

Reduction of the Concussion Rate in the Sport of Football

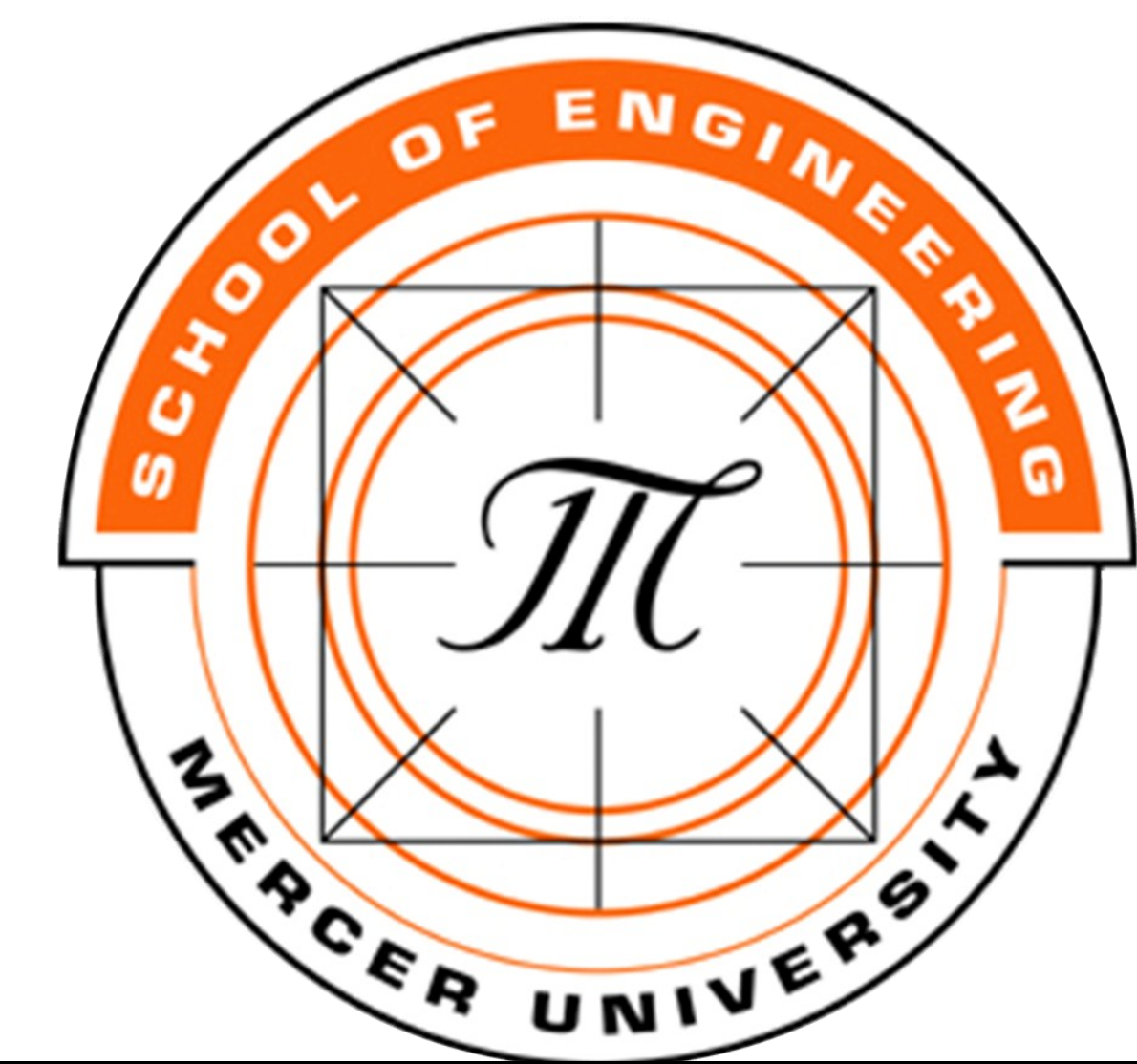
Andrew Hamilton MAE, Joshua Hicks BME, LaShon Stephens BME

Client: Dr. Ha Van Vo

Technical Advisors: Dr. Edward O'Brien, Dr. Richard Kunz

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Mercer University - School of Engineering, Macon, GA



Problem Statement

Concussions are major injuries that occur commonly in all age groups and divisions of football. A concussion is a medical condition which occurs when the brain comes in contact with the inside of the skull due to a large change in inertia of the body. This impact can cause a temporary loss of brain function. Recent studies have shown that 75 – 95% of concussions which occur during football result from excessive force applied to the front of the mandible, or lower jaw bone, by the chin strap.

A second problem exists in the testing of helmets for use. Currently, helmets are tested according to standards laid out by the National Operating Committee on Standards for Athletic Equipment (NOCSAE). The NOCSAE uses two different machines to ensure the safety of helmets used by professional football players.

EVA Padding Strap

- 1/8" of EVA padding was sewn to the interior of the chin and along the strapping
- The padding was surrounded in a cotton polyester fabric
- Both materials are inexpensive and are used often in sporting equipment



Figure 3: EVA Padding Strap

Elastic Chin Strap

- The traditional strap was replaced with 3/4" nylon webbing
- Nylon webbing was chosen for its known high strength and relatively low cost
- Nylon webbing is also used for some football shoulder pads



Figure 4: Elastic Chin Strap

Results, Cont,

EVA Padding Chin Strap Results

Test	Impact Force (N)	Chin Force (N)	Difference	% Diff
1	4548	1824	2724	0.4010
2	5358	2490	2868	0.4647
3	5808	2209	3599	0.3803
4	3767	1535	2232	0.4074
5	3921	1258	2663	0.3208
6	3906	1412	2494	0.3614
Average	4551.33	1788.00	2763.33	0.3900

Methods

Apparatus Testing Method:

- Multiple test will be run from a constant pressure of 40 PSI
- Impact acceleration of head measured by accelerometers using LabVIEW to output results
- The results presented graphically will provide a maximum peak giving the peak acceleration of the impact

Chin Strap Testing Method:

- F-SCAN sensors on the facemask and the mandible
- The peak force difference, shown graphically, will provide the force absorption information

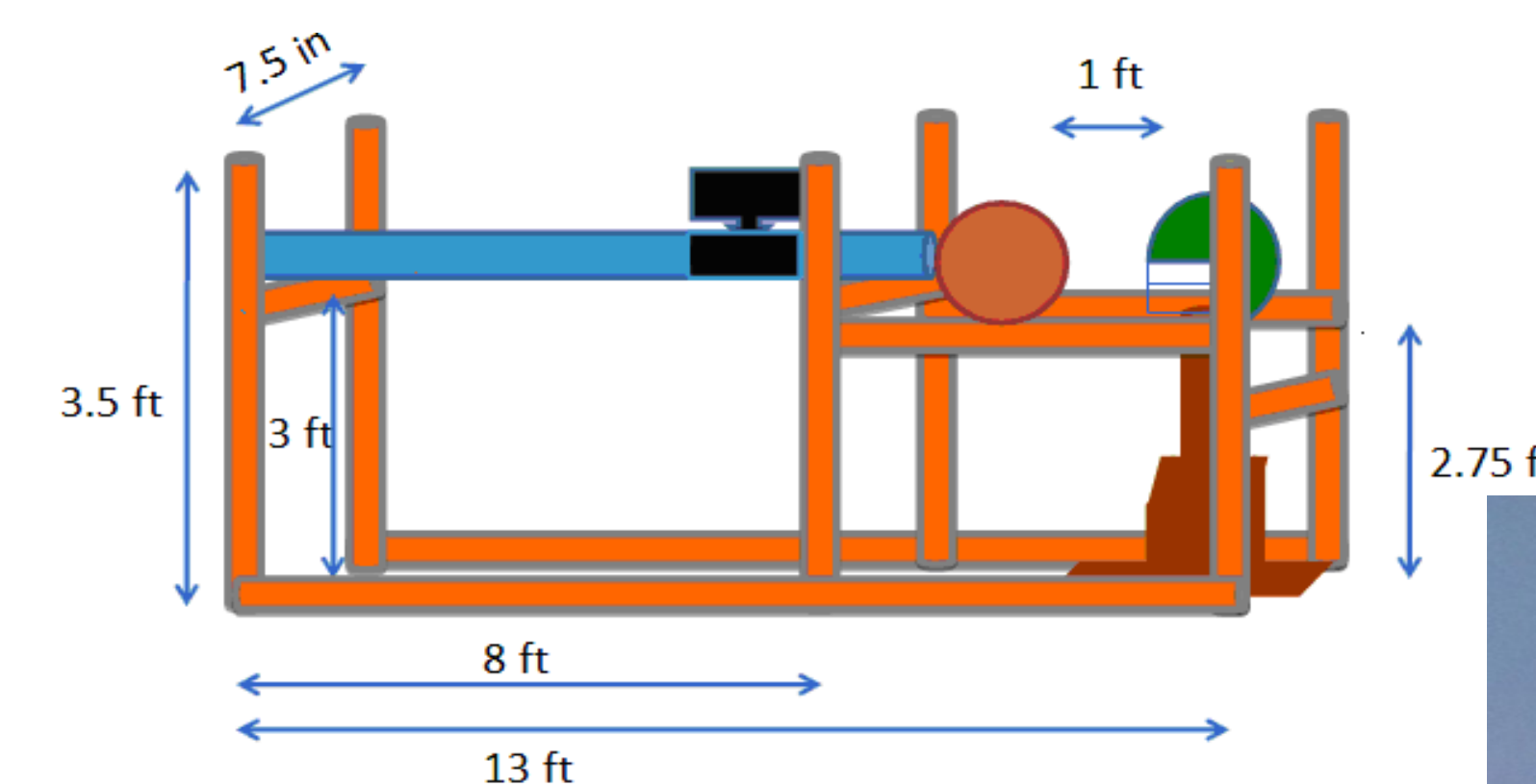


Figure 5: Apparatus Setup

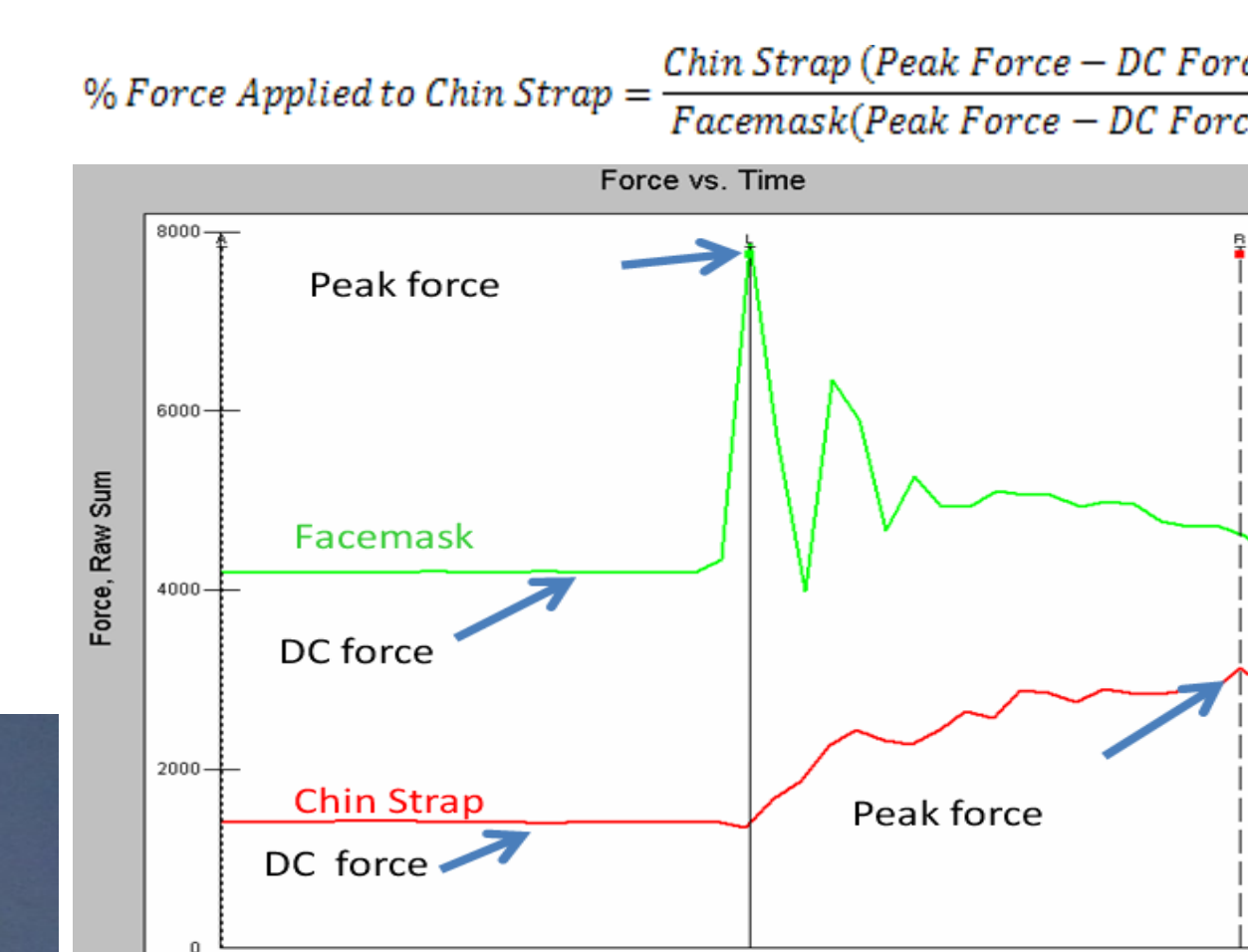


Figure 6: F-SCAN Graph

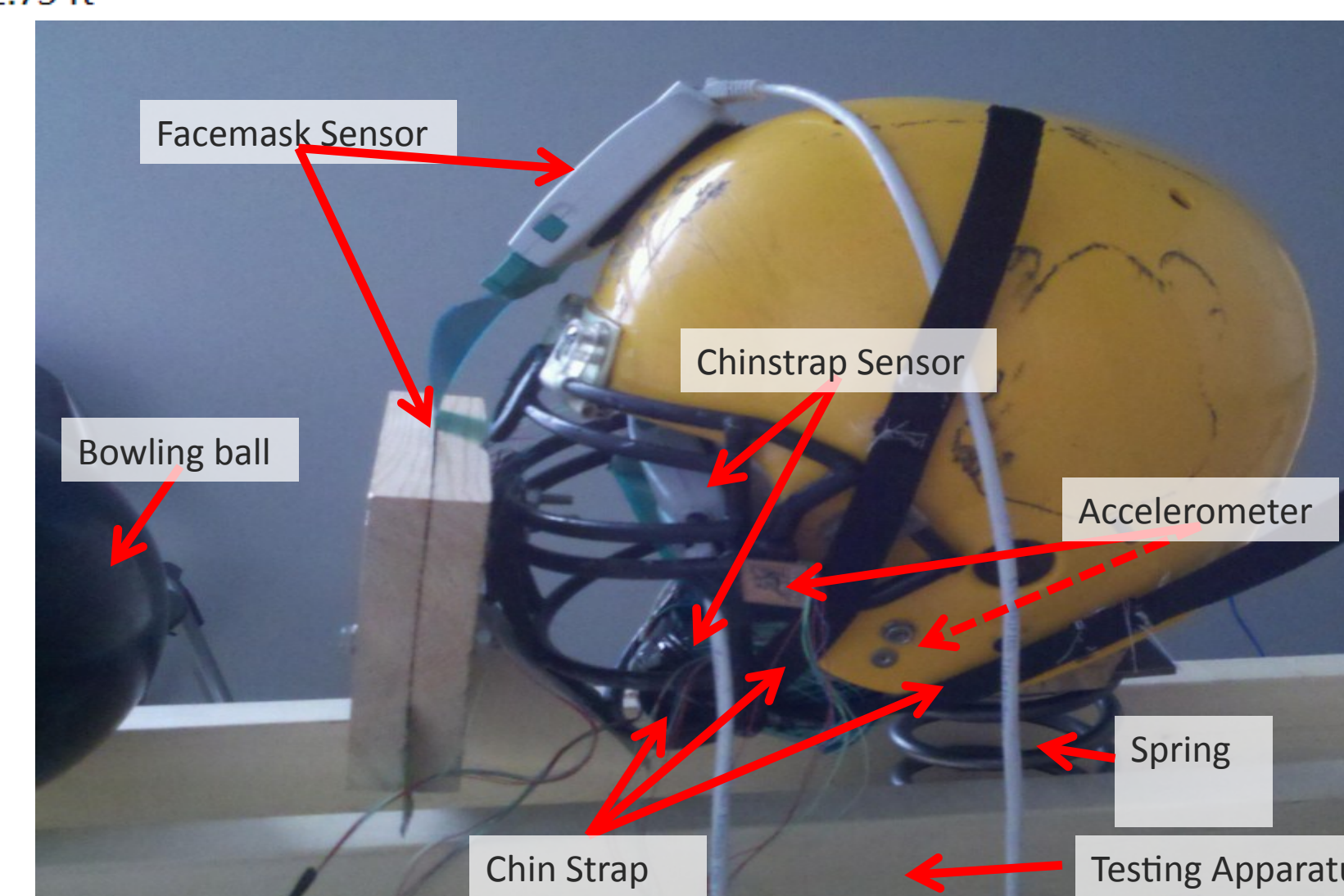


Figure 7: Testing Helmet Setup

Accelerometer Results

	Left	Right
Average	62.9877	63.24241
High	63.061	64.1727
Low	62.9043	62.3671
Std Dev	0.044459	0.265701

Conclusions

- Testing Apparatus showed consistent results and was safe and easy to use
- EVA padded chin strap absorbs more force than both the Commercial and Elastic Chin Straps
- The EVA chin strap also had the best Customer Reviews
- The EVA chin strap decreased the amount of force experience by the lower mandible from the traditional chin strap by slightly more than 20%
- As a result, it can be concluded that the addition of padding to the interior of traditional chin straps is a successful method for reducing the occurrence of concussions

Recommendations:

- Test additional chin strap designs
- Test varying thicknesses of EVA padding
- Computer simulation testing
- Application to other sports

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Project Goal

One method, not yet thoroughly considered by the sporting industry in the prevention of concussions in the sport of football, is the reduction of the force transmitted from frontal impact on the faceguard to the mandible through the chin strap. To accomplish this task, two modified chin straps will be produced.

In addition to a modified chin strap, a testing apparatus will be built which will be used to test the effectiveness of the new strapping by measuring the percentage of force transferred to the TMJ when an impact force is delivered to the faceguard. Since ideally, this design will be used in the future by agencies such as the NOCSAE to test the efficiency of the chin strap in football helmets, this device must also be both safe and easy to operate.

Results

Commercial Chin Strap Results

Test	Impact Force (N)	Chin Force (N)	Difference	% Diff
1	3265	1938	1327	0.5935
2	3274	1902	1372	0.5809
3	3677	1733	1944	0.4713
4	5411	2365	3046	0.4370
5	3493	1646	1847	0.4712
6	4405	2094	2311	0.4753
Average	3920.83	1946.33	1974.50	0.5049

Elastic Chin Strap Results

Test	Impact Force (N)	Chin Force (N)	Difference	% Diff
1	2865.00	2117.00	748.00	0.7389
2	3207.00	2277.00	930.00	0.7100
3	4155.00	3048.00	1107.00	0.7335
4	4236.00	2780.00	1456.00	0.6562
5	2658	1667	991	0.6271
6	2698	1936	762	0.7175
Average	3424.2	2377.8	1046.4	0.6931