Editor's key points

- Established recommendations for the management of sport-related concussions call for individuals to be assessed by a physician or licensed health care provider, but having timely access to qualified experts can be a challenge in most non-elite levels of competitive sports.
- A high school in Québec, Que, explored whether having a physiotherapist make some return-to-play (RTP) decisions for members of its football teams (players between 11 and 17 years old) instead of a physician affected the same-season recurrence (SSR) of concussion following RTP between 2012 and 2015. For the first 2 seasons of the study a physician made all RTP decisions.
- During the study 119 concussions were identified and followed, with an overall detection rate of 4.3 per 1000 athlete-exposures during the 4-year period. Only 1 SSR was documented following clearance by the physiotherapist. The overall SSR rate of 0.8% was relatively low compared with results from previous studies.
- The protocol that was used resulted in the safe management of concussions whether RTP decisions were made by the team physician or the physiotherapist, suggesting a collaborative, multidisciplinary approach to concussion management may help achieve a more efficient use of health care resources.

Assessment of a collaborative concussion management strategy in a school-based sport program

Prospective cohort study

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Abstract

Objective To analyze the implementation of a concussion management protocol in which a team physiotherapist is involved in the identification of concussions and return-to-play (RTP) decisions.

Design A prospective injury surveillance cohort study in a school-based Canadian football program (4 teams; grades 8 to 12) over 4 years. For years 1 to 2, the team physician made all RTP decisions; over years 3 to 4, the team physiotherapist was allowed to make some RTP decisions using pre-established criteria defined in the protocol.

Setting A high school in Québec, Que.

Participants Male student athletes between 11 and 17 years old.

Main outcome measures Same-season recurrence (SSR) of concussion symptoms following RTP.

Results A total of 119 concussions were identified (55 during the first 2 years and 64 during the last 2 years) during 27,741 athlete-exposures in 672 athlete-years for an incidence rate of 4.3 per 1000 athlete-exposures. During years 1 to 3, no SSR was observed following RTP clearance. During year 4 there was 1 case of SSR that occurred 11 days after clearance. The overall SSR rate of concussion symptoms following RTP clearance was 0.8%.

Conclusion A very low rate of SSR was achieved whether the team physician made all RTP decisions or the team physiotherapist was allowed to make some of the RTP decisions through the terms of the protocol.

Évaluation d'une stratégie de prise en charge collaborative des commotions cérébrales dans un programme de sport scolaire

Étude prospective de cohortes

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Résumé

Objectif Analyser la mise en œuvre d'un protocole de prise en charge des commotions cérébrales selon lequel le physiothérapeute d'une équipe participe à la détection des commotions cérébrales et aux décisions sur le retour au jeu (RAJ).

Type d'étude Une étude prospective de cohortes sur la surveillance des blessures dans un programme scolaire de football canadien (4 équipes; de la 8e à la 12e année), sur une période de 4 ans. Durant les années 1 et 2, le médecin de l'équipe prenait toutes les décisions sur le RAJ; durant les années 3 et 4, le physiothérapeute de l'équipe avait l'autorisation de prendre certaines décisions sur le RAJ en fonction de critères préétablis, définis dans le protocole.

Contexte Une école secondaire à Québec (Québec).

Participants Des étudiants athlètes masculins âgés de 11 à 17 ans.

Principaux paramètres à l'étude La récurrence durant la même saison (RMS) des symptômes de commotion cérébrale à la suite du RAJ.

Résultats Au total, 119 commotions cérébrales ont été recensées (55 durant les 2 premières années et 64 durant les 2 dernières), au cours de 27741 expositions par des athlètes en 672 années-athlètes, ce qui représente un taux d'incidence de 4,3 sur 1000 expositions-athlètes. Durant les 3 premières années, aucune RMS n'a été observée à la suite de l'autorisation d'un RAJ. Durant la 4e année, 1 cas de RMS des symptômes s'est produit 11 jours après l'autorisation. Le taux global de RMS des symptômes de commotion cérébrale après l'approbation du RAJ était de 0,8 %.

Conclusion Le taux de RMS des symptômes a été très bas, que le médecin de l'équipe prenne toutes les décisions sur le RAJ ou que le physiothérapeute soit autorisé à prendre certaines décisions sur le RAJ, en fonction des critères du protocole.

Points de repère du rédacteur

- Les recommandations bien établies pour la prise en charge des commotions cérébrales liées aux sports stipulent que les personnes doivent être évaluées par un médecin ou un professionnel de la santé autorisé, mais l'accès à des experts compétents en temps opportun peut être problématique dans la plupart des sports de compétition qui ne sont pas au niveau des sports d'élite.
- Dans une école secondaire à Québec (Québec), on s'est demandé si le fait qu'un physiothérapeute prenne certaines décisions concernant le retour au jeu (RAJ) des membres de l'équipe de football (joueurs âgés de 11 à 17 ans) au lieu d'un médecin avait une influence sur la récurrence durant la même saison (RMS) des symptômes de commotion cérébrale, et ce, entre 2012 et 2015. Durant les 2 premières saisons de l'étude, un médecin prenait toutes les décisions sur le RAJ.
- Au cours de l'étude, 119 commotions cérébrales ont été recensées et ont fait l'objet d'un suivi, ce qui représente un taux de détection global de 4,3 sur 1000 expositions par des athlètes durant la période de 4 ans. Seulement 1 RMS des symptômes a été documentée à la suite de la décision du RAJ par le physiothérapeute. Le taux global de RMS des symptômes de 0,8 % était relativement faible par rapport aux résultats d'autres études.
- Le protocole utilisé s'est traduit par une prise en charge sécuritaire des commotions cérébrales, que les décisions sur le RAJ soient prises par le médecin ou par le physiothérapeute de l'équipe, ce qui fait valoir qu'une approche collaborative multidisciplinaire de la prise en charge des commotions cérébrales pourrait contribuer à une utilisation plus efficace des ressources en soins de santé.

In a 2017 position statement on concussion, the College of Family Physicians of Canada indicated that family physicians should work with families, schools, and sports organizations to support and empower the implementation of proper concussion management strategies.[1] In 2014 the Canadian Concussion Collaborative also suggested that if improved concussion management outcomes are expected, then multidisciplinary participation in decision making under medically supervised concussion management protocols is a desirable and acceptable option.[2] At the time of that recommendation and throughout this study, no new concussion legislation was introduced in Canada and recommendations from various professional organizations revealed controversy about the role of different health care providers in concussion detection and management.[3-6]

More recently, the 2017 Consensus Statement on Concussion in Sport recommended that in all suspected cases of concussion, the individual should be assessed by a physician or a licensed health care provider and that participants should obtain medical clearance prior to participation in full-contact training activities.[7] In professional, varsity, and high-level elite sport, having timely access to qualified medical experts is usually not a problem. However, in earlier levels of competitive sport it remains a challenge in most environments.

Considering that the goal of concussion management is to recognize and properly react to a concussion and subsequently to avoid premature return to play (RTP),[8] outcomes that document the player's actual capacity to resume participation safely without re-injury should be used. However, the concussion literature reporting such outcomes is scarce. In 2 studies, a rate of 3.8% repeat concussion in the same sports season was documented in both high school and college sports.[9,10]

The objective of this study was to document the incidence of concussion and the same-season recurrence (SSR) rate following RTP in a school-based Canadian football (called *football* hereafter) program. In 2014, following the publication of the Canadian Concussion Collaborative recommendation,[2] the concussion management protocol was modified to allow participation of the team physiotherapist in some RTP decisions based on pre-established criteria. That change allowed a comparison of the 2 strategies over the 2 subsequent seasons.

— Methods —

This prospective, injury surveillance, observational cohort study took place over 4 seasons (2012 to 2015) in a school-based football program. This school has 4 teams (with male athletes in grades 8 to 12) that participate in a 3-month autumn schedule. The school employed a physiotherapist (E.C.) with 3 years' experience as a football therapist at the beginning of the study. The physiotherapist was present during games, contact practices, and twice during weekdays for follow-up of injuries. One physician (P.F.) with 16 years' experience as a sport medicine doctor at the beginning of the study was involved, as described below, for medical decisions.

The study was initiated in 2012 and the protocol was modified in 2014 (**Figure 1**) to define criteria allowing the team physiotherapist to make some RTP decisions (**Box 1**).[3,11] This study was authorized by the school board of the Académie Saint-Louis, a high school in Québec, Que. Informed consent was obtained yearly from a parent of each participant.

The identification of a suspected concussion[3] by the physiotherapist using the Sport Concussion Assessment Tool, version 3 (SCAT3),[12] was considered a case of concussion for the purpose of this study. *Same-season recurrence,* the primary outcome of this study, was defined as the recurrence of any sport-related concussion symptoms, during the same season of competition, after a participant who sustained a first concussion was cleared for unrestricted training.

A protocol based on the 2012 Consensus Statement on Concussion in Sport was implemented and reviewed on a yearly basis.[3] Baseline measures with the SCAT3 and a computerized neuropsychological test (CNT) battery were obtained prior to each season. The school decided to pay for and use a CNT in its concussion management protocol prior to the initiation of this study.

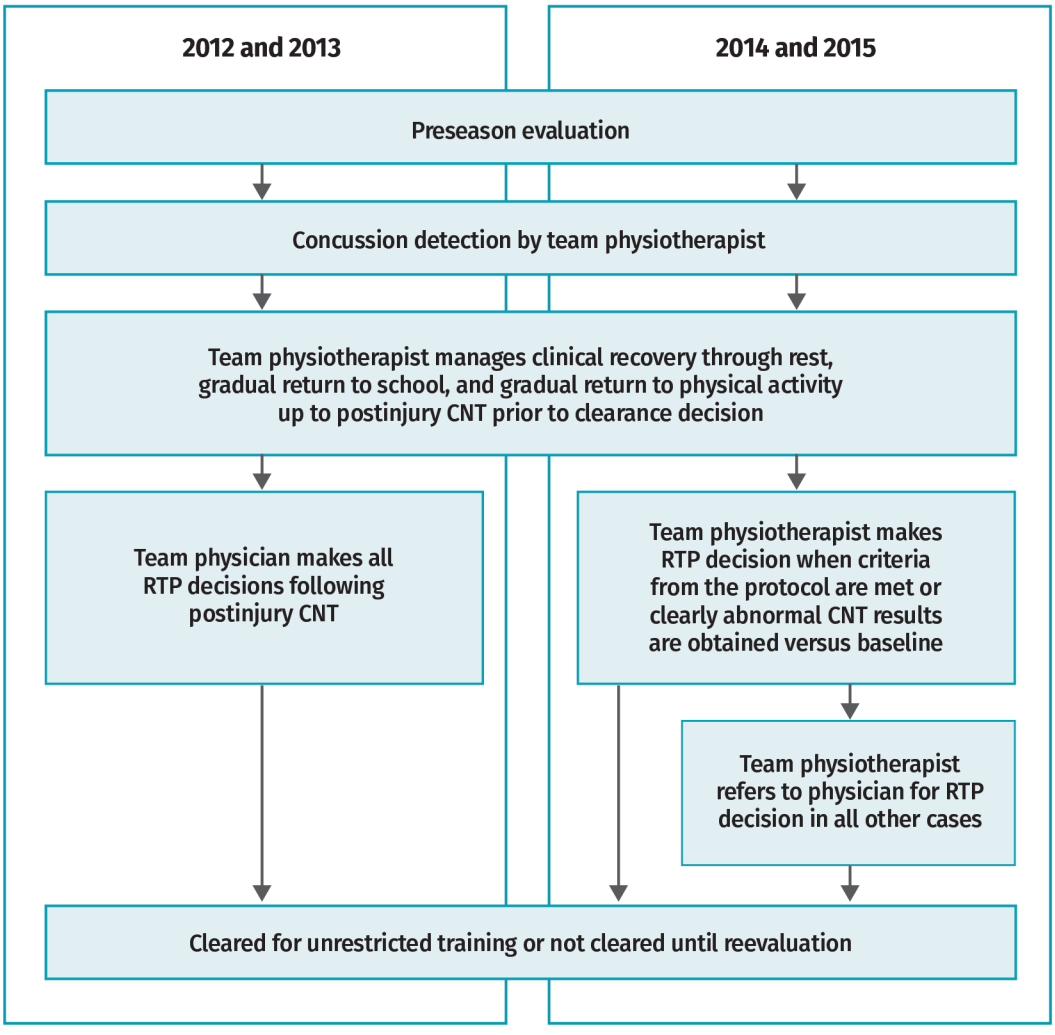
In circumstances suggesting the possibility of a concussion, the physiotherapist proceeded with a sideline assessment to document the presence of signs or symptoms of a possible concussion using the SCAT3.[12] In the absence of red flags, the physiotherapist initiated the protocol while monitoring for potential deterioration. If there was no deterioration, a systematic initial medical assessment for the sole purpose of diagnosis was not required.

Following initial rest until complete symptom resolution, players' progression through the return-to-learn (RTL) and RTP strategies was coordinated by the physiotherapist with the collaboration of the school and football program staff. *Clinical recovery* was defined as having complete resolution of symptoms, returning to full-time school participation without symptoms, being able to participate in a full session of non-contact training drills including high-intensity endurance and resistance exercise without recurrence of symptoms, and having a normal neurologic and cervical spine assessment. Return-to-play decisions were considered only once the therapist documented clinical recovery and obtained a postinjury CNT.

Protocol change

During the first 2 years of the study the physician was systematically solicited for all RTP decisions, and in 2014 the protocol was modified (**Figure 1**) to include the criteria (**Box 1**)[3,11] that allowed the physiotherapist to make some independent RTP decisions. When solicited, the

Figure 1. The RTP decision strategies used in the 2012 and 2013 seasons and in the 2014 and 2015 seasons



CNT—computerized neuropsychological test, RTP—return-to-play.

physician reviewed the file within 72 hours and provided an RTP decision while indicating whether an appointment for a medical assessment was needed. The physician could also be solicited at any time if symptoms increased or a failure to progress gradually toward the clinical recovery criteria was observed.

The physiotherapist used an injury tracking form (pen and paper) to record the injury date and context (game, training, other) and the dates of the following events: symptomatic recovery, full-time school participation, non-contact training without recurrence of symptoms, and RTP decisions. Descriptive data and qualitative analyses are presented owing to the low incidence of the primary outcome (SSR). The secondary outcomes that could be documented with the injury tracking form were concussion incidence rate per 1000 athlete-exposures (AEs) during a game or contact training session, and influence of the CNT result on the initial RTP decision and on the delay until RTP clearance. No adjustment was made for missed games or training sessions by individual players, so the total AE numbers are slightly overestimated, thereby resulting in a slight underestimation of the incidence rate of concussion.

To assess the impact of the protocol used during the 2014 and 2015 seasons on the use of medical health care resources, the proportions of decisions made by the physiotherapist and physician were also analyzed as a secondary outcome. The influence of the CNT component of the protocol was assessed at the time of clinical recovery by calculating the proportion of cases where the CNT component of the protocol contributed to a negative RTP decision.

Box 1. Criteria used during the 2014 and 2015 seasons for independent decisions by the team physiotherapist regarding clearance for unrestricted training

Pretest criteria:
- Complete asymptomatic return to school without accommodation
- Asymptomatic participation in non-contact training drills and high-intensity endurance and resistance exercise
- Valid baseline CNT result available
- Less than 14 days since injury (for favourable clearance decision)*
- No prior concussion during the same season†

Posttest criteria:
- Postinjury CNT results within 5% or above baseline score expressed in percentile of normative data
- Symptom scale evaluation result is not higher or qualitatively different from baseline when reassessed at the end of the postinjury test

CNT—computerized neuropsychological test.
*Criterion established based on the notion that 80% to 90% of concussions clearly improve in a short (7- to 10-day) period and that it may be longer in children and adolescents.[11]
†Criterion based on the need for medical assessment to consider factors related to the history of concussion[3] in such situations.

— Results —

Over the 4-year period there were 672 participant-years (11 to 17 years old) involved in a total of 27,741 AEs, and a total of 119 concussions were identified and followed until the end of each competitive season (**Table 1**). The overall concussion detection rate was 4.3 per 1000 AEs over the 4 seasons. During the first 2 seasons, when a physician was involved in all decisions, no SSR was observed. During the 2014 season, 1 recurrence of symptoms unrelated to football occurred prior to clearance. During the 2015 season, 1 case of SSR occurred 11 days following an RTP clearance made by the physiotherapist, for an overall SSR rate of 0.8%.

The mean (SD) time between injury and clinical recovery was 22.7 (17.9) days. At the time of clinical recovery, when the first RTP decision was made, the results of the CNT contributed to a negative RTP decision in 67% of cases (**Table 1**). The mean (SD) time between injury and RTP clearance was 28.0 (17.9) days. Clinical recovery criteria were documented within 14 days in 52% of cases. During the 2014 and 2015 seasons of this study, 68% of all decisions and 59% of favourable clearance decisions were made by the team physiotherapist (**Table 2**).

— Discussion —

The concussion incidence rate observed over the 4 seasons of this study was more than 6 times higher than the highest incidence rate reported between 1999 and 2012 in high school football injury reports.[5] A study of women's varsity hockey also suggested that, in an environment highly aware of concussions, the prospective identification of concussions can increase by more than 5 times compared with injury report data.[13] More recently, data from the National Collegiate Athletic Association Injury Surveillance Program from 2009 to 2014 documented a rate of 3.45 per 1000 AEs in Division I college football in the United States.[14] Overall, increased awareness of concussion has been associated with significantly increased concussion rates in several sports[15] and in clinical settings (emergency department and office visits).[16] Considering that the signs and symptoms of a concussion are nonspecific,[7] it can be argued that the clinical presentations increasingly identified as "concussions" may not actually be concussions (eg, headache of cervical origin or from dehydration). However, from a clinical perspective, when the safety of young athletes is the objective, having a highly sensitive and less specific case definition is certainly desirable. Also, in our study, the fact that only 52% achieved clinical recovery within 14 days suggests the case definition used in this study allowed us to identify more clinically significant injuries.

Out of the 119 concussion episodes documented in this study, a single case of SSR was observed and the subsequent evolution was favourable. The 0.8% SSR rate reported is lower than the 3.8% SSR rate reported in 2 previous studies.[9,10] Factors that could explain this difference are the time to RTP clearance and the detection rate. The protocol used in this study resulted, on average, in a 28-day period prior to RTP clearance compared with 7.1 days and 12.3 days in both prior studies that involved mostly high school athletes (more than 60%).[9,10] Together, the high detection rate (4.3 per 1000 AEs) and the relatively long time to recovery observed in this study might have indicated the relative safety of the protocol through the early identification and proper management of a higher number of less serious concussions. This supports the hypothesis that a high level of awareness can contribute to the prevention of more severe concussions. However, even if the results suggest that a good level of awareness was achieved, the subjective nature of concussion symptoms does not allow us to exclude the possibility that under-reporting may have contributed to the low rate of SSR observed.

An increasing number of competitive sports settings already invest resources to ensure the presence of a licensed sports physiotherapist. Involving these professionals in concussion management is a potentially effective approach in terms of timely availability, safety, and cost. The protocol used in this study allowed the team physiotherapist to safely make more than 2 out of every 3 decisions about RTP clearance, providing data in support of this more efficient use of health care resources. These results support the recommendation to

Table 1. Concussion detection rate, SSR, and delayed RTP at the time of first RTP decision over 4 seasons of competition: *Overall delayed RTP based on first CNT results is 67%, and the overall percentage of SSR of symptoms is 0.8% (1 of 119).*

TEAM	AGE, Y	WEIGHT RANGE, KG	AVERAGE WEIGHT, KG	NO. OF PLAYERS	NO. OF GAMES	NO. OF PRACTICES	NO. OF CONCUSSIONS	CONCUSSION RATE PER 1000 AEs	DELAYED RTP BASED ON FIRST CNT RESULTS, n/N	NO. OF SSR CONCUSSION SYMPTOMS
2012*										
• Atom	11-12	29-82	48	41	6	23	1	0.8	0/1	0
• Cadet B	13-14	40-100	56	31	8	39	1	0.7	1/1	0
• Cadet	13-14	47-103	65	34	7	33	6	4.4	3/6	0
• Juvenile	15-17	56-122	80	57	12	51	15	4.2	11/15	0
• Total	11-17	29-122	64.2	163	33	146	23	3.0	15/23	0
2013*										
• Atom	11-12	32-93	53	38	7	25	5	4.1	4/5	0
• Benjamin	13	30-82	53	37	7	25	7	5.9	3/7	0
• Cadet	13-14	40-102	66	33	8	25	8	7.3	7/8	0
• Juvenile	14-16	55-128	80	63	11	50	12	3.1	6/9	0
• Total	11-16	32-128	65.5	171	33	125	32	4.4	20/29	0
2014†										
• Atom	12-13	34-83	53	42	8	24	7	5.2	5/7	0
• Benjamin	13-14	34-100	59	38	8	24	7	5.8	4/6	0‡
• Cadet	14-15	32-86	60	33	8	25	9	8.3	6/9	0
• Juvenile	15-17	55-129	74	50	9	39	16	6.7	6/13	0
• Total	12-17	32-129	62.3	163	33	112	39	6.5	21/35	0
2015†										
• Atom	12-13	29-111	51	33	7	28	4	3.5	4/4	0
• Benjamin	13-14	40-90	59	42	7	28	4	2.7	1/4	0
• Cadet	14-15	43-111	66	42	7	28	9	6.1	7/9	0
• Juvenile	14-17	55-134	76	58	9	37	8	3.0	6/7	1
• Total	12-17	29-134	64.8	175	30	121	25	3.7	18/24	1
Total for seasons 2012-2015	11-17	29-134	64.2	672	129	504	119	4.3	74/111	1

AE—athlete-exposure to a game or contact practice, CNT—computerized neuropsychological test, RTP—return to play, SSR—same-season recurrence.
*All RTP decisions were made by the team physician.
†RTP decisions were made by the team physiotherapist or team physician.
‡One case of concussion symptom recurrence occurred prior to medical clearance in this group owing to an accident unrelated to football; therefore, that case did not meet the pre-established criteria for SSR.

Table 2. Proportion of RTP decisions made during the 2014 and 2015 football seasons by the physician and physiotherapist when the protocol allowed RTP decisions by the physiotherapist: *A total of 111 decisions (60 no-RTP decisions and 51 favourable decisions allowing RTP) were made regarding the 64 concussions detected. The decisions made after the end of the competitive season, including 13 favourable RTP decisions, are not included in this table.*

TYPE OF DECISIONS	TOTAL	INDEPENDENT DECISIONS MADE BY PHYSIOTHERAPIST, N (%)	DECISIONS MADE IN COLLABORATION WITH PHYSICIAN, N (%)
All clearance decisions (favourable or not)	111	75 (68)	36 (32)
Favourable clearance decisions	51	30 (59)	21 (41)

RTP—return to play.

use collaborative multidisciplinary approaches[2] that can optimize the efficient and timely use of medical assessments for concussion.[17]

The use of baseline tests in adolescents is controversial and recommendations about their use are evolving.[18,19] The fact that the CNT result consistently contributed to a negative RTP decision in 2 out of 3 cases suggests that the variables assessed by this measure may be more sensitive to residual subclinical impairment than the variables used to determine clinical recovery.

Strengths and limitations

A strength of this study is the clinical relevance of SSR as a primary outcome. However, the fact that only 1 SSR occurred in this study indicates that it was underpowered. Also, the use of a prospective cohort design might have resulted in a gradual cultural shift and an increased awareness of concussion during the study. In future studies, clustered randomized controlled trials should be used to compare different concussion management strategies.

Conclusion

Using a protocol based on the recommendations of the consensus statements on concussion in sport,[3,7] the safe management of concussions was achieved whether a team physician made all the RTP decisions or the team physiotherapist made most of the RTP decisions. The low SSR rate observed in this study will help define a comparative reference for future studies on the safety of RTP strategies following sport-related concussions.

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Contributors

All authors contributed to the concept and design of the study, data analysis and interpretation, and preparing the manuscript for submission.

Competing interests

Francesco Pepe Esposito and **Edith Castonguay** were paid employees of Académie Saint-Louis at the time of the study.

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