Fast Break

Publication for team medical personnel

March 2022

WELCOME to FAST BREAK!

Welcome to FIBA's quarterly publication. Our goal is to introduce our FIBA Sport Medicine and Sport Science community to newsworthy research topics. We welcome your questions or comments and thank you for your ongoing commitment to FIBA.

MESSAGE FROM THE FIBA MEDICAL COMMISSION

The FIBA Medical Commission is made up of medical practitioners with an involvement in basketball from all FIBA zones – Europe, Americas, African, Asia and Oceania. An important Commission role is to support team physicians working in basketball teams and through them enhance player health and wellbeing. This includes basketball teams in National and Professional competitions, major events, national leagues, 3X3 and match officials.

We have all been challenged by the COVID-19 Pandemic both personally and professionally. FIBA is currently operating under its' sixth version of Basketball COVID Protocols. The evolution of COVID-19 and its' mutations alongside new and emerging controls means FIBA is constantly reviewing how basketball is to manage the COVID-19 threat.

Finally, FIBA has a strategic goal to support National Federations. By developing FIBA's support to team healthcare professionals, the Commission contributes to FIBA's overall goals. Expect more resources and professional development activities from the Medical Commission in the future. This Newsletter is an example of that support. If you have suggestions for the Medical Commission in its' mission to support healthcare in basketball, let us know.

Dr Peter Harcourt

Chair, FIBA Medical Commission

MESSAGE FROM THE EDITOR

When I was asked to edit the Fast Break publication, the request made me pause. I had played basketball in high school and university, and I have practiced sport and exercise medicine for 24 years, providing care to elite and professional basketball players and teams. But I do not consider myself an academic in either sport medicine or basketball. I was not sure that I was qualified to assume this role.

Dr Andrew Pipe, the FIBA Medical Commission member, advised me that the Fast Break was to be a "foundation for a broadly distributed entity that would be of interest to the clinical and scientific community that surrounds basketball, and a means of catalysing the development of a 'community of practice' among physicians and clinicians involved with the game. It was intended to be a cogent synthesis of current clinical/scientific evidence and a vehicle for friendly communication using electronic distribution to all who were interested."

The first few issues of the Fast Break that I reviewed simply listed recent basketball-related publications. It is my hope that this new and the evolving versions of the Fast Break will help to better realise the development of a global community of medical and sport science experts to participate in quarterly academic pursuit and collegial discussion with basketball at the heart of our interest. Maybe the content will make you smile or provoke a new way to consider how you provide care for athletes who play basketball. This issue may seem rather ego-centric on my part, and I do appreciate that the content has been entirely my discretion. However, I do this to highlight the manner in which I hope that future issues of the Fast Break will evolve with the help of contributions from everyone reading this work. I cannot continue to expand and develop this publication without input from you, and our basketball colleagues around the world. I invite everyone to contribute to the subsequent issues in any of the segments of the Fast Break. If you have an idea for other sections or titles we can feature in this work, I am keen to hear your thoughts.

Marni Wesner, MD, MA, CCFP(SEM), FCFP, Dip Sport Med

Editor, Fast Break

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IN THIS ISSUE

SELECTED PUBLICATIONS OF INTEREST

Is it enough to use the traditional approach based on average values for basketball physical performance analysis?

Vazquez-Guerrero J, Garcia F

European Journal of Sport Science EJSS : Official Journal of the European College of Sport Science. 21(11):1551-1558, 2021 Nov.

Understanding the most demanding scenarios of basketball match-play can optimise training prescription. We established physical demand differences in total distance covered, distance covered at high-speed running, distance covered at high-intensity accelerations and decelerations, number of high-speed running actions and number of high-intensity accelerations comparing the traditional average method with the most demanding scenarios based on 1-minute rolling averages. Physical demand parameters were analysed from 21 elite basketball players according to playing position during a friendly game via local positioning system microtechnology. The results showed that players covered a total distance of 141.3 $m.min^{-1}$ ($p < 0.001$; ES = 7.80) and 25.4 $m.min^{-1}$ ($p < 0.001$; ES = 4.52) at high-speed running using rolling averages, compared to 66.3 and 3.2 m min^{-1}, respectively, using the traditional average approach. These data represent a very large increase of 113.1% for total distance per minute and 686.4% for high-speed running distance per minute, 252% for the number of high-intensity accelerations and 290.5% for the number of high-intensity decelerations, respectively, demonstrating the relevance of this novel approach. In conclusion, this investigation indicated that the traditional average method underestimates peak physical demands over a 1-minute period during a basketball game. Thus, the average approach should be complemented by analysing the most demanding scenarios in order to have a better understanding of physical demands.

Muscle activation time and free-throw effectiveness in basketball.

Pakosz P, Domaszewski P, Konieczny M, Baczkowicz D

Scientific Reports. 11(1):7489, 2021 04 05.

This study attempts to analyze the relationship between free-throw efficiency and the time of arm muscle activation in players from 3 basketball teams with different levels of experience was investigated. During the experiment each player made 20 free throws during which the activation time of his right and left biceps and triceps brachii muscles were measured with the use of surface electromyography and high-speed cameras. Significant differences in muscle activation time (t) during a free throw were found between the groups of basketball players (p = 0.038) (novices: t = 0.664 +/- 0.225 s, intermediate-level players: t = 1.15 +/- 0.146 s, experts: t = 1.01 +/- 0.388 s). In the right triceps brachii muscle in expert basketball players the coefficient of variation (CV) amounted to 44.60% at 81% efficiency, and in novices to 27.12% at 53% efficiency. The time of arm muscle activation during a free throw and its fluctuations vary along with the training experience of basketball players. In all studied groups of players, the variability of

muscle activation time in accurate free throws is greater than in inaccurate free throws. Free-throw speed is irrelevant for free-throw efficiency.

Effects of an Injury Prevention Program on Anterior Cruciate Ligament Injury Risk Factors in Adolescent Females at Different Stages of Maturation.

Otsuki R, Benoit D, Hirose N, Fukubayashi T

Journal of Sports Science & Medicine. 20(2):365-372, 2021 06.

The ideal timing to implement anterior cruciate ligament injury prevention programs with respect to maturation is unclear. The purpose of this study was to investigate the effects of an injury prevention program on knee mechanics in early-, late-, and post-pubertal females. In the study, 178 adolescent female basketball players were assigned to six groups: early-pubertal training, early-pubertal control, late-pubertal training, and late-pubertal control, post-pubertal training, and post-pubertal control. The training groups performed an injury prevention program for six months. Medial knee displacement, knee flexion range of motion, and the probability of high knee abduction moment were assessed before and after the training period. After the six-month training period, medial knee displacement was significantly increased in the early-pubertal control group whereas it was unchanged in the early-pubertal training group. Knee flexion range of motion was significantly decreased in the early-pubertal control group whereas it did not change in the early-pubertal training group. The probability of high knee abduction moment was increased in the early-pubertal control group whereas it was unchanged in the earl-pubertal training group. The probability of high knee abduction moment was also decreased in the post-pubertal training group whereas it did not change in the post-pubertal control group. The program limited the development of high-risk movement patterns associated with maturation in early puberty while improving the knee mechanics in post-pubertal adolescents. Therefore, an injury prevention program should be initiated in early puberty and continue through the post-puberty years.

The Relationship of Intra-Individual Release Variability with Distance and Shooting Performance in Basketball.

Slegers N, Lee D, Wong G

Journal of Sports Science & Medicine. 20(3):508-515, 2021 09.

The aim of this study was to investigate the role of release parameter changes within individuals (intra-individual) on basketball shooting performance across both free throws and three-point shots, and identify whether any velocity dependence exists. Twelve male basketball players were recorded shooting seventy-five three-point shots (6.75 m) and fifty free throws (4.19 m). Ball release parameters were estimated by combining an analytic trajectory model including drag, a least squares estimator, and gradient-based release distance compensation. Intra-individual release velocity standard deviations (SD) were found to be significantly smaller across all distances ([0.05-0.13 m/s] when compared to statistics reported by other studies [0.2-0.8 m/s]). Despite an increase in lower body motion and a 24% increase in release velocity ($p < 0.001$) as shooting distance increased, no increases in intra-individual release velocity or angle SD were observed indicating velocity-

dependent changes in release parameters were absent. Shooting performance was found to be strongly correlated to the release velocity SD (r = -0.96, p < 0.001, for three-point shots, and r = -0.88, p < 0.001, for free throws). Release angle SD (1.2 +/- 0.24 deg, for three-point shots, and 1.3 +/- 0.26 deg, for free throws) showed no increase with distance and unrelated to performance. These findings suggest that velocity-dependent factors have minimal contribution to shooting strategies and an individual's ability to control release velocity at any distance is a primary factor in determining their shooting performance.

Multiparametric MRI characterization of knee articular cartilage and subchondral bone shape in collegiate basketball players.

Gao KT, Pedoia V, Young KA, Kogan F, Koff MF, Gold GE, Potter HG, Majumdar S

Journal of Orthopaedic Research. 39(7):1512-1522, 2021 07.

Magnetic resonance imaging (MRI) is commonly used to evaluate the morphology of the knee in athletes with high-knee impact; however, complex repeated loading of the joint can lead to biochemical and structural degeneration that occurs before visible morphological changes. In this study, we utilized multiparametric quantitative MRI to compare morphology and composition of articular cartilage and subchondral bone shape between young athletes with high-knee impact (basketball players; n = 40) and non-knee impact (swimmers; n = 25). We implemented voxel-based relaxometry to register all cases to a single reference space and performed a localized compositional analysis of T 1rho - and T 2 -relaxation times on a voxel-by-voxel basis. Additionally, statistical shape modeling was employed to extract differences in subchondral bone shape between the two groups. Evaluation of cartilage composition demonstrated a significant prolongation of relaxation times in the medial femoral and tibial compartments and in the posterolateral femur of basketball players in comparison to relaxation times in the same cartilage compartments of swimmers. The compositional analysis also showed depth-dependent differences with prolongation of the superficial layer in basketball players. For subchondral bone shape, three total modes were found to be significantly different between groups and related to the relative sizes of the tibial plateaus, intercondylar eminences, and the curvature and concavity of the patellar lateral facet. In summary, this study identified several characteristics associated with a high-knee impact which may expand our understanding of local degenerative patterns in this population.

Metabolic load comparison between the quarters of a game in elite male basketball players using sport metabolomics.

Khoramipour K, Gaeini AA, Shirzad E, Gilany K, Chashniam S, Sandbakk O

European Journal of Sport Science EJSS : Official Journal of the European College of Sport Science. 21(7):1022-1034, 2021 Jul.

Purpose: A basketball match is characterized by intermittent high-intensity activities, thereby relying extensively on both aerobic and anaerobic metabolic pathways. Here, we aimed to compare the metabolic fluctuations between the four 10-min quarters of high-level basketball games using metabolomics analyses. *Methods*: 70 male basketball players with at least 3 years of experience in the Iran national top-league participated. Before and

after each quarter, saliva samples were taken for subsequent untargeted metabolomics analyses, where Principal component analysis (PCA) and Partial least squares-discriminant analysis (PLS-DA) were employed for statistical analysis. *Results*: Quarters 1 and 3 showed similar metabolic profiles, with increased levels of ATP turnover (higher Lactate, Pyruvate, Succinic Acid, Citric Cid, Glucose and Hypoxanthine), indicating more reliance on anaerobic energy systems than quarters 2 and 4. In comparison, quarters 2 and 4 showed a reduction in Valine and Lucien and an increase in Alanine, Glycerol, AcetoAcetic Acid, Acetone, Succinic Acid, Citric Acid, Acetate and Taurine that was not present in quarters 1 and 3, indicating greater reliance of aerobic energy contribution, fat metabolism and gluconeogenesis. *Conclusion*: Our data demonstrate that the higher intensity of movements in the first quarter, where players are more rested, induce an increase in anaerobic energy contribution. This seems to be the case also for the third quarter that follows 15 min of rest, whereas the accumulated fatigue and reduction of high-intensity movements in the second and fourth quarters also reduces the speed of energy production and players thereby utilize more aerobic energy.

High school female basketball athletes exhibit decreased knee-specific choice visual-motor reaction time.

Nagai T, Schilaty ND, Bates NA, Bies NJ, McPherson AL, Hewett TE

Scandinavian Journal of Medicine & Science in Sports. 31(8):1699-1707, 2021 Aug.

Weaker hamstrings muscular forces and lower ratio of the hamstrings/quadriceps muscular forces in female athletes have been identified as modifiable risk factors for anterior cruciate ligament (ACL) injuries. However, sex differences in athletes' ability to react to visual cues (Choice Visual-Motor Reaction Time: VMRT) and to generate knee muscular forces (rate of force development: RFD) immediately following the visual cues were largely unknown. Therefore, the purpose of the study was to examine sex differences in Choice VMRT and RFD. A total of 50 high school basketball athletes (26F/24 M) participated in the study. Subjects sat in the knee dynamometer chair with their knee secured at 70degree of knee flexion and performed knee extension or flexion maximum voluntary isometric contractions immediately after they saw the visual cue: "UP" or "DOWN" arrows, respectively. Choice VMRT was defined as the time between the visual cue and the initiation of muscular force development (>5Newtons). RFD was calculated by dividing the changes in forces over the changes in time at four time points (0-50/100/150/200 ms). Peak muscular forces and RFD were normalized to their body mass. Average of three trials in each direction (flexion and extension) in each leg was used for statistical analyses. Females had significantly slower Choice VMRT ($p < 0.001$-0.027) and lower knee extension RFD at 100 ms ($p = 0.005$). In addition, females had significantly higher knee flexion/extension ratio than males in late RFD (150 ms and 200 ms) ($p < 0.004$). The current study has provided additional sensorimotor characteristics of athletes and sexes in addition to their knee muscular characteristics.

Symmetry does not Indicate Recovery: Single-leg Hop Before and After a Lower Extremity Injury.

Simon JE, Yom J, Grooms DR

International Journal of Sports Medicine. 42(4):344-349, 2021 Apr.

Current recommendations for return-to-play decision-making involve comparison of the injured limb to the uninjured limb. However, the use of the uninjured limb as a comparison for hop testing lacks empirical evidence. Thus, the purpose of this study was to determine the effects of lower extremity injury on limb symmetry and performance on the single-leg hop for distance. Two-hundred thirty-six adolescent athletes completed the single-leg hop for distance before the beginning of the season (pre-injury). Forty-four adolescent athletes sustained a lower extremity injury (22 ankle and 12 knee) and missed at least three days of sports participation. All individuals had completed the single-leg hop for distance before the beginning of the season (pre-injury) and at discharge (post-injury). Injured limb single-leg hop for distance significantly decreased at return-to-play from pre-injury with a mean decrease of 48.9 centimeters; the uninjured limb also significantly decreased, with a mean decrease of 33.8 centimeters. Limb symmetry did not significantly change pre- to post-injury with a mean difference of 1.5%. Following a lower extremity injury, single-leg hop for distance performance degrades not only for the injured limb but also the uninjured limb. However, limb symmetry did not change following a lower extremity injury.

Lower preseason reactive strength index scores are associated with injury in female collegiate volleyball players but not male collegiate basketball players.

Brumitt J, Dorociak R, Dunn S, Critchfield C, Benner J, Cuddeford T

Journal of Science & Medicine in Sport. 24(6):549-554, 2021 Jun.

OBJECTIVES: Functional tests are used by sports medicine professionals to discriminate injury risk in athletes. One test that has shown promise is the drop vertical jump (DVJ); however, it is primarily used to evaluate measures associated with anterior cruciate ligament injury. The DVJ test can also be used to calculate the reactive strength index (RSI); a measure used to assess an athlete's power. The ability of the RSI to discriminate injury risk is unknown. The purpose of this study was to prospectively evaluate the ability of preseason RSI scores to identify athletes at risk for a noncontact time-loss injury to the low back or lower extremities.
DESIGN: Prospective cohort.
METHODS: One hundred and fifty-five male collegiate basketball (BB) players and 117 female collegiate volleyball (VB) players were recruited for this study. DVJ tests were performed in a motion capture lab.
RESULTS: Female VB players with a RSI 0.9125m/s or less (30.48cm box) were 4 times (relative risk=4.2 [95% CI: 1.0, 17.7]; p-value=0.024) more likely to be injured. There was no association between preseason scores and injury in the male BB athletes.
CONCLUSION: RSI scores should be collected for female collegiate VB players as part of a preseason screen.

Effects of age on physical and technical performance in National Basketball Association (NBA) players.

Kalen A, Perez-Ferreiros A, Costa PB, Rey E

Research in Sports Medicine. 29(3):277-288, 2021 May-Jun.

This study evaluated the effects of age on physical and technical game performance for different positions in professional basketball players. In this cross-sectional study, a total of 25,523 individual match observations were undertaken on players from the 2018-19 NBA season. The players were classified into four age groups (19-22 years, 23-25 years, 26-29 years, and 30-42 years). Differences in physical and technical match performance were analysed for the following variables: distance covered, average speed, minutes played, points scored and playing efficiency. The results showed that players older than 30 covered shorter distance and had lower average speed than younger players, that guards and forwards older than 26 played more minutes per game than younger ones, and that guards older than 26 scored more points and were more efficient than younger one, while centres age 23-25 scored more points per games than centres older than 30. In conclusion, physical performance declined with age, and while playing time and technical performance generally remained stable or increased, especially for guards. However, there was some evidence of decline for centres.

The effect of high intensity functional training on the oxidative status, muscle damage and performance of basketball players.

Hovsepian A, Esfarjani F, Bambaeichi E, Zolaktaf V

Journal of Sports Medicine & Physical Fitness. 61(2):188-198, 2021 Feb.

BACKGROUND: The purpose of this study was to evaluate the effect of 10 weeks of two different in-season training programs on the oxidative status and muscle damage and performance of professional basketball players. We hypothesized that high intensity functional training (HIFT) induces more redox sensitive adaptations than common strength and conditioning training (CSCT).
METHODS: Twenty professional basketball players of Iran national women's basketball league (age 21.95+/-2.45, years of experience 7.15+/-1.7), were divided into two equal training groups; HIFT and CSCT (in average of 80-150 and 180-240 minutes per week respectively). Blood samples and performance tests including VO2max, basketball simulated performance (BEST), anaerobic power, agility and vertical jump were taken before and after training. Oxidative status and tissue damage were assessed through xanthine oxidase, total antioxidant capacity, pro-oxidant/antioxidant balance and creatine kinase. Data were analyzed through repeated measure mixed ANOVA.
RESULTS: BEST, average power and Fatigue Index significantly improved in HIFT group (alpha<0.05). VO2max and agility t-test improved significantly in both groups (alpha<0.05), with no significant difference between the two groups. Lateral agility and vertical jump did not change significantly in neither of the groups. No significant group x time interaction was observed in the biochemical factors. XO increased, TAC and CK decreased significantly in both groups (alpha<0.05), with no significant change in PAB in neither of the groups after training.

CONCLUSIONS: The findings of the present study showed no oxidative stress and tissue damage in none of the training groups, recommending the implication of more time-efficient HIFT method into the in-season training of team sports.

Quantifying Training and Game Demands of a National Basketball Association Season.

Russell JL; McLean BD; Stolp S; Strack D; Coutts AJ

Frontiers in Psychology. 12:793216, 2021.

Purpose: There are currently no data describing combined practice and game load demands throughout a National Basketball Association (NBA) season. The primary objective of this study was to integrate external load data garnered from all on-court activity throughout an NBA season, according to different activity and player characteristics. Methods: Data from 14 professional male basketball players (mean +/- SD; age, 27.3 +/- 4.8 years; height, 201.0 +/- 7.2 cm; body mass, 104.9 +/- 10.6 kg) playing for the same club during the 2017-2018 NBA season were retrospectively analyzed. Game and training data were integrated to create a consolidated external load measure, which was termed integrated load. Players were categorized by years of NBA experience (1-2y, 3-5y, 6-9y, and 10 + y), position (frontcourt and backcourt), and playing rotation status (starter, rotation, and bench). Results: Total weekly duration was significantly different ($p < 0.001$) between years of NBA playing experience, with duration highest in 3-5year players, compared with 6-9 ($d = 0.46$) and 10+ ($d = 0.78$) year players. Starters experienced the highest integrated load, compared with bench ($d = 0.77$) players. There were no significant differences in integrated load or duration between positions. Conclusion: This is the first study to describe the seasonal training loads of NBA players for an entire season and shows that a most training load is accumulated in non-game activities. This study highlights the need for integrated and unobtrusive training load monitoring, with engagement of all stakeholders to develop well-informed individualized training prescription to optimize preparation of NBA players.

The Problematic Experience of Players' Mutations Between Clubs: Discovering the Social Adaptability Skills Required.

Owiti S; Hauw D

Frontiers in Sports & Active Living. 3:591438, 2021.

Objective: During their career, most players working in professional team sports move from club to club. These transitions are not always completely successful and could highly impact the route of the players' development. However, there is a lack of knowledge on the psychological processes involved when players encounter problems in adapting from one club to another. Thus, it was the aim of this study to identify the most difficult aspects of these transitions, as experienced by team sports players and the psychological skills that contribute to successful outcomes. Design and Method: The present study included twenty professional basketball players (aged between 20 and 36 years old; Mean = 26.05, SD = 4.12), who had played under different coaches (coach range 4-15; Mean = 8.65, SD = 2.92), and also played for different clubs (range 3-10; Mean = 5.35, SD = 2.08). They took

part in retrospective interviews regarding their embedded experiences during club to club transitions. A situated E-approach was used to identify their problematic experiences, the adaptability skills and how they are applied during club mutations. Results and Conclusions: The identification of problematic experiences revealed seven components in relation to coaching (e.g., obeying orders, reduced play time), three components with teammates (e.g., respect), two components with the club (e.g., lack of support), and three components with family/friends (e.g., geographical constraints). Additionally, results indicated that the adaptability skills used during mutation are related to three groups namely mental skills, learning methods, and interpersonal skills. The results provide coaches, players, sports psychologists, and national sport organizations a set of issues for understanding the challenges players encounter when they move from one club to another.

High-Acceleration Movement, Muscle Damage, and Perceived Exertion in Basketball Games.

Koyama T; Rikukawa A; Nagano Y; Sasaki S; Ichikawa H; Hirose N

International journal of sports physiology & performance. 17(1):16-21, 2022.

PURPOSE: To evaluate the effect of the number of high-acceleration movements on muscle damage and the rating of perceived exertion (RPE) in basketball games.

METHODS: Twenty-one male collegiate basketball players (mean age, 20.0 [1.0] y) were included. A triaxial accelerometer was used to measure acceleration in basketball-simulated scrimmages. To detect higher physical load during the actual game, the resultant acceleration was calculated, and 3 thresholds were set: >4G, >6G, and >8G resultant accelerations. The number of the extracted movements was calculated at each acceleration threshold. Plasma creatine kinase (CK) levels (marker of muscle damage) were estimated before and 24 hours after the match, and the session-RPE load was calculated within 30 minutes after the match. Pearson product-moment correlations with 95% confidence intervals were used to determine the relationships between the number of high-acceleration movements and plasma CK and session-RPE load.

RESULTS: Significant correlations were observed between the number of high-acceleration movements >8G and CK level ($r = .74$; 95% confidence interval, 0.44-0.89; $P < .0001$). Furthermore, the correlation coefficient between acceleration and CK increased with increased acceleration threshold (>4G: $r = .65$; >6G: $r = .69$). Contrastingly, the correlation coefficient between acceleration and the session-RPE load decreased with increased acceleration threshold (>4G: $r = .72$; >6G: $r = .52$; >8G: $r = .43$).

CONCLUSIONS: The session-RPE reflects the total amount of movement, while the high-acceleration movement reflects the momentary large impact load or intensity, and they evaluated different factors. Basketball coaching and conditioning professionals recommended combining acceleration and session-RPE when monitoring the load of athletes.

The "SHRed Injuries Basketball" Neuromuscular Training Warm-up Program Reduces Ankle and Knee Injury Rates by 36% in Youth Basketball.

Emery CA; Owoeye OBA; Raisanen AM; Befus K; Hubkarao T;

Palacios-Derflingher L; Pasanen K

Journal of Orthopaedic & Sports Physical Therapy. 52(1):40-48, 2022 Jan.

OBJECTIVE: To evaluate the effectiveness of a neuromuscular training warm-up prevention program, Surveillance in High school and community sport to Reduce (SHRed) Injuries Basketball, for reducing all-complaint ankle and knee injuries in youth basketball players.

DESIGN: Quasi-experimental study.

METHODS: High school/club basketball teams (male and female players aged 11-18 years) in Calgary, Canada participated in 2016-2017 (control; season 1) and 2017-2018 (intervention; season 2). The control season included a standard-of-practice warm-up. In season 2, a SHRed Injuries Basketball coach workshop was completed by participating team coaches. Teams were randomized by school/club to an unsupervised or a supervised (weekly supervision by study personnel) implementation of the coach-delivered SHRed Injuries Basketball program. The 10-minute SHRed Injuries Basketball program included 13 exercises (ie, aerobic, agility, strength, balance). All-complaint ankle and knee injuries were collected weekly using validated injury surveillance. Multilevel, multivariable Poisson regression analyses (considering important covariates, clustering by team and individual, and offset by exposure hours) estimated incidence rate ratios (IRRs) by intervention group (season 1 versus season 2) and secondarily considered the control versus completion of the SHRed Injuries Basketball program, unsupervised and supervised.

RESULTS: Sixty-three teams (n = 502 players) participated in season 1 and 31 teams (n = 307 players: 143 unsupervised, 164 supervised) participated in season 2. The SHRed Injuries Basketball program was protective against all-complaint knee and ankle injuries (IRR = 0.64; 95% confidence interval [CI]: 0.51, 0.79). Unsupervised (IRR = 0.62; 95% CI: 0.47, 0.83) and supervised (IRR = 0.64; 95% CI: 0.49, 0.85) implementations of the SHRed Injuries Basketball program had similar protective effects.

CONCLUSION: The SHRed Injuries Basketball program was associated with a 36% lower rate of ankle and knee injuries. Neuromuscular training warm-ups are recommended as the minimal standard of practice for injury prevention in youth basketball.

LET'S CHAT ABOUT...

Let us know what is on your mind, what you want to chat about in the next issue of the FAST BREAK. Email to mwesner@ualberta.ca.

In this issue of Fast Break, Marni Wesner (Canada) chats about injury prevention:

"During my tenure as the lead physician with the Canadian national women's basketball team, I had the privilege to accompany the team to events in North and South America, Europe and Asia. While some of the facilities we played in had better cosmetic appeal, a basketball court is still just 92x49 feet of hardwood. Today elite basketball is a multi-billion dollar industry, and sponsorship and advertising are part of the financial success of the game. However, the decals that are plastered on the court changes the traction of the shoe and creates a risk for injury. There have been many players, teams and leagues that have called for the discontinuation of decals on the court but advertising revenue has seemingly superseded injury prevention. Perhaps the detail of the decal needs to be considered when we are collecting injury data in a more standardized and consistent manner so that we can be a more effective body promoting injury prevention."

FROM THIS HISTORY BOOKS

In 1891, Canadian Dr. James Naismith invented basketball in Springfield, Massachusetts.

His task was to create an indoor sport that would keep athletes in shape during the cold winter months. His original 13 rules were published in the Springfield College newsletter and explained the game in 474 words.

Today, the FIBA basketball rules require 113 typed pages to explain the game.

SHARE YOUR PHOTOS

Please send us your funny, interesting, or remarkable basketball pictures that we can share with the medical and sport science basketball community.

Photo caption: At 176 cm tall, I have never considered myself to be a short person, but this walk to the bus at the Tokyo Olympics gave me a new perspective (photo compliments of Marni Wesner).

THE STUDENT'S CORNER

This space is intended for sport science and medical students, residents, and fellows to contribute to our knowledge and conversation.

Please encourage your students to contribute to the Fast Break on a topic of their choosing related to basketball injury, rehabilitation or sport science.

Lisfranc Injuries

by Dr. Nolan Rau, Sport and Exercise Medicine Fellow, University of British Columbia

Who is Lisfranc?

Jacques Lisfranc de Saint-Martin was a French surgeon who first described an amputation through the tarsometatarsal joint. Contrary to popular belief, he did not describe any specific injury or mechanism of injury to this joint, nor its clinical importance, though it does now bear his name!

What is a Lisfranc Injury?

A Lisfranc injury is best described as an injury to the tarsometatarsal joint, which connects the three cuneiforms and cuboid bones to the base of the metatarsal bones-essentially linking the midfoot to the forefoot. A Lisfranc injury can be a bone injury, ligamentous injury, or combination of both. The severity can range from a sprain to a significant fracture-dislocation.

What Anatomy is Involved?

The tarsometatarsal joint is often categorized into 3 columns, the medial column involves the articulation of the 1st metatarsal and medial cuneiform, the middle column involves the articulation of the 2nd and 3rd metatarsals to the middle and lateral cuneiform, and the lateral column involves the articulation of the 4th and 5th metatarsals to the cuboid[2]. These columns form the transverse arch of the foot, and are intrinsically very stable with numerous ligamentous attachments in the dorsal and plantar regions, as well as interosseous ligaments[2]. Of note, the medial and middle columns are most rigid, and serve an important role in allowing the foot to act as a lever during normal ambulation, particularly during the push-off/heel rise component of gait, when forces across this joint are very high[2].

How does it happen? (Mechanism of Injury)

A Lisfranc injury can occur through a variety of different mechanisms. In the general population, Lisfranc injuries tend to be from high-energy mechanisms such as motor vehicle accidents or falls from height, however lower energy mechanisms, including non-contact injuries from cutting or falling on a plantar-flexed foot are not uncommon in athletes [1,2,3,]. The most common mechanism is from an axial load applied longitudinally to a plantar-flexed foot, especially if followed by forceful abduction or twisting [1,2]. A classically described mechanism is an equestrian athlete falling from a horse while their foot is stuck in the stirrups, and being held up/dragged with their foot stuck in a plantar

flexed position in the stirrup [2,3]. Direct crushing loads to the midfoot can also cause Lisfranc injuries, though this is less commonly a mechanism in athletes .

Who does it affect?

Lisfranc injuries can occur to anyone, but the most common demographic is in males in their 3rd decade of life (20's). A variety of different athletes can be affected, but the most common sports include American football, gymnastics, soccer, equestrian, rugby, windsurfing, basketball, dance/ballet, baseball, and even running [1,3].

Why is it significant?

Lisfranc injuries are relatively uncommon in the general population, however they are more common in athletes. They are listed as the 2nd most common foot injury in American football after MTP joint injury (turf toe) [1], and up to 20-40% are undiagnosed or misdiagnosed on initial presentation [1,2,3]. Recent studies estimate 4% of collegiate level football players will experience a Lisfranc injury annually [4].

The TMT joint serves as a connection between the midfoot bones to the forefoot is vitally important to proper function/biomechanics of the foot [1,3]. In particular, the middle column of midfoot (2nd and 3rd MT and their corresponding TMT articulations) are rigid, which is very important for proper function of the foot as a lever arm during normal ambulation. Unrecognized Lisfranc injuries can lead to significant pain and functional deficits due to collapse of the longitudinal arch, and premature arthritis across the TMT joint [3].

How can we diagnose it?

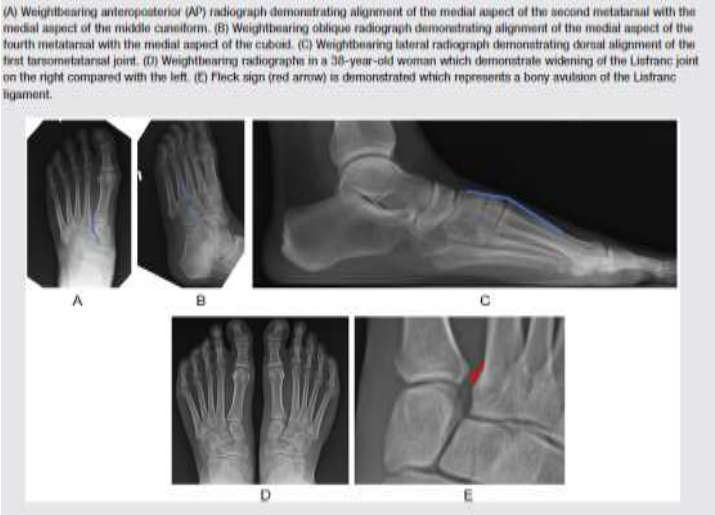
Many Lisfranc injuries can be easily misdiagnosed, or overlooked particularly those with lower energy mechanisms, or in polytrauma situations, so it is important to keep a Lisfranc injury in mind as a possibility for any acute foot injury, particularly in those with a compatible mechanism, or midfoot pain. Most patients can recall a specific acute traumatic episode, and many have pain significant enough to limit their ability to bear weight, however a lack of severe pain does not rule out a Lisfranc injury [2,3].

When examining the patient, plantar ecchymosis at the midfoot is pathognomonic, but pain to palpation or swelling over the TMT joint are also highly suggestive [2,3]. Stress testing with passive abduction and pronation of forefoot will holding hindfoot fixed can be provocative for more subtle/mild cases, and the piano key test, performed by moving the metatarsal head while fixating the midfoot can sometimes aid in finding metatarsal instability [3].

Ensure to do a good neurovascular exam; the dorsalis pedis and terminal branch of deep peroneal nerve run in close proximity to the Lisfranc joint.

Radiographs, including AP, 30-degree oblique, lateral and weightbearing views with comparison to the contralateral side can be helpful to assess for any discrete changes or widening across the TMT or intra metatarsal spaces [2,3].

Normally, the medial 2nd metatarsal base should line up with the medial aspect of medial cuneiform on the AP view. Any diastasis of >2mm compared to other side is abnormal [3]. On oblique imaging, the fourth metatarsal and cuboid bone should align, and on lateral imaging, the dorsal and plantar metatarsal cortices should align with the proximal cuneiforms and cuboid bones [3]. The "fleck sign" refers to a small piece of bone between 1st and 2nd MT's, which represents avulsion of Lisfranc ligament from 2nd MT and can be pathognomic [2]. Abduction stress radiographs are described in literature, but are technically difficult and often not tolerated by patient [1,2].



(A) Weightbearing anteroposterior (AP) radiograph demonstrating alignment of the medial aspect of the second metatarsal with the medial aspect of the middle cuneiform. (B) Weightbearing oblique radiograph demonstrating alignment of the medial aspect of the fourth metatarsal with the medial aspect of the cuboid. (C) Weightbearing lateral radiograph demonstrating dorsal alignment of the first tarsometatarsal joint. (D) Weightbearing radiographs in a 38-year-old woman which demonstrate widening of the Lisfranc joint on the right compared with the left. (E) Fleck sign (red arrow) is demonstrated which represents a bony avulsion of the Lisfranc ligament.

(Image from Chen J, Sagoo N, Panchbhavi VK. The Lisfranc Injury: A Literature Review of Anatomy, Etiology, Evaluation, and Management. Foot & Ankle Specialist. 2020 Aug 20:1938640020950133.)

A CT scan or MRI can be considered for cases that remain unclear after examination and x-rays, which is not uncommon, as up to 20% of Lisfranc injuries are no readily apparent on x-ray [2]. A CT scan typically finds 60% more metatarsal fractures and at least twice as many tarsal fractures as an x-ray [3]. For more mild injuries, an MRI can be considered to further assess soft tissue and ligamentous injuries, though this approach is associated with more false positives [3]. Bone scans are described in some classification systems, particularly for mild injuries, however they are not commonly ordered, and abnormal uptake can sometimes persist for up to a year post injury in Lisfranc injuries [1,2,3].

How should it be treated?

It is generally accepted that Lisfranc joint sprains, and stable injuries (ie no diastasis on x-ray nor with stress imaging) can be treated non-operatively, though the protocols that are recommended to do so are variable. Many resources recommend a non-weightbearing cast or boot for 2-8 weeks, though some protocols allow for early protected weightbearing in a boot [1,2,3,4]. Most resources recommend a period of protection with a boot or cast for 6 weeks minimum, followed by transition to full weightbearing as tolerated. It is important to continue with follow-up imaging to ensure no widening/diastasis, and counsel the patient regarding the longer expected recovery for this injury compared to a typical lateral ankle sprain, as it often requires at least 2-3 months of healing prior to return to sports or high impact activities [2,3,4,].

For any injuries with diastasis, surgical intervention is recommended [1,2,3,4,]. The quality of the initial reduction is described as one of the most important factors for long-term prognosis, so most suggest a low threshold for open reduction and internal fixation (ORIF), particularly in athletes [1,2]. Specific surgical techniques are outside the scope of this article, but screw or plate based ORIF techniques are some of the most commonly described.

Arthrodesis is another option but is most commonly recommended as a salvage procedure, or for more severe initial injury [1,2,3,]. Flexible fixation with suture endobutton tightrope systems are a more recent development that may become more prevalent as more research becomes available [3].

What are long term outcomes and return to play implications?

If the injury is appropriately diagnosed and treated, outcomes are generally quite good, though a prolonged recovery period is almost always required. In studies of athletes, 85-93% of patients report good to excellent outcomes if initial reduction was high-quality [3].

Return to play decision making is individualized, however most cases require at least 3 months prior to return to sports, and many require 6-12 months, particularly if there was a surgical intervention involved [1,2,3,4].

In a study of all NFL players with Lisfranc injuries from 2000-2010, 90% returned to play within 11 months, and though there was a decrease in their performance markers compared to pre-injury scores, the differences were not statistically significant, and mirrored control players at similar stages of their careers [3,5].

A separate European study assessed professional soccer and rugby players who sustained Lisfranc injuries and found that 94% returned to their prior level of sport at an average of 25 weeks [3,6].

While the return to sport implications are often quite good, the research regarding longer term outcomes is more limited, however it has been found that up to 54% of patients with Lisfranc injuries will go on to develop midfoot osteoarthritis at 10 years, regardless of initial treatment [7].

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