EVA PERFORMANCE IN ZYGOMATIC BONE PROTECTION DURING SPORTS PRACTICE: PILOT NUMERICAL STUDY

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Introduction

In sport competitions, facial bone fractures, particularly in the zygomatic bone, are becoming increasingly common. Thus, further studies on the material possibilities for an efficient protection are extremely valuable. The present work aims to test different layer thickness combinations of semi-rigid and flexible EVA – Ethylene-vinyl acetate – looking for an optimized performance for the impact protection of the zygomatic bone. Results will guide subsequent indications for individualized face protectors.

Methods

As illustrated by Fig.1, the study considered bone and soft tissue material overlapped by layers of flexible and/or semi-rigid EVA, in a simple geometry. The studied geometries consist of circular disks of 100mm radius and four different layer configurations: **CG**: cortical bone and soft tissue layers (Fig.1a); **G1**: CG overlapped by 2mm flexible EVA + 1mm semi-rigid EVA + 1mm flexible EVA (Fig.1b); **G2**: CG overlapped by 3mm flexible EVA + 1mm semi-rigid EVA (Fig.1c); **G3**: CG overlapped by 2mm flexible EVA + 1mm semi-rigid EVA (Fig.1d). The effect of the impact of a golf ball at 10m/s was analyzed for all configurations.

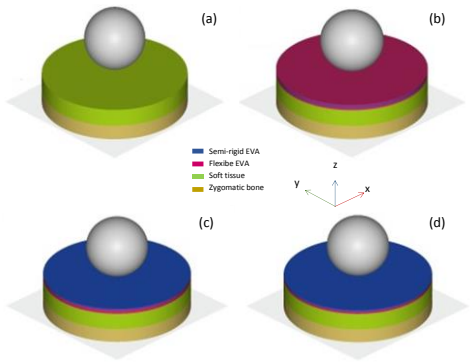

Figure 1: (a) CG, (b) G1, (c) G2, (d) G3.

LS Dyna® finite element software was used to perform the dynamic analyses (solver), and HyperMesh® and HyperView® softwares to generate the model (pre-processing) and analyze the results (post-processing), respectively. All material properties are defined in Coto(2015). Particularly, maximum compression of 2.7 MPa for bone and 5.0 MPa for EVAs were considered.

Results

According to the analyses, G2 showed higher energy absorption capacity and, consequently, the best protection to the studied bone. Fig. 2a, shows that, in the CG, the pressure exceeds the minimum value that leads to bone fracture. Figures 2b,c show the pressure profile in the EVA for G1 and G3. Figure 3 shows the energy conversion during impact in G2.

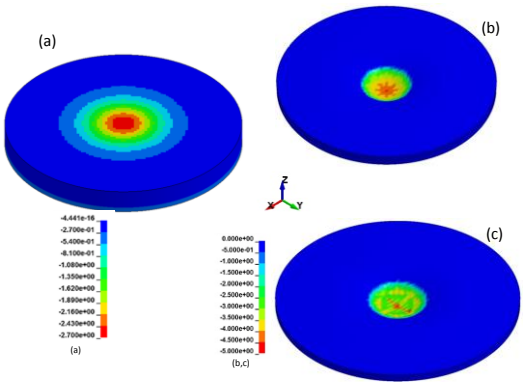

Figure 2 - Results of pressure profile (a) CG (in the bone), (b) G1 (in the protector) and (c) G3 (in the protector).

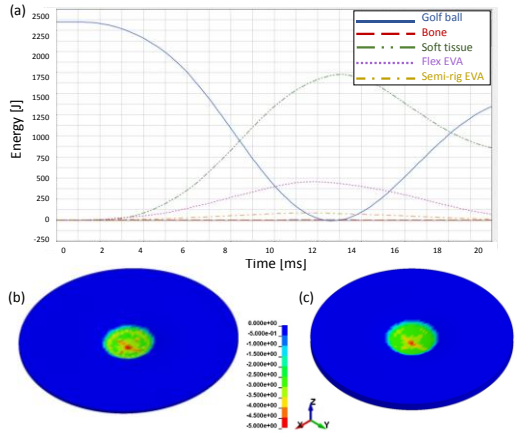

Figure 3 – (a) Energy conversion during impact for G2; pressure in the (b) semi-rigid and (c) flexible EVA.

Discussion

The protector of 4mm, G2 group of 3mm flexible EVA + 1mm semi-rigid EVA proved to be efficient in numerical analysis. Such protector configuration does not compromise peripheral view and does not cause discomfort to the athlete.

References

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