

## Appendix 1.

### Video Review List of Potential Features

1. The location of the impact on the helmet. The location of impact is shown in Figure 1 and defined as:
  1. Frontal (Helmet Shell/Badge Area)
  2. Peak
  3. Peak and Grill
  4. Grill
  5. Temple Region
  6. Occiput
  7. Crown
2. Direction of travel of the ball after impact. Direction of travel is shown in Figure 2. The ball is tracked in relation to direction in a horizontal and vertical plane. Due to the limited availability of multiple camera angles, this may have to be estimated from a uniplanar camera angle using landing spot of ball, reactions of other visible players and trajectory change after helmet / head impact. In order to simplify this, the space around the batsman's head is split into four potential zones of directions of travel, Green representing the space above and behind, red representing the space in front and below and yellow representing the space laterally on either side.
3. Angle, in degrees, of travel of the ball in the transverse plane. As in 2, this may need to be estimated based on the available camera angles.
4. Players looks to follow the ball after helmet strike. Following the helmet strike, the player immediately moves their head to identify or follow the path of the ball.
5. Removes Helmet/Checks Helmet. Following the helmet strike, the player removes their helmet and/or inspects it in their hands.
6. Officials/Other players check the player in a relaxed manner. Following the helmet strike, other players or officials walk to the end of the struck player and "check on" him. This might involve talking, arms round shoulders, assisting the player to his feet.
7. Officials/Other players check the player showing greater concern. Following the helmet strike, other players or officials jog or run to the end of the struck player and "check on" him. This might involve talking, arms round shoulders, assisting the player to his feet.
8. Officials/Other players check the player in an urgent manner. Following the helmet strike, other players or officials run to the end of the struck player and are seen to call for medical staff or cessation of play.
9. Medical staff run onto the pitch when no apparent invitation is seen on video.
10. Player stumbles or loses footing / balance after strike. Following the helmet strike, the player appears unsteady on their feet. This may include the player appearing off balance, staggering, stumbling or appearing to not be in control of the follow through of their shot. This may occur prior to the player falling over but is only counted if it occurs as a separate action. For example the player is hit and stumbles and then after a few steps falls over.

11. Player falls to his knees. Following the helmet strike, the player falls to their knees or finishes their follow through on their knees.
12. Player falls over. Following the helmet strike, the player falls over or finishes their follow through in falling over.
13. Player stumbles or loses footing on returning to their feet. Similar to player stumbling or losing footing but does this on returning to their feet following helmet strike.
14. Player walks away from play. Following the helmet strike the player walks away from the crease. They may take some time to adjust equipment, stretch or speak with other players, for example.
15. Player holds face/holds head. Following the helmet strike the player clutches, holds or rubs head or helmet.
16. Player bends their head down/looks at the ground. Following the helmet strike the player spends some time with their head bent down or looking at the ground. For example, whilst leaning on their bat. The appearances are that they are trying to regain/maintain their balance.
17. Player immediately alert and looks for run / state of play. Following the helmet strike the player is immediately alert to the game situation around them. For example running between wickets, calling to their batting partner to run or hold.
18. Play resumes immediately. Following the helmet strike there is no break in play for the batsman to speak to other players or be attended to. He quickly returns to his "ready" position at the crease to face the next ball.
19. Player appears dazed. Where the video allows it to be appreciated the player is seen to exhibit a confused, vacant or glassy expression.
20. Player takes > 4 seconds to be ready for next delivery.
21. Player knocked backwards / sideways. Following the helmet strike the player's head or upper body changes direction (ie backwards or to the side) as a consequence of the impact.
22. Player retires from game

## Appendix 2.

Table 1. Combined analysis of location of impact and direction of ball travel following helmet strike between the Helmet Strike-Concussion (HS-C) and Helmet Strike-No Concussion (HS-NC) groups.

Combined Location of Impact and Direction of Ball Travel	Frequency HS-C N=16	Frequency HS-NC N=153	Relative Risk
Red Frontal	3	20	1.46
Red Grill	1	16	0.6
Red Temple	0	12	0
Yellow Frontal	4	26	1.54
Yellow Grill	2	9	2.05
Yellow Temple	2	25	0.75
Green Frontal	2	8	2.27
Green Grill	0	3	0
Green Temple	1	12	0.8