INTRODUCTION

As many as 65% of college football players will suffer a transient brachial plexopathy, commonly called a burner or stinger, at some point (Sallis 1992). Stingers result from a stretching or pinching of the brachial plexus. Symptoms include pain, numbness, and tingling in the shoulder and upper arm, sometimes extending to the forearm and fingers, but are usually transient, disappearing within one or two minutes (Clancy 1977). Brachial plexus axonotmesis is a more serious injury that occurs from the same injury mechanisms. It may present itself as a common brachial plexopathy, but can cause loss of strength and axon degeneration for weeks or months after the injury (Pellman 2003). These injuries are commonly caused by lateral flexion of the neck due to an impact of the player’s head with another player or the ground. Studies have found a connection between cervical stenosis and a higher incidence of multiple injuries (Castro 1997). Often, players with multiple occurrences of these injuries will wear accessory cervical orthoses, or neck collars, to reduce the risk of injury. The design and use of these collars is based largely on empirical data (Gorden 2003, Hovis 1994). Previous studies have examined the motion-limiting capabilities of accessory collars, both in passive and active lateral flexion and hyperextension of the neck in a static situation (Gorden 2003, Hovis 1994), but no studies have examined these orthoses in a dynamic environment. The purpose of this study is to evaluate a range of neck collars and determine their efficiency at limiting head and neck forces in dynamic impacts.

METHODS

A total of 48 impacts were performed using four different collar/shoulder pad combinations. The control configuration consisted of a set of regular shoulder pads, Douglas model CP25, with no accessory collar. In addition, two collars were tested: the McDavid Cowboy Collar™, and a custom-designed and fitted orthosis worn by a Virginia Tech player called the Bullock collar. These were fitted onto a Hybrid-III dummy, along with a Riddell VSR-4 football helmet. The Hybrid-III was instrumented with upper and lower neck load cells, as well as head CG tri-axial accelerometers and angular rate sensors. High-speed video of the impacts was recorded at 1,000 frames per second. In addition, the impactor was instrumented with a load cell and a light gate to record impactor load and impact velocity, respectively. Each collar/shoulder pad combination was tested in a normal and a
raised state. The raised state was intended to simulate a player assuming a tackling posture, in which the shoulders are naturally raised in anticipation of an impact. Each padding combination and state was subjected to impacts in three locations: front, side, and an axial loading condition. Impacts were performed at 7.5 m/s and 11 m/s at each test condition, using a linear pneumatic impactor similar to the new proposed NOCSAE impactor (Pellman 2006). These locations and impact velocities were selected to replicate on-field impacts (Pellman 2003).

RESULTS AND DISCUSSION

Data are presented for selected impacts in Figure 2 and Table 1. In the side position, the Bullock Collar provided a reduction in the lower neck bending moment. The Cowboy Collar, however, did not reduce this moment. In the front position, both collars provided a reduction in the lower neck bending moment, with the Cowboy Collar having the most effect.

In the axial loading position, the Cowboy Collar provided a larger percent reduction of the impactor load compared to the shoulder pads alone. The Bullock Collar did not improve the percent reduction of impactor load.

Table 1: Impact force and moment data, multiple impact locations.

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Side Mx (Nm, positive to left shoulder)</th>
<th>Front My (Nm, positive to back)</th>
<th>Axial Loading Percent reduction of impactor load (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Collar</td>
<td>222.54</td>
<td>284.10</td>
<td>24.41</td>
</tr>
<tr>
<td>Cowboy Collar</td>
<td>223.11</td>
<td>226.11</td>
<td>27.89</td>
</tr>
<tr>
<td>Bullock Collar</td>
<td>200.60</td>
<td>254.72</td>
<td>22.38</td>
</tr>
</tbody>
</table>

CONCLUSIONS

Both collars limited loads at some locations; however, no collar was effective at limiting loads at all locations. Further testing is needed at lower impact velocities that are similar to injurious impacts in the field.

REFERENCES


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