

# Use of a Customized Mandibular Orthotic (CMO) for the prevention of concussion in high-school footballers

## Introduction

Controversy exists over the utility of "mouthguards" in the prevention of concussions/minor traumatic brain injury (MTBI). Previous studies have shown the efficacy of mouthguards in the prevention of oro-dental trauma, but the role of "mouthguards" in the prevention of MTBI is contentious. However, a clear distinction needs to be made on the classification of various oral appliances, which can be classified as follows:

Mouthpieces: Commercial, over-the-counter, products

Mouthguards: Laboratory-fabricated appliances for the prevention of oro-dental trauma

Oral splints: Laboratory-fabricated appliances for the treatment of temporo-mandibular dysfunction (TMD)

Oral orthotics: Customized, laboratory-fabricated appliances for the prevention of TMJ-mediated concussions/MTBI.



Figure 1: Mouthpiece



Figure 2: MouthGuard



Figure 3: Oral/TMJ Splint



Figure 4: Customized Oral Orthotic

In football, it can be argued that a mouthguard is not needed, as the cage protects the face and teeth. In one study<sup>1</sup>, no dental injuries were reported when wearing a helmet during play.



Figure 5: A footballer's face cage prevents oral and dental trauma



Figure 6: Dental casts used to produce CMOs for professional athletes

Conversely, in boxing, the "Glass Jaw" concept is a well-recognized phenomenon. A direct blow to the lower jaw is one technique of inducing concussions/MTBI in boxers. Similarly, the unprotected lower jaw of footballers may represent a method of precipitating a concussion/MTBI, especially in an athlete predisposed to TMD.

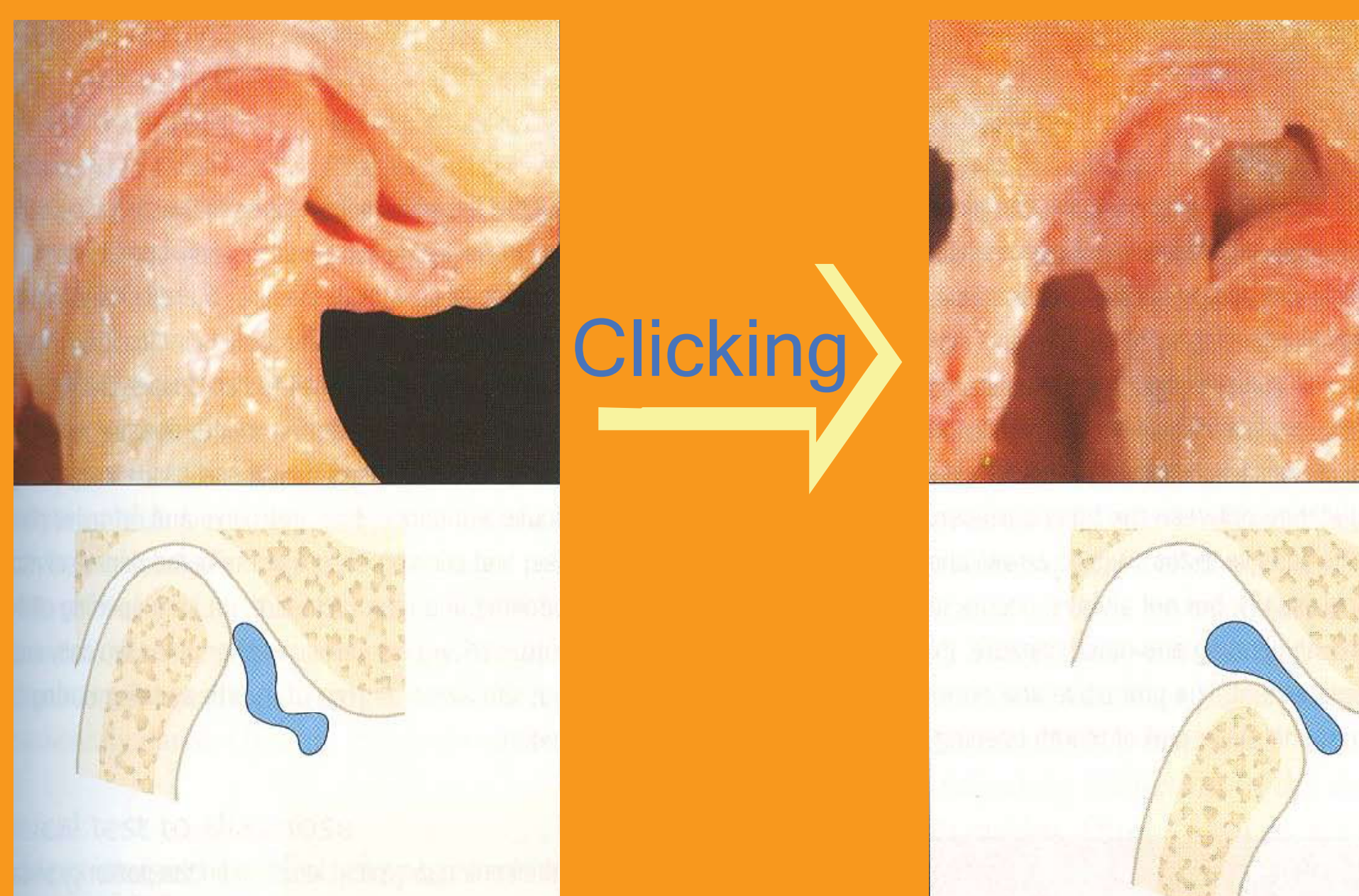


Figure 7: TMJ structural pathology

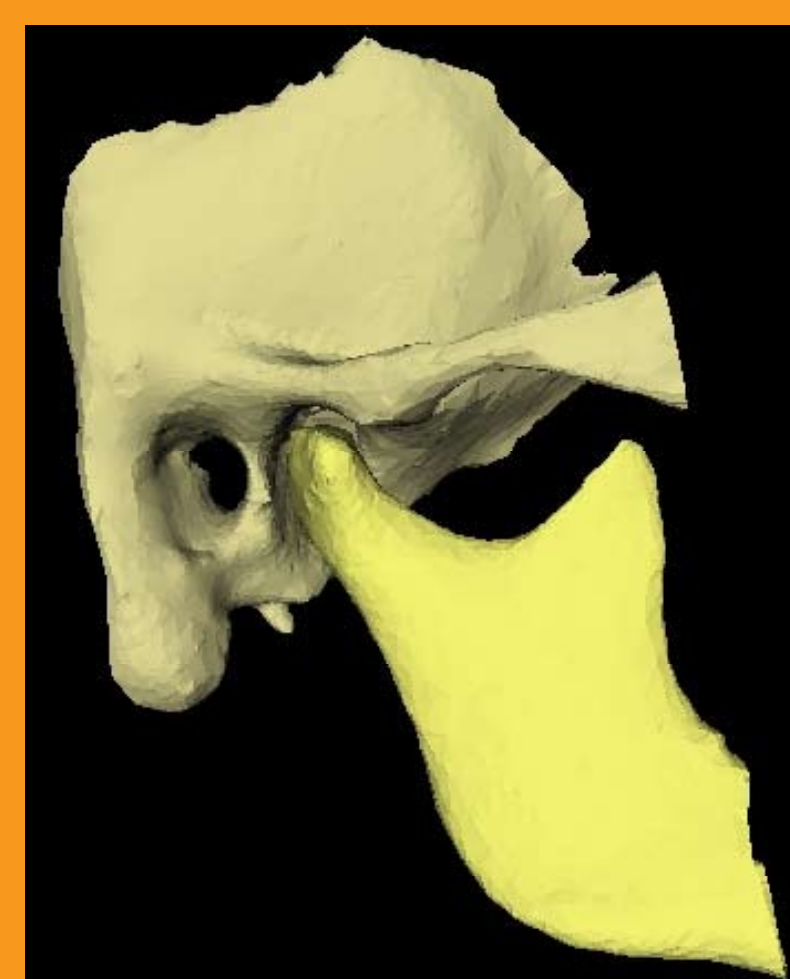


Figure 8: 3-D segmentation of the TMJ from cone-beam CT scan data

## Objective

The aim of this retrospective, longitudinal, preliminary study is to determine the effect of a custom-made mandibular orthotic (CMO) on the incidence of concussion/MTBI in high-school footballers. The null hypothesis to be tested is that a CMO has no effect on the incidence of concussion/MTBI in high-school footballers.

## Sample and methods

In this study, 22 male high-school footballers were recruited after obtaining informed consent. The study period lasted 3 football seasons. Any prior experience of concussion/MTBI was recorded, following neurologic examinations. Dental and TMJ examinations were done on all subjects, and each subject was fitted with a customized mandibular orthotic (CMO). Any instance of concussion/MTBI was self-recorded, and all subjects completed a questionnaire, the data from which was subjected to statistical analysis.

## Subject I

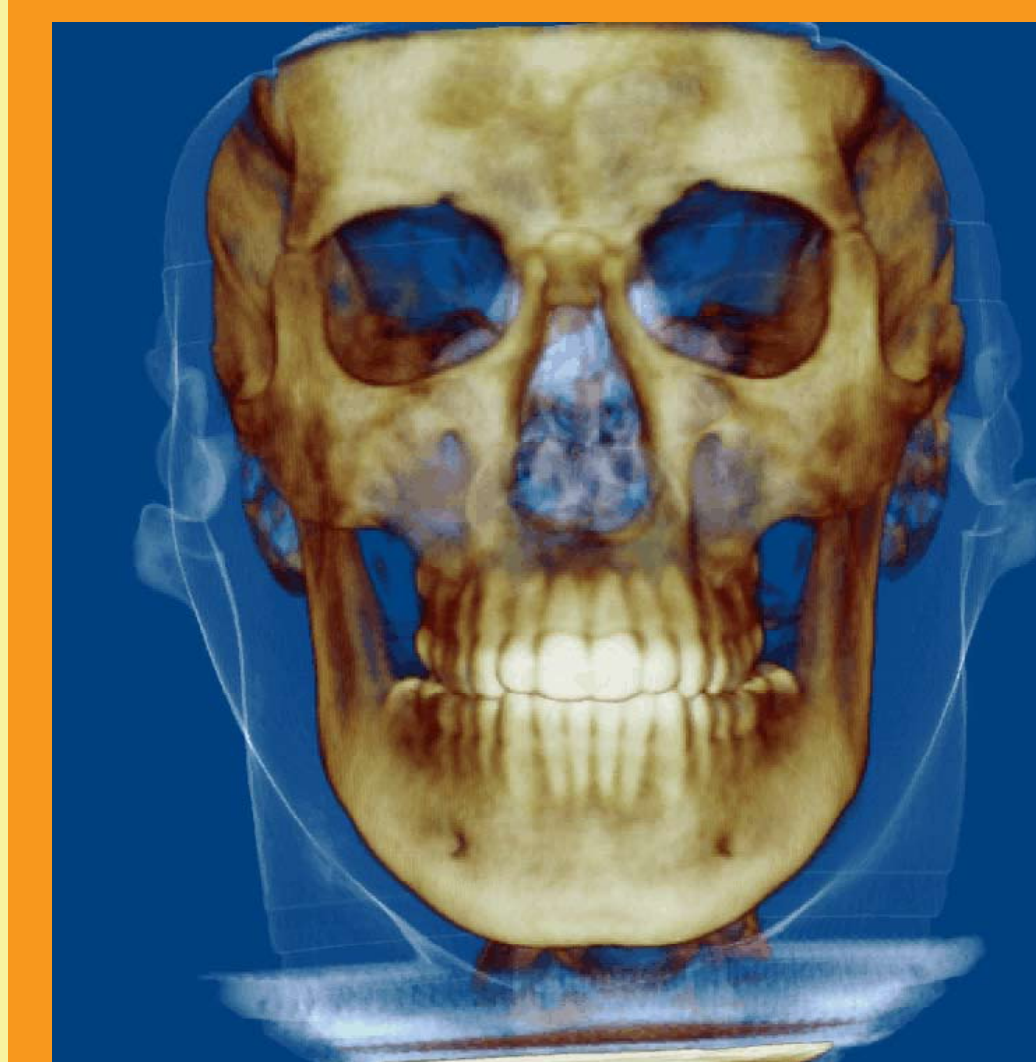


Figure 9: At rest

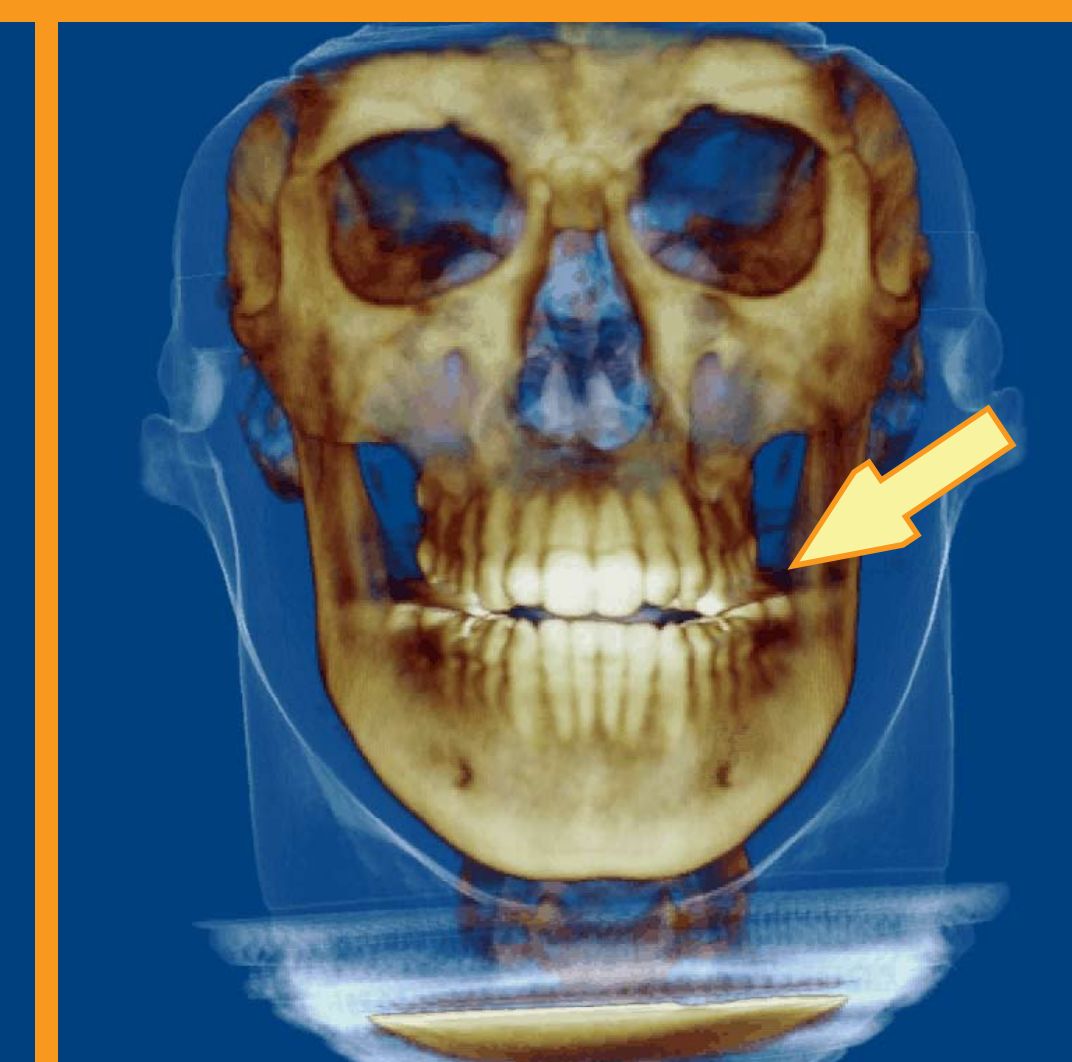


Figure 10: Note that the mandible appears to lie outside the maxilla with the CMO in situ

## Subject II



Figure 11: At rest

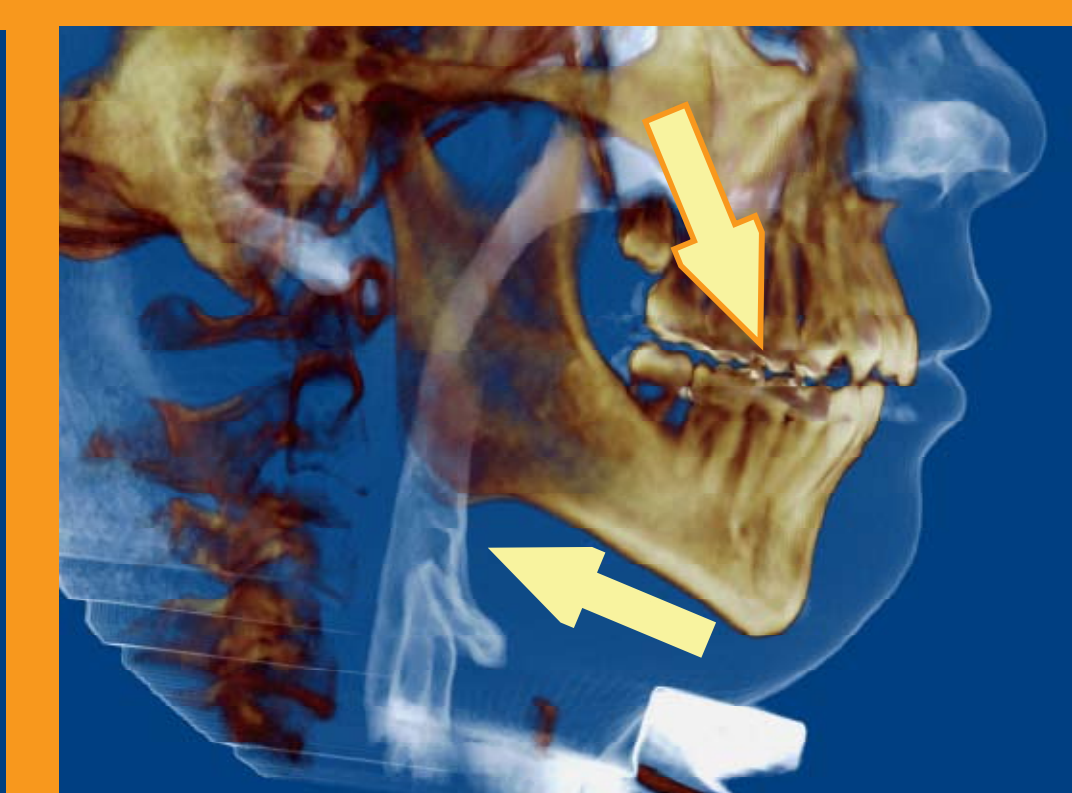


Figure 12: Note the separation of the occlusion and the widening of the upper airway with the CMO in situ

## Results Table 1

Subject	Pre- CMO	Post - CMO Age*	Pre-CMO MTBI	Post-CMO MTBI
1	19	21	3	0
2	16	20	4	0
3	19	21	3	0
4	16	20	3	1
5	16	18	3	1
6	17	19	4	0
7	20	22	2	0
8	15	18	2	0
9	16	19	1	0
10	15	17	0	0
11	20	22	0	0
12	17	20	1	1
13	15	17	2	0
14	15	17.5	1	0
15	20	22	2	0
16	15	17.5	1	0
17	17.5	19.5	5	0
18	17.5	19.5	0	0
19	16	18	0	0
20	19	24	3	0
21	21	24	3	0
22	17	19	0	0
Mean	17.2	19.7	1.9	0.14
STD	1.9	2.1	1.5	0.4

Table 1 shows the raw data, which returned an "OR = 21.53" and "(95% CI 4.46 to 103.90) p < 0.01

## Conclusions

The preliminary results of this study suggest that a CMO may decrease the incidence of concussion/MTBI in high school football athletes, but a comprehensive study is required to confirm these initial findings.

Further research is also required to indicate possible mode(s) of action of a CMO, and to determine optimal biomaterials in the fabrication of CMOs in other Applications.

## Acknowledgements:

Scott Lozanoff, PhD- University of Hawaii

Sal Rodas- President, SMILE Foundation

Christina Berg- CE Coordinator, SMILE Foundation

## Reference:

Beachy G. Dental injuries in intermediate and high school athletes: A 15-Year Study at Punahou School. J Athl Train. 2004;39(4):310-315