

PREDICTION OF BALL SENSING BY SKIN SENSATION MEASUREMENTS

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INTRODUCTION

From a questionnaire with 250 soccer players we found that good ball sensing is one of the top desirable properties that players expect wearing their soccer shoes. Therefore, thin and soft leather uppers (e.g. kangaroo leather) are used in top end soccer boots. The purpose of this study was to explore the possibility to predict ball sensing properties in soccer boots as perceived by the players from skin sensation measurements.

METHODS

20 experienced male soccer players participated in this study which included two parts:

1) The influence of different shoe uppers on the perception of vibration stimuli was analyzed. A commercial available soccer shoe (control condition) and four modifications of this shoe model were tested. Foam was added to the medial side of the front part of the shoe. This material differed in thickness and density (2mm added foam with low density (LD), 5mm with low and high density (HD) and 8mm with low density). A "Horwell" neurothesiometer probe was applied to the shoe upper above the distal end of the first metatarsal bone and the medial side of the hallux in all five shoe conditions. At a time, unknown to the subjects, a ramp generator was triggered, which increased the neurothesiometer vibration amplitude linearly. Subjects were sitting blindfolded in a quiet room to focus their attention in recognizing the onset of vibration. As soon as they detected vibration, they had to push a button that triggered the recording of the vibration amplitude value.

2) In the second part of this study the subjects had to rate the modified shoes on a 7-point scale in a field test. They performed several soccer specific movements (juggle the ball, play the ball between the insides of the right and left foot, kicking the ball at a target). Afterwards they had to judge whether the shoe upper allowed more or less ball sensing in comparison to the reference shoe.

Finally, the correlation coefficient between measured sensory threshold values and the subjective ratings from the field test was determined.

RESULTS AND DISCUSSION

The first part of this study showed, that density and thickness of the shoe upper have an influence on vibration perception. These differences were statistically not significant, but there is a tendency, that vibration perception is improved in shoes with a thin upper.

		Control	2mmLD	5mmLD	5mmHD	8mmLD
Vibration perception	AV	100%	94.3%	98.86%	99.73%	96.71%
	SD	0	7.16	9.58	6.78	11.16
Subjective rating	AV	4	3.48	4.1	4.05	3.78
	SD	0	0.85	0.77	0.99	0.67

Table 1: Average values and standard deviation of vibration perception and subjective rating (normalized to control condition).

Surprisingly, a low density thick upper (8mm) showed the 2nd best results (Figure 1). Soccer players also report best ball sensing with the thinnest followed by the thickest low density padding (Figure 2).

We assume that the good perception results of the thick upper are caused by a better coupling of the shoe upper to the skin surface. The additional material makes the fit of the shoe tighter. It is known that soccer players prefer tight shoes for an improved feeling of the ball.

The similar results of the first and second part of this study show that there is a high correlation of $r = + 0.94$ between measured skin sensation vibration thresholds and the subjective ratings from field tests. Therefore, ball sensing can be predicted by skin sensation measurements and could become an important tool for quantifying the ball sensing quality of soccer shoes.

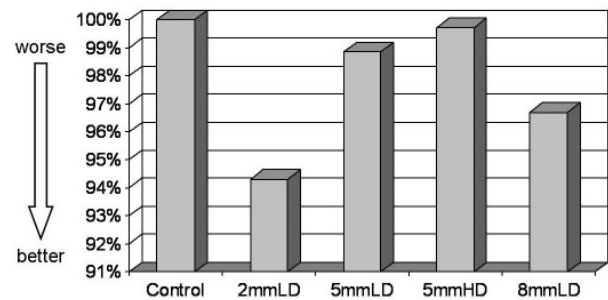


Figure 1: Normalized vibration perception with soccer shoes with different thickness of the upper.

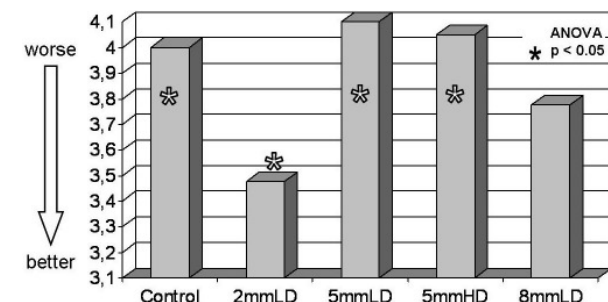


Figure 2: Subjective rating of soccer shoes with different thickness of the upper with respect to ball sensing.

CONCLUSIONS

Shoe upper has an influence on perception of vibration stimuli and the subjective rating of ball sensing: a thin upper and a tight fitting shoe improves perception and ball sensing. A high correlation coefficient between the results of the two studies shows that laboratory skin sensation measurements can predict ball sensing properties of shoes, as they are perceived by soccer players in the field.

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