

Incidence, Mechanisms, and Severity of Game-Related High School Football Injuries across Artificial Turf Systems of Various Infill Weight

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Summary of Research

Context

Today's new generations of artificial turf are increasingly being installed to duplicate or exceed playing characteristics of natural grass. Rather than playing on the polyethylene turf fibers, shoe: surface interaction actually occurs between the cleat and the various proprietary sand/rubber infill composites of varying weight. At this time, the influence of surface infill weight on football trauma is unknown.

Objective

The objective was to quantify the incidence, mechanisms, and severity of game-related high school football trauma across artificial turf systems of various infill weight. It was hypothesized that there would be no difference in injury incidence between surface infill weight.

Design and Participants

A prospective cohort study involving 43 high schools participating across four states (Pennsylvania, Montana, Southern California, Texas) over 3 competitive seasons from 2010-2013.

Interventions

Artificial turf systems were divided into four sand/rubber infill weight groups based on lbs per square foot: (A) > 9.0, (B) 6.0 – 8.9, (C) 3.1 – 5.9 and, (D) 0.0 – 3.0.

Main Outcome Measures

Surface infill weights were evaluated for injury incidence, injury category, injury time loss, player position, injury mechanism and situation, primary type of injury, injury grade and anatomical location, field location at time of injury, injury severity, head, shoulder, and lower extremity trauma, cleat design, turf age, elective imaging and surgical procedures, and environmental factors. Injury incidence rates (IIRs) were calculated based on injuries per 10 games [(number of injuries/number of team matches) x 10].

Results

Of the 847 high school games documented, 301 games (35.5%) were played on infill (A), 231 (27.3%) on infill (B), 189 (22.3%) on infill (C), and 126 (14.9%) on infill (D). A total of 1,979 injuries were documented indicating:

- Significantly lower total injury incidence rates (IIR), [18.8 (95% CI, 18.3-19.1) vs 23.3 (22.4-24.0) vs 31.6 (30.5-32.2) and 22.1 (20.8-22.9)], substantial IIRs [3.9 (95% CI, 3.4-4.5) vs 4.8 (4.1-5.4), 7.7 (7.1-8.3) and 6.1 (5.2-5.9)] while competing on infill weighing >9.0 (A) versus 6.0-8.9 (B), 3.0 – 5.9 (C), and 0.0-3.0 (D), respectively.
- Significantly lower trauma from player-to-player collisions [8.7 (95% CI, 8.2-9.0) vs 11.0 (10.5-11.5), 16.4 (15.5-17.1) and 9.8 (9.4-10.0)] while competing on infill weighing >9.0 (A) versus 6.0-8.9 (B), 3.0 – 5.9 (C), and 0.0-3.0 (D), respectively.
- Significantly lower playing surface impact trauma [2.6 (95% CI, 2.1-3.1) vs 4.2 (3.6-4.8), 5.6 (4.8-6.2) and 4.4 (3.5-5.2)] while competing on infill weighing >9.0 (A) versus 6.0-8.9 (B), 3.0 – 5.9 (C), and 0.0-3.0 (D), respectively.
- Significantly less muscle trauma [6.1 (95% CI, 5.5-6.6) vs 9.7 (9.4-9.9), 13.7 (12.8-24.4) and 8.7 (8.0-9.2)], while competing on infill weighing >9.0 (A) versus 6.0-8.9 (B), 3.0 – 5.9 (C), and 0.0-3.0 (D), respectively.
- Significantly lower number of radiographs requested [2.7 (95% CI, 2.3-3.2) vs 4.2 (3.7-4.8), 6.1 (5.6-6.7), and 5.7 (4.9-6.5)], while competing on infill weighing >9.0 (A) versus 6.0-8.9 (B), 3.0 – 5.9 (C), and 0.0-3.0

(D), respectively.

- Significantly lower number of total elective imagery and surgical procedures combined [7.0 (95% CI, 6.6-7.4) vs 9.1 (8.7-9.4), 13.8 (13.2-14.4), and 11.1 (10.4-11.8)], while competing on infill weighing >9.0 (A) versus 6.0-8.9 (B), 3.0 – 5.9 (C), and 0.0-3.0 (D), respectively.
- Significantly lower trauma ($P < .05$) was also observed across concussions, muscle-tendon overload, time loss, skill positions, injury mechanism and situation, lower and upper extremity joints, adverse weather conditions, and turf age while competing on infill (A) versus infill (C).

Summary

Some of the key differences found are as follows:

Concussions Injuries Combined

- **15.7%** lower incidence of injury between FieldTurf and 3-5.9 p/sq.ft of infill weight

Total Injuries

- **13.4%** lower incidence of injury between FieldTurf and 3-5.9 p/sq.ft of infill weight

Severe Injuries

- **13.3%** lower incidence of injury between FieldTurf and 3-5.9 p/sq.ft of infill weight

Player-to-Turf Collision

- **17.8%** lower incidence of injury between FieldTurf and 3-5.9 p/sq.ft of infill weight

Adverse Weather Conditions Combined

- **22.0%** lower incidence of injury between FieldTurf and 3-5.9 p/sq.ft of infill weight

Turf Age (8+ years)

- **20.2%** lower incidence of injury between FieldTurf and 3-5.9 p/sq.ft of infill weight
- **41.0%** lower incidence of injury between FieldTurf and 0-2.9 p/sq.ft of infill weight

Turf Age 4 to 8+ years)

- **19.2%** lower incidence of injury between FieldTurf and 3-5.9 p/sq.ft of infill weight

Elective Imaging and Surgical Procedures

- **8.1%** lower incidence of radiographs between FieldTurf and 6-8.9 p/sq.ft of infill weight
- **18.2%** lower incidence of radiographs between FieldTurf and 3-5.9 p/sq.ft of infill weight
- **16.1%** lower incidence of radiographs between FieldTurf and 0-2.9 p/sq.ft of infill weight
- **5.1%** lower incidence of total procedures combined between FieldTurf and 6-8.9 p/sq.ft of infill weight
- **16.6%** lower incidence of total procedures combined between FieldTurf and 3-5.9 p/sq.ft of infill weight
- **10.0%** lower incidence of total procedures combined between FieldTurf and 0-2.9 p/sq.ft of infill weight

Conclusions

As the artificial infill surface weight decreased, the incidence of game-related high school football trauma significantly increased across numerous playing conditions. This is the first study to investigate the influence of artificial infill surface weight on the incidence of game-related high school football trauma. Since this study is in the early stages, further investigation is continuing.