Does Your Athletic Field Pass The Test?
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How the Surface Impacts the Game
Athlete-to-surface interactions
Ball-to-surface interactions

Ground Reaction Forces

Consistency of Surface Conditions
What is playing quality?

Field Safety and Playability

What is Friction/Traction

• Friction is the force resisting the relative motion of solid surfaces, fluid layers, and material elements sliding against each other

• Friction force is directly proportional to the applied load

Research on Injuries

• Up to 2/3 of non-contact injuries may be due to excessive surface to shoe friction
  (Ekstrand and Nigg, 1989)

• Injuries to the knee and ankle ligaments account for approximately 71% of injuries in ball sports
  (Powell and Schootman, 1992)

• 56% of ACL were non-contact injuries

• 69% of ACL injuries occurred during games vs. practice
  (Lambson et al., 1996)

Summary – Lower Extremity Injuries for NFL Football Players 2012-2016

• Synthetic surfaces continue to show higher rates of lower body injuries compared to natural surfaces

• Restricting to non-contact injuries further increased injury rates on synthetic turf relative to natural surfaces

• Adjusting for weather/surface hardness and removing anomalous synthetic fields didn’t change results (<0.08 difference)


• Athletes in Division I competitions experienced 10% higher ACL injury rates on artificial turf than on natural grass.

• Athletes in Division II and III competitions experienced 21% higher ACL injury rates on artificial turf than on natural grass.

Field Testing: Where Should I Start?

Where to Start?

- What type of surface do you have?
- What sport or sports are played on the field?
- How much time and money can be dedicated to testing?

Where to Test?

Basic Kit for Natural Grass

Soil Moisture Research

- Due to soil moisture contents relationship with surface hardness altering irrigation management practices to soften a surface can reduce surface hardness, traction, and ACL injury incidence

(Baker, 1991; Orchard et al., 1999; Orchard and Finch, 2002; Dickson et al., 2018)
Soil Profile Sampler

Rotational Traction Research

- Rotational traction is positively correlated with
turfgrass root density
- ground hardness
- grass type and density
- Negatively correlated with soil moisture content
(Holmes and Bell, 1986; McNitt et al., 1997; Orchard, 2002)

What does it cost

- Total ~$2,500 to $5,000
- Soil Moisture probe
  - $1,500 - $3,500
- Soil Profile Sampler
  - $230
- Rotational Traction Test
  - $750

Basic Kit for Synthetic Turf

Infill Depth
Previous Research on Heat Injuries

- Extended knee posture and higher ankle and hip angular velocities were recorded on the warm surface. (Charalambous, 2016)

- The average release coefficient of all shoes combined increased 19.4% between artificial turf temperatures of 52°F and 110°F. (Torg et al., 1996)

- Excess heat has been shown to speed dehydration, increase the heart’s rate, and lead to heat cramps due to the loss of salt in perspiration—all of which are related to the major types of “heat injury.” (Lind, 1963; Toor, 1981)

Rotational Traction

What does it cost

- Total ~$1,000
- Infill Depth Gauge
  - $40 - 200
- Temperature Gun
  - $40
- Rotational Traction Test
  - $750

How long does it take

- Testing for both natural and synthetic will take less than an one hour to do 10-12 spots on a field for all three tests
- Can be done by one person
- Additional tests can be completed to address areas of concern

Record Keeping
Heat Maps Can Help Understand the Data

Conclusions

• Collect some type of data
• Keep a record to see how the field progresses with the season

Additional Testing

Yearly Soil Tests

Irrigation Audit

Clegg Surface Hardness

2.25 kg (5 lb) missile
45 cm (18") drop height
**Surface hardness**
- F355 A missile
  - 9.1 kg flat missile
  - 61 cm drop height

**Sports Specific Tests**
- Each sport has specific tests that can be completed to ensure optimal performance

**Advanced Artificial Athlete**
Curved projectile mimics head shape
- 4.6 kg (10 lbs.) curved missile
- 1.3 m (51") drop height
- HIC must be less than 1000

**F355 E missile**
1 M drop on synthetic turf

**ASTM F355 E**
- 1 M drop on synthetic turf

**Graph**
- Head Impact Criteria (HIC) vs. Drop height (m):
  - KBE & BS-USA
  - KBE-Native
  - BS-Native
  - CFH
Thatch

Summary

• Critical fall height is more of a function of soil texture than soil moisture for sand root zones

• Critical fall height is impacted by soil water content in silt loam soil root zones
Contracting Independent Field Testing

- Can be contracted to complete testing
- Costs can vary
  - Several hundred to several thousand
- Ability to test fields with tests hard to justify purchasing

Lower Extremity Testing

- Athletes ability to adjust their leg stiffness through flexion/extension changes indicated that fixed energy devices, such as the AAA or Clegg should not be seen as substitutes for human movement testing

Main Focus of Lower Extremity Testing

1. Injury
2. Performance

Ground Reaction Forces

Rotational Traction
Running Traction

Deceleration

Acceleration

Ground Reaction Forces

Ground Reaction Forces

Biomechanics of Running
Many Factors Impact Athlete-to-surface interaction

- Sport
- Cleats
- Moisture conditions (above and below ground)
- Type of surface (Synthetic or natural)
- Athlete maneuver and force being applied
- Below the surface (Soil type, gravel base, concrete)
- Just to name a few

You Have the Data Now What?

Ways to Share the Information

Ways to Share the Information

Conclusions

- Basic testing provides data to improve field performance and safety
- There are several tests available to test a field, proper test selection is key
- Cleat selection is critical for optimal traction and safety of a surface
- Communication is a key component

Thank You
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