MEN'S LACROSSE PERFORMANCE ENHANCEMENT AND INJURY PREVENTION

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INTRODUCTION

Lacrosse is often referred to as the fastest game on two feet and is one of the fastest-growing sports in the United States with participation surging to 829,423 athletes across all competitive levels (23). Participation at the collegiate level across all divisions accounts for 43,228 athletes based on the most recent participation report by U.S. Lacrosse (23). Lacrosse gameplay dictates the inclusion of collision and contact engagements (5,11). However, non-contact injuries are sustained at all levels of play resulting in time loss from participation (13). Due to the nature of the high-velocity changes in direction and collision impacts commonly observed in men's lacrosse, time-loss injuries have been attributed to player-to-player contact, equipment contact, non-contact events, and deterioration due to chronic overuse of connective and contractile tissues (11,14,22).

Specific mechanisms of injury (MOI) have been outlined in collegiate men's lacrosse, with rates of injury predominately occurring during competition and in the lower extremities (14). Change of direction (COD) is a common MOI for non-contact knee ligament ruptures (22). As men's lacrosse requires repeated bouts of rapid and explosive COD, it has been indicated as a high-risk sport for anterior cruciate ligament (ACL) injuries sustained in non-contact events (11,22). Thus, it is imperative to develop programs that may reduce the risk factors influencing ACL injuries.

Presently, there is a paucity in the literature surrounding lacrosse-specific injury-prevention protocol data. Sports with similar physiological profiles to lacrosse have evaluated lower-body injury risk in trained athletes and may provide the context for the implementation of lacrosse-specific exercise-related injury prevention programs (ERIPP) (3,4,24). Recently, injury prevention protocols have been evaluated in elite-level soccer athletes, yielding successful reductions in hamstring injuries after adherence to a Nordic hamstring exercise (NHE) protocol (4). Nordic hamstring exercise protocols may be efficiently and effectively integrated into regular training sessions, requiring minimal time for completion (4). Lacrosse requires multiple acceleration and decelerations at low, moderate, and high intensities for COD during gameplay. Including the development of so-called "posterior chain musculature" (e.g., hamstrings, glutes) in collegiate lacrosse athletes may potentially assist in the reduction of non-contact hamstring and ACL injuries during competitive events (1,3,7,11,17).

Lacrosse-specific research has identified training components of periodized programming that influences performance and provides context for the reduction of injuries in college lacrosse athletes (5,21). Prevention programming yielding reductions in the incidence of injury has been assessed in soccer athletes and found to be beneficial (4,16,20). However, presently, there are no lacrosse-specific ACL injury prevention programs available in the literature. Therefore, the purpose of this article is to present a sample injury prevention program with a specific emphasis on lower body posterior chain development throughout competitive and non-competitive college lacrosse seasons. This will help provide a practical outline for generating daily training practices to assist in reducing the incidence of musculoskeletal and ligamentous injuries in college male lacrosse athletes.

ACL INJURY PREVENTION TRAINING STRATEGIES

Knee ligament internal derangements (sprains and ruptures) rank within the top three most common injuries sustained in collegiate lacrosse (18). Such injuries, specifically ACL injuries, typically require surgical intervention and rehabilitation for recovery and return to play following significant time loss from lacrosse-specific activities (18). During sports movement, poor acceleration and deceleration mechanics may result in compensatory movement throughout the kinetic chain, allowing valgus knee positions leading to ACL injuries (16). Lacrosse strength and injury prevention training programs must consider variations of plyometrics, neuromuscular training, and strength drills, including single-leg derivatives specifically addressing landing and deceleration techniques (2,16). The inclusion of the aforementioned training methods should address proper biomechanics, program adherence, frequency, feedback, and variation of prescribed exercise (16).

PLYOMETRIC TRAINING

Plyometric training properly prescribed as part of a comprehensive strength and conditioning program assists in concentric and eccentric strength development required for successful and efficient lacrosse-specific movement (2). Focused training concerning landing and deceleration techniques properly integrated assist in reducing ligamentous injuries (10). Comprehensive plyometric training programs should include variations of hip-dominant, knee-dominant, linear, lateral jumping, hopping, and bounding drills (2). Table 1 includes recommendations for plyometric training with college lacrosse

TABLE 1. ACL INTERVENTION DRILL RECOMMENDATIONS

1	45-degree lateral bound (stick landing)	2 x 10 per side	Figures 1 and 2
2	Single-leg hop (stick landing)	2 x 6 per side	Figures 3 – 5
3	Double-leg hop (stick landing)	2 x 6	Figures 6 and 7
4	Hip airplane	2 x 10 per side	Figures 8 and 9
5	Nordic curl	2 x 5	Figures 10 – 12/Table 2

players addressing each joint and plane-dominant movement, including lateral bounds and various repeated hop derivatives. Figures 1 – 7 illustrate proper execution of 45-degree lateral bounds, single-leg (SL) hops, and double-leg (DL) hops, all emphasizing sticking the landing prior to the execution of the next movement. The bounds and hops are recommended at an initial prescription of two sets of 10 on each side and three sets of six repetitions, respectively for a total of 94 ground contacts within a session, which aligns with the National Strength and Conditioning Association's (NSCA) recommendations for athletes beginning plyometric training (9). Appropriate volume should be prescribed by the strength and conditioning coach, accounting for the plyometric experience of the athlete and depending on respective volume and intensity (9). It is imperative to provide verbal feedback to the athletes, cueing a stuck landing in all variations of the aforementioned bounds and hops. Athletes should be coached to maintain knee alignment with the foot, ensuring medial collapse is not present during takeoff and landing, emphasizing proper biomechanical principles.

NEUROMUSCULAR TRAINING

Modifiable risk factors, including the dynamic valgus collapse of the knee and change of direction (COD) faults, contribute to the risk of ACL injuries via compromised stress loading mechanisms (6,19). The inclusion of proper neuromuscular training drills helps to optimize skeletal muscle rate firing and joint stabilization of the hip and knee musculature required for lacrosse gameplay demands, including shooting, passing, sprinting, cutting, and repeated body-to-body contact in collision scenarios (6,19). Integrated into the recommendations in Table 1 are rotational hip airplanes performed for two sets of ten repetitions per leg (Figures 1 – 2). The dynamic stability of the hip airplane, in addition to jump training and plyometric recommendations, may increase postural control by addressing hip abductor strength and stability imbalances of the hip external rotators. Correctly performing these drills, specifically the single-leg derivatives, may assist in reducing medial deviations of the knee in the frontal plane that contribute to an ACL injury via increased gluteus medius and hamstring activation used in the stabilization of the femur (19).

STRENGTH TRAINING

Imbalances in anterior and posterior strength of the lower extremities increase the risk of ACL injury (6). Many athletes, including lacrosse players, present with quadriceps dominance and posterior (hamstring) weakness, resulting in anterior translation of the tibia (6). This anterior translation of the tibia is commonly associated with deceleration or COD movements resulting in non-contact ACL tears. Thus, the need for integrated posterior chain strength training is recommended for all college lacrosse athletes to potentially resist anterior shear loading and reduce the incidence of injury (11). Figures 10 – 12 demonstrate the phases of the NHE. Table 2 is adapted from previous soccer-related NHE protocols that were designed to reduced the risk of injury (4,20). Frequency, volume, and intensity are suggested in Table 2, including beginning NHE training with one session per week of two sets of five repetitions. Clear instruction to the athletes in NHE eccentric strength training of the posterior chain requires a slow decent hinging at the knee without hip flexion (Figure 11). The athlete may use the hands to catch themselves during initial attempts. The concentric phase of the movement is initiated by the use of the hand push-off (Figure 12) until the hamstrings and glutes engage in completing the concentric contraction to return to the starting position. As neuromuscular strength and morphological adaptations improve in the posterior chain, the athlete may rely on the use of the hand-assist movement to a lesser degree.

PRACTICAL APPLICATIONS FOR INTEGRATED TRAINING

The recommended combination of isolation and compound dynamic movement prescription of plyometric, neuromotor control, and strength training (Table 1) drills are suggested on the premise that the volume and intensity are supplemental to an appropriately prescribed strength and conditioning program. Annual training cycles typically emphasize additional injury prevention during the off- and pre-season. The specific use of these drills is recommended to be integrated either following or in part of a pre-existing dynamic warm-up for all on-field sessions for a minimum of 10 weeks, followed by integrated maintenance training as indicated in Table 2 (weeks 11+).

TABLE 2. RECOMMENDED NHE TRAINING LOAD

WEEK	SESSIONS PER WEEK	SETS	REPETITIONS
1	1	2	5
2	2	2	6
3	3	3	6 – 8
4	3	3	8 – 10
5 – 10	3	3	10 +
11 +	1 – 2	3	10 +

Adapted from Sayers (2008)

FIGURE 1. 45-DEGREE LATERAL BOUND - START

FIGURE 2. 45-DEGREE LATERAL BOUND - LANDING

FIGURE 3. SINGLE-LEG HOP - START

FIGURE 4. SINGLE-LEG HOP - EXECUTION

FIGURE 5. SINGLE-LEG HOP - LANDING

FIGURE 6. DOUBLE-LEG HOP - START

FIGURE 7. DOUBLE-LEG HOP - LANDING

FIGURE 8. HIP AIRPLANE - START

FIGURE 9. HIP AIRPLANE - FINISH

FIGURE 10. NORDIC CURL - START

FIGURE 11. NORDIC CURL - ECCENTRIC

FIGURE 12. NORDIC CURL - CONCENTRIC

Plyometric and neuromuscular training, in conjunction with emphasized strength drills, provide the needed reduction in biomechanical risk factors, increased dynamic stability, and strength to resist torque and shear load at the knee joint. The drills selected address a need for potential improvements in balance, dynamic reactive movement, and positive transfer to on-field performance, thereby reducing the potential risk of injury in male college lacrosse athletes. While not all athletes will require the same level of intervention, the recommendations of this article recognize the benefit of increased stability and strength as favorable to all intermittent team sport athletes. The recommendations allow the ability to modify volume and intensity as the strength and conditioning coach deems necessary, accounting for the individual needs of the athletes.

CONCLUSION

The growth of the sport of lacrosse has necessitated the advancement in sport-specific performance and injury prevention protocols (12,13,21). While it is widely accepted that the prescription of strength and conditioning programs are advantageous in sports performance and injury prevention, they are still in need of specialized and integrated injury prevention programs in collegiate lacrosse (15). The present program's recommendations encompass the benefits of integrated training to improve strength, neuromotor control, and biomechanical output, thereby enhancing overall musculoskeletal durability, on-field performance, and potentially reducing the risk of an abrupt non-contact ACL injury resulting in extensive time loss. Practical applications of the present recommendations account for minimal equipment needs and ease of implementation, providing the opportunity to enhance performance and reduce the potential risk of injury without the stress of increased training volume or financial expense.

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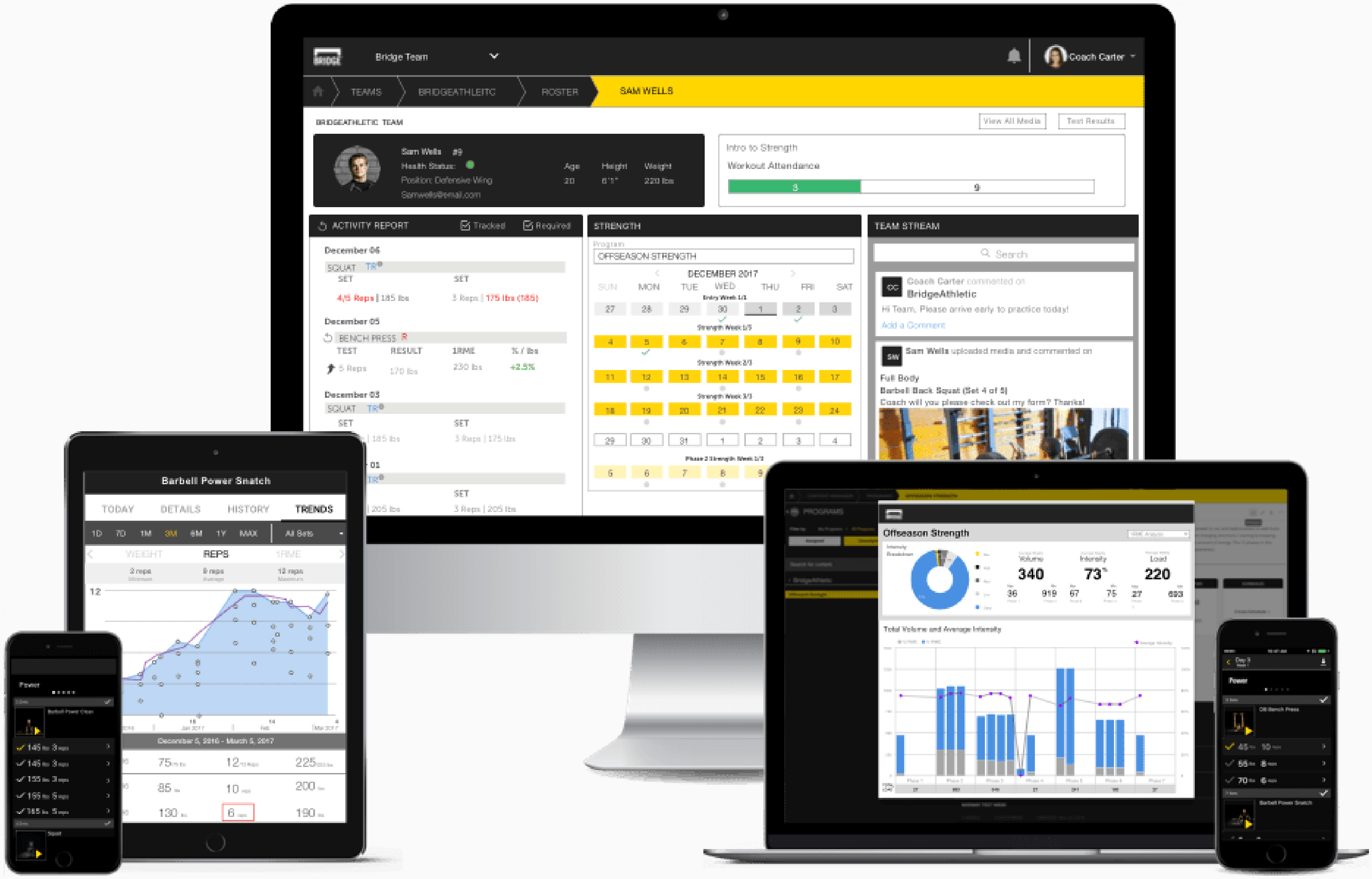

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