**Note: The highly recommended CDEs have been listed below with asterisks (\*) and bolded.**

1. **\*Subject age:** (years)
2. **\*Start of data collection (date / time)**
   1. **Date of first event:**
   2. **Time of first event:**    am pm 24-hour clock
3. **\*End of data collection (date / time)**
   1. **Date of last event:**
   2. **Time of last event:**   am pm 24-hour clock
4. **\*Activity (Indicate all that pertain to subject):**
5. **\*Camera manufacturer:**
6. **\*Camera model:**
7. **\*Camera resolution:**
8. **\*Camera sample rate:**
9. **\*Camera positions:**
10. **\*Method of timestamp creation:**
11. \***Resolution of time-synchronization between video and device: (e.g. ±1 second, ±1 millisecond)** (Note: This is different from maximum allowable DeltaT between correlated video and device exposures – see specific instructions following the questions)**:**
12. **\*Method of time-synchronization between video and device:**
13. **\*Method of cross-verifying video and device exposures:**

Device as ground truth

Video as ground truth

Only impacts/exposures verified in both device data and video are considered

Other, specify

1. **\*Method of analysis/link to correlate video and device exposures:**

Maximize exposure timing correlation after identifying all video and all device impacts/exposure(s)

Real-time stamp matching between video and device

Other, specify:

1. **\*Maximum allowable DeltaT between correlated video and device exposures:**
2. **\*Number of true positive exposures:**
3. **\*Number of false positive exposures:**
4. Number of false negative exposures:
5. Of the true positive exposures, number of confirmed head to head exposures:
6. Of the true positive exposures, number of confirmed head to body exposures:
7. Of the true positive exposures, number of confirmed head to ground exposures:
8. Of the true positive exposures, number of confirmed head to object exposures:
9. Of the true positive exposures, number of confirmed body exposures:
10. Number of events that were unable to be classified:

GENERAL INSTRUCTIONS

Important note: The data elements noted with an asterisk (\*) on this CRF Module are classified as Supplemental-Highly Recommended (i.e., strongly recommended for Biomechanical Devices in TBI clinical studies to collect). The remaining data elements are classified as Supplemental and should only be collected if the research team considers them appropriate for their study. Please see the Data Dictionary for element classifications.

Additional considerations include adding element to link the video clip to each impact and providing guidance on what video file type should be stored, how to facilitate the sharing of video file types, and consideration on privacy, de-identification or seeking consent for release of video clips.

**\* DATA ELEMENTS ARE SUPPLEMENTAL-HIGHLY RECOMMENDED. ALL OTHER DATA ELEMENTS ARE SUPPLEMENTAL.**

SPECIFIC INSTRUCTIONS

Please see the Data Dictionary for definitions for each of the data elements included in this CRF Module*.*

* Subject Age - Enter subject age in years.
* Start of data collection - the date/time when data acquisition started
* Date of first recorded event (mm/dd/yyyy) and Time of first recorded event (hh:mm) - Report the time and date when the first event was recorded.
* End of data collection - the date/time when data acquisition ended
* Date of last recorded event (mm/dd/yyyy) and Time of last recorded event (hh:mm) - Report the time and date when the last event was recorded.
* Activity - Please indicate all activities under study which pertain to the subject (e.g. football, soccer)
* Camera manufacturer - Please indicate manufacturer of video camera(s) used for recording event footage.
* Camera model - Please indicate model of video camera(s) used for recording event footage.
* Camera resolution - Please indicate resolution of video camera(s) used for recording event footage.
* Camera sample rate - Please indicate sample/frame rate of video camera(s) used for recording event footage.
* Camera positions - Please indicate positions of video camera(s) used for recording event footage.
* Method of timestamp creation - Please indicate method of creating timestamps on video footage. The approach used to generate a timestamp for each individual video frame used to verify impacts. The timestamp is the time of day of a given video frame which will be compared with the time of day an event is recorded via the device. The timestamp can be generated by the camera using an internal clock (e.g., a GPS synched clock, an internal software clock, etc.) or can be tracked using an external source (e.g., a digital clock in view of the camera, calibrating the frames using a digital clock shown a single time, etc.). These methods are not exclusive, and other approaches may be described.
* Resolution of time-synchronization between video and device - Resolution of time-synchronization is the amount of error allowed between the device timestamp and video timestamp. Appropriate answers for this would be ±1second, ±1millisecond, etc. The resolution will depend on the accuracy of the device clock and the accuracy of the video clock (e.g., if the device timestamp is accurate to the millisecond, and the video timestamp is accurate to the second the resolution would be ±1second). Please indicate time resolution of time-synchronization between the video and the device. For example, if both video and device has 1 second resolution for their real-time stamps, the time resolution would be 1 second.
* Method of time-synchronization between video and device - The approach used to synchronize the timestamps of the device and video. Please choose or describe the method to synchronize video and device information. The time-synchronization between the device and video can be accomplished using several approaches. For example, both device and video could be synchronized with a third source (e.g., the NIST traceable time source time.gov, or localized computer time source), or they could be synchronized by forcing events on the devices in view of the camera and documenting any offsets in time. These methods are not exclusive, and other approaches may be described. The requested input is for a description of how the time-synchronization between the device and video was accomplished.
* Method of cross-verifying video and device exposures - The accelerometry device and video recording can independently capture exposure information and can be cross-verified to increase confidence of the exposure measurement. This CDE differentiates which set of information serves as the ground truth for verification. For example, if video is served as ground truth, exposures captured on video but not measured by the device would be considered as missing (false negatives). It is also an option to only consider exposures measured by both the video and the device to be 'verified' exposures. Please select from following options or, if another method is used, provide a detailed description of the method.
* Method of analysis/link to correlate video and device exposures - Exposures measured by the device and those observed in video need to be linked with each other for verification. For example, if a sports player was observed to sustain a head impact at 10:30:56 am on video while wearing an accelerometry device, it is expected that the accelerometry device will have a recording corresponding to this observation. The method to link the exposures could include 1) identifying the time differences between exposures in video or device and finding the time-syncing difference to maximize the correlation between the video exposure timings and device exposure timings, 2) having a timestamp for each exposure on the video or device that is synchronized with a standard real-time clock (e.g. [nist.gov](https://www.google.com/url?q=http://nist.gov&sa=D&ust=1511275479220000&usg=AFQjCNFSPyOAb4CcgVpmDm1G57TRUo15ng) time) and correlating exposures via the real-time stamp. Please choose from the following options, or if another method is used, provide a detailed description of the method.
* Maximum allowable DeltaT between correlated video and device exposures – Where DeltaT is the amount of time between an identified device/video exposure(s). Due to uncertainties in real-time stamps or time offset calculations, the timing of individual exposures may not have an exact match between video and device. For example, if there is a +/- one second uncertainty in the timestamp, it is possible that a video exposure at 12:30:45 may be matched with a device exposure at 12:30:46. This CDE specifies the amount of tolerance allowed for the difference between video and device time stamps. Indicate time offset in number of seconds between video and device time stamps allowed for linking exposures.
* Number of true positive exposures - Both video and device indicate an exposure(s)- happened within the allowable time-period (Maximum Allowable DeltaT - #15 above). Head impact events in which both the video and the device indicate an exposure. Through careful review of the video, identify head impact exposures. The definition of this will vary by the sport setting studied but could include identifiable change in the head kinematics (in the case of a head impact in football for example) or an identifiable change in the ball trajectory (in the case of a head to soccer ball impact). It is highly suggested that this process be conducting by multiple coders blinded to each other’s' efforts. Have a master coder reconcile any differences in exposure identification. Count the number of head impact events recorded on the device that can be confirmed via video. This may be tied to g-force level (e.g., impact as 25g+).
* Number of false positive exposures - Head impact exposures recorded on the device but unable to be verified by video within the allowable time-period (Maximum Allowable DeltaT - #15 above). Through careful review of the video, identify head impact exposures. The definition of this will vary by the sport setting studied but could include identifiable change in the head kinematics (in the case of a head impact in football for example) or an identifiable change in the ball trajectory (in the case of a head to soccer ball impact). It is highly suggested that this process be conducting by multiple coders blinded to each other’s' efforts. Have a master coder reconcile any differences in exposure identification. Count the number of head impact exposures recorded on the device that cannot be confirmed via video. This should only include those events in which the player for whom the exposure is recorded is visible on the video. It should not include unverifiable exposures out of frame of the video. This may be tied to g-force level (e.g., impact as 25g+).
* Number of false negative exposures - Head impact exposures observed on video but lacking corresponding device exposure data within the allowable time-period (Maximum Allowable DeltaT - #15 above). Through careful review of the video, identify head impact exposures. The definition of this will vary by the sport setting studied but could include identifiable change in the head kinematics (in the case of a head impact in football for example) or an identifiable change in the ball trajectory (in the case of a head to soccer ball impact). It is highly suggested that this process be conducting by multiple coders blinded to each other’s' efforts. Have a master coder reconcile any differences in exposure identification. Count the number of head impact exposures identified on video that do not have any corresponding data on the device within the allowable time-period.
* Of the true positive exposures, number of confirmed head to head exposures - The number of visually verified head impact events that resulted from head to head contact (including helmet to helmet contact).
* Of the true positive exposures, number of confirmed head to body exposures - The number of visually verified head impact events that resulted from head to body contact (e.g., head contacts the torso of another person).
* Of the true positive exposures, number of confirmed head to ground exposures - The number of visually verified head impact events that resulted from head to ground contact (e.g., while falling or diving, head contacts playing surface).
* Of the true positive exposures, number of confirmed head to object exposures -The number of visually verified head impact events that resulted from head to object contact (e.g., head contacts the ball).
* Of the true positive exposures, number of confirmed body exposures - The number of visually verified events in which the person's body comes in contact with another person, the ground, or an object that result in an “acceleration event” of the head – without direct contact to the head.
* Number of events that were unable to be classified – These could include those events where there is device data but video data is not available (e.g. player out of frame, etc).

References

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Kuo C, Wu LC, Loza J, Senif D, Anderson S, Camarillo DB. Comparison of video-based and sensor-based head impact exposure. bioRxiv 235432. 2017. doi: https://doi.org/10.1101/235432