

FAQ Paper

FAQ #1: How do smart mouthguards help with concussion safety?

Answer: Smart mouthguards help with concussion safety by giving real-time head impact data that may be hard to see from the sideline. Smart mouthguards have small sensors inside them that measure head movement during and after impact. This includes linear acceleration, rotational acceleration, and angular velocity. Another advantage of these mouthguards is that they are in your mouth, placing the sensors closer to the skull and leading to more accurate data. Sensors have been placed on helmets, headbands, and skin, but the data isn't considered reliable due to their proximity to the skull. Camarillo et al. found that smart mouthguards have potential as research tools for measuring head impact. (Camarillo et al., 2013). These mouthguards do not replace medical staff; they make them better. Not everything is visible on the field, and these mouthguards provide data on everything all the time.

FAQ #2: Can smart mouthguards prevent concussions?

Answer: Smart mouthguards are not a guaranteed way to prevent concussions. Concussions happen in many different ways, and a mouthguard can't prevent the brain from moving inside the head. The advantage of the mouthguard is that it identifies the dangerous impacts more quickly. Using football as an example, players get hit near the head every single play, and the mouthguard isn't worn to prevent a concussion. When a player gets hit near the head, the mouthguard can record data and alert medical staff in real time. This data allows medical staff to remove the player from the game to prevent further injury. Playing with a concussion is more dangerous than the actual concussion itself, and the data given allows staff to pull a player and keep them safe. The National Athletic Trainers' Association explains that "sport-related concussion management still depends on proper education, assessment, treatment, and return-to-activity decisions by

trained professionals” (Broglia et al., 2024). World Rugby has also integrated smart mouthguards into its head injury assessment process, showing that top sporting organizations care about the use of this technology. Smart mouthguards aren’t meant to prevent concussions, as concussions do happen. They are meant to keep players safe after severe head impacts.

FAQ #3: Why are the mouthguards useful if teams already have countless people monitoring head impacts?

Answer: As I stated earlier, these mouthguards aren’t meant to replace humans. The teams of people are very useful when it comes to keeping an eye on everyone. In a sport like rugby or football, where things are happening in multiple parts of the field at the same time, it is hard to see it all. Video can be helpful, but angles are important and a camera may be too far or blocked. Athletes may hide symptoms to keep playing or may not show symptoms immediately. These mouthguards provide real data that gives them the evidence they need. World Rugby says, “Instrumented mouthguard data can act as a complementary objective measure alongside match officials, doctors, and video review.” (World Rugby). Their use of the word complementary shows that this technology isn’t a replacement for medical staff. We become more efficient when using this technology, as it combines everything while using medical teams to make the final decision.

FAQ #4: How accurate are these smart mouthguards?

Answer: Smart mouthguards are very accurate, but the accuracy also depends on the device. In a professional rugby study, mouthguards showed 93.6% sensitivity and a positive predictive value of 92.4% in detecting direct head impacts. (Field et al., 2023). This shows that these smart mouthguards have been tested and have shown positive results in measuring head impacts during a game. World Rugby has created performance specifications for its instrumented mouthguards.

They must be lab- and field-tested and meet real-time performance expectations to be used by the federation. Once again, the mouthguard does not diagnose a concussion on its own. Some high-impact hits don't always cause a concussion, and medical staff is still required to diagnose or clear a player. The data is used as a support tool rather than as the final solution. The best way to use them is for medical staff to combine data with concussion evaluations to obtain the most accurate answer.

FAQ #5: What are the biggest concerns or limitations with smart mouthguards?

Answer: The biggest limitations revolve around costs, access, fit, and over-reliance on them. Fit matters heavily because placement affects the measurements. If a mouthguard doesn't fit properly, it can move, which can skew the numbers. Gellner, who conducted a study on these mouthguards, found that poor fit, wear and tear, or impact forces can increase error in the data. (Gellner et al., 2024). This also means teams cannot just buy the technology, and it will work perfectly. You need to properly fit them to the athlete, perform maintenance, and get staff who understand the data. Cost is another issue because they are not very affordable. High schools, small colleges, and youth teams will not be able to afford all the technology and its necessities. The final problem is the over-reliance, which we have discussed before. The mouthguards aren't meant to be a diagnosis; they are a precursor to protocols. Smart mouthguards are valuable but there are concerns about how everyone will be able to use them. In the future, this can all change, but for now, it is limited to the top levels of sports.

Works Cited

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