Low Cost Impact Testing Device

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Abstract

The purpose of this project is to produce a machine that will simulate blunt force trauma on bone samples, in particular a pig skull. The customer wants a device that can deliver a range of velocities, up to 6 m/s, with a variable amount of mass to break bone. The device must be able to deliver certain energy levels (different masses at different velocities from different heights). The main consideration for this project is the mechanics of the device. The only data acquisition the group must consider is integration of an existing force plate. Research suggests that such an impact machine ought to be able to deliver up to 68.5 Joules of energy to break a bone over an impact time ranging from 0.005 to 0.01 seconds.

A vertical-drop impact design was chosen, which can easily provide the required energy. The vertical design incorporates a slide that moves on a three-rail system supported by a rib/brace structure. The impact head is attached to the slide and can be easily replaced for versatility purposes. The slide has a mass of 15 kg by itself, extensible by adding separate weights. When the machine is not in use, a lock will be used to block slide motion in order to prevent accidental injury or damage.

The bone samples will be held in place using Bondo casts to minimize attachment effects on bone damage. All design decisions were made using decision techniques and impact/stress analyses. In terms of manufacturing processes, this device has been designed in several pieces using SolidWorks software so it can easily be put together and taken apart. At this point, all the manufacturing can be done in house.

The machine is currently in the manufacturing process, and will be completed by mid-April. Several tests will be conducted to ensure that the machine will achieve the targeted capabilities. A motion capture system will be used to validate the acceleration and maximum velocities of the slide in comparison to theoretical values, resulting in a calibration between drop height, mass, and speed.