Journal of Physics Special Topics
An undergraduate physics journal

A3_3 When the Preacher shot the Priest

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December 5, 2018

Abstract

In the Amazon Prime show Preacher, the protagonist Jesse Custer shoots a character called Allfather in the chest with a pistol, knocking him to the ground [1]. The Allfather then stands up and removes the bullet from his chest. His body fat has supposedly prevented the bullet from killing him and keeping him alive. In this paper we find out if this feat is possible by finding the depth of human body fat required to stop a bullet fired from a pistol six metres from the target. This depth - considering reductions in velocity from air resistance and piercing human skin - was found to be s = 21.2 m. This high value for the distance the bullet travels means that it is not feasible for the Allfather to survive being shot.

Introduction

In season three, episode eight, of the show Preacher, the character Allfather survives being shot due to excessive amounts of body fat. We investigated if a person of his build could survive being shot with a pistol by calculating the amount of human body fat required to bring a bullet to rest. We modelled the bullet being fired from six metres before hitting and piercing the skin and then the distance the bullet would travel in human body fat before coming to rest. The weapon used for calculations appeared similar to a M1911 pistol which fires .45 ACP bullets which have a diameter of 12.1 mm [2].

Theory

The force of the bullet can be found using equation (1) [3].

$$F = mg – cv^2, \tag{1}$$

$$a_1 = \frac{-v_1^2 \rho_1 A}{4m}. \tag{2}$$

Here, a_1 is the deceleration due to air resistance, c is the drag coefficient, given by $c = (\rho_1 A)/4$, v_1 is the initial velocity of the bullet (253 ms^{-1} [2]), m is the mass of the bullet (1.5×10^{-2} kg [2]), A is the cross-sectional area of the bullet (1.04×10^{-4} m^2 [2]) and ρ_1 is the density of air (1.23 kgm^{-3}) [3]. In this paper we are calculating the horizontal deceleration and thus $g = 0$. We also assumed constant deceleration due to air resistance [3]. By finding the force from equation (1), we found the acceleration using $F = ma$. The velocity at time of impact with the skin was then calculated using equation (3),

$$v_f^2 = v_i^2 + 2as, \tag{3}$$

where v_f is the final velocity of the bullet (when it impacts on the skin, which in this case will be called v_2), v_i is the muzzle velocity of the bullet v_1, and s is the distance between Jesse's gun and Allfather (6 m). Next, the bullet would impact and pierce the skin, and the deceleration of the

bullet was calculated using equation (4).

$$a_2 = \frac{-PA}{m} \tag{4}$$

a_2 is the deceleration caused by the skin and P is the pressure required for the bullet to pierce the skin (27.2 MPa) [4]. The velocity of the bullet as it exits the skin and impacts the human body fat, v_3, is found using equation (2), where v_3 can be set as v_f, v_2 for v_i, a_2 for a and $s = 2 \times 10^{-3}$ m (the average thickness of skin on a human's chest) [5]. Equation (5) gave the deceleration required to stop the bullet with the body fat.

$$a_3 = \frac{-v_3^2 A \rho_2}{4m}. \tag{5}$$

$\rho_2 = 909$ kgm^{-3} is the density of human body fat and a_3 is the deceleration due to the body fat [6]. The amount of body fat required to bring the bullet to rest was be calculated using equation (3), rearranged to make s the subject. The final velocity of the bullet is set to rest, v_3 can be substituted for v_i, and a_3 for a. s is the distance travelled through human body fat to bring the bullet to rest. Now we compare s to the width of the Allfather's chest, found to be $w = 0.73$ m from analysis of the episode footage [1], to determine if Allfather's survival is possible.

Results and discussion

The velocity when the bullet impacts upon the skin is 252.95 ms^{-1}, due to the deceleration due to air resistance, found to be -135.74 ms^{-2}. The deceleration caused by the skin is -1.88×10^5 ms^{-2}, therefore decreasing the velocity of the bullet to 248.25 ms^{-1}. Human body fat was found to decelerate the bullet by -1455.29 ms^{-2}, thus giving a length of 21.17 m to bring the bullet to rest. This shows that the quantity of fat in the Allfather would be insufficient to stop a bullet. The margin of error in the calculations is down to the tolerances in the referenced values used in the equations. Only three values were found to have an error associated with them, the tensile strength of skin ± 9.3 MPa [4], the thickness of human skin $\pm 0.5 \times 10^{-3}$ m [5] and the density of body fat ± 9.8 kgm^{-3} [6]. No error could be found in the other values used in the equations. Therefore, the overall compound error in the length of human body fat was found to be 2.33 m.

Conclusion

The length of human body fat required to bring the bullet to rest was found to be $s = 21.17$ m. This value is far greater than the width of the Allfather, 0.73 m, so he could not survive being shot according to our model, as the bullet would have entered his chest and exited his back. In this paper we have not taken into account the effects of muscle and bone that would help to stop the bullet, and this may change the results.

References

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