EVALUATION AND QUANTIFICATION OF BRUISING

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INTRODUCTION

In the United States there were 903,000 estimated cases of child abuse or neglect in the year 2001 [1]. Despite this high number, many cases go unreported each year due to an inability to positively identify a case of abuse. In fact, a child will be seen several times in the acute care setting before an exact diagnosis and proper intervention can occur. This delay is partly due to subjectivity that results when dealing with cases of bruises with unknown etiology and the lack of proper documentation. The accuracy of a physician's assessment in terms of timing of a bruise based on physical examination has been previously reported to be less than 48% [2]. Therefore, there is an urgent need to objectively quantify bruises in order to document the occurrences early in the treatment process.

The purpose of this research is to develop a model for bruising to evaluate methodologies to assist in the quantification of bruises with known impact conditions.

METHODS

The gastrocnemius muscle complex of the adult Wistar rat was selected for impact based on the relative size of the complex and the ease of access. 30 adult female Wistar rats weighing between 300 to 375 grams were tested. Prior to testing, approval from the Animal Care Committee at Wayne State University was granted.

As part of this effort, a pneumatic impactor was developed to achieve a wide range of impact conditions. The pneumatic system consists of a pressure accumulator which is attached to a tube or barrel by way of an electric solenoid. A projectile is placed into the barrel and when triggered the solenoid opens and the pressure accelerates the projectile which is allowed to drive into the specimen. Three impactors ranging in mass from 50 to 100 grams were used. Each impactor surface has a diameter of 1.27 cm and a cross-sectional area of 1.27 cm^2. The impactor surfaces are a flat circle with 1 mm radius around the entire circumference to reduce the edge loading effects.

After anesthetization, the hind limbs of each specimen were shaved to expose the gastrocnemius muscle complex which includes the gastrocnemius, soleus, and plantaris muscles. Both hind limbs of the specimen were then scanned in a 4.7 T MRI to establish a baseline image. Next, one hind limb from each animal was randomly selected for impact with the other limb serving as a control. The specimen was placed in sternal recumbency with the selected hind limb extended and 90° of dorsiflexion in the ankle. The gastrocnemius complex was impacted with one of the six impact conditions list in table 1. After impact the hind limbs of the specimen were scanned again to determine the volume of the contusion that was created.

Table 1: Impact Conditions for the Six Impact Groups

Impactor Mass (g)	Impactor Velocity (m/s)	Impact Energy (J)
50	14.14	5.00
75	11.55	5.00
100	10.00	5.00
50	16.73	7.00
75	13.66	7.00
100	11.83	7.00

RESULTS AND DISCUSSION

The impact conditions were selected based on preliminary pilot studies. Multiple masses were selected to assess the effect of varying mass and velocity while maintaining impact energy. Two impact energies were selected to assess the effect of increasing velocity while maintaining the mass. Impact energies were selected based on preliminary studies and published data [3]. Figure 1 is an MRI scan of the contusion created at the 4.92 J energy level.

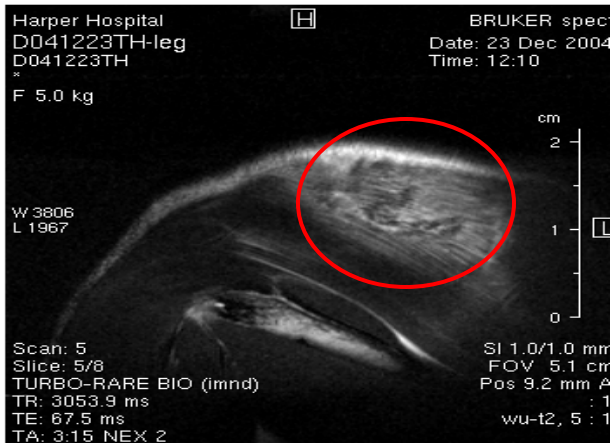

Figure 1 : A T2 weighted MRI scan of an impacted gastrocnemius (Impact energy was 4.92 J)

CONCLUSIONS

This model is capable of producing bruises on the adult Wistar rat. The 4.7 T MRI provides a viable method for visualizing and quantifying a bruise in vivo.

REFERENCES

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