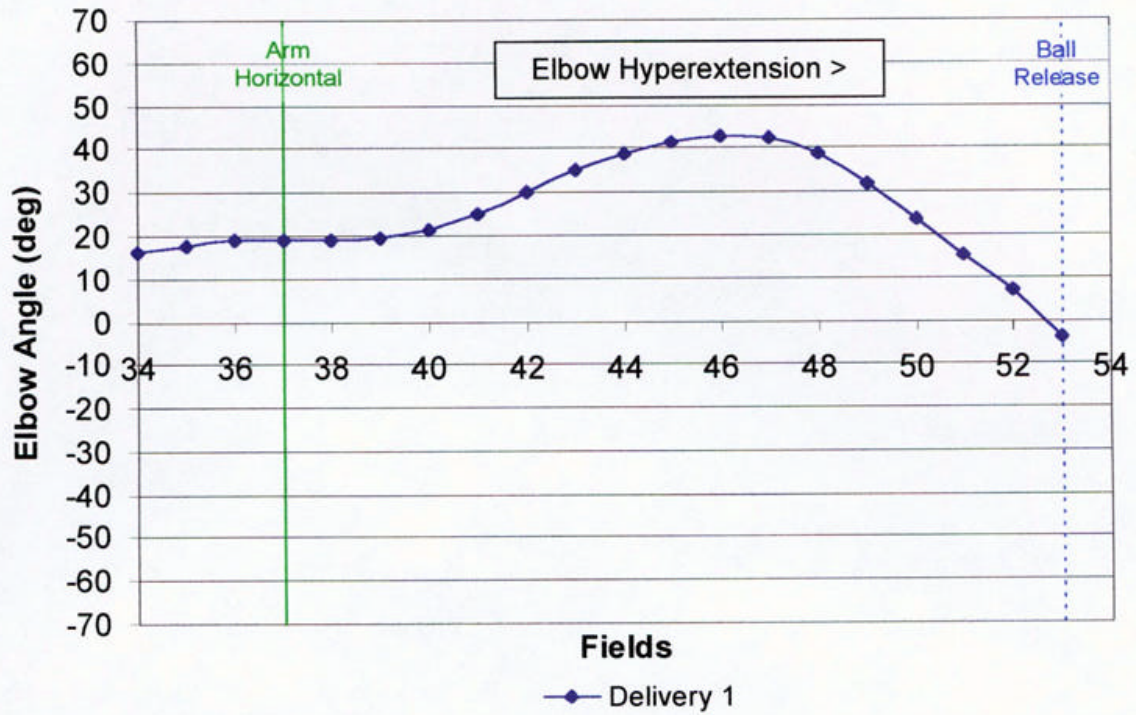


Figure 12: Projected sagittal plane (2D) elbow angle across 2 trials

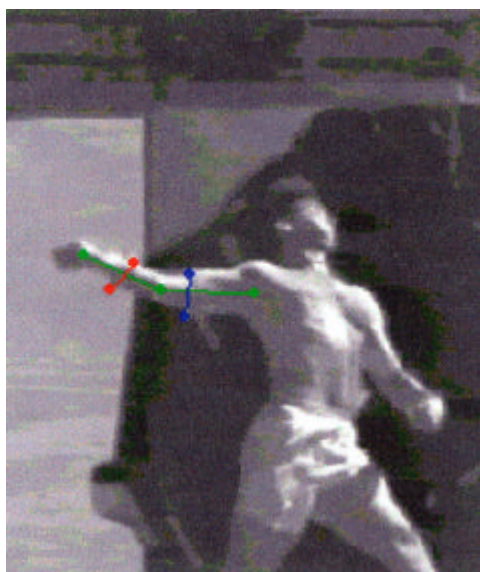
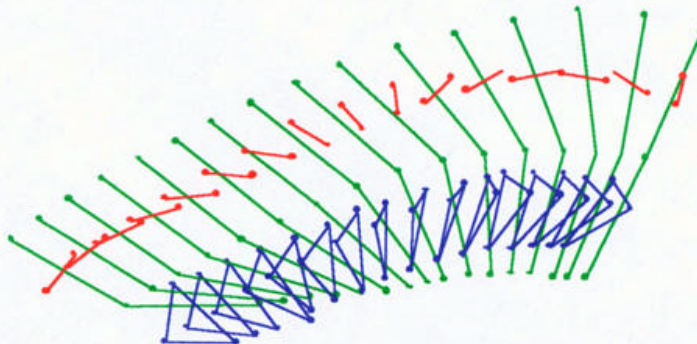


Figure 13: Side-on view of carry angle

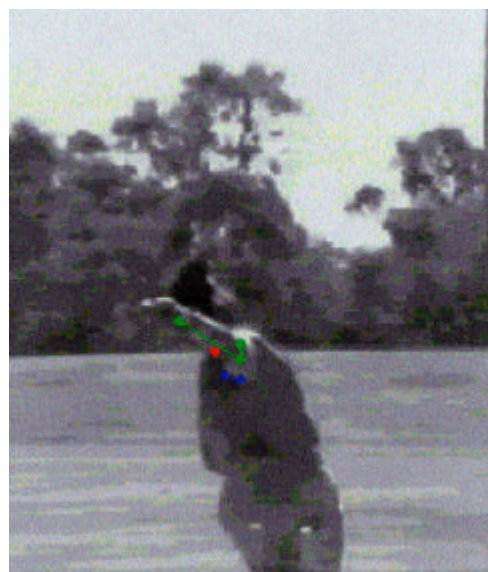


Figure 14: Rear view of carry angle





Figure 15: Side-on view of hyperextension

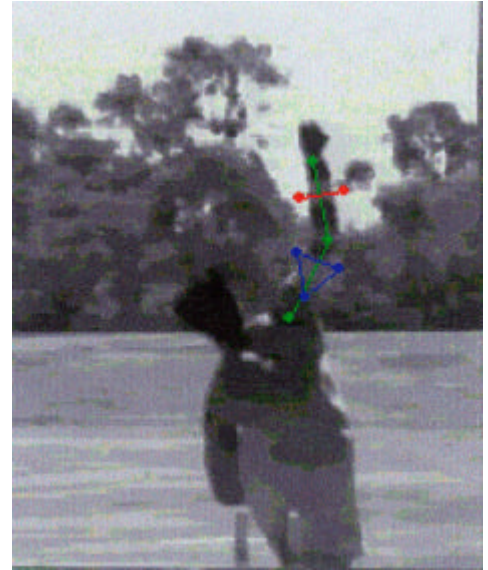


Figure 16: Rear view of hyperextension & carry angle

Changes in the elbow angle do occur between the 20° angle recorded when the arm was horizontal to the ground until maximum hyperextension of approximately 40° (table 1 & figure 15). This increase in hyperextension is certainly against the *'letter of the law'* but not against the *'spirit of the law'*. Mr Akhtar has no control over this additional extension as it is a physical characteristic of his arm. The flexion at the elbow that occurs leading to ball release (the arm is straight at ball release-figure 17) is not against the *letter or spirit* of the law. At release the arm is straight as seen in figures 17 and 18.

**Table 1:** Arm angles during delivery from horizontal until ball release

Peak Hyperextension	Ball Release	Total Range
40°	3°	37°

### Ball Release

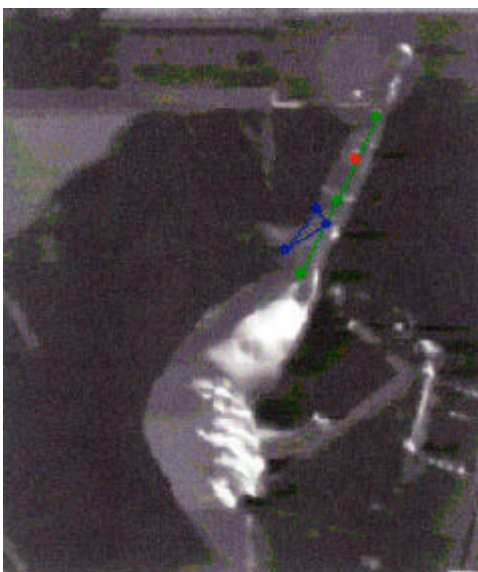


Figure 17: Side-on view of hyperextension



Figure 18: Rear view of hyperextension & carry angle

## Summary

"Hypermobility is not only a problem in sport as it relates to injury but it can be very detrimental to technique. Athletes who are hypermobile often have too wide a range of movement with back-swings and follow throughs" (Bloomfield et. al., 1994) In Mr Akhtar's case this is certainly true. A hypermobile shoulder and elbow joint combined with an abducted forearm (increased carry angle) has caused concern for umpires when viewing Mr Akhtar's bowling action with the naked eye. His bowling action has been reported as being suspect both in Australia and New Zealand. Mr Akhtar is unable to avoid the hypermobility in his bowing action that is depicted in figures 15 through 18 and therefore should **NOT** be regarded as throwing due to his abnormal anatomical characteristics.

It is the opinion of the testing team that Mr Akhtar would not be able to modify his bowling action when delivering the ball at the speeds recorded during filming. That is, we are confident that all angles reported would reflect data collected during match conditions. It has also been shown that Mr Akhtar is consistent with respect to his upper limb angles during the bowling of express deliveries: over the wicket, around the wicket and when bowling a bouncer.

We the undersigned therefore declare that Mr Akhtar **does not throw** based on the biomechanical assessment of his bowling action. Unfortunately, the abnormalities in his bowling limb give the impression of a semi-throwing motion when viewed from a single location and the additional extension recorded following the arm attaining the horizontal position is a manifestation of his hypermobile elbow joint.

(Signed)

---

Professor Bruce Elliott

Dr David Lloyd

Ms Jacque Alderson

Mr Daryl Foster

## References

Bloomfield, J., Ackland, T.A., & Elliott, B.C. (1994). Applied anatomy and biomechanics in sport. Blackwell Scientific Publications; Melbourne.

Hoppenfeld, S. (1976). Physical examination of the spine and extremities. Prentic-Hall; London.