New methods to evaluate traction on fields
Player Surface Interaction

Shoe-surface interaction is important for both the performance and the safety of athletes

This interaction is related to:

- **Performance:** improvement of performance during displacements, sprints, changes of direction, ...

- **Injuries:** excessive or insufficient traction can lead to injury
Shoe-Surfaces Interaction & Injuries

• In American Football, the severity and incidence of knee and ankle injuries were reported to be significantly lower when using shoes with friction properties (Ekstrand & Nigg, 1989)

• An athlete’s skills are limited by the quality of the fixation of that player to his present playing surface... but there is a trade off. Any increase in fixation increases the risk of injury (Levy et al., 1990)

• Friction is necessary for rapid starting, stopping, cutting and pivoting; however, increased frictional force may contribute to the increased incidence of injury (Inklaar, 1994)

• Increase in turf temperature, in combination with cleat characteristics, affects shoe-surface interface friction and potentially places the athlete’s knee and ankle at risk of injury (Torg et al., 1996)
Shoe-Surfaces Interaction & Injuries

• It is possible that measures to reduce shoe-surface traction, such as ground watering and softening (...) and player use of boots with shorter cleats, would all reduce the risk of football injuries (Orchand, 2002)

• Cold weather is associated with knee and ankle injury risk in outdoor stadiums, probably because of reduced shoe-surface traction (Orchand & Powell, 2003)

• While traction is frequently necessary for athletic performance, excessive traction increase the risk of ‘foot fixation’, an etiological factor in some types of injury (Shorten et al., 2003)

• ...
Standard methods to evaluate traction

- TRRL pendulum

Is there a relation between these tests results and players’ perception and performance?

-The result is maximum traction value (nothing about time to obtain the maximum or rotated angle)
New methods to evaluate traction

- IBV has developed two methods to evaluate traction:

  - Mechanical test: it consists of a machine capable of reproducing the lateral displacements that sportsmen make in their natural movements during matches.

  - Biomechanical test: it consists of a soccer boot with instrumented studs.
New methods to evaluate traction

**Mechanical test device:**

- The movement of this machine consists of a horizontal displacement at controlled velocity, recording the horizontal force necessary to produce the displacement.
- Vertical force = 150 N; constant velocity = 0.4 m/s
New methods to evaluate traction

**Mechanical test device:**

\[
C_{FD} = \frac{F_h}{F_v},
\]

\[
tg\alpha = \frac{F_h}{F_v},
\]

\[
C_{FD} = tg\alpha; \quad \alpha = actgC_{FD}
\]
New methods to evaluate traction

- Biomechanical test device:
  - It consists of a soccer boot with thirteen instrumented studs by means of strain gauges for measuring forces in each stud
New methods to evaluate traction

- Biomechanical test device:
New methods to evaluate traction

- Two studies were carried out:
  - Mechanical test
  - Subjective study
  - Biomechanical test
  - Comparative study
New methods to evaluate traction

- **Mechanical test & Subjective study:**
  - Five natural grass and five artificial turf fields
  - Five points were tested by means of IBV test device and three repetition for each one
  - Five experienced soccer players without injuries performed the test
New methods to evaluate traction

Mechanical test & Subjective study:

Mechanical test:
- $CDF_{peak}$
- $t_{peak}$

Subjective study:
- easiness to stop
- easiness to begin to run
- slips
- risk of injury perception
- performance
- traction in general
Results

Mechanical test results:

- **Field**: artificial, natural

- **$C_{FD_{peak}}$**: 2.4

- **Range**: 1.8 to 2.2
Results

• Differences between surfaces were found in easiness to stop (players perceived easier to stop in artificial turf than in natural grass); there is a correlation between these results and mechanical test results

• Differences were not found about easiness to run and slips between surfaces

• Players perceived a better performance in artificial turf, related to larger CFDpeak

• Traction in general was perceived as larger in artificial turf than in natural grass
Results

- Mechanical test results:
Results

- Mechanical test results:
  - Players perceived more risk of injury in artificial turf than in natural grass
Conclusions

About mechanical test:

• A good correlation exists between mechanical test results and players perception about:
  - easiness to stop
  - performance
  - traction in general

• It is possible that the relation $CFD_{\text{peak}} \cdot t_{\text{peak}}$ is an indicator of the severity of the stopped, related to risk of injury
New methods to evaluate traction

- **Biomechanical test:**
  - Five males semi-professional soccer players participated in the experiment
  - They performed five repetitions of three common movements in soccer over a natural turf ground:
    - start running
    - outer turning
    - inner zigzag
  - These movements were selected because:
    - they are very common movements on soccer matches
    - they are related to typical injuries suffered by soccer players
    - the influence of the studs could be important for the performance of the action
Results

Biomechanical test results:

Outer turn

Start running

Inner turn
Results

- Biomechanical test results:

![Graph showing force (N) over time (s) with markers at different points on a foot model.]

Start running
Results

Biomechanical test results:

Outer turn
Results

Biomechanical test results:

Inner zigzag
Conclusions

About biomechanical test:

• The front-outer studs presented the highest forces and time of actuation during the studied movements

• The forces in the rear studs were very low in the majority of movements

• These results suggest that different areas of actuation exist and they require different design parameters for studs
Conclusions

• Traction in artificial turf is different than in natural grass. It is necessary to continue working in this term

• Traction is different depending on shape and size of studs. It is necessary to know the influence of these in traction (standard methods simplify to a one type of stud)

• Future works: try to develop models to predict risk of injury starting from traction values
Thanks for your attention

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