

AN INVESTIGATION INTO THE IMPACT FORCE EXPERIENCED BY DIFFERENT TYPES OF FOOTBALLS

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INTRODUCTION: The impact force of kicking varies with different materials and the estimated force in powerful (maximal velocity) instep kick was 1100N (Tsaousidis and Zatsiorsky, 1996). The force may cause injuries and stress accumulated on the foot especially in novices, due to unfamiliar skill. Rubber is durable, cheap but stiffer; TPU (Thermoplastic Polyurethane) and PU (Polyurethane) material has higher elasticity and impact absorbability. The purpose of this study was to identify the impact force, max velocity and travelling distance with different material footballs.

METHODS: Four footballs (inflated pressure 0.6 bar), molten FVA 5000 (PU), Adidas Final 8 (PU), Adidas Sportivo (TPU), and Spalding 61-731 (Rubber), were used. Impact force was measured by 2.5 m ball drop test on KISTLER 9187 force plane (90*60 cm², 1000 Hz, Unit: kg), each drop test was proceeded 3 trials. Two elite football players (subject A: 175 cm height and 80 kg weight; subject B: 172 cm height and 72 kg weight) without lower extremity injuries were recruited. A radar gun (sampling at 300 Hz) was used to measure peak ball velocity with powerful instep kick, and a measuring-wheel were used to measure ball travelling distance with powerful goal kick. For the reliability and repeatability each kicking task was repeated 3 times in the windless environment, and the kicking data required to exceed 90 km.h⁻¹ were identified.

RESULTS: The impact force, velocity and travelling distance of the footballs are shown in Table 1. Adidas Final 8 is a FIFA approved ball for UEFA Champions cup, and it has lower impact force and higher velocity and travelling distance in this experiment. In the drop test, ball and force plane contact time was 7-10 m.s⁻¹, and the impact force greater than 1000 N was maintained 2m.s⁻¹.

Table 1. The impact force, velocity and travelling distance

	Molten FVA5000	Adidas Final 8	Adidas Sportivo	Spalding 61-731
Impact force (N)	1068	1058	1077	1145
Velocity (km/h)	94(5.0)	100(3.2)	98(4.2)	98(4.6)
Traveling distance (m)	49(2.9)	50(2.3)	48(2.8)	47(3.2)

DISCUSSION & CONCLUSION: The result 94 to 100 km.h⁻¹ ball speed is close to related research of elite player (Nunome et al.,2006). Adidas Final 8 had lower impact force and higher ball velocity and travelling distance in the test, and Sportivo had similar data with Final 8. The higher impact force was presented at Spalding rubber ball, TPU and PU material had lower impact force. Rubber balls are durable, but it is not appropriate in powerful kick or heading task for novices. Non-FIFA approved Adidas TPU ball also reach the standard level, it is suit to practice and competition.

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