INTRODUCTION

Lower extremity injuries from car crashes are associated with decreased quality of life. This research effort is motivated by a need to identify CT scans of a 5th female and a 50th and 95th male leg for use in finite element model development. Our goal is to outline a method for obtaining retrospective data on skeletal anthropometry and relate this data to the population when subject anthropometry is unavailable and use this information to create models that can predict injury in humans of all shapes and sizes.

METHODS

Developing Normal Distribution Curves

Data from Schneider et al. was used to determine leg lengths for a 5th percentile female, a 50th percentile male, and a 95th percentile male [1]. In this study the distance from the lateral femoral condyle to the lateral malleolus defined the length of the leg (Figure 1).

Leg length was calculated to be 23% of overall height, thus, the standard deviation of leg length was determined to be 23% of the standard deviation of height. The resulting normal distribution curves for males and females were plotted for +/-3 standard deviations (figure 2).

Determining 5th, 50th and 95th Percentile Study Scans

Z-scores were determined for each study scan using Equation 2. The probability associated with the z-score was calculated using Equation 3. This equation was used to determine the percentile rank of all study scans so scans closest to the 5th, 50th and 95th percentile models could be identified.
\[ z = \frac{x - \mu}{\sigma} \quad (2) \]

\[ \Phi(z) = P(Z \leq z) = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-\frac{u^2}{2}} du \quad (3) \]

**RESULTS and DISCUSSION**

Developing ATDs and computer models that are the correct size and shape is very important because this allows for more accurate predictions by the computer model or ATD of what an occupant will experience during a crash event. The goal of the research described in this paper was to create a method for using CT scans retrospectively to garner information on human anthropometry, specifically leg length. The information presented in Tables 1 and 2 and Figure 2 allows for a comparison between the 5\(^{th}\), 50\(^{th}\), and 95\(^{th}\) percentile models from the normal distribution curves and the study CT scans found to approximate these percentiles. Approximating the 5\(^{th}\), 50\(^{th}\) and 95\(^{th}\) percentile models with the 3\(^{rd}\), 49\(^{th}\) and 93\(^{rd}\) percentile study scans is justified because of the inherent lack of accuracy in the measuring system. Cheung et al found intra-observer variation for placing probes to measure length was 3.3mm [2]. Table 2 shows all three study scans have leg lengths that are within 3mm of the 5\(^{th}\), 50\(^{th}\) and 95\(^{th}\) percentiles respectively.

**CONCLUSIONS**

Leg injuries are not often life threatening; however, they can have a large impact on quality of life. While this study took into consideration the gender of the individual other variables such as height, weight and age were left out. This study also considered only the length of the leg; other aspects such as tibia and fibula shape were ignored. The ultimate goal for this research is to create a comprehensive model that can accurately measure stress and strains in models representative of the anatomy of a wide range of individuals.

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**REFERENCES**
