EVALUATION OF CLOTH SPORT SHOE AS A FOOTWEAR FOR HONG KONG PRIMARY SCHOOL STUDENTS IN PHYSICAL EDUCATION LESSONS

Daniel T.P. Fong, Youlian Hong and Jingxian Li
Human Movement Laboratory, Department of Sports Science and Physical Education,
The Chinese University of Hong Kong, Hong Kong SAR, China

INTRODUCTION

In Hong Kong, most primary school children in physical education lessons wear cloth sport shoes, a kind of low-price and light shoe with thin inner sole and cloth upper sole (Figure 1). Despite the recent rising concern on the protective function of such shoe, it is still left uninvestigated. The present study is to compare the cushioning ability and lateral stability of cloth sport shoes with other sport shoes under a simulated situation in the school physical education lesson. Human pendulum and cutting movement tests were used on a group of human subjects.

Figure 1 – Students wearing cloth sport shoe

METHODS

Twelve male subjects (mean ± S.D.: age: 12.7 ± 0.4 yrs; mass: 40.7 ± 5.9 kg; height: 150.4 ± 4.25 cm) with a same shoe size (38.5, length = 26cm) were recruited from three local primary schools where physical education lessons with some low intensity running and cutting movements were involved. Subjects were free of injury and pain on the testing day. Informed consents were obtained. Five shod conditions were investigated (running shoe, basketball shoe, cloth sport shoe, cross-training shoe, barefoot).

The human pendulum method (Figure 2) (Lafortune & Lake, 1995) was used to simulate the impact velocity (1.15 m/s) in running at a velocity of 3.6 m/s, which is the average running velocity in primary school physical education lesson. Ten impact forces were recorded at 1000 Hz with subject performing a left heel impact with a straight leg and loose ankle on a vertically wall-mounted force platform (Kistler, 9281CA). High-speed video camera (JVC, GR-DVL 9600) was used to record the impact movement at a sampling rate of 100 Hz to check the impact velocity with Arial Performance Analysis System (APAS®). Cushioning ability was compared by the peak impact forces.

Figure 2 – Human Pendulum

Ten cutting movements with a forward and sideward approach (Figure 3) (Stacoff et al, 1996) with the same five shod conditions were performed to compare lateral stability. Subjects were asked to perform the cutting movement with a speed as they do in physical education lessons. Reflective skin markers were attached to the left ankle at the tibia, talus, calcaneus, lateral and medial malleolus for measuring ankle in/eversion. Holes were cut on the shoe to allow the markers to be seen from the outside. As Stacoff (1996) mentioned that inversion should occur right after touchdown during a cutting movement, trials where eversion occurred, or where the foot was aligned out of the filming area were determined to be bad trials and were discarded. The trials were filmed with four high-speed video cameras at 100Hz for three-dimension motion analysis with APAS. A force platform (Kistler, 9281CA) was located beneath the filming area to locate the exact touchdown time. Video and force platform data were synchronized by a synchronization box which lighted up four small bulbs placing right in front of the cameras and outputted a square wave signal to the force platform data. Lateral stability was compared by the range of ankle inversion after touchdown until it reached its maximum.

Figure 3 – Cutting Movement Direction

RESULTS AND DISCUSSION

One-way ANOVA was applied to see significant difference in impact peak and range of inversion respectively. The results in cushioning (in terms of bodyweight, BW) showed that the running shoe gives the best performance (2.06 ± 0.30 BW) compared with all other shod conditions ($p<0.05$). The basketball shoe (2.37 ± 0.30 BW) and cross-training shoe (2.30 ± 0.32 BW) both give significantly more cushioning compared with barefoot (2.65 ± 0.38 BW) ($p<0.05$). The cloth sport shoe (2.56 ± 0.40 BW) showed no significant cushioning effect. The results are shown in Table 1. However, in normal Hong Kong primary school physical education

lessons twice a week, with each lesson lasts for 35 to 45 minutes, it is suggested that the inferior cushioning ability of cloth sport shoe would not be a critical factor because it is not likely to cause harmful impact in such brief bouts of activity.

	Mean Peak Impact Force (BW)	Comparison with barefoot
Running shoe	2.06 ± 0.30	Excellent ($p<0.05$)
Basketball shoe	2.37 ± 0.30	Good ($p<0.05$)
Cross-training shoe	2.30 ± 0.32	Good ($p<0.05$)
Cloth sport shoe	2.56 ± 0.40	No significant difference ($p>0.05$)
Barefoot	2.65 ± 0.38	-

Table 1 - Mean peak impact force and comparison with barefoot for different shoes (with standard deviation)

In the stability test, the mean range of inversion was from 2.31 (basketball shoes) to 5.26 degrees (barefoot). No significant difference of range of ankle inversion was found between all shod conditions ($p>0.05$). These results are shown in Table 2. The results were much smaller than that recorded by Stacoff (1996) which were as much as 20 degrees, in which more vigorous cutting movements were performed by adult athletes (age = 25). It is suggested that in low-intensity physical education lessons in primary schools, the lack of lateral stability provided by the cloth sport shoe would not be a critical factor to cause ankle injury.

	Mean Range of Inversion (degree)	Comparison with barefoot
Running shoe	4.64 ± 5.12	No significant difference ($p>0.05$)
Basketball shoe	2.31 ± 2.69	No significant difference ($p>0.05$)
Cross-training shoe	3.27 ± 4.49	No significant difference ($p>0.05$)
Cloth sport shoe	4.29 ± 2.95	No significant difference ($p>0.05$)
Barefoot	5.26 ± 4.61	-

Table 2 - Mean range of inversion and comparison with barefoot for different shoes (with standard deviation)

SUMMARY

The cloth sport shoe does not provide significant cushioning effect and lateral stability for Hong Kong primary school students to participate in physical education lessons However, it is believed that the thin shoe sole of the cloth sport shoe may be an advantage to facilitate the perception of the foot as a sensory organ, which may play a role in the development of the foot anatomy for better adaptation to the floor surface. Further ergonomic investigations are suggested.

REFERENCES

Lafortune, M.A. & Lake, M. (1995) *J. Biomech*, **28**, 1111-1114.
Stacoff et al. (1996). *Proceeding of XIV ISB Congress '96*, 1278-1279.