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The Interval Kicking Program (IKP) as a Reprogramming Technique for the Soccer Player in an Anterior Cruciate Ligament (ACL) Rehabilitation: A Technical Report

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SUMMARY

Introduction. We can state as technical-athletic gestural movements that we might call clinical (pivoting, cutting maneuvers, sidestep cuts, changes of direction) associated with ACL injuries.

Objective. This technical report was conducted to research methods of reprogramming basic technical skills in the soccer player after anterior cruciate ligament reconstructive surgery.

Technical report results. The Interval Kicking Program (IKP) is a model proposed as a neuromotor remodelling of basic gestures and techniques after an ACL injury in soccer player. The teaching progression is ordered regarding the diversified techniques of passing and receiving the ball. The volume, intensity, and progression steps are governed by 1) clinical status (*i.e.*, type of injury, conservative/surgical treatment type, type of sport), 2) performance status, and 3) objective evaluative analysis of periodic follow-ups. The steps provided by the IKP can be 15 and end with the introduction of the player into technical drills with the presence of opponents the first sessions include about 30 minutes of sport-specific, low-intensity exercises, while in the last ones, the volume remains constant, but the intensity and technical complexity of the movements increase.

Conclusions. In this technical report, we have highlighted how IKP can be a teaching model for reprogramming basic technical skills in the soccer player after injury. It remains fair to point out how aberrant technical movement partners, side-to-side asymmetries, and postural dysfunction are predictive of the risk of compliance and second injury. Further studies and insights are needed to customize the reprogramming of the soccer player's gestural movements during return to play.

KEY WORDS

Interval kicking program; kicking load; return to sports; groin pain; soccer kicking.

INTRODUCTION

High axial and torsional loads applied to the knee joint during soccer-specific gestures such as side-step cutting plant-and-cut manoeuvres, change of directions, and landing actions are movements associated with injuries from noncontact of the anterior cruciate ligament (ACL).

The overall incidence rate of ACL injuries in the Italian Serie A league was 0.062 per 1,000 hours, with the risk 14 times higher

in games than in training. Specifically, 25% were second injuries (1). Most of the injuries occurred in October and March. The incidence rate and percentage were almost doubled in the teams ranked in the top 4 positions of the league (2).
Wiggins *et al.* (3), in a systematic review and meta-analysis, show that the percentage rate of re-injury related to second ACL injuries is 15% (with an ipsilateral re-injury rate of 7% and a contralateral rate of 8%). Side-to-side asymmetries, dysfunctions/postural present in athletes who have returned to the sport are at high risk of injury, especially ipsilateral muscle or contralateral limb injury. Thus, technical gesture/postural asymmetries significantly elevate the risk factors for a second ACL injury (4).
Anterior cruciate ligament reconstructive surgery is a common treatment for athletes after ACL injury. Incidence of these noncontact/contrast injuries seems to be higher among young athletes who participate in sports defined as "pivoting", such as soccer (5).
Return to Sport after ACL injury is a rigorous and objective complex process. The post-surgical objective remains the constant search for the perfect balance between the healing process, the development of biomechanical/motor expressive qualities, and optimal performance achievement (4-6). This process requires interprofessional cooperation to ensure the optimal outcome and guarantee the continuation of the sports career.
Communication regarding the interactions of scientific knowledge among various professionals is critical for optimizing outcomes. According to a widely accepted guideline, return to full activity should not be allowed until six months after surgery; however, a range of 4.1-8.1 months has been reported for return to sport (7).

THE TECHNICAL AND TACTICAL PROCESS IN THE RETURN TO SPORT

In soccer, general tactics imply a permanent interrelationship between patterns of play that are intercalated between defensive and offensive phases with dynamic interactions between teams to control space and time (8).
Tactical variability in-game models arise from the modes in which players and teams manage the constraints that emerge from their cooperation-opposition-behavior and situational variables such as the status of the match, the quality and identity of opposing teams' individual technical skills.
For coaches, tactical modulation provides an opportunity to identify match variables and the random and unpredictable characteristics of the game according to the alternation between offensive/defensive possession/non-possession phases (9). Technical/tactical soccer drills occupy the majority of training sessions probably because of their direct relationship to match success.
Sarmento *et al.* (10) further emphasize that analysis of ball possession duration is necessary in order to contribute to a greater understanding of overall team performance. Studies have shown that long ball possession, in the pre-offensive and ultra-offensive phases, gives greater positive results in successful situational moments. For Barreira *et al.* (11), the interpretation of behavioral information about the organizational pattern of play is crucial, as the tactics and strategies of team sports attempt to anticipate, at various levels of the field, the opponent's offensive and defensive actions.
The defensive system is related to the construction of the offensive phase, arguing that good defence is the best basis for the optimal construction of offensive actions. Of course, reading performance data is crucial to achieving individual and team effectiveness because this is formed as a fundamental evaluative criterion for the tactical development process.
In line with this perspective, an organizational model is outlined using defensive and offensive dynamics according to the various phases of the game. The strategies and tactics of modern soccer are more focused on aspects in the defensive zone, even though the level of lines to win the ball back has shifted to the offensive and ultra-offensive zones.
Soccer communication is represented by the dynamics of passages between one player and another. These constitute a network of dynamic systems composed of articulated and interactive units that enable the identification, quantification, and evolution of play over time and space, taking into account stochastic processes combined with the complexity of analysis typical of the technical and tactical organization of a team. In this context, the individual action of each player must coordinate with that of others, harmonizing into common team goals collectively expressed by tactical symmetries having as their goal the successful offensive or defensive action.
It is evidenced by how the ball-carrier, with all its acquired technical skills, interacts through passes and actions establishing between them in a communication a chain unique in the development of the game in its offensive phase and contraposition through a series of positionings search and recovery of the ball in the various areas of the field of play (12). This dynamic conception of tactics and the remodelling of basic techniques must be transferred within the Late-Stage Rehabilitation and Return-to-Sport (RTS) of the soccer player after ACL reconstructive surgery (4, 12). The return to sport decision-making process of the injured athlete must therefore include pre-injury technical/tactical and sport-related performance levels achievement (13).

PREDICTIVE FACTORS OF RE-INJURY DURING RETURN TO SPORT

Prominent risk factors for primary ACL injury are female sex, increased joint laxity as well as aberrant neuromuscu-

lar and biomechanical movement patterns, such as deficits in neuromuscular control of the trunk and lower extremity and higher ground reaction forces during landing as well as valgus movements during specific technical and tactical gestures (5, 6, 12).

We emphasize as dysfunctional postural frameworks are present during the return to sport after anterior cruciate ligament reconstruction (ACLR). These dysfunctional frameworks must be resolved before the return to the remodelling of soccer techniques and tactics. Symmetrical gestures associated with movement quality are now crucial elements in preventing any contralateral *vs* ipsilateral second injuries or muscle complications during the return-to-sport process (4-6, 12).

The rate of ACL secondary injury in professional soccer players is high (6, 13), affecting nearly one in five players in an average of 5 years. A second ipsilateral or contralateral knee injury in young athletes could be as high as 40%, with a higher incidence of reconstructive surgery of the contralateral ACL than the revision of the ipsilateral ligament. Thus, it is possible to state that the young, active athlete (< 20 years) who resumes activity after ACLR has an increased risk of sustaining a second ACL injury. Injury rates in this young cohort of up to 23-29% have been reported in the literature (6, 13). It is recognized that injury to the ACL can influence qualitative technical expressivity of movement, stabilization of the lumbopelvic complex, and side-to-side asymmetries (4).

These present in the last step of sport rehabilitation can greatly elevate the risk factors of re-injury or complications specially referred to as overuse pathologies. It is argued that observation and data analysis is needed not only to improve team strategies but also the quality of training and decision-making related to returning to sport after injury.

THE INTERVAL KICKING PROGRAM (IKP): ANALYSIS OF PASSES DURING THE SOCCER MATCH

Data analysis

The fundamental technical skills in the game of soccer are developed over time through educational progressions that have as their objectives the structuring, improvement and refinement of the fundamental motor prerequisites for acquisition of the various soccer expressivity.

Basic technical performance depends on the speed and accuracy of the ball kicked. Although accuracy is an important factor, technical performance (passes the ball) in soccer has been evaluated predominantly by the maximum speed of the ball. Therefore, assuming that passing is accurate, the chance of scoring increases with higher ball speed (14). Factors contributing to maximum ball kicking speed include age, gender, limb dominance, football practice time, level of competition, and playing position (14).

Information on basic technical skills is crucial for achieving individual and team tactical effectiveness because it is a fundamental criterion for the process of soccer training. A greater understanding of the results of data analysis of professional soccer can enable progressive program prescriptions on the return to technical and tactical skills after anterior cruciate ligament reconstruction that fall under recovering sport-specific function and return to play. Thus, these further highlightings how knowledge of the volume and intensity of passes required during competition is essential for basic technical reprogramming after ACL injury (**figures 1-3**).

In the 4 major European soccer leagues, the numbers of successful/completed passes were (Sports Reference LLC (based in Pennsylvania)) (14):

1. Serie A Championship 2021-2022, the total completed passes were 291,895 of which: 1) short: 131,724; 2) medium: 131,724; 3) long: 32,355; and 4) with crosses in the area that were 1,519.
2. Premier League Championship 2021-2022, the total passes completed: 297,456; of which: 1) short 137,468; 2) medium 121,829; 3) long: 29,065; and 4) with crosses in the area that were 1,394.
3. LaLiga Championship 2021-2022, the total passes completed: 277,891 of which: 1) short: 125,096; 2) medium: 110,393; 3) long: 32,889; and 4) with crosses in the area that were 1,617.
4. Bundesliga Championship 2021-2022**,** the total passes completed: 200,220 of which: 1) short: 84,339; 2) medium: 87,842; 3) long: 22,975; and 4) with crosses in the area that were 1,236.

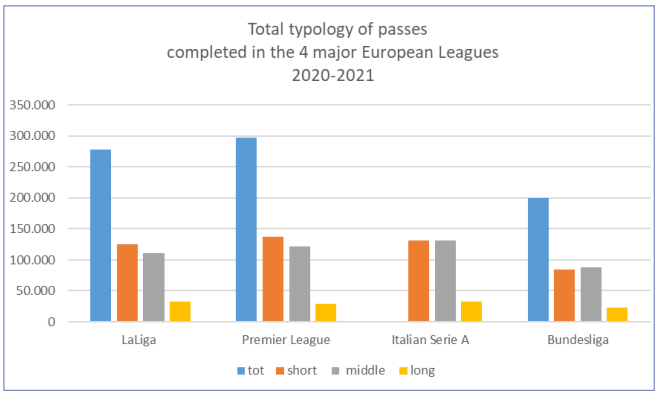

Figure 1. Total type of passes completed in Major European Soccer Championships 2021-2022.
Sports Reference LLC (based in Pennsylvania) (14).

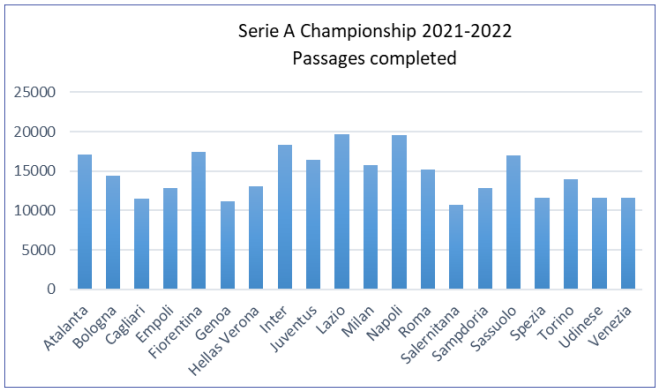

Figure 2. Total passes completed by the team in the Italian Serie A Soccer League 2021-2022.
Sports Reference LLC (based in Pennsylvania) (14).

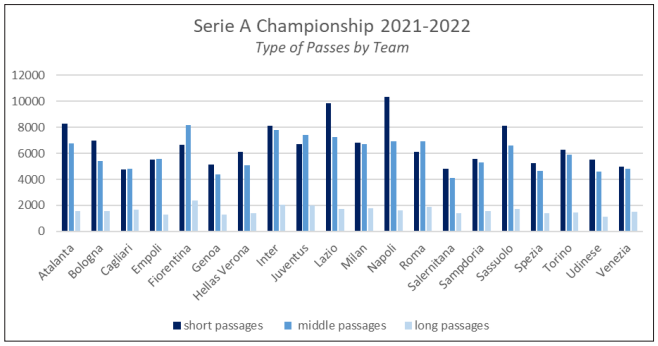

Figure 3. Total type of passes completed by the team in the Italian Serie A Soccer League 2021-2022.
Sports Reference LLC (based in Pennsylvania) (14).

These data should be considered in structuring a rehabilitation protocol and subsequent remodelling of technical skills after ACLR and in contralateral *vs* ipsilateral second injury prevention. The study of biomechanics (15), pathological framework, rehabilitation process and total kicking load is fundamental knowledge to remodel the structuring of technical skill recovery. The possible link and/or correlation between the post-injury resumption of technical skills, such as groin pain (16), psoas syndrome, and abnormal activity of hip adductor muscles, has been suggested (13, 16, 17).
In soccer players, abnormal technical movements and structural asymmetries post anterior cruciate ligament reconstruction (4, 13) have been proposed as risk factors for adductor muscle injuries (up to 63% in soccer) (18) and groin pain. During rehabilitation process, a gradual and progressive re-introduction of kicking load of basic technical skills is considered a dogma of clinical reasoning (19).

THE INTERVAL KICKING PROGRAM (IKP)

The Interval Kicking Program (IKP) (20) is designed to restore movement, strength and technical confidence in the soccer kick after injury or surgery by increasing kicks and intensity. Thus, the IKP is designed to restore specific gestures and technical skills after ACLR. Therefore, the educational progression concerns the diverse passes techniques defined by Whiteley (20) in: (a) short (0-12 meters), (b) medium (12-30 meters), and (c) long (> 30 meters).
The volume, intensity, and various advanced steps are regulated depending on the type of injury, conservative and/or surgical treatment type, clinical and rehabilitation status, the result of periodic clinical follow-ups, sport type, the role occupied on the playing field, the amateur or professional category, the status of the process of return to sport, and the multidisciplinary decision making.
The sport-specific loads scheduling stems from the functional responses and adaptations that each footballer achieves, as suggested in the literature (21).
The steps provided by the IKP can be 15 and end with the introduction of the player into technical drills with the presence of opponents (21): the first sessions include about 30 minutes of sport-specific, low-intensity exercises, while in the last ones, the volume remains constant, but the intensity and technical complexity of the movements increase.
To encourage an alternation between specific and general loads, the sessions can be completed with aerobic or anaerobic exercises depending on the recovery phase and the soccer player condition.
In the last steps of the IKP, it could be useful to characterise these supplementary exercises (aerobic or anaerobic) in relation to the player's role.
The resumption of technical skills should be proposed when: 1) side-to-side symmetry balances of strength and flexibility, 2) sport-specific gestural quality and symmetry, and 3) postural and neuromuscular expressiveness consistent with sport-related movements.
It is appropriate to emphasize how aberrant movement partners during on-field ACL rehabilitation (4) are predictive of the risk of a second ACL injury during return to full competitive sports activity (5, 6, 12, 13).
The didactic progression of the applicability of IKP (20) should be individualized and based on clinical assessment and pain monitoring that will determine an appropriate Kicking Load to promote modulated and symmetrical joint loading aimed at reducing complications and abnormal compensatory movement partners.
In IKP, muscle strengthening, plyometrics, and neuromuscular control exercises should be performed on alternate days for cardiovascular training and core stability (20). IKP should be initiated only when an athlete has been cleared to

resume running, torsional movements, and changes of direction and when no symptomatic picture, especially articular is evident at clinical follow-up.
Once an athlete has a correct gestural pattern in the execution of individual technique with the ball, you can proceed with applied technique drills (**table I**) or individual tactical drills in the two phases of the game possession, and non-possession of the ball.

Table I. The different types of Push Kicks that underlie the reprogramming of technical skills in the field.

Type of kick
The Push Kick
The Short Pass
The Long Pass
The Through Pass
The Cross Pass
The Chip Pass
Lob pass
Back pass
One-touch pass
Wall pass
Flick pass
Diagonal pass
Switch pass
Overlap pass

Next, one can re-modulate the situations of the two phases of play (possession and non-possession) so that one's performance gradually increases until an optimal return to full physical activity without restrictions.
Increasing the number of steps in an abnormal and unstructured manner during the return to the sport could increase risk factors for new injuries, from overuse, especially injuries to the long adductor (15-18). One must, therefore, be aware of the risk and refrain from suddenly increasing the amount and intensity of passes. In this way, you give the musculoskeletal system time to adapt, and you can avoid injuries that shorten your soccer career.

DISCUSSION

The primary objective of the last phase of the rehabilitation remains the constant search for the perfect balance between the healing process, the development of biomechanical and gestural expressive qualities, and the optimal reaching of performance.
It is fair to point out, however, that the criteria used to assess progress during the rehabilitation period are often vague, subjective and lack standardisation and consensus. Most rehabilitation protocols, with the consequent return to full sporting activity, involve assessing the status of the clinical/rehabilitation process with functional tests, which, however, have often shown poor predictive ability on return to sport decision-making and prevention of second ACL injuries (4-7, 13).
The return to full competitive activity after an ACL injury becomes a complex, rigorous and objective pathway that goes in a continuum up to full participation without restriction in soccer activity.
Decision-making purely based on time should be abandoned today. The return to full competitive activity without restrictions is characterised by reaching the pre-injury level of sports performance and implies a progression based on scientific criteria.
The literature (4, 5, 13) today indicates a dichotomy of subjective evaluations that do not include a scientific consensus exclusively based on objective criteria. The decision to allow an athlete to return to full-contact training sessions is multifactorial.
A qualitative assessment of a footballer's basic technical performance is crucial before he returns to full sporting activity after an ACL injury. Knowledge of an athlete's pre-injury technical skills and/or playing style is useful for assessing the quality of basic post-injury soccer gestural patterns.
It becomes evident how the analysis of the technical and tactical skills of a player who is about to resume training without restrictions is important to prevent abnormal and/or pathological compensatory postural patterns. This knowledge could be applied to the prevention of muscular injuries, especially of the long adductor (via Copenhagen adduction exercise (CAE)) (22) and (groin pain) (23).

THE LAST PHASE OF THE REHABILITATION: REMODELLING OF TECHNICAL AND TACTICAL SOCCER SKILLS

In the late phase (5-12 months after injury), technical and tactical skill training must be carefully structured within the return to sport process to decrease the risk factors for re-injury or muscle injuries.
Recently, the repetitiveness of the technical gesture in situational non-linear moments with complex gestures has been identified as the main mechanism of injury to both muscles (40%) and in particular to the groin region (24).
Thus, studying the influence of tactical patterns, match status, individual qualities of the opponent, and physical performance can provide minute information on the remodelling of the injured athlete's basic technical skills. This type of analysis is crucial for the clinician for evidence-based decision-making outcomes and objective testing.

Whiteley *et al.* (20) examined match analysis data for the entire 2012 US Major League Soccer season using both a distance- and speed-based approach. The author points out that distance- and speed-based approaches were not found to be equivalent, while the speed-based approach was found to be more representative of the real requirements of soccer technique.
In the study, the number and type of passing ((short (<10 m), medium (10 ≥ 30 m), long (>30 m)) executed in each category varied according to playing position as follows: the average for goalkeepers in a match is less than ± 60 kicks and for midfielders ± 120. Based on the average and the variance in the number of kicks, a technique reprogramming programme after ACLR is described.
Knowledge of individual data and position on the playing field allows us to structure a programme that describes the performance of technical skills re-modulation after ACLR with customisation.
In order to determine the loads for planning the re-modulation of the expressiveness of technical skills, it is, therefore, necessary to know the normal loads of both individual and team passing and shooting in the game. The volume and intensity of football activities correlate with an increase in injury risk factors.
From the analysis of the technical data of the competition, it can be deduced that players possess the ability to perform about 67% of the basic technical skill loads (passing) expressed during a complete match (20).
Again Whiteley *et al.* (20) conclude as the volume and intensity of passing shots in professional football are best described using a speed-based approach, with the workload of kicks varied according to playing position.
So, we can suggest, after a clinical-functional follow-up, gradually adding kicking load steps structured in the step 1 (67%), step 2 (80%), step 3 (95%), and step 4 (99%) of the maximum load of individually performed steps during a match. In contrast, a programme based on estimating the speed of kicking soccer balls requires more training education for the athlete than a simple distance-based programme.
According to Whiteley *et al.* (20), ball speed also depends on field position and tactical orientation: slow (0-6 m/s); medium (6-12 m/s); and fast (> 12 m/s). For the phase "slow", the ball should travel approximately 6 m (range between 1-12 m); "medium", the ball should travel approximately 18 m (range between 12-24 m); and "fast", the ball should travel more than 24 m (in 2 s) (25).
Relative to our experience, footballers have to go through a preparatory feedback period with a typical didactic progression: 1) sponge football, 2) plastic football number 5, 3) football number 3, 4) football number 4, and 5) football number 5. An erroneous didactic progression of the reacquisition phase of technical skills could increase the risk factors of new injuries, especially, in addition to the knee, of the hip and pelvic girdle anatomical district. Any restrictions in the mobility of the hip joint can contribute, during technical expressiveness, to overuse pathologies of the lumbopelvic complex on the one side and accelerate the degradation of the joint environment on the other side (4, 5, 13).
The IKP, as proposed in the literature, allows for the remodelling and re-training of gestural moments that can be linked to basic technical football skills (4). The reacquisition of these qualities is fundamental for the full restitution in integrum of the athlete in the competitive sporting activity. The strength expressions of the adductors and the range of motion of the hip have received particular scientific interest due to the repetitiveness of soccer gestures.
Studies (18, 26) have shown injuries to the adductor and quadriceps muscles in the dominant/kicking limb compared to the non-dominant leg. Bi-articular muscles, with a prevalence of type II muscle fibres (rectus femoris approx. 65%) (27), subjected to eccentric contraction, present a greater risk of injury during a technical gesture such as kicking the "ball off the instep". In this context, the rectus femoris is most frequently affected by injuries during incorrect technical activity (27).
Hiti *et al.* (28) showed that high eccentric loads during the swing phase of a technical fundamental, such as "push pass", exert repetitive overstress on the adductor muscles and the ischiopubic girdle with increased risk factors for new injuries in the athlete during the return to sport phase. It is, therefore, essential to remember that from the beginning of the swing phase of the kicking leg until the impact with the ball, the long adductor has an elongation of 22.3 ± 5.3 cm/s and the maximum hip extension (23.3 ± 8.80) occurs close to 40% of the swing phase (28).
Long adductor activation occurred between 10 and 50% of the swing phase. The maximum length of the long adductor occurred at 65% of the swing phase. The maximum hip abduction (25.3 ± 5.40) occurred at 80% of the swing phase. The long adductor appears to be at risk of stress injury during its transition from hip extension to hip flexion (29).
Watanabe *et al.* (30) studied the neuromuscular activation of the great and long adductor muscles during a kick to the ball of the instep and external instep in college students. Eight college soccer players performed the two types of soccer technique at 50%, 75% and 100% of maximum ball speed (30). Surface electromyography (EMG) was recorded from the great adductor, long adductor, vastus lateralis, and biceps femoris muscles of both kicking and supporting limbs of the kicking leg. In the kicking leg, an increase in EMG activity correlating with an increase in ball velocity during the instep kick was noted in the great adductor muscle but not in the vastus lateralis and long adductor and biceps femoris muscles.

Dupré *et al.* (16, 25) investigated the kinematics of the hip joint, especially the activity of the long adductor and the gracilis during the "push pass" transition. The strength of the gracilis muscle was 9% lower than that of the long adductor ($p = 0.005$). "Muscle stress", during the technical gesture, was 183% greater in the gracilis ($p = 0.005$).
Contraction velocity reveals an eccentric contraction of the gracilis in the last quarter of the swing phase. Considering the combination of eccentric contraction, high muscle stress, and the repetitive nature of the inside pass, the gracilis accumulates high loads in the game and training. These results indicate that the high incidence of groin injuries in soccer could be related to passing training.
It is evident (16, 25) that an overstress on the gracilis during a pass of the inside foot reaches up to 450 kPa (kilopascal - 4.5 kg/cm^2) and is correlated almost as much as a kick of the instep. Considering the repetitiveness of inside-foot and "push pass", the adductor muscles experience high loads in games and training. This could contribute to the explanation of the high incidence of adductor and rectus femoris injuries (25, 26, 29, 30).
An unstructured IKP can lead to a disabling musculoskeletal pathological condition for a future sports career. However, the evidence (13, 24, 25, 26, 29, 30), strongly suggests that the extent of kicking load plays a key role in musculotendinous and/or joint adaptation during the injured athlete's return-to-sport process.
For these reasons, great attention must be paid to motor load progression before the footballer is exposed to specific high-intensity sports exercises such as Small-Sided Games (SSG). These exercises are now widely used in soccer player training and constitute a significant moment in the RTS process of the injured athlete before participating in official competitions (31, 32).
The IKP model can be an effective tool for soccer-specific, intensity-controlled conditioning in the phase before the introduction of the athlete into SSG exercises with the various formats and training volumes.
In summary, ACL injuries occur with motion of the knee in all three cardinal planes of motion (33). Side-step cutting, jump, and cutting manouvre is an action associated in the soccer player with non-contact anterior cruciate ligament injury.
An anterior cruciate ligament injury can have implications for a soccer player's athletic career as well as have long-term consequences, such as the development of future knee osteoarthritis (34).
Anterior cruciate ligament reconstruction aims to restore normal knee joint function, stability and biomechanics (35). Return to sport after ACLR is an arduous decision-making process that needs to be structured based on shared and homogeneous scientific assessments. Periodic short- and long-term follow-ups should be included in the rehabilitation process to examine the impact of the injury on the return to sport. Side-to-side asymmetries of movement, and dysfunctional postural frames (36) after reconstructive acl surgery can delay the process of return to performance and be identified as risk factors for injury.
Careful planning, in the final phase of sports rehabilitation, of the recovery of basic technical skills and a re-analysis of postural/functional aspects during the rehabilitation and reconditioning phase, to optimize the return to performance levels prior to reconstructive surgery and reduce the risk of "compliance" and re-injury.
The evaluation of asymmetric movements related to football expressiveness, the choice of therapeutic exercises, as well as neuromuscular training programs (37) aimed at modulating adaptive valgus knee control (4-6, 13, 36) should be considered as an effective measure to study each athlete, returning from injury as an individual case.
Identifying modifiable factors predictive of a second cruciate ligament injury is necessary to effectively reduce the high risk of a second injury. This technical report indicates how reprogramming basic technical skills and quality of movement expressiveness with the interval kicking program can help the kicker return to the sport, more safely, and reduce the risk of "compliance" and reinjury (**table II**).

Table II. Final focus.

Considerations
• The IKP program describes clinical guidelines for beginning a basic technique program.
• The IKP gradually introduces a player to ball loading and impact.
• The program should be run every other day integrating therapeutic exercise and cardiovascular performance.
• The progression of re-modulation of basic technique can be structured either by increasing the distance (short, medium, long) of the passing or concerning the speed of the ball.
• We must not forget how ball speed is directly proportional to the effect of age, gender, dominant and non-dominant limb, training time, level of competition, playing position, playing field, different surfaces of foot contact with the ball, and with or without a previous run-up.
• The IKP should be individualized concerning the pathology, the evolution of the rehabilitation process, and/or past injury histories.
• Incorrect planning and structuring of the rehabilitative process and timing of the transitions phase, not based on scientific evidence, will result in increased risk factors of groin pain and muscular lesions at load, particularly regarding the long adductor and Femoro Acetabular Impingement (FAI) in young athletes for high impact gestures.

CONCLUSIONS

Injuries of the ACL in soccer can affect basic technical skills. The IKP model represents one of the strategies for re-programming basic soccer techniques. Progression can be structured either by increasing distance (short, medium, long) and passing techniques, or concerning the ball speed. This re-programming must be personalized and individualized after assessing the status from the clinical, rehabilitation status, performance, and the role occupied on the playing field. Incorrect planning of kicking load may correlate with over-stress, especially in the transverse plane on the hip joint and the muscles that insert on the pelvic complex and axial and torsional on the knee joint. This could explain the high rates of re-injury, groin pain and muscle injuries during football rehabilitation late-stage. Only after IKP, it is suggested that the injured player participates in high-intensity SSG exercises. Further studies and insights are needed to personalize the reprogramming of soccer gestural movements during on-field rehabilitation.

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None.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

RD: formulation of study idea, conceptualization, data collection and analysis, writing – original draft, literature revision and analysis. ARA, GA, IS, VM: supervision, writing – review & editing, final revision.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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