A COMPARISON OF SHOCK ABSORBENCY BETWEEN NATURAL AND LONG PILE ARTIFICIAL TURF

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SUMMARY
To compensate inadequacies of the standard test (DIN18032-2) for evaluating the shock absorbency of long pile artificial turf (3-g turf), we proposed a new testing procedure which precisely reproduces acute, high loading likely caused by human sports action. The present study was designed to compare the shock absorbency of 3-g turf with that of natural turf using the new testing procedure. As the acceleration change of the impact head precisely reflects the loading force (R^2 =.990), the shock absorbency of natural turf was measured from the surface in the field. This nature was compared with those of 3-g turfs with different infills: sand, rubbers (large, medium and small grain) and sand/rubber, and with underneath shock pads (rubber/urethane combined and polythene foamed). In contrast to our conventional understanding, most types of 3-g turf showed smaller peak acceleration and milder jerk than those of the natural turf. Moreover, a 3-g turf with unusual infill component with rubber/urethane shock pad demonstrated a quite similar jerk with that of natural turf. This result may reinforce the needs for reconsideration of appropriate shock absorbency for 3-g turf.

INTRODUCTION
Use of artificial turf is becoming very common for sports that are usually played on natural lawn, in particular for football codes (Soccer and Rugby). After alternations of artificial turf generation, it seems that 3-g turf actualized more "natural turf" like appearance and properties, such as: ball-surface and shoes-surface interaction. Major soccer (FIFA and UEFA) and rugby organizations (IRB) recently accepted the use of the 3-g turf for official and international tournaments.
In contrast to the report for the earlier generation of artificial turf, cohort studies [5,7,8] reported no clear differences for injury risk of between 3-g turf and natural turf. However, there still exists an indistinct anxiety among coaches and players that some mechanical characteristics of artificial sports surfaces may link acute or chronic sports injuries. Soccer players still had negative overall impression and felt greater physical efforts when they play on 3-g turf [1].
Of various aspects, the cushioning ability is a key feature. To date, "Shock Absorbency" of the 3-g turf has been approved by a simple mechanical testing (DIN18032-2). However, it has been suggested that the current, conventional testing procedure does not reflect actual loading action occurring in sports movements [3,4,10]. To compensate these inadequacies, a new testing procedure has been proposed [11].
The present study was designed to compare the shock absorbency of 3-g turf with that of natural turf using the new testing procedure.

METHODS
Several types of 3-g turf tray with different infill components: sand, rubbers (large, medium and small grain) and sand/rubber, and with underneath shock pads (rubber/urethane combined and polythene foamed) were prepared. Each tray was designed to have the same infill depth (35 mm).
To measure the shock absorbency of natural turf from the surface, an accelerometer was attached to the impact head of the testing rig, and an attempt was made to examine how much the acceleration change precisely reflects the loading force measured from the bottom of the tray using force platform. The acceleration change were precisely reflects the change of the loading force (R^2 = 0.990) (Figure 1). After the verification of linearity between the changes of acceleration and loading force the shock absorbing property of natural turf and 3-g turfs were measured in the field where a professional soccer team regularly use for training..

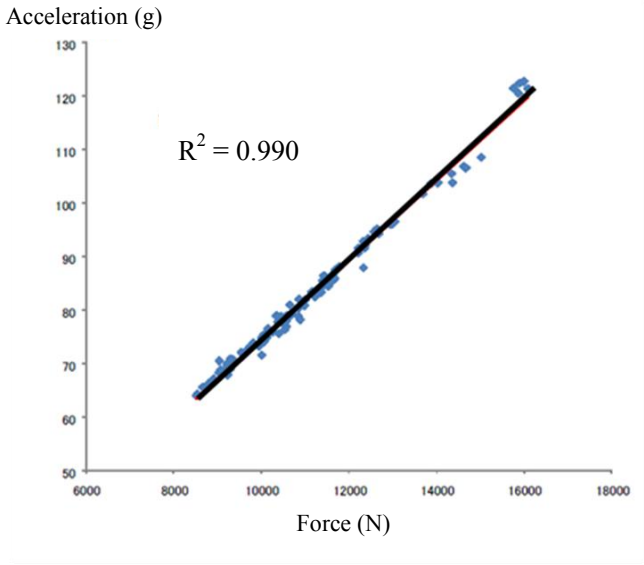

Figure 1: Linearity verification of between the changes of acceleration and loading force during testing.

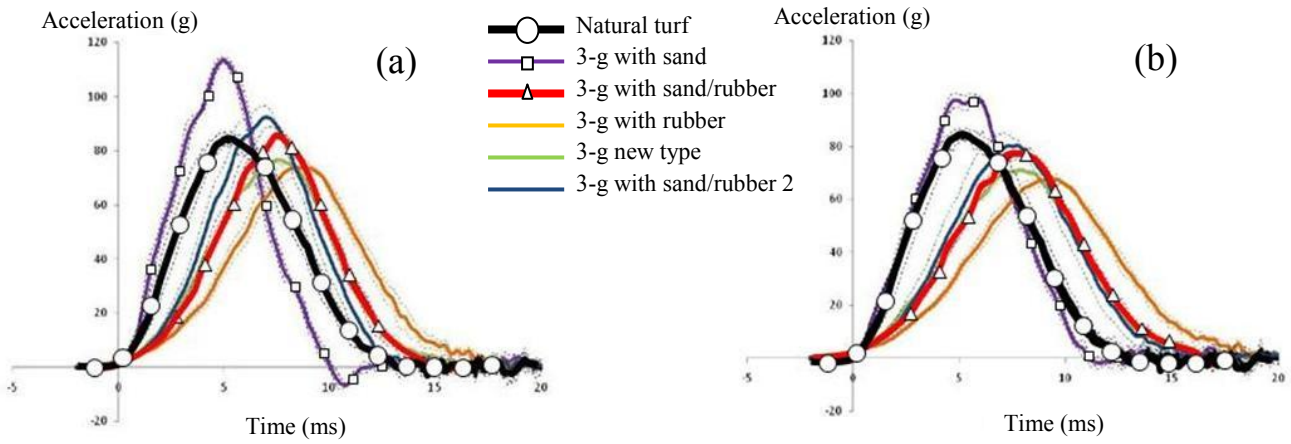

Figure 2: Changes (±SD) in accelaration of natural turf and 3-g turfs. Panel (a) shows the changes without underneath rubber/urethane shock pad and panel (b) shows the changes with the shouck pad.

RESULTS AND DISCUSSION

The average (±SD) changes of acceleration measured from the surface of natural and 3-g turf were shown in Figure 2. It can be seen that most types of 3-g turfs except for the one with sand infill, demonstrated milder rate of acceleration (jerk) during loading (Figure 2, panel a). The peak acceleration become even smaller when underneath rubber shock pad was installed (Figure 2, panel b). A 3-g turf with unusual infill component (sand only) with rubber shock pad demonstrated quite similar jerk with that of natural turf.

It can be assumed that most types of 3-g turf have excessive shock attenuation property than that of natural turf in contrast to our conventional understanding. This property likely induces larger energy absorption when soccer specific actions such as running, stopping and jumping were done on the surface. This may explain why soccer players are demanded greater physical efforts when they play on 3-g turf [1].

CONCLUSION

The present study clarified that most types of 3-g turf have excessive shock attenuation property than that of natural turf. This result may reinforce the needs for reconsideration of appropriate shock absorbency for 3-g turf.

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