Ewa Wodka-Natkaniec 1(A,B,D,E,F), Łukasz Niedźwiedzki 1(D), Justyna Pawłowska 2(B), Joanna Zyznawska 1(F), Anna Świtoń 1(E)

1 Department of Physiotherapy Collegium Medicum of Jagiellonian University, Cracow, Poland
2 Department of Orthopedics and Physiotherapy Collegium Medicum of Jagiellonian University, Cracow, Poland

CURRENT REPORTS ON FOOT AND ANKLE INJURIES OF AMERICAN FOOTBALL PLAYERS

AKTUALNE DONIESIENIA NA TEMAT URAZOWOŚCI STÓP I STAWÓW SKOKOWYCH ZAWODNIKÓW FUTBOLU AMERYKAŃSKIEGO

Key words: American football, injury, foot, ankle
Słowa kluczowe: futbol amerykański, urazy, stopa, staw skokowy

Summary

Background. The purpose of this study was to collect current research lines in American football regarding the ankles and the foot. The specific goal was to determine how American football affects the ankle joints and the foot, i.e. the frequency, causes and types of injuries as well as various links between the footwear and failure of these structures.

Material and methods. The study included 26 publications, drawn mainly from PubMed and related databases, meeting the search criteria.

Results. As a result of the review of the publications, the frequency and types of ankle and foot injuries with regard to lower limbs were discussed along with the conditions predisposing for such injuries. Current works focus primarily on injury surveillance databases and on the research on the impact of footwear on the foot and ankle joint. There are works showing the relationship between ankle and foot injuries on the one hand, and the balance on the other. Additionally, some of the articles deal with the past treatments, the time of exclusion from the game and the use of stiffeners to protect the players against overloads and damage to the above-mentioned structures.

Conclusions. Our research draws attention to the problem of foot and ankle injuries and shows that preventive, training and physiotherapeutic programs should still be improved due to their high level of trauma. More clinical study is needed to find the specific causes of injuries and prevent them effectively.

Streszczenie

Wstęp. Celem badania było zebranie aktualnych kierunków badań w futbolu amerykańskim dotyczących stawów skokowych i stopy. Celem szczegółowym było określenie w jaki sposób futbol amerykański wpływa na stawy skokowe i stopy, tj. częstość, przyczyny i rodzaje urazów oraz powiązań z obuwiem na niewydolność tych struktur.

Materiał i metody. Do tego badania włączono 26 publikacji, głównie z bazy PubMed i powiązanych, spełniających kryteria wyszukiwania.

 Wyniki. W wyniku przeglądu publikacji wykazano częstość występowania urazów stawów skokowych i stopy na tle kończyn dolnych oraz ich rodzaje i warunki predysponujące do urazów. Analizowane prace skupiają się przede wszystkim na bazach nadzoru/przeciwdziałaniu urazu oraz badaniach wpływu obuwia na stopy i staw skokowy. Pojawiają się prace wykazujące związek urazów stawów skokowych i stopy z równowagą. Dodatkowo niektóre prace dotyczą przebytych operacji, czasu wyłączenia z gry, stosowania usztywnień w celu zabezpieczenia zawodników przed przeciwdziałaniem i uszkodzeniami wymienionych struktur.

Wnioski. Badania zwracają uwagę na problem urazowości stóp i stawów skokowych oraz wykazują, iż nadal powinny być upowszechniane programy profilaktyczne, treningowe i fizjorehabilitacyjne w związku z dużą ich urazowością. Istnieje potrzeba większej ilości badań klinicznych, aby znaleźć szczegółowe przyczyny urazów i skutecznie im zapobiegać.

Address for correspondence / Adres do korespondencji
Ewa Wodka-Natkaniec
Katedra Ortopedii i Fizjoterapii, Instytut Fizjoterapii, Wydział Nauk o Zdrowiu, Uniwersytet Jagielloński, Collegium Medicum
ul. Kopernika 19 e, 31-501 Kraków, Poland, tel. +48 500 279 950, e-mail: ortopedia@cm-uj.krakow.pl

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Background

Today, American football is most popular in the United States, but is also gaining popularity in other countries. Dynamically the ongoing training and match are conducive to injuries and injuries of football players American. Trauma covers four main areas: head, torso, and extremities top and bottom. In the US, each country's national injury report databases are currently in use team. Such activities allow to control the types and frequency of injuries [1]. The main one of them is to track the risk of injury to players and to eliminate them through changes environmental.

Research on American football players occupy a particularly important place in scientific literature. Scientific works on typical for this sport are popular severe head injuries, modification of the game or modification of training programs for the purpose securing the competitor against injury. [1-4] Injuries and injuries are common among both amateurs and professional American football players. Injury mechanisms they are not always unambiguous [5]. You can prevent injuries by making changes to your training sports, providing time for the player to regenerate by changing his body weight, BMI, well-chosen sports outfit with protective functions. The use of a variety Preventive exercise can be beneficial in preventing injuries and injuries in sports collision [3,6,7]. Epidemiological data clearly show a high percentage of injuries feet and ankles among athletes [4,5,8-10]. There are frequent lesions within forefoot and metatarsal and ankle sprains are caused by large ankle joints loads [4,8]. Various methods are used to prevent ankle injuries, among the confirmed exercises are balance and proprioception [11,12]. Footwear designs sports for American football are more and more widely modified depending on loads transferred by the feet and ankle [13-18]. Appropriate footwear size, insole, matching the surface of the sole to the pitch surface are important in prevention ankle and foot injuries American footballers, especially since many professional athletes are over them eliminated from the game for a long time. [21] The topic of contusions and injuries is quite extensive discussed in the literature. However, collectively, studies on the feet and ankles American football players are described in a small sense.

The overall aim of the research was to gather information on current research on the feet and ankles in American football. The specific goal was determining the frequency and types of failures, provoking conditions and situations, and the relationship with shoes.

Material and methods

A review of the literature on the issues of the foot and joints was carried out jumping American football players. Articles from the last 10 years were taken into account (2011-2021). The basic base was Pub-Med. The search criteria were slogans: american football (american football), foot, feet, ankle (pond jump-
ing), prevention (prevention), injury and shoe. The works by the mentioned keywords in the keywords and in the content of the article.

Works that were rejected were not related to the research of American footballers and published in languages other than English. 13 articles from the PubMed database and 13 articles were selected related and matching inclusion criteria (Fig. 1). Additional criterion the exclusion was limited due to the small number selected articles, 26 items were included in the final analysis (Tab. 1). Literature items organized and presented in 2 subchapters: research based on databases supervision and clinical tests and footwear.

Tab. 1. Characteristics of the publications included in the final analysis

| NR | Referece [miejsce publikacji] | Rok | Kraj | Stowa kluczowe Keywords | Typ |
|----|------------------------------|-----|------|-------------------------|-----|
| 1  | Juster et al. [13]           | 2017 | USA  | athletic shoe wear; cleated shoe; footwear. | clinical review. |
| 2  | Liewers et al. [24]          | 2015 | Canada | ankle; foot; football; injuries | descriptive epidemiology study |
| 3  | Mack et al. [25]             | 2020 | USA  | National Football League; injury epidemiology; injury prevention; lower extremity injury; sports injury. | descriptive epidemiology study |
| 4  | Juster et al. [35]           | 2019 | USA  | artificial turf; field turf; playing surface; synthetic turf. | clinical review |
| 5  | Wannop et al. [19]           | 2019 | Canada USA | 3-dimensional foot scanning; footwear fitting; footwear sizing system. | descriptive review |
| 6  | Song et al. [27]             | 2019 | USA  | daily activities; long-term health; professional athletes. | case-control study |
| 7  | Wikerson et al. [30]         | 2012 | USA  | clinical prediction rule, injury prevention, injury risk, core stability | cohort study |
| 8  | Pietrosimone et al. [2]      | 2015 | USA  | - | cross-sectional studies |
| 9  | Kamsovsky et al. [26]        | 2019 | USA  | Jones fracture; NFL; fifth metatarsal morphology; metatarsus adductus | retrospective comparative study |
| 10 | Iguchi et al. [31]           | 2013 | Japan | Japanese football, American football, college football, injury rates | cohort study |
| 11 | George et al. [32]           | 2014 | USA  | NCAA football; first metatarsophalangeal hyperdorsiflexion; hallux disorders; plantar plate injury; sesamoid fracture; turf toe | case series |
| 12 | Westermann et al. [21]       | 2016 | USA  | ankle injury; concussion; football; knee; rule change | descriptive epidemiology study |
| 13 | Lareau et al. [33]           | 2016 | USA  | Jones fracture; NFL; athlete; fifth metatarsal; football; return to play | retrospective case series |
| 14 | Clifton et al. [22]          | 2017 | USA  | ankle sprain; football; incidence; injury surveillance | descriptive epidemiological study |
| 15 | Wiersma et al. [23]          | 2018 | USA  | Ankle; Collegiate athletes; Emergency department; Injury surveillance; Pediatrics; Sports | descriptive epidemiological study |
| 16 | Lawrence et al. [28]         | 2016 | Canada | NFL; National Football League; concussion; epidemiology; injury prevention; temperature | case-control study |
| 17 | Iguchi et al. [29]           | 2016 | Japan | contact sports; power; muscular strength; multivariate analysis | retrospective cohort study |
| 18 | Willeford et al. [34]        | 2018 | USA  | Y-Balance Test; ankle support; prophylactic bracing | crossover study |
| 20 | Gribble et al. [4]           | 2016 | USA  | BMI; functional movement screen; injury risk; star excursion balance test | case-control study |
| 21 | Brock et al. [14]            | 2014 | USA  | American football; Synthetic turf; cutting; footwear; single-leg landing | comparative study |
| 22 | Taylor et al. [8]            | 2018 | USA  | American football; Plantar pressure; foot injury; footwear design | comparative study |
| 23 | Kent et al. [15]             | 2015 | USA  | Athletes; biomechanics; injury; performance; sports equipment | comparative study |
| 24 | Kent et al. [16]             | 2015 | USA  | Equipment; injury; performance | comparative study |
| 25 | Crandall et al. [17]         | 2015 | USA  | bending; stiffness; longitudinal; cleated shoe; forefoot (foot); football | comparative study |
| 26 | Button et al. [36]           | 2015 | USA  | Biomechanics | comparative study |
Results and Discussion

Trauma surveillance databases and clinical trials

Among the publications reviewed, a significant part of them is based on online trauma databases. These systems are developed in the United States for athletes and completed by coaches and a team of physiotherapists. This is especially important for American football players, thanks to the collection of data it is possible verification of various sports injuries and evaluation of the player in terms of health. Clifton et al. [22] collected information from 3 trauma surveillance databases: Youth Football Safety study – YFSS, National Athletic Treatment, Injury...
American football practitioners. The authors confirm - epidemiological study concerns groups of primary metatarsus and adducted forefoot as the most vulnerable. The authors concluded that a higher percentage of ankle sprains in college football players compared to high school players middle and youth. In 1000 reported cases, the incidence of injuries in adolescents is 0.59, in secondary schools 0.73, and in higher education 1.19. The presented work it is marked the problem of recurrent sprains of the ankle joints, especially in the youth group.

Athletes who are at frequent risk of ankle injuries and relapses should undergo dedicated, additional preventive programs in this regard. [22] Similar the results of the study of football players were obtained by Wiersma et al. [23]. The researchers confirm the greater one the percentage of injuries during sports training in university players in comparison to secondary schools. Compared to other sports, it was found that American football was the discipline with the highest number of ankle injuries [23].

Lieves et al. [24] also collected epidemiological data among American footballers colleges. They used to assess the most common and severe injuries of the feet and ankles based on: National Collegiate Athletic Association – NCAA Injury Surveillance System – ISS. According to the authors, 80% of foot and ankle injuries are: lateral sprains and medial ankle joints with damage to the ligament complex, joint sprains ankle with damage to the tibiofibular ligament, injuries of the metatarsus and the first metatarsophalangeal joint (MTP1). Among the analyzed injuries, ankle sprains take the longest time to heal, second Metatarsal fractures followed by fractures within the ankle joints.

The authors of the most severe injuries include sprains of the upper ankle joint with damage to tibiofibular ligaments, lateral sprains of the ankle joints with damage to ligaments, fractures of the metatarsus, and fractures of the medial ankle or lateral ankle joints [24]. Mack et al. [25] showed that in the National League Futbolowej – NFL (National Football League) in 2015-2018 most often the damaged area of the lower limbs outside the knee joint (almost 30%) was the joint ankle (22.4%), followed by the thigh (17.2%) and foot (9.1%). Among the most common types lateral ankle sprains and sprains were listed the upper ankle [25].

Retrospective study by Karnovsky et al. [26] among NFL and NFL players Combine (96 feet, 51 athletes) shows that nearly 16% of the feet tested suffered fractures of the fifth metatarsal. Thanks to the radiographic analysis it was found the relationship between the foot after a fracture of the fifth metatarsal and its structure morphological. Alloys showing certain structural features were found to be more susceptible to trauma in this area. The researchers' conclusions identify players with long, narrow and straight metatarsus and adducted foot as the most vulnerable to fractures fifth metatarsal bone. The authors' results suggest that repeated loads on the metatarsus and overload of the fifth metatarsal bone may lead to its fracture [26].

and Outcomes Network – NATION, National Collegiate Athletic Association – NCAA Injury Surveillance Program – ISP. Descriptive badanie epidemiologiczne dotyczy grup młodzieży szkół podstawowych oraz uczniów szkół średnich i wyższych trenujących futbol amerykański. Autorzy potwierdzili wyższy odsetek skręceń stawów skokowych u futbolistów niż u uczestników. W 1000 zgłoszonych przypadków częstość urazów u młodzieży to 0,59, w szkołach średnich 0,73, a w wyższych 1,19. W przedstawianej pracy zaznaczono problem nawracających skręceń stawów skokowych, zwłaszcza w grupie młodzieży. Sportowcy, którzy często narazeni są na urazy stawów skokowych i ich nawroty, powinni przechodzić dedykowane, dodatkowe programy profilaktyczne w tym zakresie. [22] Podobne rezultaty badań futbolistów otrzymali Wiersma i wsp. [23]. Badacze potwierdzają większy odsetek urazów podczas treningu sportowego u zawodników niż w grupie młodszej. Podobnie jak wyniki Lievers et al. [24] także zebrali dane epidemiologiczne wśród futbolistów amerykańskich szkół średnich. Oceniając najczęstsze i najczystsze urazy stóp i stawów skokowych posłużyły się bazą: National Collegiate Athletic Association – NCAA Injury Surveillance System – ISS. Według autorów 80% urazów stóp i stawów skokowych stanowią: skręcenia boczne i przyśrodkowe w obrębie stawów skokowych z uszkodzeniem więzadeł, skręcenia boczne i przyśrodkowe z uszkodzeniem kompleksu więzadeł, skręcenia stawów skokowych z uszkodzeniem więzadla stawu skokowego. Paluszkowym końcowym stawu skokowego, urazy śródrodostu i pierwszego stawu śródrodostopno-paliczkowego (MTP1). Sposób przeanalizowanych urazów, skręczenia stawów skokowych wymagają najwięcej czasu na gojenie, w drugiej kolejności uplasowały się złamania śródrodostu, a następnie złamania w obrębie stawów skokowych. Autorzy do najczystszych urazów zaliczają skręcenia górnego stawu skokowego z uszkodzeniem więzadła, złamania śródrodostu oraz złamania kostek przyśrodkowej lub bocznej stawów skokowych [24]. Mack i wsp. [25] wykazały, że w Narodowej Lidze Futbolowej – NFL (ang. National Football League) w latach 2015–2018 najczęściej uszkadzany obszar kończyn dolnych poza stawem kolanowym (prawie 30%) był staw skokowy (22,4%), a następnie ukość (17,2%) i stopa (9,1%). Wśród najczęstszych rodzajów obrażeń stawów skokowych wymieniono boczne skręcenia w stawie skokowym i skręcenie górnego stawu skokowego [25]. Badanie retrospektywne Karnovsky i wsp. [26] wśród zawodników NFL i NFL Combine (96 stóp, 51 sportowców) wykazało, że prawie 16% badanych stóp doznalo złamania piątej kości śródrodostu. Dzięki przeprowadzeniu analizy radiograficznej stwierdzono związek między stopą po przebytym złamaniu piątej kości śródrodostu, a jej budowa morfologiczna. Uznaną, że stopy wykazujące pewne cechy budowy są bardziej podatne na uraz w tym obszarze. Wnioski badaczy określają zawodników mających dłuż się, wąskie i prosté śródrodostopie oraz przywiedzione przedostosowanie jako najbardziej narażonych na złamania piątej kości śródrodostu. Wyniki autorów sugerują, że powtarzające się obciążenia śródrodostopie i przeciążenia piątej kości śródrodostu mogą prowadzić do jej złamania [26]. Skutkiem
The result of the bad treatment may delay union and re-fracture, resulting in long-term effects the exclusion of a player from the game. Therefore, the use of relief inserts is recommended orthopedic, orthosis or fitting, shoe modification. [26] Song et al. [27] confirm that the prevalence of ankle injuries in the majority of retired people NFL players increase the likelihood of osteoarthritis (OA) and its negative impact on everyday functioning.

Higher incidence of OA found in former athletes who had ankle and / or foot surgery in compared to those who have not experienced it. This data applies to players who reported 1-2 or 6 or more ankle and / or foot operations. In the studied population, almost 60% reported ankle injuries. In 100% of the cases mentioned, nearly 90% do not reported no ankle or foot surgery.

The research is retrospective and holds limited information on surgical treatment and the location of OA, therefore should be interpreted with caution. [27] Lawrence et al. [28] in a prospective study by several seasons (2012-2013 and 2013-2014) found that an external risk factor for injury may be temperature. It has been confirmed that in American football players it increases the tendency to injure the ankle joints with a decrease in the average air temperature in match day [28]. Iguchi et al. [29] performed a retrospective and selective evaluation of 8 potential risk factors for injury such as body weight, increase in BMI, position player, power-long jump, strength, maximum one-time squat with a barbell on back and past injuries. Among 153 (100%) young Japanese football players American ankle sprains were found to be 15% in the surveyed season. Athletes with less power were more likely to risk ankle sprains. Taking into account a total of 2 seasons (assessed and preceding), ankle injuries were more common compared to the knee joints or damage to the sciatic and shin pads. The players' increasing strength and less power are independent factors injuries in American football. The authors emphasize that the athlete's fitness tests in addition to sports performance evaluation can also be used to detect risk factors and predicted injuries [29]. Ankle sprains, lateral dislocations in ankle and metatarsal injuries were typical injuries sustained during the season, during the competition [1,30]. Research by Japanese footballers shows that to injuries to the knee, ankle and foot joints most often occurred during matches, while damage to the thighs and buttocks during training [31].

The results of George et al. [32] confirm that dislocations of the first metatarsophalangeal complex (MTP – turf toe) occurred 14 times more often during matches than training sessions.

The study was relevant for the seasons from 2004-2005 to 2008-2009 and the data was collected from the Supervisory System Injury (ISS) NCAA. The injury resulted in a loss of an average of 10 days, and more the probability of injury was found in running backs and quarterbacks [32]. Exclusion of National Football players was shown League NFL play for 8-10 weeks also after Jones' breaks [33]. It has been confirmed that thanks to appropriate surgery, and then increased rehabilitation, a quick recovery time game is possible after this fracture (Jones fracture) [33]. La-reau et al. [33] suggest that however, watch out for players in wide receivers and support positions (line-
2013 to 2015. The authors suggest that it may were most affected steps (28.5%). Ankle injuries were lower limb injuries in seasons 2009-2010 to 2014-2015. It was found that the knees (33.6%) and joints perative to apply preventive measures to these play-ers [33]. Westermann et al. [21] conducted studies of and their occurrence increased in the years 2012-2013 to 2014-2015. The authors suggest that it may be related to the rules of the game, training programs or the position and behavior of the player [21]. Occurrence of ankle injuries and knee injuries are associated with previous concussions in former NFL players [2].

Pietrosimone et al. [2] suggest to use appropriate training programs and strategies preventing muscu-loskeletal damage after head injuries, concussions. Willeford et al. [34] agree that the ankle joints are stiffened with a bandage sports and orthosis, similar-ly reduce their mobility, effectively minimizing risk of damage in this area. The authors also analyzed the influence of the types of stiffeners ankle joints for the dynamic balance of young football players American. The Y Balance Test (YBT) results did not differ from one to the other types of stiffening of ankle joints used. The study covered one season training and players who wore braces on a daily basis, this is a limitation in generalizing the results [34]. It is confirmed that players who experienced a twist lateral ankle sprains (LAS) had worse exercise performance lower limb in SEBT test in the anterior direction and showed higher BMI in compared to athletes without injury [4]. Identifying clinical tools for effectively predicting the risk of a LAS injury will be a key step towards creating effective pre-ventive programs to reduce maintenance risks LAS.

**Footwear and turf**

Sports footwear is part of the American football player’s clothing that it should provide protection of the foot and ankle joints [13]. A number of studies take up the topic defining the optimal footwear for elite players [13,14,19,35]. Among them the stiffening of ankle joints through the upper, flexibility of the sole are considered in its various areas, matching the si-zes and distribution of mechanical loads on footwear. Especially in American football, there are dynamic twists during the action and unforeseen high-energy contact between players. Research projects more and more often they concern the interaction of footwear with the pitch [35]. Adaptation The right shoe for the type of turf, artificial or natural, is a challenge for re-searchers Athlete safety by minimizing the effects of shear forces and the transferred loads assume a prior-ity role. Choosing the right footwear must be at a high level. Brock et al. [14] conducted a shoe impact study a sports shoe and a cork shoe with the surface of the litacj szybki czas powrotu do gry jest możliwy po tym złamaniu (Jones fracture) [33]. Lareau i wsp. [33] sug-gerują, aby uważać jednak na gracz na pozycjach skrzędowy (wide receivers), wspomagający (lineback-ers) i skrzędowy końcowy (tight ends), ze względu na obserwowane u nich prawdopodobieństwo kontu-zji. Konieczne jest stosowanie środków zapobiegaw-czych u tych zawodników [33]. Westermann i wsp. [21] przeprowadzili badania urazów kończyn dolnych w sezonach 2009-2010 do 2014-2015. Wykazano, że większość dotyczyła kol na (33,6%) i stawów skokowych (28,5%). Urazy sta-wów skokowych były najczęściej spowodowane kontakt-kiem z innym zawodnikiem (59,2%) i ich występo-wanie wzrósło w latach 2012-2013 do 2014-2015. Autorzy sugerują, że może być to powiązane z zasa-dami gry, programami treningowymi czy pozycją i za-chowaniem zawodnika [21]. Występowanie urazów sta-wów skokowych i kolanowych są powiązane z przeby-tymi wstrząsami mózgowymi w trakcie zawodów [16]. Pietrosimone i wsp. [2] sugerują, aby stosować odpowiednie programy treningowe, strategie zapobiegające uszkodzeniom mięśniowo-szkieletowym po urazach głowy i wstrząśnienia mózgu.

Willeford i wsp. [34] są zgodni, że usztywnienia stawów skokowych zarówno bandażem sportowym, jak i ortezą podobnie zmniejszają ich ruchomość, sku-tecznie minimalizując ryzyko uszkodzeń w tym obsza-rze. Autorzy analizowali także wpływ typów usztyw-nień stawów skokowych na równowagę dynamiczną młodych zawodników futbolu amerykańskiego. Wy-niki testu równowagi Y Balance Test (YBT) nie różniły się zależnie od typów stosowanych usztywnień sta-wów skokowych. Badanie dotyczyło jednego sezonu treningowego i graczy, którzy nosili usztywnienia co-dziennie. Stanowi to ograniczenie w uogólnianiu wy-ników [34]. Potwierdzono, że zawodnicy którzy doświad-czyli skręceń bocznych stawów skokowych (lateral ankle sprains-LAS) mieli gorsze wyniki ruchu kończy-ny dolnej w teście SEBT w kierunku przemiany i wyka-zywali wyższe BMI w porównaniu do sportowców bez urazu [4]. Zidentyfikowanie narzędzi klinicznych do skutecznego przewidywania ryzyka urazu LAS bę-dzie kluczowym krokiem w kierunku tworzenia sku-tecznych programów profilaktycznych w celu zmniej-szenia ryzyka utrzymania LAS.

**Obuwie i murawa**

Obuwie sportowe jest częścią odzieży zawodnika futbolu amerykańskiego, które powinno zapewnić ochronę stopy i stawów skokowych [13]. Szereg ba-dań podejmuje temat zdefiniowania optymalnego obu-wia dla elitarnych zawodników [13,14,19,35]. Wśród nich rozpatrywane są usztywnienia stawów skokowych poprzez cholewkę, elastyczność podszewy w różnych jej obszarach, dopasowanie rozmiarów i rozkład obciążéń mechanicznych obuwia. Szczególnie w futbolu amerykańskim dochodzi do dynamicznych zwrotów podczas akcji oraz nierzewidzianego wysokoenere-gicznego kontaktu między zawodnikami. Projekty ba-dań coraz częściej dotyczą interakcji obuwia z na-wierzchnią boiska. [35] Dostosowanie odpowiednio buta do typu murawy, sztucznej lub naturalnej stan o-wyższy dla ba-dań Bezpieczeństwo sportowca poprzez minimalizowanie działania sił ściągających i przenoszonych obciążeń przyjmuje priorytetową ro-łę. Dobór odpowiedniego obuwia musi być na wyso-
pitch. The results suggest that the increased strength of the reaction artificial turf ground at a 90-degree angle may increase the risk of joint injury ankle or knee. Jastifer et al. [35] confirmed that there is a relationship between artificial turf and the occurrence of an injury. According to the authors, the risk of injury to the artificial turf is larger than the natural turf. Artificial turf blocks the foot more by increasing shear forces and foot torque. This leads to overloading of the foot and affects the whole the lower limb [35]. George et al. [32] confirmed a higher incidence rate dislocation of the first complex of the metatarsophalangeal joint (MTP-turf toe) on artificial turf as compared to natural turf.

Taylor et al. [8] examined the footwear in terms of the loads transferred during exercise resistant pushing. Turf boots and cleats on artificial turf were compared. In the results the authors indicate that the median and lateral parts of the metatarsus as well as the medial and lateral parts the forehead is subjected to a higher force in the traffic jams. The relative burden was bigger in the plugs, medially and laterally in the midfoot and laterally, laterally in the forehead, but smaller in the median part of the forehead and toe compared to a turf boot. Turf shoes and cleats show a different load distribution on the sole, which is important for prevention injuries [8]. Kent et al. [15] also conducted a study of a variety of corks (19 types) and their impact on natural and artificial surfaces. It was found that almost all plugs used on natural turf caused damage to the surface in relation to shoes on artificial turf. Most of the boots on artificial turf held a firm grip the ground, so that during activity, the shoes produced increased forces in between the surface and the shoe. The same authors in another study [16] assessed the performance of sports shoes compared to 8 different surfaces (2 natural and 6 artificial).

In contrast to artificial turf surface, the horizontal force acting on traffic jams on natural turf was smaller and allowed more traffic. Shoe rotational tests showed on artificial surface, smaller angular displacements and higher torque [16]. Crandall and co-workers [17] showed that the shoe’s resistance to flexion in the forefront determines the proportion external load application, which is borne by the shoe and thus influences on bend in the area of 1MTP.

The tests of 21 pairs of shoes included dynamic tests under bending angle from 30 degrees to 90 degrees. Relationship between torque, a the angle of the fold was linear. The peak torque was much lower in comparison to the articular moment measured in the foot during sports activities. Authors suggest that the flexibility or stiffness of the footwear when flexing as well as rotating the shoe may play a significant role in the severity of 1MTP and ankle injuries [17,36].

In research Button et al. [36] showed no evidence of both stiff uppers and flexible uppers securing the ankle joints during simulated movements leading to them injuries. The correct stabilization of the ankle joints in a shoe is the basis of prevention ankle injuries. All tested types of tested shoes did not hold sufficient stiffening of the ankles and did not fulfill their role. Button et al. [36] confirmed that both excessive flexibility and stiffness of the shoe affect the severity of ankle injuries. The NFL team used footwear fit the shape of the player’s feet based on a 3D scan. This method was found to be objective and facilitating the
individual choice of footwear for an American football player [19]. Summarizing the above data, it was found that the feet and ankles were affected American football players are influenced by a number of factors, both external and anthropometric features related directly to the player. Both counts stamina, performance, weight and other characteristics of the player which may vary in impact and depending, for example, on the pitch or footwear. It should be mentioned here generated loads and forces acting during matches. Foot and ankle injuries may result from both the mechanism of direct contact between players and non-contact. The number of foot and ankle injuries in football players the American ranks among the most common along with head and joint injuries knee [10, 25]. The types of injuries are diverse and affect both soft tissues and bone. Fractures often occur in the foot and the ankles are more frequent vulnerable to ligamentous and tendon injuries. There are reports of overloads feet provoking fractures of the toes and metatarsal bones. Among the preventive methods ankle stiffening is used, suggested changes to conditions and programs training, analyzing fitness tests, losing weight, reducing loads, proper selection and modification of footwear. American football shows long-term effects of its cultivation, and previous injuries to the feet and ankles did not they remain unanswered in future years of life.

Conclusions

The conducted review shows a large percentage of publications focusing on injury and footwear impact surveillance databases. More research work is still missing, clinical trials that would find the exact and detailed causes of trauma ankles and feet.

Wnioski

Przeprowadzany przegląd wskazuje na duży otsetek publikacji skupiających się na bazach nadzoru urazów i wpływu obuwia. Nadal brakuje większej ilości prac badawczych, klinicznych, które pozwoliłyby znaleźć dokładne i szczegółowe przyczyny urazowości stawów skokowych i stopy.

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