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Treatment Options for Turf Toe: A Systematic Review

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ABSTRACT

Turf toe is hyperextension injury of the plantar plate at the first metatarsophalangeal joint. Etiologies have often included sports/activities with excessive forefoot axial loading and/or violent pivotal movements. The purpose of the systematic review was to systematically review and present an overview for the current evidence-based treatment options of turf toe. Both authors systematically reviewed the PubMed and EMBASE databases from inception to April 2016 based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The level of evidence and quality of evidence were assessed by using the Level of Evidence for Primary Research Question of the *Journal of Bone and Joint Surgery*, and the quality of evidence was assessed with use of the Newcastle-Ottawa scale. Data were collected and categorized into: case reports and case series. Eight studies (16 turf toes) met the aforementioned criteria and were included. Five case reports and 3 case series reported various treatment options for turf toe. Specifically, 3 studies reported solely conservative treatment (n = 5), 1 study reported solely surgical treatment (n = 1), and 4 studies involved patients in conservative and/or surgical treatments (n = 10). All studies were of level of clinical evidence 4 and quality of clinical evidence score 2 (poor quality). Conservative treatment included closed reduction and immobilization, and surgical treatment included plantar plate tenodesis. Restricted dorsiflexion was the most common complication reported. Turf toe is an underreported injury with no evidence-based treatment guideline to date. Future studies of higher level and quality of evidence with a specific classification system (Jahss or Anderson) consistently reported are warranted for the development of an optimal guideline to determine the most appropriate treatment for each specific severity in injury.

Turf toe is a plantar plate injury at the first metatarsophalangeal joint (MTPJ) that has been reported to often occur in sports or activities that require sudden directional changes (1,2). This has been most commonly observed in American football players playing on artificial surfaces; 11% of National Football League players have been reported to have sustained at least 1 turf toe injury at some point during their career (3–6).

Pathogenesis occurs when an excessive axial load is delivered to an equinus forefoot, prompting hyperextension of the hallux MTPJ beyond its biomechanical limit and subsequently initiating microtears/tears of the plantar joint complex (3,7–9). Clinical features of turf toe include swelling and tenderness at the first hallux MTPJ with pronounced pain on extension and a reduced range of motion (8,10).

Current treatment guidelines revolve around the Anderson classification (8,11). Grade 1 injuries have been suggested to be treated conservatively with closed reduction, early rehabilitation, and return to play as tolerated. Grade 2 injuries have been suggested to be treated with the addition of custom orthotics, and grade 3 injuries have instead been suggested to be treated with surgical reduction (8,11). Surgical treatment has also been suggested in the cases of any failed conservative treatment. Above all, it is notable that no established guidelines have been available.

Given the lack of a clear evidence-based treatment guideline for turf toe injuries in the current literature, a consensus is warranted. Therefore, the purpose of the present study was to systematically review and present an overview for the current evidence-based treatment options of turf toe.

Materials and Methods

Search Strategy

Both authors systematically reviewed the PubMed and EMBASE databases from inception to April 2016 based on the Preferred Reporting Items for Systematic Reviews

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Table 1
Eligibility criteria

Inclusion Criteria	Exclusion Criteria
Treatment was for turf toe	Human cadaver studies
Clinical studies with outcomes reported	Animal studies
Published in peer-review journal	In vitro studies
Full-text studies	Review studies
Written in English	

and Meta-Analyses guidelines (12). The searched terms were: (turf toe OR first metatarsophalangeal joint injury OR first metatarsophalangeal joint sprain OR first metatarsophalangeal joint tear OR plantar plate injury OR plantar plate sprain OR plantar plate tear) AND (treatment OR intervention). Specific eligibility criteria listed in Table 1 were applied, with relevant studies filtered. References of all included studies were also assessed for possible inclusion. Any disagreement to include/exclude a study was discussed between the authors and agreed by mutual consensus.

Assessment of Level and Quality of Evidence

The level of clinical evidence (LOCE) was determined by using the Level of Evidence for Primary Research Question of the *Journal of Bone and Joint Surgery* (13), and the quality of clinical evidence (QOCE) was assessed with use of the Newcastle-Ottawa scale (14). The Newcastle-Ottawa scale evaluates the methodology of clinical studies; it is a 9-point scale, and studies with ≥6 points are defined as being of good quality (15). The LOCE and QOCE were also assessed by both authors, and disagreements were discussed and agreed on mutually.

Data Extraction and Categorization

Predetermined variables were extracted onto a datasheet. The variables collected were number of turf toes, event surrounding the injury, lesion character, lesion classification, imaging for assessment of first MTPJ, treatment specifics, follow-up, time to full weightbearing, time to return to activities, dorsiflexion range of motion, and complications. The included studies were then categorized into case reports and case series.

Statistical Analysis

Statistical analysis was performed by using RStudio version 1.1.456 (RStudio, Inc., Boston, MA). Descriptive statistics were used for all continuous and categorical variables. Continuous variables were reported as means with standard deviations, and categorical variables were reported as frequencies with percentages.

Results

Literature Search and Study Characteristics

The search strategy generated 500 studies across the PubMed and EMBASE databases with 114 duplicates removed and the resultant 386 studies screened. There were 8 studies that met the aforementioned eligibility criteria and, therefore, were included in the current systematic review (Fig.) (16–22). The included studies were published between 2008 and 2015 and were LOCE 4 and QOCE 2 (all poor quality, score <6). The largest series reported in a single study was 5 patients (20).

Patient Demographics

A total of 16 patients (16 turf toes) underwent conservative and/or surgical treatment with a mean follow-up of 17.6 ± 20.4 (range 0.92 to 60) months. The population included 13 males and 3 females with a mean age of 25.2 ± 7.0 (range 18 to 41) years. The imaging modality selected to assess the first MTPJ injury included radiography (3 studies, n = 5) (18,19,22), magnetic resonance imaging (MRI) (1 study, n = 2) (21), both radiography and MRI (4 studies, n = 8) (10,16,20,21), or arthroscopy (1 study, n = 1) (17). Concomitant lesions were present in 3 patients (18.8%) (17,20,22); this included plantar plate synovitis, sesamoid fractures, and osteochondral involvement of metatarsal head.

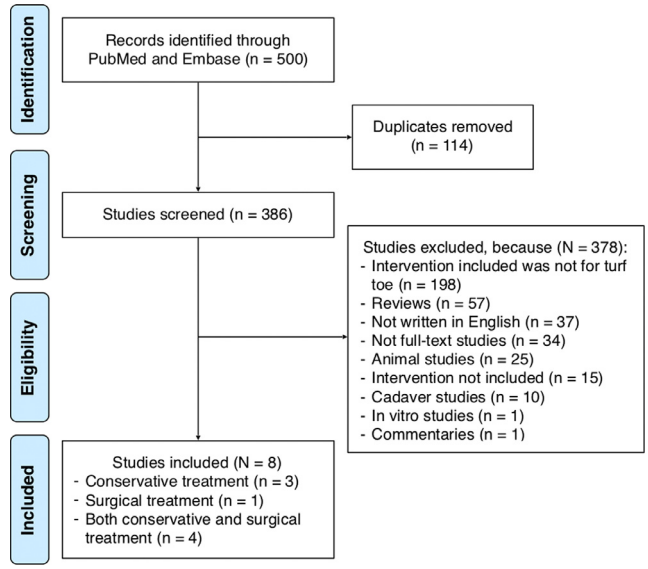

Fig. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

Case Reports on Turf Toe

Five case reports were reported—2 turf toes were sustained by competitive injuries (10,16) and 3 turf toes were sustained by noncompetitive injuries (17–19). All case reports were grade QOCE 2 (16–19). Concomitant lesions were present in 1 of the 5 plantar plate injuries (17). Only a single study provided classification of injury, which was of Jahss type 1; this patient received solely conservative treatment and had a reported time to return to activities at 16 weeks (19). In comparison to another case report that contrastingly received sole surgical treatment, the patient returned to activities at 24 weeks (17). In 2 studies that reported surgical treatment after failed conservative treatment, the return to activities ranged from 22 weeks to 16 months (10,16). Restricted dorsiflexion was noted in the single case report of solely conservative treatment (18), whereas discomfort over the site of tenodesis was noted in the study of solely surgical treatment (17). A summary of case reports for turf toe is given in Table 2.

Case Series on Turf Toe

Five case series were reported—8 turf toes were sustained by competitive injuries (20,21), and 3 turf tows were sustained by noncompetitive injuries (22). All case series were grade QOCE 2 (20–22). Concomitant lesions were present in 2 of the 11 plantar plate injuries (20,22). One turf toe was noted to have Jahss type 1 injury (22), another turf toe had Jahss type 2 injury (22), and a third turf toe had Anderson grade 2 injury (20). These 3 turf toes were treated conservatively, but only the study with the Anderson grade 2 injury reported the time to return to activities, which was at 8 weeks (20). In all studies of solely conservative treatment, time to return to activities ranged from 8 to 22 weeks (20,21) compared with the studies of solely surgical treatment, in which the time ranged from 16 to 24 weeks (20,21). A single case series of a single turf toe that underwent surgical treatment after failed conservative treatment had a reported time to return to activities of 20 weeks (20). Restricted dorsiflexion was only noted in all turf toes (n = 3) from a single case series (21); however, no other complications were noted across all the other case series (20–22). A summary of case series for turf toe is given in Table 3.

Discussion

The systematic review indicated there are no treatment guidelines for turf toe to date—in particular, the time to or extent until a specific

Table 2
Case reports on turf toe

Study	n	Event Surrounding Injury	Concomitant Lesions	Classification	Imaging for Assessment of First MTPJ	Treatment	Follow-Up	Time to Full Weightbearing	Time to Return to Activities	Dorsiflexion ROM	Complications
Sahin et al, 2004 (16)	1	Competitive taekwondo	None	NR	Radiographs + MRI	Conservative treatment with compressive bandages and NSAIDs (6 months) then surgical repair of plantar plate and compressive dressing (3 weeks)	16 months	NR	16 months	NR	None
Lui, 2008 (17)	1	Security guard	Plantar plate synovitis	NR	Arthroscopy	Plantar plate tenodesis	24 months	NR	24 weeks	- ROM in turf toe = 60° - ROM in normal toe = NR	Mild discomfort at site of tenodesis
De Palma et al, 2011 (18)	1	Noncompetitive soccer player	None	NR	Radiographs	Closed reduction with immobilization and non-weightbearing (4 weeks)	60 months	NR	NR	- ROM in turf toe = restricted dorsiflexion at 30° - ROM in normal toe = NR	None
Roche and Calder, 2014 (10)	1	Competitive soccer player	None	NR	Radiographs + MRI	Restricted weightbearing (3 weeks) then surgical repair of plantar plate and sesamoid approximation	32 months	NR	22 weeks	NR	None
Killian et al, 2015 (19)	1	Fell down flight of stairs	None	Jahss type 1	Radiographs	Closed reduction with compressive bandages and crutches then physical therapy (at 3 weeks)	10 months	16 weeks	16 weeks	NR	None

Abbreviations: MRI, magnetic resonance imaging; MTPJ, metatarsophalangeal joint; NR, not reported; NSAID, nonsteroidal antiinflammatory drug; ROM, range of motion.

treatment was optimally advocated after a turf toe injury. The conservative treatment included closed reduction with and without immobilization. The surgical treatment included plantar plate tenodesis. A complication was reported only in the study of solely surgical treatment, in which the patient had mild discomfort at the site of tenodesis. Because turf toe is an injury prevalent in sports, it is noteworthy that evidence-based treatment is crucial for clinicians (3,5,6,23,24). Therefore, it is important to emphasize that the current evidence to support the various treatment options of turf toe have been of low LOCE (all studies' LOCE = 4), low QOCE (all studies graded as poor quality), and low total cohort (all studies had a total of 16 turf toes).

An understanding of prime treatment is important in preventing irreversible damage of the plantar plate and/or the first MTPJ. Potential sequela has included but is not limited to persistent pain, restricted range of motion, loss of push-off strength, hallux valgus, and hallux rigidus (4,24). Initial management has included the principles of rest, ice, compression, and elevation to reduce swelling, and nonsteroidal antiinflammatory drugs can be added to relieve pain (8,10). Taping has generally not been advised in the initial stages of injury because circulation can be compromised. When initial swelling settles, toe spica extension in slight plantarflexion has been used to protect hallux extension at the MTPJ along with bringing the planar plate rupture into closer apposition (8). McCormick and Anderson (9) advised the use of a walking boot only under severe circumstances, because the early initiation of range of motion exercises can favor rehabilitation. However, it remains important that comfort also was to be considered (4,10).

Anderson grade I and II turf toe injuries have been suggested to solely require conservative treatment (5,11,23,24), with Anderson et al (11) and McCormick and Anderson (8) having further recommended surgical treatment for grade 3 injuries. However, Kadakia and Molloy (25) stated that insufficient evidence has been available to firmly recommend that patients with grade 3 injuries receive surgery and, therefore, vigilance to proceed with surgical treatment for grade 3 injuries must be affirmed. George et al (6) reported in 147 turf toe injuries sustained in college American football players that surgical treatment was required in only 1.74%. In their report, classic turf toe injuries required surgery at a rate of 1.2% and turf toes with concomitant sesamoid fractures required surgery at a rate of 14.3%. Kadakia and Molloy (25) and Maison and Molloy (26) have supported this result to suggest that surgical treatment may be necessary only in turf toes with concomitant sesamoid fractures. However, our review has demonstrated that even in the presence of concomitant sesamoid fractures in turf toe injuries, limited evidence has been present to support the necessity for surgical treatment. The study by George et al (6) was excluded from the current systematic review because of the lack of reported outcomes after treatment and, therefore, was meaningless for the current study analysis.

Surgical treatment has generally been recommended for patients who were symptomatic, who had extensive adjacent structural damage (capsular damage, deformity, osteochondral involvement, intra-articular loose body), and/or who had failed conservative treatment (6,9,11,24,27). Kadakia and Molloy (25) supported this and recommended surgical treatment in turf toe injuries with osteochondral involvement. Common surgical treatment has involved plantar plate with or without capsular repair and excision of loose bodies (7,24,28). For capsular damage distal to the sesamoid bones, McCormick and Anderson (29) advised the performance of a direct plantar plate repair end-to-end with nonabsorbable sutures. For situations with a lack of distal soft tissue present, Maison and Molloy (26) advised reattachment of the plantar plate to the plantar aspect of the proximal phalanx using suture anchors or tunnels. Return to full activities after surgical treatment has ranged from 16 weeks to 16 months based on the current systematic review (10,16,17,20,21). Future studies focused on optimizing rehabilitation protocols may result in faster recovery and restoration of function in these injuries.

Table 3
Case series on turf toe

Study	n	Event Surrounding injury	Concomitant Lesions	Classification	Imaging for Assessment of first MTPJ	Treatment	Follow-Up	Time to Full Weightbearing	Time to Return to Activities	Dorsiflexion ROM	Complications
Faltus et al, 2014 (20)	5	NCAA Division 1 American football	1 patient that underwent surgical treatment: osteochondral defect on metatarsal head	Patient with partial plantar plate rupture was classified as Anderson grade 2	- 3 patients: radiographs + MRI - 2 patients: MRI	- 1 patient: treated conservatively with hallux taping, CAM boot and physical therapy - 1 patient: treated conservatively then surgical treatment - 3 patient: treated with surgical treatment	NR	- Conservative treatment: 4 weeks - Conservative then surgical treatment: 6 weeks - Surgical treatment: 6 to 8 weeks	- Conservative treatment: 8 weeks - Conservative then surgical treatment: 20 weeks - Surgical treatment: 16 to 18 weeks	NR	None
Drakos et al, 2015 (21)	3	NCAA Division 1 American football	None	NR	Radiographs + MRI	- 1 patient treated conservatively with plaster cast in plantarflexion (6 weeks) then CAM boots and physical therapy - 2 patients treated with surgical treatment	NR	NR	- Conservative treatment: 20 to 22 weeks - Surgical treatment: 16 to 24 weeks	- ROM in turf toe Conservative: 35° Surgical treatment: 62° to 63° - ROM in normal toe Conservative: 42° Surgical treatment: 63° to 70°	None
Garcia Mata et al, 2015 (22)	3	2 road traffic accident, 1 hiking accident	Mountaineering accident patient: fractured medial sesamoid	2 road traffic accident patients: Jahss type 1, Jahss type 2a	Radiographs	- 2 road traffic accident patients treated conservatively with closed reduction and strapping of first 2 toes (3 weeks) - Mountaineering accident patient treated conservatively with closed reduction and strapping of first 3 toes (4 weeks)	- 2 road traffic accident patients: 4 weeks, 5 weeks - Mountaineering accident patient: 3 months	4 to 12 weeks	NR	NR	None

Abbreviations: CAM, controlled ankle movements; MRI, magnetic resonance imaging; MTPJ, metatarsophalangeal joint; NCAA, National Collegiate Athletic Association; NR, not reported; ROM, range of motion.

Several limitations existed in the current systematic review, notably that the included and only available studies were all case reports or series with poor QOCE and low total cohort. The included studies also involved turf toes with concomitant lesions and, therefore, the accuracy of reported results could have been compromised because these factors can affect recovery potential. The lack of present studies that have investigated the conservative and/or surgical treatment for turf toe limited meaningful meta-analyses to be performed. The inclusion criteria included only full-text studies written in English and, therefore, may have had predisposed the current study to selection bias.

In conclusion, turf toe has been an underreported injury with no evidence-based treatment guideline to date. The frequency of surgical treatment appeared similar to that of conservative treatment based on the current literature. The optimal treatment option for a specific severity level (based on Jahss or Anderson classification system) was undetermined because these classification systems were reported only in limited studies and, therefore, were insufficient for meaningful meta-analyses (3 studies, n = 4) (19,20,22). Future studies of higher level and quality of evidence with consistently reported classification systems (Jahss or Anderson) remain warranted to optimize a treatment guideline for turf toe injuries.

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