Kaplan, Y., Myklebust, G., Nyska, M., Palmanovich, E., Victor, J., Witvrouw, E. (2014). Injuries can be prevented in contact flag football!. *Knee Surgery, Sports Traumatology, Arthroscopy*. doi: 10.1007/s00167-014-3266-0

INJURIES CAN BE PREVENTED IN CONTACT FLAG FOOTBALL!

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ABSTRACT

Purpose: This original prospective cohort study was conducted in an attempt to significantly reduce the incidence and the severity of injuries in an intervention cohort as compared to a two-season historical cohort, and to provide recommendations to the International Federation of Football (IFAF) pertaining to prevention measures to make the game safer.

Methods: 1260 amateur male (mean age: 20.4 ± 3.9yrs) and 244 female (mean age: 18.5 ± 1.7 yrs) players participated in the study. Four prevention measures were implemented: The no-pocket rule, self-fitting mouth guards, ankle braces (for those players with recurrent ankle sprains) and an injury treatment information brochure.

All time-loss injuries sustained in game sessions were recorded by the off-the-field medical personnel and followed up by a more detailed phone injury surveillance questionnaire.

Results: There was an 54% reduction in the total number of injuries, and a significant reduction in the incidence rate and incidence proportion between the intervention cohort as compared to the historical cohort ($P<0.001$). There was no statistically significant reduction in the number of injuries in any of the body parts, except for in hand/wrist injuries related to the use of pockets ($p<0.001$) , as well as the severity of mild-moderate injuries ($p<0.05$).

Conclusions: This study provided evidence that hand/wrist injuries can be significantly reduced in flag football. Recommendations to the IFAF include strict enforcement of the no-pocket rule, the use of soft headgear, comfortable-fitting ankle braces and mouth guards and additionally, to change game rules concerning blocking.

Level of evidence: 11

Key Terms: Contact flag football, Sports injuries, Prevention, Intervention

INTRODUCTION

The implementation of evidence-based methods to prevent sports injuries is critical due to the possibility of preventing a substantial proportion of these injuries [7,19,24]. American flag football (AFF) is a modified version of tackle football without significant physical contact. In place of tackling the ball carrier, flags that are clipped to a belt worn around the waist, must be removed. The removal of at least one of the flags is equivalent to a tackle and ends the play [11].

In a study conducted on American army recruits, AFF resulted in the third highest incidence of injuries in the sports and recreation category, following basketball and softball [4]. Despite its lessened physical contact and injury susceptibility as compared to tackle football, AFF produces a relatively high injury incidence [4,6,24], and there has been no prospective, longitudinal study reported in the literature that has examined the impact of interventions to reduce the incidence of these injuries.

Previous studies in flag football have shown a high percentage of anatomical specific injuries; the hand/wrist (16-34%), the knee (11-18%), the ankle (8-17%), the face and head (18-29%), and the shoulder (9-10%) [4,6,15,16]. Direct trauma was responsible for the vast majority of injuries (64-75%).

During a previous prospective epidemiological study conducted during the 2007-9 playing seasons (Historical cohort), almost all players wore pants with side pockets and refrained from playing with mouth guards [15]. Despite the available evidence illustrating that mouth guards provide impact energy attenuation and limited prevention against concussions [2,5, 7,21], the use of mouth guards is not enforced in the sport of contact flag football. Furthermore, in the historical cohort, 40% of the hand/wrist injuries were reported as a direct result of fingers being caught in the pockets of the opposing players' pants (Fig.2) [15]. Although ankle braces have proven to be successful in reducing ankle injuries in sports, primarily in those players with recurrent sprains, very few players in the historical cohort used them [17,24]. There have been no studies published regarding the role of ankle braces in American flag football.

A pilot injury prevention study in flag football has been conducted [16]. The study provided preliminary evidence that hand/wrist injuries can be significantly reduced as well as important information that aided in refining research methodology for this present prospective prevention study.

The hypotheses of this study included:

1. The enhanced awareness of safety due to the study would lead to a significant reduction in the total incidence of injuries.
2. Adherence to the no-pocket rule would significantly reduce the incidence of finger injuries, as compared to the historical cohort.
3. Mouth guards would reduce the severity of concussions and oral injuries, as compared to the historical cohort.
4. There would be a significant reduction in re-injury amongst players with recurrent ankle sprains if they wore ankle braces, as compared to the historical cohort.

This intervention study is the first prospective injury prevention study in flag football. The authors consider that the primary long term goal of any prevention study should be how the outcomes of the efficacy research can be translated into actions that can actually be implemented in the real-world context of on-field sports behaviors. To realize this goal, they planned to implement the study recommendations initially on a local sporting level and then to inform the International Federation of American Football (IFAF) of the findings of the study. The intention would be to make changes in the international rules, thus making flag football a safer sport for all involved.

MATERIAL AND METHODS

A two-season longitudinal, prospective injury prevention study was conducted over the 2011-2013 playing seasons. The cohort was comprised of post high school American and Canadian males and females who were studying abroad in Israel for a year. All participants had joined the flag football league of their own accord and teams were formed in Israel. Participants were of similar age, socio-economic background (had similar levels of education and were from the same ethnic communities) and played a similar number of games during the league season as those in the historical cohort (Table 1.) A time-loss injury was defined as an injury that resulted in a player being unable to return to the current or future game [8]. All

game sessions were played on a synthetic grass surface. The above injury definition and reporting mechanism was the same as that used in the historical cohort.

Following agreement with the management of the AFI, four intervention measures were implemented for the intervention cohort:

I. **The no-pocket rule**. Players were not permitted to play with pants which had open side pockets. Unlike the pilot study protocol, players were not permitted to glue or tape their pockets.

II. **Self-fitting mouth guards (Everlast™ double Mouth Guard).** Prior to the first game of the season, all players were fitted with individually-moulded mouth guards. Referees did not allow players to participate in the game sessions without mouth guards.

III. **Ankle braces (Universal Ankle Stirrup DJO™).** One hundred and eighty-seven ankle braces with fitting instructions were distributed to 153 (10.2%) players. These players had reported a history of at least two previous sprains on the ipsilateral ankle with accompanying subjective functional instability within the previous five-year period. Some players had bilateral instability and therefore received a brace for each ankle.

IV. An injury treatment information brochure. In an attempt to reduce the severity of the injuries, the brochure provided information on how to effectively treat an injury in the acute phase (P.R.I.C.E. method), as well as information pertaining to medical facilities available to the players in the event of an injury [3,14]. Upon signing the consent form, the brochure was handed out individually to each player, as well as sent to their electronic mail addresses. Injury severity is defined as the number of days that had elapsed from the date of injury to the date of the player's return to full participation in team training and availability for match selection [8].

As a result of the AFI's amateur league status, there are no official league practice sessions held during the season. This fact also precluded a pre-participation examination of each of the participants with appropriate follow-up therapeutic measures. League registration is done only online, and there is no way of knowing until the league commences, how many players will be involved. All teams play a one hour game per week. Injured players were either referred by the attending medic to their local physician or sent to the emergency unit of a local clinic or hospital. The attending physicians were requested to provide a specific written diagnosis or to use a sport specific injury coding system, such as the Orchard system [22]. This was done in order to reduce the risk of misclassification of injury.

Time-loss injuries were recorded by the attending paramedics throughout the playing season. They were then collected manually by the principal author (YK) following the conclusion of all games that were played on that day. A telephonic, in depth injury-surveillance questionnaire was subsequently conducted within two days, following the injury. This questionnaire was based on the recommendations of the internationally accepted consensus injury-surveillance questionnaire of Fuller, et al. [8] and was further adapted for AFF. Injuries which occurred outside of game play, were not included. Following the collection of the exposure data, the injury rates were calculated using incidence rate (IR)/1000 athletic exposures and the total incidence proportion (IP) [18].

Upon the termination of the study, all players who received ankle braces were contacted telephonically and surveyed about their ankle brace, mouth guard and no-pocket rule compliance. In order to examine the overall baseline demographic data of the injured players, as compared to the non-injured cohort, an internet-based random number generator (random.org) was used in a random cohort of 60 non-injured players who were questioned with regards to their compliance with the no-pocket rule and adherence to wearing mouth guards.

Prior to signing the informed consent form, each participant was given a brief explanation about the study. Helsinki approval (No. 0052-11-MMC) was obtained by the medical ethics committee of the Meir Hospital, Kfar Saba, Israel

STATISTICAL ANALYSIS

In order to compare quantitative variables between the two cohorts (demographic as well as physical characteristics), the independent samples two-tailed t-test for equality of means was used. Comparison of qualitative variables between the historical and intervention cohorts was executed by means of the Pearson chi-square test. Statistical analysis was undertaken via the use of SPSS® predictive analytics software package (version 18.0), as well as the WinPepi package of statistical programs (PEPI-for-Windows) (version 11.18).

With the assistance of the "Power and Precision" statistical power analysis software package, the calculation of an appropriate sample size for the planned study was computed. In order to yield a power of 80% and N=1400, to prove that the difference between the groups is statistically significant, the 11% injury incidence rate (from the historical cohort) would have to be reduced to 9% as a result of the

intervention program. In order to prove that a significant decrease in finger injuries, assuming a 5% significance level, a power of 80% and N=1400, at least a reduction from 17.5% to 15% needs to be achieved, if the significance level is one-tailed, and at least a reduction from 17.5% to 14.7 %, if the significance level is two-tailed. In order to prove that a significant decrease in ankle injuries occurred, assuming a 5% significance level, a power of 80% and N=1400, at least a reduction from 13.5% to 11.3% needs to be achieved, if the significance level is one-tailed. There needs to be at least a reduction from 13.5% to 11 %, if the significance level is two-tailed. The p-value of statistical significance was 5% or less.

RESULTS

There was no significant difference between the cohorts regarding demographic data ($p<0.05$) (Table 1). Of the total 1504 players who played in the 2011-13 seasons (intervention cohort), 1257 (83.6%) participated in the study. Ninety-four (7.5%) players did not play. The authors were unable to make contact with 153 (12.2%) players.

When comparing the two cohorts, the intervention study resulted in a 54% (86/161) reduction in the total number of injuries, as well as a statistically significant reduction in the total incidence rate (IR)/1000 athletic exposures ($p=<0.001$) and the total incidence proportion (IP)($p=<0.001$)(Table 1). Table 2 represents the incidence rates between the cohorts in relation to the specific injuries. There was a statistically significant reduction in the number of hand/wrist injuries that resulted from the fingers/thumb having been caught in the opposing player's pockets, ($p<0.05$). There was a non-significant (N.S) reduction in the incidence of injuries in the shoulder and the knee regions. Although there was a 40% reduction in ankle injuries, this was N.S. No player who received and played with an ankle guard re-injured his ankle.

There was a significant difference with regard to the injury severity in the head/ face region (Fig.1) ($P<0.05$). The values in the bars in Fig. 1 represent the percentages of the total number of injuries per anatomical region. Overall, there was a significant difference between the cohorts with regard to the severity of injury ($p<0.05$). In the historical cohort, 35% (56/161) of the injuries were defined as either minimal-mild, while 65% (104/161) were moderate-severe. In the intervention cohort, 17% (15/86) of the injuries were defined as either minimal-mild, while 83% (71/86) were moderate-severe. The compliance rates and reasons for non-compliance for the intervention cohort are summarized in Table 3.

DISCUSSION

The most important finding of this prevention study was the significant reduction in both the injury incidence rate (IR) and incidence proportion (IP) between the historical and the intervention cohorts (Table 2). This provides convincing evidence that the combination of intervention methods employed had a positive impact on reducing the injury statistics in the intervention cohort.

In the intervention cohort, there were no injuries that resulted from fingers being caught in the opposing players' pockets. This can be compared to hand/wrist injuries in the historical cohort, of which 40% were caused by pockets (Fig.2)[15]. Thus, the no-pocket rule proved beyond reasonable doubt that it is a significant factor in reducing hand/wrist injuries in flag football.

At the very outset of the study, the authors of this study made a concerted effort to convince the AFI league management and medical staff to be active promoters of this prevention project. It is the authors' experience that a successful symbiotic relationship between researchers and sport management personnel, will determine to a great extent the eventual success of prevention programs. In the final season of this study (2012-2013), teams were penalized if any player was found playing with open pockets or without a mouth guard. The inclusion of penalties is a possible contributing factor in the increase in compliance percentage, compared to the previous season (Table 3). The permanent institution of proven intervention methods should therefore serve as a primary goal in any prevention study. Previous prevention trials have shown that when successful intervention methods are discontinued, injury incidence rates return to their previous levels [20]. Although International Flag Football Rules (Section 3. Article 1. Mandatory Equipment) lists the no-pocket rule as mandatory, there are no listed penalties for any player violating the rule. In addition, mouth guards are only recommended for national competition games [12].

Seventy-five percent of the reported head and face injuries, as well as 62% of the finger and wrist injuries were as a result of players knocking into one another during blocking or direct collision. Certain key injury prevention interventions, including changing blocking rules and wearing soft headgear were not accepted by the AFI management, although the implementation of such interventions could possibly have provided significant evidence with regard to injury prevention in contact flag football. As a member of the International Federation of American Football (IFAF), the AFI management is bound by IFAF rules and therefore refused to alter any rules regarding blocking as set out in International Flag Football Rules[12].

The finding that no player who had received and played with an ankle guard re-injured his ankle is of significance as recurrent injury has been reported to be a significant predictor for re-injury [10,17]. Twelve percent of the players (Table 3) who had reported ankle instability, felt that ankle braces were unnecessary despite strong evidence that ankle braces significantly reduced the incidence and the severity of ankle injuries[10,17]. The literature reports ankle sprain incidence in various sporting activities between 15–73%, which is influenced by factors including sporting type, playing frequency, age, gender and previous injury [10,17].

Although 18% of injuries in the historical cohort and 16% in the intervention cohort involved the knee region (Fig.1.), research is limited on the use of knee braces (prophylactic and functional) to potentially prevent knee ligament injury in a non-injured population [1]. Knee braces have not to date proven to be effective in reducing the number and severity of knee injuries.

Although all of the players were given the brochure upon signing the ethics consent form, as well as it being affixed on the field notice board, and available on a freely available online module, most players did not take the time to read the brochure. Many admitted discarding it almost immediately. A possible method for neutralizing this drawback would be to host a series of information seminars during the pre-season to better inform the players and team captains regarding the brochure's contents. This has been successfully executed in a previous injury prevention study [25].

In order to have achieved a higher level of evidence in the study, it would have been preferable for the intervention study cohort to have been randomized into those who received the prevention measures and those who did not. Whilst randomized controlled trials are theoretically ideal, they are hard to conduct - particularly taking into account the broad safety culture of a sport and the safety behaviors of its participants [7]. This was not possible for numerous reasons. As the AFI is an amateur league with no team coaches to monitor the interventions used, there existed the risk of an unplanned crossover effect, whereby players assigned by the randomization to the control group could have had second thoughts and decided of their own accord, not to utilize the intervention measures provided. This phenomenon would have posed a serious challenge in the analysis of the data and undermined the very experimental design [9]. Pasanen et al [23] showed in a cluster randomized trial comprising female footballers, that randomization in sports injury prevention is possible, with good intervention results.

Other limitations of the study included the possible underreporting of injuries by the players themselves. This could be due to players being injured towards the end of the game and not wanting to report their injuries for personal reasons, including "hiding" the injury from their captains and league officials. Although a telephonic, in-depth questionnaire was administered by the principal author within two days following each injury, there were cases where the player's condition necessitated a follow-up medical investigation, and therefore a final diagnosis could not be made until 7-14 days post-injury. Although the authors felt that this time period was short enough that players would not suffer from recall bias, the possibility still existed.

Examining the effect of more than one or two interventions at a time, may have made it more difficult to determine the effect of each individual intervention. The authors therefore used only one intervention to reduce the incidence of injuries for each body part.

As stated previously in this paper, due to the amateur nature of the AFI , there are no official league practice sessions held during the AFI season and registration is done only online. Pre-participation examination for each of the participants was therefore precluded. The injury questionnaire used in this study did in fact contain questions pertaining to previous injury, and this was taken into account when the prevalence of injuries was calculated. This however was retrospective in nature, and player recall bias may have resulted in inaccuracies.

Co-intervention bias or attention effect may explain part of the positive reduction in injuries in the intervention group, not related to the four intervention actions. Although there were a similar number of

players in the two cohorts, there were approximately 200 more games played in the historical cohort. This may have allowed for more opportunities for injuries to occur.

CONCLUSION

This is the first prospective prevention study in American contact flag football and has provided convincing evidence that finger/thumb injuries can be significantly reduced in flag football. Based on the results obtained, recommendations to the IFAF include the mandatory use of mouth guards, and the strict implementation of the no-pocket rule, including harsh penalties for their violation. In addition, comfortable-fitting ankle braces, the use of soft headgear and changing the blocking rules, should be considered.

AKNOWLEDGEMENTS

The authors would like to thank Mrs Tali Bdolah, MSc, Senior statistician, Hebrew University, Jerusalem, for her assistance with the statistical analysis, as well as Mrs Sari Diament BSc, for her editing assistance in preparing this manuscript

The authors declare that no organization sponsored the research and there is no conflict of interest.

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FIGURE CAPTIONS

Table 1. Demographic and Injury Result Data
Table 2. Incidence rates in relation to the specific injuries
Table 3. Non-Compliance Data and Compliance Rates
Figure 1. Number of Injuries vs. Injured Body Part
Figure 2. Body part vs. Injury Mechanism