Grip Lock: A Unique Mechanism of Injury in Gymnastics

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THE MANEUVERS performed in gymnastics require the upper extremity to assume a weight-bearing role that produces a high incidence of hand and wrist injuries.[1-2] The purpose of this report is to present a rare and unique mechanism of injury among gymnasts, referred to as grip lock. The available literature that is relevant to the topic is sparse and nonspecific.[3,5-8] Therefore, this presentation of information on grip lock injury may enhance its proper diagnosis and treatment, thereby reducing time loss from practice and competition.

Key Points

- Grip lock occurs when the hand grip sticks to the bar as the gymnast rotates, thereby inducing wrist injury.
- Rehabilitation of injuries caused by grip lock is individualized, with physician consultation.
- Injuries sustained from grip lock can take up to one year to rehabilitate fully.

Advanced-level gymnasts utilize dowel grips on the hands during performance of high bar and uneven bars events to improve hold on the bar when executing forceful maneuvers (Figure 1).[4] Grip lock injury rarely occurs in gymnastics, but a grip lock mechanism of injury often leads to fracture of the distal radius and ulna.[1-3] Grip lock occurs when the distal portion (i.e., finger) and proximal portion (i.e., wrist) of the grip come in contact with each other when grasping the bar (Figure 2). When the grip completely encircles the bar, friction can causes the grip to stick to the bar, which locks the metacarpalphalangeal (MCP) joints in flexion. The gymnast continues to rotate around the bar in a locked MCP flexion position, which imposes forces on the wrist that produce fractures, sprains, and strains.[1] If unrecognized or improperly treated, the resulting injury can debilitate a gymnast for a period of up to a year.

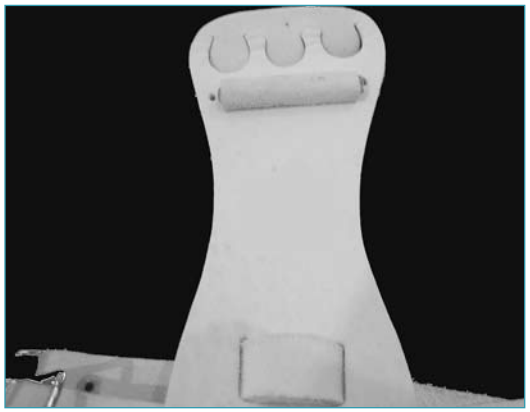

Figure 1 Dowel grip for men's gymnastics.

Figure 2 Grip lock action.

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Dowel Grip Injuries

Dowel grips are necessary for the proper execution of bar maneuvers. The dowel grip straps place the MCP, proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints in flexion, which enhances the gymnast's ability to clench the bar with maneuverability. The grip increases the surface area of contact, while adding friction when the gymnast swings around the bar. Poorly manufactured grips or old and stretched grips may contribute to injury. An elongated grip further increases the surface area of contact with the bar, thereby increasing the potential of grip lock (Figure 3).

Figure 3 Old dowel grip (left) vs. new dowel grip (right).

Minimal research has analyzed the pathomechanics of grip lock injury. Two case studies have been published. In 1990, a case study described the role of dowel grips in contributing to wrist injuries among adolescent gymnasts.[9] On the basis of comparisons of radiographic changes in the physes and metaphyses of the radius, the authors suggested that dowel grips might have played a role in producing injury. A 1988 case study suggested that radiographic changes associated with physeal injury occurred in gymnasts wearing dowel grips.[10] Research has demonstrated increased tensile force across the wrist during giant swings on high bar while wearing dowel grips in comparison to bare-hands performance of the high-velocity maneuver.[6]

High-velocity maneuvers involve release skills; the gymnast gains momentum by performing powerful tap swings, followed by release of the hands and catching the bar in mid-air. The grip lock mechanism of injury occurs when the distal portion of the grip contacts the proximal portion during an attempt to grasp the bar. The gymnast's phalanges and wrist become locked in flexion as he or she continues to swing around the bar. A sprain of the radial and/or ulnar collateral ligaments, or a fracture of the distal radius and/or distal ulna is the result.[2] Extensor tendon strain can occur, due to the high eccentric force that is imposed; however, there are no published reports of the incidence of strains and sprains resulting from grip lock.[1,2,7] The pathology produced is not unique in terms of common gymnastics injuries, but the mechanism of injury is specific to the performance of high-velocity maneuvers on the high bar or the uneven bars.

The incidence of grip lock injury among male gymnasts over a 10-year period reported by 38 high school coaches was 17 injuries, and 32 college coaches reported 21 injuries.[3] The study documented a low 0.2% incidence rate of grip lock in men's gymnastics, but the injury often required open reduction and internal fixation surgery to repair fractures of the distal radius and ulna. The recovery time of gymnasts who sustained the injury averaged one year. A more recent case report published in 2005 reported a grip lock injury in a 17-year-old junior elite gymnast who sustained the injury while performing a release maneuver on the high bar.[11] Upon clinical examination, edema within the hands and phalanges was observed, and severe tenderness was elicited by palpation of the injured area. The distal radial pulse was intact. Radiographs confirmed a fracture of the ulna and radius, which was complicated by forearm compartment syndrome. Immediate treatment involved open reduction with internal fixation. The rehabilitation program progressed to weight-bearing exercise at 4 months post-injury.

Prevention

The most common cause of grip lock injury is poor condition of the grip.[1,7] Grips become stretched and deteriorated with prolonged use. The straps of the grip may also stretch around the wrist, which permits excessive wrist mobility. The risk of grip lock injury is increased by the lengthening of the grip across the palmer aspect of the hand. The grip is more likely to get caught and locked onto the high bar when the surface area of contact increases.[1] Gymnasts should wear properly fitted grips and should continually check them

for stretching or tearing.[1,5] Grips should be discarded and replaced when they become worn or excessively stretched.

Fatigue may lead to use of improper technique when performing forceful and difficult bar skills. Advanced-level gymnasts undergo intense training that can last from 30-50 hours per week.[12] Mental and physical fatigue during long practice regimens may increase susceptibility to acute injury like grip lock. Rest periods between workouts and the periodic provision of light-practice days may decrease fatigue-related susceptibility to injury.[10,13]

The most common skills being performed at the time of grip lock injury have been reported to be the cubital (eagle) grip positions and maneuvers.[3] The cubital grip technique places the shoulder in internal rotation with pronation of the forearm and slight flexion at the wrist (Figure 4).[6] This position poses a high risk for grip lock injury because the wrist and dowel grip directly contact the bar. The cubital grip requires movement precision and proper body momentum in order to swing around the bar. Gymnasts performing skills in cubital grip positions should be observed closely to ensure that the performance technique does not impose excessive force on the wrist.

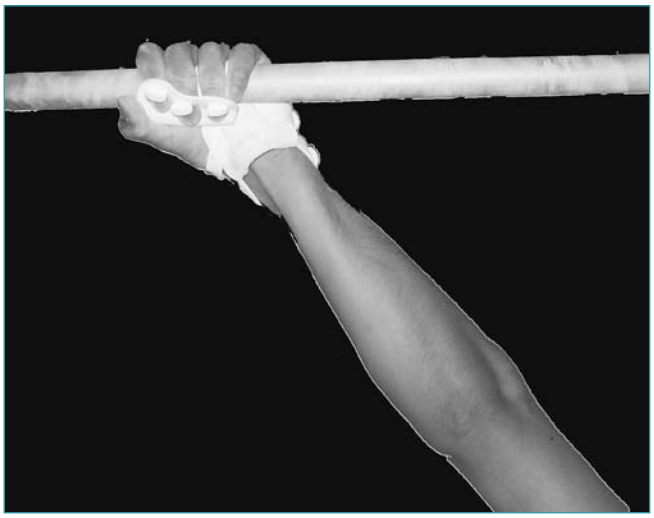

Figure 4 **Cubital (eagle) grip position.**

Management of Injury

The 1996 grip lock survey documented that 9 out of the 20 fractures due to grip lock injury required surgical intervention.[3] Open reduction and internal fixation of the radius and/or ulna is required if the fracture is malaligned and unstable.[5,11] A grip lock mechanism of injury can produce either a Smith's fracture or a Colles' fracture. A gradual return to gymnastics by 4 months post-injury is typical. For non-surgical cases, immobilization that is followed by rehabilitation may return the gymnast to full activity in 3 months.[1] Immobilization is maintained for 4 to 6 weeks, followed by active and passive range of motion exercises for the MCP, PIP, DIP, and wrist joints. Range of motion exercises must include all degrees of freedom. Clinicians can also begin early grip strengthening exercises.[5] The patient may progress to nonweight-bearing strengthening activities, such as resistive elastic bands and dumbbell weights and eventual implementation of weight-bearing activity. Residual pain and limited pronation and supination of the forearm may be experienced.[5] Passive and active range of motion exercises for wrist flexion, extension, and radial/ulnar deviation are also recommended.

Literature pertaining to the management of grip lock injury is vague and primarily oriented to diagnosis.[1,5,9,10,12] Athletic trainers should manage grip lock injury on an individualized basis, with frequent physician consultation and careful assessments of functional status throughout the rehabilitation process. A gradual return to full participation in gymnastics may require up to a year in severe cases that require surgical intervention.

Conclusion

Grip lock is a mechanism of injury that rarely occurs in gymnastics, but it can produce a severe injury. Athletic trainers and therapists should become familiar with the cubital grip positions that place gymnasts at high risk for grip lock injury and carefully observe performances on the high bar in men's gymnastics and the uneven bars in women's gymnastics for utilization of proper technique. Grip lock injury may be prevented through education of gymnasts and their coaches. ▮

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