An Ergonomic Intervention in Cricket to Solve a Throwing Controversy

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ABSTRACT

The unorthodox bowling action of an International cricket player has been investigated using objective measurements. An electro-goniometer and a force sensing resistor were used for this purpose. The electro-goniometer measured the elbow angles in the sagittal plane, while the force sensing resistor (FSR) indicated the instant of ball release in order to assess the presence of any elbow "straightening" directly preceding delivery. The FSR was attached to the spinning finger depending on the type of ball delivered. Angles and force values were sampled at 500 Hz and stored in a data logger. The information collected was downloaded on to a computer for further analyses. The angle information clearly shows that preceding ball release, there is no "straightening" of the bowling arm. Hence it is clear that the unorthodox action of this bowler is legitimate as defined by the International Cricket Council (ICC) laws.

Keywords: Cricket, throwing, chucking, bowling

1. BACKGROUND

The study reported here investigates the unorthodox bowling action of an International Cricketer. According to two Australian match umpires, the action was suspect. As a result, the bowler was called for throwing seven times by one match umpire on Boxing Day, 1995 and four times by the other on a different day. In the game of cricket, throwing is illegal. The International Cricket Council (ICC) is the governing body for all the laws of cricket. Throwing is defined in Law 24.2 Note (a) of the ICC rules as "... the process of straightening the bowling arm, whether it be partial or complete, ... during that part of the delivery swing which directly precedes the ball leaving the hand. This definition shall not debar a bowler from the use of the wrist in the delivery swing." (ICC, 1992). Due to the nature of the definition, it becomes extremely critical to know the exact time at which the ball is delivered in order to determine whether any straightening exists directly preceding delivery. During an actual game, the call for an outlawed delivery is based on subjective judgments. The methodology reported here illustrates the use of an objective measure to decide on the accuracy of the subjective opinion of match umpires. Even though testing was done under controlled conditions, this technique can, if necessary, be used under match conditions.

2. METHODOLOGY

2.1 Equipment

To determine whether the bowler in question was throwing the ball, a Penny & Giles Electro-goniometer model XM180 (Figure 1) and paper thin electronic force sensing resistors (FSR) of 15 mm diameter were used. The data collected from the goniometer and the FSR were stored in a data logger and later downloaded on to a portable computer. The electro-goniometer used was able to simultaneously measure angles in two planes. However, only one plug was used to measure the elbow angle in the sagittal plane as shown in Figure 2. The electro-goniometer was light-weight (weighing 19 grams), unobtrusive and permitted elbow angles to be displayed or recorded while allowing the person freedom of movement. It consists of two end-blocks connected by a protective spring. Between the two end-blocks, and inside the protective spring is a composite wire which has a series of strain gauges mounted around the circumference. As the angle between the two ends vary, the change in strain along the length of the wire is measured and this is translated to elbow angle (Figure 2). The data logger weigh 160 grams and was 100 x 60 x 25 mm in size powered by a 9 Volt DC battery.

In addition to the above, two JVC camcorders, a Panasonic professional video mixer and a portable VCR were used to store video images of the bowling action.

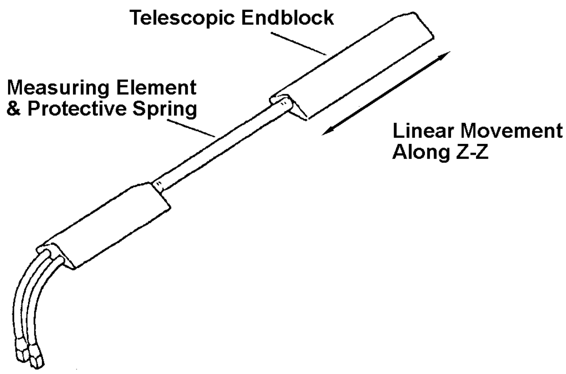

Figure 1. Electro-goniometer

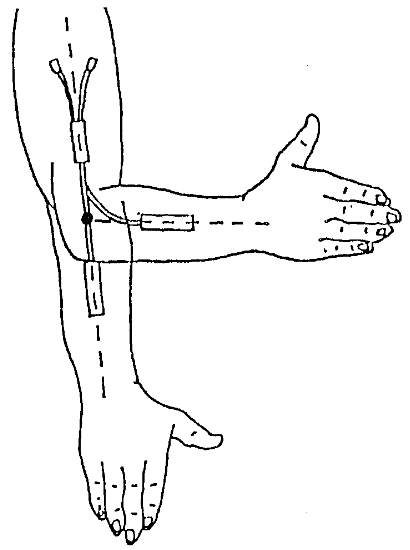

Figure 2. Elbow angle measurement with electro-goniometer

2.2 Subject

The subject in this study was the cricketer whose unorthodox bowling action was investigated.

2.3 Procedure

The electro-goniometer was attached to the right arm of the subject using two kinds of specialty tape. Firstly, double sided tape was attached to the underside of the goniometer end-blocks. These were stuck on to the subject's upper and lower arm, ensuring allowance for the telescoping of the goniometer. Secondly, to ensure firm attachment, Tegaderm™ tape was applied on top of each end-block. The effects of pronation and supination were minimized by attaching the end blocks to the arm in predetermined positions based on the author's experience. The cable and connector leaving the goniometer were also secured using Tegaderm and Micropore™ tape to provide strain relief on the goniometer unit. The cable was then connected to the data logger unit.

The force sensor was attached to the spinning finger at an appropriate place using Micropore tape. The force sensor positioning is critical since it is the only means by which the instant of ball release can be accurately determined. Based on a number of tests performed with the subject, the critical position for the sensor attachment was determined prior to all tests. For off-spin, the force sensor was attached to the index finger, and for leg-spin, the sensor was attached to the ring finger of the subject. The cable from the sensor was attached to the data logger unit through a load measuring interface. The data logger and the load measuring interface were placed in a leather pouch which was tacked on to an elastic, velcro band and strapped to the subject's waist. After attaching all equipment, and within a short time of usage, the subject was able to bowl without any hindrance or knowledge of the equipment. This situation is important in the event a decision is made to use the equipment and monitor the bowler under match conditions.

The data logger was first pre-programmed to record at 500 samples/second. After recording, the finger force and elbow angle data were downloaded to a portable computer for processing and analysis.

™ Tegaderm and Micropore are registered trademarks of 3M, Inc., Two video cameras were positioned to monitor the back and side view during bowling. Due to space constraints, the video analyses will not be reported here.

2.4 Measurement Conditions

All tests were done over a period of three days. On the first day, the subject was instrumented and allowed to bowl for long spells to get accustomed to the equipment. The second day involved over 5 hours of continuous testing. The third day involved checking all possible variations in his style of bowling. Three types of deliveries were monitored and evaluated. They were off-spin (normal trajectory and low trajectory), leg-spin, and the arm-ball.

3. RESULTS

Law 24.2, Note (a) defines throwing as "... the process of straightening the bowling arm, whether it be partial or complete, ... during that part of the delivery swing which directly precedes the ball leaving the hand. ...". The simplest means to understand this concept is to ask the question: "Is there undue advantage with the use of the bicep/tricep muscles just before delivery which is outlawed by the ICC?". All bowlers have an arm straightening prior to delivery since they start the bowling cycle in a bent arm position. Hence what matters is whether there is any straightening immediately preceding delivery so that no advantage may be gained.

Figure 3 illustrates the elbow angle and finger force variation for one bowling cycle. The zero value for the electro-goniometer reading depends on the reference setting which was set at about the fully extended elbow position. Hence a positive angle represents a flexing motion. The absolute values of the angles are not of importance to test the legitimacy of the bowling action. The point at which there is no finger force (=0) indicates ball release. Immediately after the line marked "start of bowling action", there is elbow straightening which does not constitute throwing as defined in Law 24.2 since this is not immediately preceding delivery.

Figure 4 is a graph that illustrates throwing as defined by Law 24.2 demonstrated by a different bowler. The point of delivery is determined as the point at which the finger force magnitude is zero. The vertical line **A** corresponds to the point at which the elbow is fully bent. It is approximately the start of the bowling action. The vertical line **B** corresponds to the point of zero finger force or ball release. Once the position of line **B** is known, it is relatively easy to determine whether there is straightening of the arm preceding delivery. If there is straightening of the arm, the elbow angle will decrease when moving from left to right and at the intersection of line **B**. Throwing which constitutes straightening is clearly seen from Figure 4.

Figure 3 is a typical off-spin delivery bowled by the subject with the electro-goniometer and one force sensor attached to the index finger. It can be seen from Figure 3, that just preceding ball release, there is no straightening of the arm. This pattern is consistent with the different type of deliveries throughout the three days of the subject's bowling.

4. CONCLUSIONS

The computerized data analysis shows that the subject's bowling action is legitimate according to the ICC rules which defines throwing in cricket.

5. REFERENCES

ICC (1992). International Cricket Council (ICC) Laws and Regulations. London: Clifford Frost Ltd.

6. ACKNOWLEDGMENT

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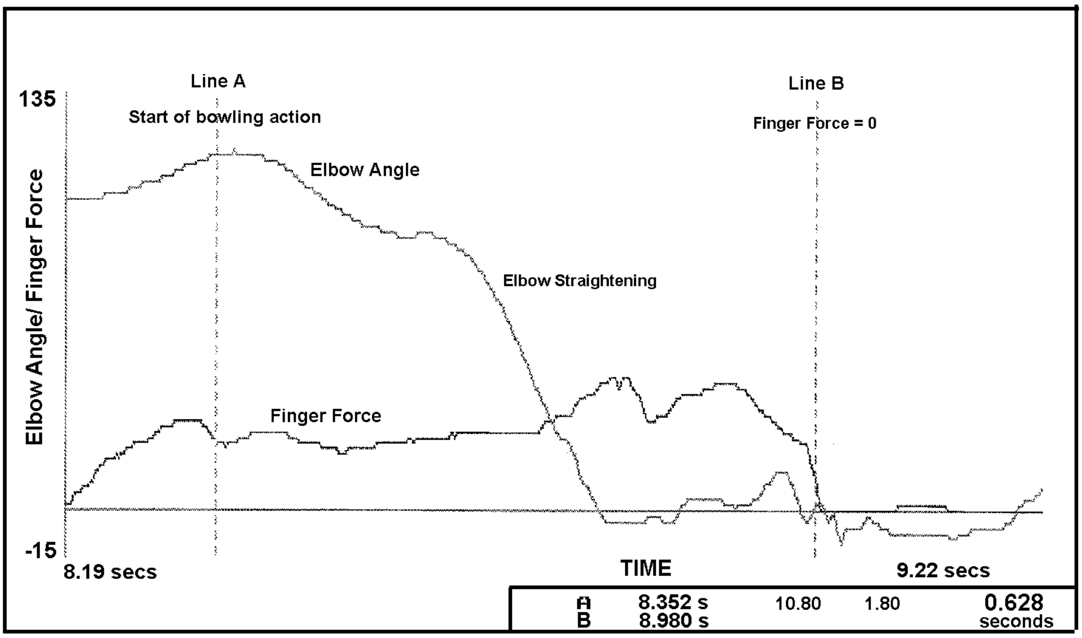

Figure 3. Elbow angle and finger force variation for a typical off-spin delivery

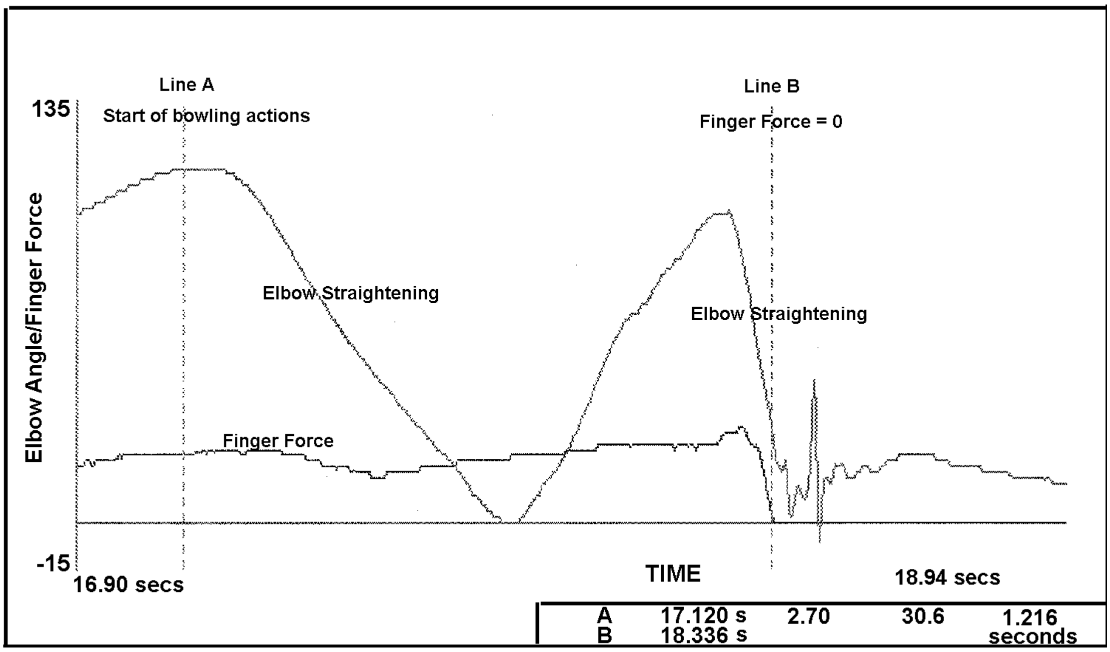

Figure 4. Elbow angle and finger force variation for a throw