



**Association of Ringside Physicians**

# **Journal of Combat Sports Medicine**

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## From the Editor's Desk

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Dear Colleagues,

I trust this issue finds you all in good health. In Volume 6 Issue 2 of the *ARP Journal of Combat Sports Medicine*, Rynecki et al. present the results of their retrospective study looking at short-term outcomes and return to play with nonoperative treatment of grade I and II isolated lateral collateral ligament injuries encountered in combat sports (MMA and Brazilian Jiu Jitsu). Nonoperative management of these injuries in their cohort resulted in return to play as early as 12 weeks, with all patients reporting significant improvement in patient reported outcomes at two-year follow-up. Lily Khabie and Victor Khabie provide an excellent editorial review of the study. The ARP Position Statement on Skin Infections in the Combat Sport Athlete is included in this issue of the journal. Sethi presents a case report on the value of the CBC and highlights the importance of uniform health and safety standards in boxing. Goedecke and Visser present a case report of a young boxer with polymicrogyria and discuss whether he should be medically cleared to box.

I take this opportunity to wish you and your families a very Happy New Year. May 2024 be filled with good health and happiness. Our two Senior Editorial Managers Lisa Nelson and Susan Rees continue to work tirelessly to improve the journal and make it a valuable resource for the combat sports community. The *ARP Journal of Combat Sports Medicine* is actively soliciting case reports, case series, review articles and original studies related to the field of combat sports medicine. Please consider the journal for publication of your valuable work.

Sincerely,

Nitin K Sethi, MD, MBBS, FAAN

# SHORT-TERM OUTCOMES AND RETURN TO PLAY WITH NON-OPERATIVE TREATMENT OF GRADE I AND II ISOLATED LATERAL COLLATERAL LIGAMENT INJURIES ENCOUNTERED IN COMBAT SPORTS

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- New Jersey Orthopedic Society: Board or committee member
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INFORMED CONSENT: The Harrison Endo Surgical Center LLC IRB reviewed and approved a request to waive the individual authorization requirements under HIPAA for the use and disclosure of PHI for Research under 45 CFR § 164.512(i)(2)(ii)(A-C). A waiver of Informed Consent had been granted in accordance with 45 CFR 46.116 (f).

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KEYWORDS: Lateral collateral ligament injury, Brazilian Jiu Jitsu, Mixed Martial Arts

## **Abstract**

Isolated injury to the lateral collateral ligament (LCL) without concomitant posterolateral corner injury is a rare injury, encountered more frequently in patients participating in mixed martial arts (MMA) and Brazilian Jiu Jitsu (BJJ). Controversy exists regarding which of these patients can be effectively treated nonoperatively. The purpose of this investigation is to report on two-year, patient-reported outcomes (PROs) for patients with grade I and II LCL injuries treated nonoperatively. A retrospective review of prospectively collected data from eight patients who sustained isolated LCL injuries while participating in MMA or BJJ treated by the senior author between 2011 and 2019 was performed. PROs were obtained at their initial and two-year follow-up with the International Knee Documentation Committee (IKDC) and Lysholm scoring forms. Wilcoxon Rank Sum tests were utilized to analyze the difference in PROs between initial and 2-year follow-up. Eight males average age 35.3 years old (27-46) sustained isolated LCL injuries. All patients were treated nonoperatively with six weeks of weight bearing as tolerated in a hinged knee brace. Patients were permitted to return to light, non-contact activity at the 6-week mark with clearance to return to unrestricted play at 12 weeks. Average IKDC and Lysholm scores increased from  $40.7 \pm 15.9$  (mean  $\pm$  SE) and  $52.7 \pm 6.50$  to  $90.1 \pm 14.8$  ( $p < 0.001$ ) and  $90.6 \pm 12.1$  ( $p = 0.003$ ), respectively. All patients met criteria for MCID with significant improvement in PROs. Submission maneuvers and fight techniques unique to MMA and BJJ may predispose athletes to isolated LCL injuries. Our case series demonstrates that patients with grade I and II LCL tears can successfully be treated nonoperatively, with quick return to play and significant improvement in PROs at 2-year follow-up.

## **Introduction**

The lateral collateral ligament (LCL) is the primary varus stabilizer of the knee.<sup>1-3</sup> Varus instability can lead to abnormal gait patterns, meniscal injuries, and osteoarthritis.<sup>1,3,4</sup> Various injury mechanism combinations can lead to LCL injury including

contact or noncontact hyperextension, an antero-medial or varus blow to a flexed knee, and external rotation.<sup>5,6</sup> Isolated injury to the LCL of the knee is rare as most injuries are part of a broader pattern of damage to other knee structures. Not only do LCL injuries more frequently occur as part of a posterolateral corner (PLC) injury rather than in isolation, but PLC injuries themselves usually occur as part of a multiligamentous knee injury or knee dislocation, with concomitant damage to the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and/or medial collateral ligament (MCL). With PLC involvement, there is typically damage to one or more of the other static stabilizers (popliteofibular ligament and popliteus tendon), and/or the secondary stabilizers (menis-cofemoral ligament, meniscotibial ligament, coronary ligament, lateral head of the gastrocnemius, fabellofibular ligament, the long head of the biceps femoris, and the iliotibial band [ITB]). Thus, the majority of published treatment protocols involve assessing LCL injuries in the context of this multitude of associated injuries.

Isolated LCL tears are frequently encountered in mixed martial arts (MMA) and Brazilian Jiu Jitsu (BJJ) fighters.<sup>7,8</sup> Submission maneuvers and fight techniques encountered in these sports likely predispose athletes to this injury due to the aforementioned force vectors stressing the LCL. LCL injuries can oftentimes be diagnosed clinically with a good history and physical exam but are confirmed radiographically. Based on work done by LaPrade et al,<sup>9</sup> in addition to a standard weightbearing radiographic knee series, initial imaging evaluation of LCL injuries should involve bilateral varus stress radiographs with the knees in 20° of flexion. Lateral compartment gapping of 2.7 - 4.0 mm compared to the contralateral side is consistent with a complete, isolated LCL tear. Magnetic resonance imaging (MRI) is used in most cases to quantify percentage of fiber disruption, injury location, and assess for associated injuries.<sup>10-12</sup>

Little data regarding isolated LCL injuries exists in the literature and there is subsequently no standardization to their ideal management or operative indications. With the growing popularity in

MMA and BJJ, the goal of our investigation is to present a treatment protocol used by the senior author to treat patients with isolated grade I and II LCL injuries. We hypothesize that use of this treatment protocol will result in good short-term, validated PROs at 2-year follow-up.

## **Methods**

### *Study Design*

Institutional review board study approval was granted. A retrospective review was performed between 2011 and 2019 that identified patients who were diagnosed with isolated LCL injuries sustained while participating in MMA or BJJ with at least 2-years of follow-up and both baseline and 2-year follow-up PROs. Clinically, LCL injuries were graded using the LCL Injury Grading System compared to the contralateral side.<sup>13</sup> Patients with documented grade III injuries were excluded from our cohort. Other exclusion criteria included ipsilateral meniscal or associated ligamentous injury and/or any prior surgery to the ipsilateral knee.

### *Patients*

All patients initially presented reporting pain and subjective instability with pivoting and side-to-side movement after a traumatic event sustained during combat sport. Laxity to varus stress on physical examination at full extension and 30° of flexion was documented by the sports medicine fellowship trained senior author and graded. No patient demonstrated posterolateral rotary instability. All patients had negative Lachman, anterior drawer, posterior drawer, and dial tests at 30° and 90°. These clinical diagnoses were confirmed both via standard and varus stress radiographs and MRI as described by LaPrade et al.<sup>14</sup>

Charts were reviewed to obtain patient demographics, mechanism of injury, length of follow-up, specifics of treatment, time to return to full competition, and PROs. Validated PROs utilized included International Knee Documentation Committee (IKDC) and Lysholm knee scoring forms.

### *LCL Injury Treatment Protocol and Rehabilitation*

All patients with grade I and II LCL injuries were treated nonoperatively. This treatment consisted of 6 weeks of weight bearing as tolerated in a hinged knee brace with full withdrawal from training. Physical therapy was commenced at the 2-week mark, focused on range of motion (ROM). Exercises were progressed after achieving full active ROM, emphasizing functional movement, strengthening, and proprioceptive training. The brace was discontinued at 6 weeks and light training was initiated. Clearance to return to unrestricted training occurred at the 12-week mark. All patients were evaluated in the outpatient setting by the treating orthopedic surgeon at 2-weeks, 6-weeks, 3-months, 6-months, 1-year, and 2-year marks.

### *Outcome Assessment and Statistical Analysis*

Means and two standard errors of the mean were calculated for initial and final IKDC and Lysholm scores as well as time to return to sport. PRO score distributions were non-parametric and, therefore, Wilcoxon Rank Sum tests were utilized to analyze the difference in means between initial and 2-year follow-up scores. Significance was set at  $p < 0.05$ . Minimally clinically important difference was calculated utilizing half a standard deviation from the mean difference technique, one of the most common methods utilized in orthopedic lower extremity literature.<sup>15</sup>

## **Results**

There were eight males and zero females who sustained isolated LCL injuries through a varus force placed on the knee while participating in MMA or BJJ that were treated nonoperatively by the senior author over an 8-year period (2011-2019). Two patients with documented grade III injuries were excluded from our cohort as they were treated operatively by the senior author. The average age was 35.3 years at time of injury (27-46). Time to final follow-up was at least 2 years. Three patients had grade I LCL tears, and five had grade II LCL tears. All patients returned to full unrestricted competition and one patient returned to

**Table 1:** Demographics and Injury Characteristics of Cohort

Case	Age at time of Injury	Mechanism of Injury	Grade of Varus Laxity	Location of Tear on MRI	Return to full sport (weeks)
1	34	Opponent passed open guard	1	Femoral origin	12
2	35	Gogoplata	1	Femoral origin	12
3	32	Rolling back attack	1	Femoral origin	12
4	46	Triangle	2	Femoral origin	12.5
5	34	Opponent passed butterfly guard	2	Femoral origin	12
6	44	Opponent passed De La Riva guard	2	Fibular insertion	24
7	30	Triangle	2	Mid substance	16
8	39	Unspecified varus stress	2	Femoral origin	12

professional competition at a championship level. Patients returned to full activity by a mean of  $13.3 \pm 2.8$  (mean  $\pm$  2SE) weeks after injury (Table 1).

Average IKDC and Lysholm scores for patients increased from  $40.7 \pm 15.9$  (mean  $\pm$  2SE) and  $52.7 \pm 6.50$  to  $90.1 \pm 14.8$  and  $90.6 \pm 12.1$ , respectively. There was a statistically significant increase in PROs between initial visit and final follow-up at two years after injury, demonstrated by increased IKDC ( $p = 0.001$ ) and Lysholm scores ( $p = 0.003$ ). All PROs met MCID criteria ( $>11$  for IKDC and  $>8$  for Lysholm scores).

### **Discussion**

Isolated injuries to the LCL are uncommon because they are typically part of broader soft tissue injury pattern to the knee. However, submission maneuvers and fight techniques in MMA and BJJ may predispose these athletes to this otherwise uncommon, isolated injury. While there are several studies examining nonoperative management

protocols and clinical outcomes after grade I and grade II LCL injuries, these are in the context of other concomitant ligamentous injuries.<sup>16</sup> Other publications have been limited to case reports, given the uncommon nature of this isolated injury.<sup>17,18</sup> Far more is published in the literature regarding the management of grade III LCL injuries.<sup>19-21</sup> We present one of the largest case series examining a nonoperative management protocol of grade I and II isolated LCL injuries in combat athletes, supported by excellent short-term PROs that meet MCID and 100% return to play.

A study by Kannus et al published in 1989, one of the largest discussed in the literature, reported on 13 patients with grade II LCL injuries treated with immobilization (either in a plaster cast, posterior splint, or knee bandage) for 2-5 weeks. Patients began isometric quadriceps strengthening during the early phase of the immobilization period. However, the lack of standardization in the rehabilitation protocol among patients and wide range of the initial immobilization time period limits drawing

conclusions.<sup>22</sup> Sikka et al<sup>12</sup> utilized the NFL Injury Surveillance System reporting on 22 players sustaining clinical grade I and II LCL injuries. They reported an average 1.3 week and 3.5 week return to sport for grade I and grade II injuries, respectively. They admit that the nonoperative protocol and clearances differed between players and football organizations, and they do not comment on ROM or weight bearing status restrictions. Some players returned to play in a brace, while others did not. Importantly, the authors note that experience with these injuries is limited to small retrospective cohorts with inconsistencies in rehabilitation protocols due to the rarity of encountering this injury. Furthermore, the pressures on professional athletes to return to sport are different than those of recreational athletes, and thus is important to note. Patel et al presented a case report of a 34-year-old male with a grade II isolated LCL injury at the fibular insertion sustained due to varus force placed on the knee while placing his foot behind his head during a yoga pose. The patient was treated nonoperatively with a supervised physical therapy program and returned to yoga at 8 weeks. Again, the specifics of the weight bearing and ROM restrictions as well as the specific rehabilitation protocol was not reported.<sup>18</sup>

Although our study certainly fills a gap in the literature, demonstrating excellent short-term PROs and reliable return to play with nonoperative management of isolated grade I and II LCL, it has several limitations. As a case series, there is no control group. Thus, we did not examine an alternative rehabilitation protocol or operative intervention. Further, due to the rarity of this injury, our sample size is small, limiting power for statistical analyses. Despite this, however, our study remains one of the largest reported on nonoperative management of isolated LCL injuries with standardization of initial treatment and rehabilitation. Significant improvement in PROs at 2-year follow-up supports its efficacy.

## Conclusions

This study provides a treatment protocol for the nonoperative management of isolated grade I and II LCL injuries encountered in MMA and BJJ athletes, with emphasis on early weightbearing and ROM progression. Isolated LCL injuries are rare, but the incidence is increasing as MMA and BJJ become more popular combat sports. Nonoperative management of these injuries in our cohort resulted in return to play as early as 12 weeks, with all patients reporting significant improvement in PROs at 2-year follow-up.

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### Short-term outcomes and return to play with non-operative treatment of grade I and II isolated lateral collateral ligament injuries encountered in combat sports

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No conflicts of interest

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Dear Colleagues:

This edition of the *Journal of Combat Sports Medicine* features an article entitled, “Short-Term Outcomes and Return to Play with Nonoperative Treatment of Grade I and II Isolated Lateral Collateral Ligament Injuries Encountered in Combat Sports”, which provides guidelines for a standardized protocol to treat isolated grade I and II LCL injuries.

Knee injuries are very common in combat sports, the most common involves the medial collateral ligament (MCL). Treatment guidelines are well established for isolated MCL injuries with the far majority being treated nonoperatively in combat athletes. Although grade I and grade II LCL injuries are less common and are not covered as extensively in the literature, LCL injuries are sustained in this patient population and must be treated appropriately for the welfare of the combat athlete. LCL injuries are often not isolated injuries and occur in conjunction with posterolateral corners injuries, cruciate tears, meniscal tears, and MCL disruptions. These are clinically unstable injuries when occurring in combination, often requiring surgical reconstruction. When treating a combat athlete with a lateral knee injury, it is important to understand the anatomy and complex constellation of injuries affecting the lateral side of the knee.

Little has been written regarding the isolated treatment of grade I and II LCL injuries in this patient population. Traditionally, most LCL injuries have been treated operatively because of their associat-

ed injuries. This article is the first to demonstrate the excellent outcome of nonoperative treatment for grade I and II LCL injuries in combat athletes. Low grades I and II LCL injuries can be missed as many go undiagnosed. Since by definition they are “partial tears”, many may not present with clinical instability at the time of the exam. Furthermore, the “warrior mentality” of many combat athletes leads them to minimize symptoms and not seek medical attention even when they are in pain. Physicians caring for these athletes should be aware that lateral sided knee pain in these athletes may represent low grade LCL injuries. If on exam the LCL is tender to palpation and illicit pain with a varus force to the knee, then an MRI should be considered to investigate the magnitude of this injury even in the absence of clinical instability.

As this article suggests, when an LCL injury is suspected in a combat athlete, it is important for the physician to take a history, perform a thorough physical examination and order the appropriate testing to arrive at the diagnosis. This article demonstrates that with knee bracing and a sports-specific rehabilitation protocol, grade I and II LCL injuries do not require surgery and combat athletes have a high chance of returning to competition 12 weeks following injury.

Overall, this is a very strong paper. It is the first article to demonstrate a standardized protocol for treating grade I and grade II LCL injuries. We applaud the others for their diligent and comprehensive work on this important issue.

# SKIN INFECTIONS IN COMBAT SPORTS ATHLETES: POSITION STATEMENT OF THE ASSOCIATION OF RINGSIDE PHYSICIANS

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KEY WORDS: Skin infection, combat sports, wrestling, judo, jiu-jitsu, boxing, karate, taekwondo, tinea, herpes gladiatorum, MRSA.

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## *Abstract and Position Statement*

The prevalence of infectious skin conditions is high in combat sports athletes, so primary and secondary prevention, early recognition of infection, and sports restriction during treatment are critically important to minimize the burden of suffering. Given the paucity of evidence-based guidelines, consensus return-to-sport guidelines published by the National Federation of High Schools (NFHS) and the National Collegiate Athletic Association (NCAA) should continue to be utilized by physicians, coaches, officials and athletes. Exceptions to these guidelines may be considered for elite and professional athletes or non-elite athletes in high-stakes competitions with conditions that have relatively low morbidity and high cure rate such as tinea corporis, common warts and molluscum contagiosum. Another recommended deviation from the NFHS/NCAA guidelines is restriction from contact sports activities until completion of 6 to 10 days of oral antiviral treatment for primary or recurrent herpes gladiatorum to reduce the risk of viral spread. Coaches, athletes, and medical providers should strongly consider prophylaxis of elite combat sports teams (those who train with each other) with daily antiviral medication to reduce the risk of both new and recurrent HSV infections that can lead to lost training or cancelled competitions. Likewise, they should strongly con-

sider prophylaxis of any team which has a history of tinea corporis or tinea capitis with periodic oral antifungal medication.

## *Development of this Statement*

The Association of Ringside Physicians (ARP), an international non-profit organization dedicated to the health and safety of the combat sports athlete, sets forth this Position Statement to establish management and prevention guidelines that ringside physicians, athletes, referees, trainers, promoters, sanctioning bodies, and other health-care professionals can use in the combat sports competition and training settings. This position statement expresses a collaborative effort among the ARP Board of Directors, Emeritus Board, and subject-matter experts. A writing group of specialists in family medicine, dermatology, and sports medicine was appointed by the ARP Board of Directors to develop this Position Statement based on a systematic review of the literature and expert opinion. An extensive literature search including but not restricted to MEDLINE, Cochrane Reviews and non-indexed, peer-reviewed articles published in online medical journals was performed using search terms of combat sports, sports, boxing, martial arts, and specific infectious skin conditions.

Dermatologic infectious conditions are highly prevalent in combat sports. The skin infection rate was found to be 14.23 per 10,000 athlete-exposures in collegiate wrestlers.<sup>1</sup> This is significantly higher than the prevalence in high school athletes of 2.27 per 100,000 athlete exposures.<sup>2</sup> Twenty-two percent of these skin infections become recurrent. Most infections (67.9%) are acquired during the regular competitive season. They are most often identified during practice and result in loss of training time.<sup>1</sup> The burden of suffering is significant. A National Collegiate Athletic Association (NCAA) study suggested that up to 20% of wrestlers lose training or competition time each year due to skin infections.<sup>1</sup> Tinea corporis gladiatorum affects about 60% of collegiate wrestlers and 52% of high school wrestlers each season.<sup>3</sup> About 76% of college wrestlers are carriers of community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA), and 0.9% of high school wrestlers contract a CA-MRSA infection each season. It appears that the longer an athlete participates in contact sports the incidence of CA-MRSA increases.<sup>4</sup> Currently there is no available data on the incidence of infectious dermatologic conditions in professional versus amateur athletes in combat sports.

### ***Common Skin Infections Found in Sports***

#### ***Bacterial Infections***

*Staphylococcus* or *Streptococcus* pathogens encompass most bacterial skin infections.<sup>3,5,6,7</sup> Bacterial skin conditions are named based on which dermatological layers are affected. The mainstay of treatment for bacterial skin infections is antibiotic therapy. Topical and/or oral medications can be selected with initial treatment focused on common *Staphylococcus* or *Streptococcus* susceptibility, keeping in mind local susceptibilities. Contacting the local tertiary infectious disease department to determine antibiotic susceptibilities is good antibiotic stewardship practice.<sup>3,8</sup> This can be challenging when competitors are presenting from different geographic regions. Oral medications may be chosen based on clinical judgment, lesion size, compliance, athlete immune status and timing of compe-

tion. Whenever possible, culture and sensitivity of lesions prior to initiating antibiotic therapy is also recommended.<sup>9</sup> Antibiotics should be adjusted based on sensitivity results, if needed.

For all bacterial skin infections, as soon as the diagnosis is suspected, the athlete should be isolated from training partners.<sup>9</sup> Lesions are highly contagious, and covering of untreated lesions to allow participation in contact sports should be strictly forbidden. Return to contact sports activities requires meeting several criteria: completion of a 72-hour course of directed antibiotic therapy, no new skin lesions for at least 48 hours, no drainage or exudate from the wound, and no systemic signs or symptoms (e.g. fever, malaise).<sup>9-12</sup>

#### ***Non-purulent Skin Infection (Impetigo/Cellulitis/Erysipelas)***

The diagnosis of bacterial skin infections is based on clinical history and characteristic appearance.<sup>9</sup> Impetigo is a superficial infection localized to the epidermis.<sup>6</sup> Erysipelas is localized to the upper dermis and skin lymphatics; cellulitis goes deeper, involving the dermis and subcutaneous fat.<sup>7</sup> Cultures can be obtained for definitive diagnosis and antibiotic sensitivities. Impetigo treatment often includes topical mupirocin, fusidic acid, or retapamulin.<sup>9</sup> Cellulitis requires systemic (usually oral) antibiotics.<sup>7,9</sup> Treatment should include oral antibiotics such as penicillin, amoxicillin, clindamycin, or trimethoprim-sulfamethoxazole.<sup>13</sup>

#### ***Purulent Skin Infection (Folliculitis/Abscess)***

Folliculitis is an infection of an epidermal hair follicle. A furuncle is an infection that involves a coalescence of multiple follicles but remains in the epidermis and can be treated with topical or oral antibiotics. A carbuncle or “boil” is a furuncle that has progressed into the dermis and subcutaneous fat.<sup>14</sup> Treatment may include incision and drainage (I&D) if an abscess is present. Oral antibiotic therapy is warranted for multiple lesions, surrounding cellulitis, signs of systemic illness or poor response to I&D.<sup>9,13-16</sup>

### *Methicillin-Resistant Staphylococcus aureus (MRSA)*

Special consideration should be given for MRSA, which has more antibiotic resistance and can result in higher morbidity and mortality.<sup>10,17</sup> MRSA skin infections often present initially like non-MRSA skin infections but can progress more rapidly.<sup>17</sup> For localized MRSA infections, trimethoprim-sulfamethoxazole (TMP-SMX), tetracyclines (doxycycline, minocycline) or clindamycin are the recommended first-line options.<sup>18</sup> Early I&D is important for obtaining cultures and antibiotic sensitivities and in speeding resolution of infection. If an athlete has extensive soft tissue involvement, systemic toxicity (fevers, malaise, nausea, etc.), or persistent symptoms after 72 hours of oral therapy, parenteral antibiotic therapy may be warranted.<sup>19</sup>

### *Fungal Infections*

Fungal skin infections most seen in athletics involve the *Trichophyton* genus and are further named based on the affected body region.<sup>3,5</sup> The treatment and return to competition guidelines vary based on infection location. These infections have very little morbidity, have relatively lower transmission rates than bacterial and viral infections, and are easily cured with antifungals. Therefore, while preventing widespread outbreaks by withholding infected athletes from contact sports is effective, there are certain exceptions to this rule, in our opinion.

#### *Tinea corporis*

Tinea corporis or “ringworm” is a fungal infection on the trunk or extremities.<sup>5</sup> Diagnosis can be made empirically by its classic appearance, or definitively with culture or KOH preparation or a scraping from the lesion.<sup>9</sup> Untreated athletes should be withheld from competition if all lesions cannot be covered with reliable dressings, with the exceptions noted below. Treatment consists of topical antifungals such as terbinafine, naftifine, ciclopirox, or oxiconazole twice daily, usually for two weeks. If extensive lesions are present, systemic antifungal treatment is indicated.<sup>9</sup>

NFHS guidelines and other sources recommend

that athletes may return to competition after 72 hours of treatment and the lesions must be covered.<sup>9,10,12</sup> However, we agree with NCAA wrestling guidelines which state that tinea corporis infections can be evaluated on an individual basis. It recommends allowing wrestlers to compete with untreated lesions that are solitary or closely clustered and can be covered adequately.<sup>11</sup> Since tinea corporis is usually asymptomatic, has a relatively low contagion potential compared to viral and bacterial conditions, and is easily cured with well-tolerated medications, we believe this exception is reasonable to apply to other elite athletes and in high-level youth competitions where the stakes are relatively high, e.g. state, regional, national, or international championships. Note that some sports, leagues, or jurisdictions do not allow covering skin lesions during competition. Furthermore, skin coverings may become removed during competition. Therefore, the opponents of infected athletes should provide written, informed consent about the risk of acquiring tinea and how it may be prevented with post-exposure oral antifungal medication. (See Secondary Prevention and Prophylaxis below.)

#### *Tinea Capitis and Tinea Barbae*

Tinea capitis and tinea barbae are fungal infections involving the scalp or beard, respectively. Diagnosis can be made empirically by appearance, or definitively with culture or KOH preparation or a scraping from the lesion.<sup>3,9</sup> These variants are deeper and more difficult to treat because of hair follicle involvement and sometimes produce transudative or purulent discharge.<sup>3</sup> Topical antifungal treatments alone are not adequate, and longer periods of oral antifungal treatment are needed; withholding untreated athletes from competition is important and should be non-negotiable. Oral terbinafine, fluconazole, itraconazole, or ketoconazole are effective.<sup>9</sup> Return to contact sport requires completion of 14 days of oral antifungal treatment.<sup>11,12</sup> Concomitant use of a topical antifungal is also recommended during oral treatment and in the weeks following to reduce the risk of spread from continued shedding of fungal spores.

Selenium sulfide shampoo or ketoconazole shampoo 1-2% should be used before practice until all scalp lesions are gone.<sup>9</sup>

## ***Viral Infections***

### *Herpes Simplex Virus*

Herpes simplex virus (HSV) can involve any body region but most commonly is found on the lips (herpes labialis, or “cold sore”).<sup>20</sup> Herpes gladiatorum is an infection of any other part of the body in the athletic setting, most commonly the face. The most likely pathogen is HSV1. Transmission is thought to be exclusively from direct skin-to-skin contact.<sup>3</sup> Numerous studies have demonstrated that training mats or equipment do not significantly contribute to the spread of infection.<sup>21-24</sup> The classic lesion involves a burning or tingling sensation in the affected area, followed in hours to days by an eruption of tightly clustered painful vesicles on an erythematous base. Lesions are highly contagious and can last for days to weeks, creating a significant burden of suffering and precluding athletic participation for significant time periods. The virus also remains dormant in the spinal nerve root ganglia for a lifetime and may reactivate with various triggers, producing unpredictable recurrent outbreaks and heavy viral shedding. Therefore, strict guidelines on withholding untreated athletes from contact activities is paramount for preventing spread. Also problematic is the low-level viral shedding that occurs in some asymptomatic athletes.

Primary (first-time) HSV infections can be more severe than recurrences and may present with systemic symptoms followed by eruption of skin lesions.<sup>9,24</sup> In immunocompetent individuals, primary HSV infection resolves over days to a few weeks, but the virus will lay dormant in neural ganglia for a lifetime. Diagnosis is made empirically by the classic appearance of lesions, or definitively by viral culture and HSV polymerase chain reaction.<sup>3</sup> Culture should be obtained from freshly ruptured vesicles and should be collected using a swab/media that does not contain alginate (which

inhibits HSV growth) and has a plastic or metal shaft (wood may be toxic to HSV in culture).<sup>21,25,26</sup> The most problematic HSV infections are ones that involve the eyes. In addition to being extraordinarily painful, ocular infections can cause irreversible corneal scarring or blindness.<sup>27</sup> Treatment of primary HSV infection consists of 7 to 10 days of oral antiviral medication such as acyclovir, famciclovir or valacyclovir. Prior to return to contact sports the athlete must have completed at least 120 hours of systemic antiviral therapy, be free of systemic symptoms, have no new lesions for 72 hours, and all remaining lesions must be surmounted by firm adherent crust.<sup>9-11</sup> NFHS guidelines recommend completion of 10 days of oral antiviral treatment before resuming contact sport activities. We believe this 10-day restriction period is more prudent due to the continued viral shedding that continues after only 5 days of treatments, as discussed below.

### *Recurrent HSV Infection*

Recurrent infections can manifest at any time but are usually associated with periods of weakened immune system or stress.<sup>28</sup> Treatment involves a course of oral antivirals; topical therapy is ineffective and not recommended.<sup>29</sup> Although NFHS and NCAA guidelines recommend allowing return to practice/competition after 120 hours of antiviral treatment, assuming all lesions are crusted,<sup>11,12</sup> one small study in wrestlers treated with valacyclovir 1000 mg once daily showed that viral shedding continued for 5.9 to 10.4 days, with an average of 8.14 days.<sup>30</sup> Therefore, a longer period of treatment during contact sport restriction (6 to 10 day) may be prudent to prevent spread of the virus. As with primary infection, in addition to completing the required days of antiviral medication, there must be no new lesions for 72 hours, and all remaining lesions must be surmounted by firm adherent crust before returning to contact activities. The ARP does not support return to contact sports after less than 5 full days of antiviral treatment, and we advise obtaining written, informed consent of the opponent(s) of athletes treated for less than 10 days. Opponents should be aware that

**Figure 1. Best Practices for Primary Prevention of Skin Infection.**

1. Practice good personal hygiene.
  - a. Wash hands before practice with soap and water or sanitizer.
  - b. Wear clean clothing that protects your skin from abrasions.
  - c. Shower immediately after practice with liquid (not bar) soap; if showers are not available, soap-and-water wipes are preferable to not washing at all.
  - d. Do not co-mingle dirty and clean clothing: Can use separate bags.
  - e. Launder dirty clothing after each use and dry completely in a dryer.
2. Monitor self and teammates for new lesion(s) of concern.
  - a. Once identified, keep lesion(s) covered under a bandage.
  - b. Show lesion(s) to a coach or trainer as soon as possible.
  - c. Take care to not transfer potential lesional pathogens onto other areas of your body.
3. Avoid shaving hair on body; if this is unavoidable, trimming is preferred.

there is a chance of acquiring HSV and that it could result in lifelong recurrences. They should also be offered antiviral prophylaxis to reduce the risk of infection.

*Molluscum Contagiosum*

Infection with the molluscum contagiosum virus (a poxvirus) can involve any part of the body but most likely knees and elbows. Lesions are small, skin-colored papules with central indentation and can be numerous; diagnosis is usually made clinically but can be done histologically on an excised lesion. They are asymptomatic or mildly itchy and usually resolve over several months if untreated.<sup>31</sup> They are transmissible through direct skin-to-skin contact or via fomites such as bath sponges or towels. Treatment includes physical destruction of the lesions with sharp curette.<sup>9</sup> The greatest problem in combat sports athletes with molluscum contagiosum is secondary bacterial infection of traumatized lesions or recently curetted lesions. Return to

competition may be considered after destruction of the lesions with covering using a gas-permeable membrane and tape.<sup>9</sup> Given the low burden of suffering and curable nature of this infection, it is reasonable to allow participation in untreated elite combat sports athletes, or youth athletes in high-level competitions.

*Human Papillomavirus*

Human papillomavirus (HPV) has many strains, and the most common manifestation in athletes is common warts. Diagnosis is clinical and based on the classic appearance of small, rough, skin-colored papules. They are transmissible primarily through direct skin-to-skin contact and possibly through fomites. Treatment consists of topical preparations such as salicylic acid, cantharidin, podophyllin, or imiquimod. Duct tape, cryotherapy, and curettage are also effective.<sup>3</sup> Return to play may be considered if the lesion is adequately covered during competition.<sup>29</sup>

## ***Prevention of Skin Infections in Combat Sports***

### ***Primary Prevention***

Primary prevention of skin infections centers on decreasing the numbers of microbial organisms on participants and their environment. Colonization of participants is minimized by universal and fastidious personal hygiene practices. Environmental contamination is minimized by effective cleaning of clothing, mats, and other equipment.<sup>3,9,32</sup>

### ***Personal Hygiene***

Best practices for personal hygiene begin with hand washing with soap and water or application of skin sanitizer before practice and competition.<sup>3,33</sup> Wearing clean clothing will protect skin from abrasions and direct transmission of potentially pathogenic organisms. Showering immediately after training decreases the number of potential pathogens on the skin.<sup>3</sup> If showers are not available, soap-and-water wipes are more effective than not washing at all. Clothing can serve as fomites, so clean and dirty clothing should not be intermixed.<sup>9,32</sup> Additionally, cosmetic shaving should be avoided because the associated skin irritation can cause skin microtrauma, or even folliculitis or dermatitis, which can then become a portal of entry for pathogens.<sup>3,9,32</sup>

Primary prevention with systemic treatments has been shown to be effective but this approach is not widely recommended due to concerns for potential adverse effects and drug resistance. However, it should be considered in select patients with known histories of recurrent infections.<sup>3,22,32</sup> See Figure 1 for a summary of primary prevention measures.

### ***Environmental Hygiene***

Environmental hygiene focuses on cleaning mats and equipment.<sup>9,32</sup> Daily cleaning of equipment/facility in conjunction with the practice of good personal hygiene by athletes has been shown to decrease the incidence of infectious skin conditions in athletes.<sup>9</sup> Studies on wrestling mats demonstrat-

ed that cleansers with residual activity (e.g., thyme oil) are more effective than those without residual activity (e.g., bleach 10%). However, this benefit could be approximated if cleaning with bleach 10% was combined with strict hand sanitizer use by all wrestlers. Additionally, cleaning mats in a backwards-mopping fashion prevented secondary contamination with soil bacteria from shoes.<sup>33</sup>

### ***Secondary Prevention and Prophylaxis***

The hallmark of secondary prevention is early treatment of skin infections and withholding the athlete from participation until they are deemed no longer infectious. Early recognition and treatment of infected combat sports athletes will reduce the duration of lost training time and limit development of comorbid conditions such as secondary infection.<sup>34</sup> Clearance recommendations for athletes vary by the pathogen and affected body part and are based on consensus opinion since empiric evidence for these recommendations is unavailable. It is widely considered prudent to prohibit athletes with infectious skin conditions from competing until effective treatment has been initiated and the risk of spread is reduced.<sup>3,11,12</sup> The specific treatments and return-to-participation guidelines are summarized in Table 1. Longstanding guidelines by the National Federation of High Schools<sup>12</sup> and the National Collegiate Athletic Association<sup>11</sup> are extremely helpful and provide an objective and defensible framework for managing these difficult decisions.

Prophylactic treatment is a prudent approach to preventing recurrent infections when the risk of reinfection outweighs the risk and burden of prophylactic medication. Risks of reinfection include the clinical burden of suffering, lost training time, and possibly forfeiture of matches. It would be heartbreaking for an athlete to be eliminated from a high-level competition due to a recurrence of a preventable infection. Scenarios in which prophylaxis is prudent include recurrent tinea corporis or tinea capitis, recurrent herpes labialis or gladiatorum, or teams with high prevalence of these conditions. This approach can reduce the frequency and duration of recurrences and reduce the risk

**Table 1.** Treatment and Return to Contact Sports Recommendations for Skin Infections in Combat Sports Athletes.

INFECTION	TREATMENT	RETURN-TO-SPORTS
Nonpurulent bacterial infections (not MRSA)	<ul style="list-style-type: none"> <li>• Penicillin V 500mg PO QID 5-14 days</li> <li>• Amoxicillin 875mg PO BID 5-14 days</li> <li>• Clindamycin 450mg PO TID 5-14 days</li> <li>• Trimethoprim-sulfamethoxazole 1-2 DS Tab PO BID 5-14 days</li> </ul>	<ul style="list-style-type: none"> <li>• No new lesions for 48 hours</li> <li>• Completion of 72 hours of antibiotic therapy</li> <li>• No further drainage</li> <li>• No active infections</li> </ul>
Nonpurulent MRSA infections	<ul style="list-style-type: none"> <li>• TMP-SMX 1-2 DS Tabs BID</li> <li>• Clindamycin 450mg PO TID</li> <li>• Doxycycline 100mg PO BID</li> <li>• Minocycline 200mg PO x1 day, then 100mg PO BID</li> </ul>	<ul style="list-style-type: none"> <li>• No new lesions for 48 hours</li> <li>• Completion of 72 hours of antibiotic therapy</li> <li>• No further drainage</li> <li>• No active infections</li> </ul>
Tinea corporis (tinea gladiatorum)	<ul style="list-style-type: none"> <li>• Terbinafine 1% cream Topical BID 2-4 weeks</li> <li>• Ketoconazole 2% cream Topical QD 2-4 weeks</li> <li>• Clotrimazole 1% cream Topical QD 2-4 weeks</li> <li>• Fluconazole 150mg PO QD x 7 days</li> <li>• Itraconazole 100mg PO QD x 14 days</li> <li>• Terbinafine 250mg PO QD x 7 days</li> </ul>	<ul style="list-style-type: none"> <li>• Completion of 72 hours of antifungal therapy, or consider allowing participation with untreated lesions in elite athletes or those in high-stakes competitions</li> <li>• Lesions should be covered with reliable dressings</li> </ul>
Tinea capitis/barbae	<ul style="list-style-type: none"> <li>• Terbinafine 250mg PO QD 2-4 weeks</li> <li>• Ketoconazole 200mg PO QD 2-4 weeks</li> <li>• Itraconazole 200mg PO QD 2-4 weeks</li> <li>• Fluconazole 6mg/kg PO QD 3-6 weeks</li> </ul>	<ul style="list-style-type: none"> <li>• Completion of 2 weeks of systemic therapy, no drainage</li> <li>• Continued use of antifungal shampoo before practice until scalp lesions resolve</li> </ul>
Herpes simplex virus (herpes labialis or herpes gladiatorum)	<p>Primary infection</p> <ul style="list-style-type: none"> <li>• Acyclovir 400 mg PO TID x 7-10 days</li> <li>• Famciclovir 500 mg PO BID x 7-10 days</li> <li>• Valacyclovir 1 g PO TID x 7-10 days</li> </ul> <p>Recurrent infection</p> <ul style="list-style-type: none"> <li>• Acyclovir 400mg PO TID x 5 days</li> <li>• Famciclovir 750 mg PO bid x1 day</li> <li>• Valacyclovir 2 g PO BID x 1 day</li> </ul> <p>Suppression of infection</p> <ul style="list-style-type: none"> <li>• Valacyclovir 500mg-1000mg PO QD</li> </ul>	<ul style="list-style-type: none"> <li>• Free of systemic symptoms</li> <li>• No new lesions for 72 hours</li> <li>• Completion of 6-10 days of systemic antiviral therapy</li> <li>• Lesions surmounted by firm adherent crust</li> </ul>
Molluscum contagiosum	<ul style="list-style-type: none"> <li>• Physical destruction of lesions with sharp curette</li> </ul>	<ul style="list-style-type: none"> <li>• Consider allowing participation in untreated elite athletes or high-stakes competitions</li> <li>• Other athletes, after destruction of lesions</li> <li>• Treated lesions covered with gas-permeable membrane and tape</li> </ul>
Verruca vulgaris	<ul style="list-style-type: none"> <li>• Cryotherapy</li> <li>• Salicylic acid</li> <li>• Imiquimod</li> </ul>	<ul style="list-style-type: none"> <li>• Lesion should be covered</li> <li>• Consider allowing participation in untreated elite athletes or high-stakes competitions</li> </ul>

of transmission to uninfected training partners or opponents.

Prophylaxis of tinea corporis is indicated in athletes with a history of the condition and risk of recurrence due to continued exposure in combat sports with skin-to-skin contact such as wrestling, MMA or submission grappling. Studies are limited in number and were all conducted in wrestlers. One small study of 22 wrestlers noted a dramatic drop in tinea corporis just with daily skin checks and a barrier cream.<sup>35</sup> One randomized controlled trial in 131 high school wrestlers compared placebo to fluconazole 100 mg weekly. The incidence of infection was 22% with placebo but only 6% with fluconazole, and no side effects were reported in the treatment group.<sup>36</sup> Another study in a larger cohort of high school wrestlers showed that treating with fluconazole 100 mg daily for three days at the start of the season and again for three days 6 weeks into the season reduced the incidence from 67% in the year prior to treatment, to 3.5% in the 10-year period of treatment. Ninety percent of the wrestlers (375) on two teams participated. No adverse effects were reported.<sup>37</sup>

Prophylactic treatment of HSV infection is also of great interest since the burden of suffering for this infection can be high in combat sports athletes, with a potential for lifelong recurrences. Two small studies<sup>30,38</sup> and one large study<sup>22</sup> have shown that valacyclovir 1,000 mg per day during a wrestling season or “camp” markedly reduces the incidence of herpes gladiatorum in wrestlers about 85% and is effective in wrestlers with or without a prior history of herpes infection. We endorse this approach because viral shedding can also occur in asymptomatic athletes with a history of HSV infection. Physicians taking care of teams should strongly consider this prophylactic technique.

### ***Discussion***

The authors acknowledge that there is limited published literature regarding the treatment and prevention of skin infections in combat sports. Hence, much of this statement is an extrapolation

of current recommendations from other organizations (NFHS, NCAA) and incorporates both current best practices in combat sports as well as the collective expertise of the ARP membership, who have provided medical coverage of athletes in boxing, MMA, wrestling, judo, jiu jitsu, taekwondo, and other combat sports over many years.

Skin infections continue to be a significant cause of morbidity and lost training and competition days. Combat sports athletes—especially wrestlers and other grapplers—are at high risk due to vigorous and frequent skin-to-skin contact. This document serves as a brief review of the most important infections and the important principles of treatment and prevention so that morbidity and training restriction can be minimized though evidence-based or best-practice guidelines.

It should be emphasized again that primary prevention is paramount in importance. Coaches, athletes, athletic trainers and training or competition facility managers should be educated on prudent sanitation practices and adhere to them consistently. Practices such as personal hygiene and facility sanitation can greatly reduce the incidence of infections.

When infections occur and are identified, rapid initiation of treatment and isolation of the athletes from training and competition are important to minimize morbidity and prevent further spread. A quick-reference “fight night” decision tool is provided in Figure 2.

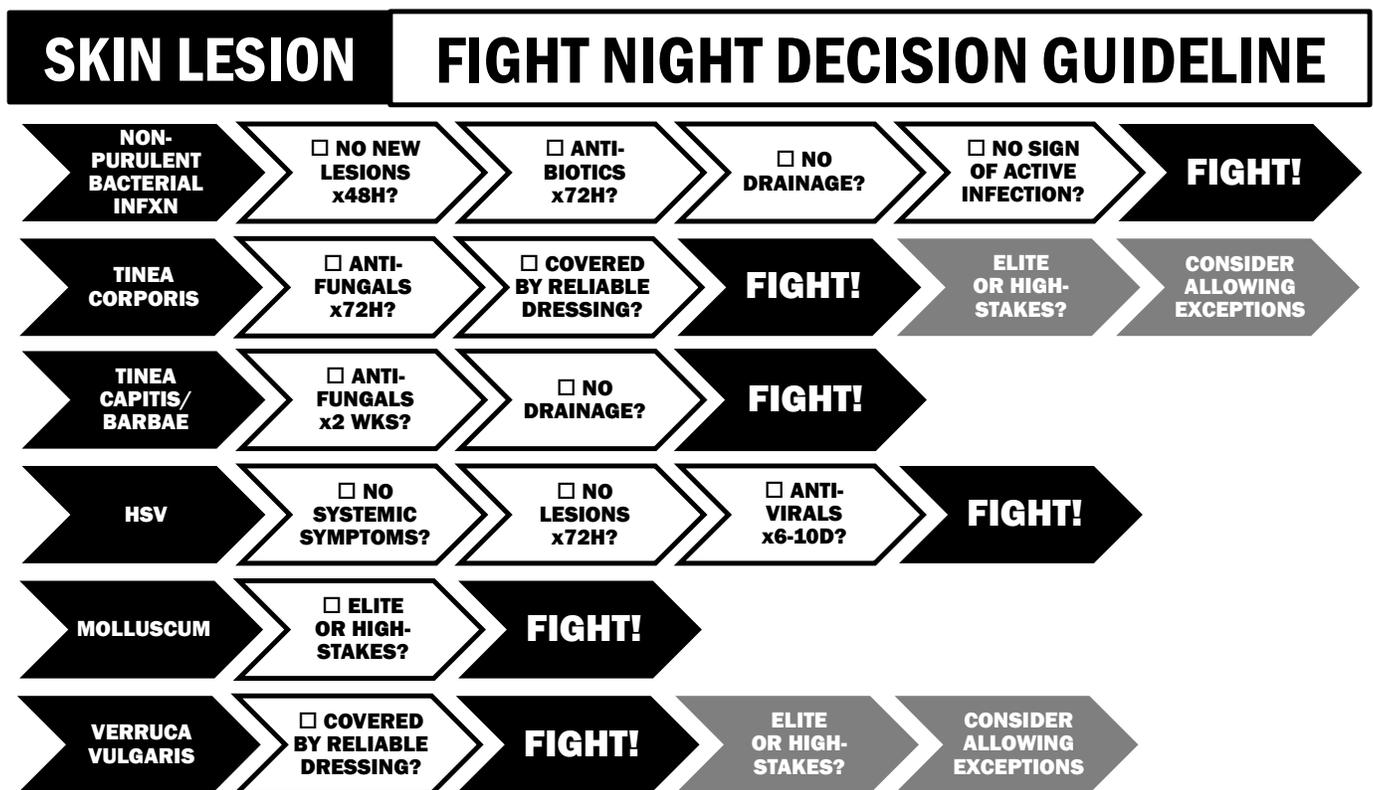
Consultation with the NFHS or NCAA skin disease guidelines for return to play are helpful and highly recommended. However, as mentioned above, deviation from these guidelines is reasonable for conditions with a relatively low burden of clinical suffering and high rate of cure with well tolerated treatments, e.g., tinea corporis, common warts, and molluscum contagiosum. This could be considered for high school state or national wrestling competitions, collegiate wrestling competition at the national and international level, and for any professional athlete competing in combat

sports, given the high stakes of the competition and the low risks of the conditions. We believe athletes with these conditions should be allowed to compete regardless of having completed a full course of treatment. However, they should cover as many lesions as possible and be advised to begin treatment as soon as possible.

In the case of herpes gladiatorum caused by HSV, using a lengthier period of isolation from contact sport during oral antiviral treatment than recommended by NFHS/NCAA should be considered. Their 120-hour (5-day) period of treatment before resuming contact sports likely comes from studies of genital herpes.<sup>39</sup> Though studies in herpes gladiatorum are very limited, one study looking at duration of viral during oral antiviral therapy in

wrestlers<sup>30</sup> showed that it took 6 to 10 days (average 8.1) for viral shedding from lesions to resolve. Therefore, the 5-day restriction period recommended by NFHS/NCAA is likely too short to prevent spread of the virus, so the ARP recommends a period of 6 to 10 days of oral antiviral treatment prior to resumption of combat sports. This should include all sports with a chance of skin-to-skin contact with the affected area. This range could be at the low end of 6 days in elite athletes at high-level competition, or at the high end of 10 days in non-elite athletes in lower-level competition or in elite athletes being restricted from contact training. Informed consent of the athlete (and guardians) and clinical judgment of the medical professional should be used to arrive at a prudent return-to-sport decision.

Figure 2. Quick-Reference "Fight Night" Decision Tool.



Prevention of new and recurrent infections of herpes gladiatorum is markedly reduced with the use of daily oral antiviral suppression therapy, both in uninfected wrestlers and those with a history of infection.<sup>22,30,38</sup> Valacyclovir 1000 mg daily is the recommended dose and is safe and well tolerated. Given the risk of transmission during both asymptomatic periods and during outbreaks, risk of lifelong recurrences if contracted, and the risk of outbreaks curtailing training and competition, prophylaxis for elite athletes is a reasonable and attractive option. Education of athletes and coaches about this approach is recommended.

### Qualifying Statement

This Position Statement (full manuscript) was approved by the ARP Board of Directors on June 2, 2023. These guidelines are recommendations to assist ringside physicians, combat sports athletes, trainers, promoters, sanctioning bodies, governmental bodies, and others in making decisions and setting policy. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints and are not intended to replace local commission laws, regulations, or policies already in place. In addition, the guidelines developed by the ARP are not intended as standards or absolute requirements, and their use cannot guarantee any specific outcome. Guidelines are subject to revision as warranted by the evolution of medical knowledge, technology, and practice. They provide the basic recommendations that are supported by synthesis and analysis of the current literature, expert and practitioner opinion, commentary, and clinical feasibility.

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## CASE REPORT

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# Incidentally detected acute leukemia in a professional boxer applying for licensure to fight—never forget the humble CBC: a case report

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DISCLOSURES: The author serves as Chief Medical Officer of the New York-State Athletic Commission. The views expressed are his and do not necessarily reflect the views of the institutions he works at and serves. Demographic details in the case report have been changed to protect the identity of the patient.

DATA SHARING STATEMENT: the author has no additional data to share.

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### **Abstract**

To determine fitness to fight, professional boxers undergo a number of tests at the time of the initial licensure and periodically thereafter. Mandatory required are not standardized and vary from athletic commission to commission. The case of a professional boxer who was incidentally detected to have acute leukemia on complete blood count (CBC) test is presented. CBC is not a costly test even if a boxer does not have insurance. The humble blood count test can reveal diseases before clinical manifestation. The value of this diagnostic powerhouse should be recognized, and all professional combatants should undergo this test at time of initial licensure and periodically thereafter.

### **Case Report**

A-30-year-old professional boxer applied for licensure to fight. As part of application for licensure medicals including CBC was presented to the attention of the Commission's medical team.

CBC showed markedly elevated WBC count at  $180 \times 10^3/\mu\text{L}$  (normal range=3.4-10.8), Hb/Hct=10 g/dL/30.4 % (normal range=13.0-17.7)/37.5-51). Platelet count was within normal limits at  $311 \times 10^3/\mu\text{L}$  (normal range=150-450). Differential showed blast cells (3) (reference interval=0), metamyelocytes (6) (reference interval=0), myelocytes (16) (reference interval=0), promyelocytes (3) (reference interval=0) and absolute neutrophils  $111.6 \times 10^3/\mu\text{L}$  (normal range is 1.4 to 7), PT/PTT/INR were 11.2/30/1.0. The blood picture of leukocytosis with myeloid left shift and few blasts was consistent with a myeloproliferative disorder such as leukemia. To rule out the possibility of laboratory error, repeat CBC was requested and it was unchanged. When questioned, the boxer denied any constitutional symptoms such as anorexia, fatigue, weight loss, fever, headache, bone and joint pain. He was denied license to fight on medical grounds and advised to make an appointment to see his primary care physician and a hematologist-oncologist.

## Discussion

Our case report highlights a few interesting observations. One is the value of the humble CBC test, a simple relatively inexpensive test that analyses the cellular components of blood. A CBC with differential is a useful test to indicate overall health status of the individual and helps to identify conditions such as anemia, infection and like in the above case report leukemia. The results of the CBC guide the physician to order more relevant testing. Acute leukemia in adult patients usually presents with constitutional symptoms. There are though atypical clinical presentations reported in the medical literature.<sup>1</sup> In our case, it was the CBC which alerted the physicians to the myeloproliferative disorder in the otherwise healthy boxer with no history of constitutional symptoms such as fatigue, anorexia, easy bruising or weight loss. Based solely on the CBC, the diagnosis of acute leukemia was made in our boxer and further delay in diagnosis was prevented.

Our case report is also a good illustration of the necessity of uniform health and safety standards in boxing. Medical requirements to compete in combat sports vary from Commission to Commission. There are still some Commissions in the United States and abroad which do not require a CBC as a prerequisite for licensure. The above boxer plying his trade in these jurisdictions would not have come to medical attention leading to delay in diagnosis and treatment. Medical requirements to compete in combat sports should be standardized across the board. Minimal medical requirements should include a CBC with differential, hepatitis B surface antigen (HBsAg), hepatitis C (HCV) serology, tests for HIV 1 and 2 (HIV-1/2 antigen/antibody combination immunoassay test), ophthalmological testing for refractive errors (visual acuity tests) and to rule out absolute ophthalmological contraindications to participation in combat sports, <sup>12</sup> lead electrocardiogram (EKG) and a neuroimaging test to rule out absolute neurological contraindications to participation in combat sports such as the presence of vascular malformations such as aneurysm, arteriovenous malformations and presence of prior significant traumatic brain injury (TBI). Ideal-

ly MRI brain without contrast should be carried out. In case of absolute contraindication to MRI scan such as the presence of metallic implants, CT scan head without contrast is acceptable keeping in mind the limitations of CT scan technology.<sup>2</sup> It should be borne in mind that when it comes to medical requirements for licensure no one size fits all. Individualized medical decision making needs to be exercised after reviewing the above minimal mandatory requirements with some combatants warranting additional testing including MRA head, cardiology clearance and neurology clearance.

Many boxers come from unprivileged backgrounds. Most do not have health insurance coverage. Our case report highlights that for many of these boxers, preflight medical tests and evaluation is their first and sole contact with health care providers and services.

## Conclusion

The CBC with differential is a simple cheap test which still retains its importance and can help the physician identify conditions such as anemia, infection and like in the above case report leukemia. Standardizing health and safety standards in boxing is the need of the hour. All boxers should undergo a CBC with differential, ophthalmological evaluation, electrocardiogram and a neuroimaging test preferably MRI brain without contrast as a prerequisite for initial licensure and periodically thereafter.

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# Polymicrogyria, To Box or Not to Box: Seizure Susceptibility with Concussion

Leah Goedecke, DO; Christopher Visser MS-III

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### *Introduction*

Polymicrogyria (PMG) is a developmental abnormality characterized by cortical malformation and is one of the most common causes of cortical malformation. The incidence of neuronal migrational defects is approximately 1 in 2,500 live births.<sup>1</sup> It is diagnosed via thin-slice MRI revealing, as the name suggests, many small gyri. It is important to obtain a high-resolution, thin-slice MRI in order to differentiate the microgyri/microsulci in PMG from the smooth cortical surface of pachygyria. The morphology and clinical presentation of this condition vary widely from extensive cortical involvement with severe disability to subtle MRI changes with minimal signs and symptoms. Common clinical presentations of PMG are mild cognitive impairment and pseudobulbar palsy.<sup>2</sup>

In unilateral polymicrogyria, the most common type of seizure is partial motor seizures, which occur in 73% of patients, followed by atypical absences in 47%, generalized tonic clonic seizures in 27% and complex partial seizures in 20% of patients.<sup>3</sup>

The etiology of PMG also varies widely. It is thought to be caused by some form of insult to development during late gestation (after 20 weeks.) There are also many genetic conditions associated with PMG such as 22q11.2 deletion and 1p36 deletion as well as over 40 single-gene disorders. Treatment of PMG is focused on symptomatic control, particularly in regards to seizure prevention.<sup>1</sup>

### *Statement of Purpose*

There are challenges that one may meet with being a ringside consultant in amateur boxing. First, you have limited time for a physical as most pre-bout physicals are done the same day. Other limiting factors include differences in regulating bodies in each state on minimal exam requirements for pre-bout physicals and limited provided medical history for each patient. Other difficulties to overcome are that most patients have no primary physician and most annual physicals are obtained from urgent care. This can often lead to missed heart murmurs, uncontrolled hypertension, improper management of chronic diseases that may limit the fighter, and in rare cases, such as this, a neurological disorder. There also seems to be limited communication between the parents, coaches, and medical professionals in management of the athletes' care.

### *Case History*

Eight-year-old male boxer presents for his pre-bout physical for his 1st USA amateur boxing match. Patient reported to the physician no medical concerns and denied any medication use or any previous loss of consciousness or concussion. The patient has been training over the last year without any complications.

### *Pre-bout Physical Exam*

Vital signs within normal limits

**HEENT:** PERRLA, convergence insufficiency with left exotropia, H-test otherwise intact with no

horizontal, vertical, or rotary nystagmus. Oral mucosa pink and moist, handling oral secretions appropriately, no uvular or lingual deviation. Mandible tracks symmetrically with opening and closing of the mouth. No pain or numbness with palpation of the bilateral forehead, eyebrows, maxilla, or mandible.

**Neck:** Head is carried in a position of subtle left side-bending. No pain with midline or paraspinal palpation of the cervical spine.

**MSK:** No gross deformity noted throughout bilateral upper or lower extremities. No obvious scoliosis noted through longitudinal palpation of the thoracic and lumbar spine. No tenderness to palpation of bony prominences in bilateral upper and lower extremities. Normal passive range of motion (ROM) with no pain of the bilateral glenohumeral joints.

**Neuro:** Shoulder shrug testing reveals markedly decreased left shoulder elevation compared to right, shoulder shrug strength against resistance is preserved, 4+/5, bilaterally. Strength is 5/5 in bilateral upper extremities, tested by having the fighter resist flexion, extension, internal rotation, and external rotation. Grip strength 5/5 bilaterally. Strength 5/5 to bilateral knee extension, plantar flexion, and dorsiflexion. Gait is intact.

### ***Differential Diagnosis:***

Accessory Nerve Injury  
Muscular Dystrophy  
Left Amblyopia  
Cerebrovascular Accident  
Polymicrogyria

### ***Final/Working Diagnosis***

Polymicrogyria

### ***Outcome/Discussion***

Based on the patient's physical exam, ability to keep his guard up, and clearance from his primary care physician, he was cleared to fight his bout. Patient did lose his bout due to a split decision. Post-bout physical was equivalent to pre-bout physical; there was no loss of consciousness or significant head trauma.

Upon further discussion with his coach, it was revealed that the patient has consistent difficulty keeping his left guard up during practices; his coach was unaware of his neurological disorder. Further discussion with the parents revealed that the patient has undergone ongoing physical therapy throughout his life with continual improvement in his strength. They additionally denied any witnessed or suspected seizure activity at any point during his life.

Significantly, as individuals with polymicrogyria reach adolescence, changes can often occur with seizure activity;<sup>4</sup> however, the greatest seizure risk does appear to be during the intense period of rapid brain growth and synaptogenesis in the first year of life.<sup>3</sup> About 80% of patients with a highly epileptogenic lesion tend to develop seizures within the first 5 years of life.<sup>3</sup> Although there are no studies directly correlating polymicrogyria seizure activity to increased concussion potential, we are aware that concussions are associated with ionic shifts altering the neuronal transmembrane potential. Neuronal dysfunction can also occur with altered metabolism, impaired connectivity and/or changes in neurotransmission.<sup>5</sup> The alpha3 Na<sup>+</sup>, K<sup>+</sup> -ATPase subunit is responsible for maintaining the normal electrocardiogram gradient in membrane potential after repeated membrane depolarization.<sup>3</sup> An alteration or decrease in this alpha 3 subunit can result in hyperexcitability of the membrane which may play a role in epilepsy. Moreover there can be alterations of the glutamate receptor distribution in the expression of NMDA receptor

subunits 1 and 2B which can result in high susceptibility to seizures with certain brain insults such as excitable cortical stimulation. During a traumatic impact to the brain, there is an indiscriminate release of neurotransmitters and unchecked ionic flux. There is also increased binding of glutamate to the NMDA receptor which leads to further neuronal depolarization. Acutely, in an effort to restore neuronal membrane potential, the sodium pump works over time and triggers a high demand in glucose metabolism. In polymicrogyria, there seems to be a predisposition to greater concussion susceptibility due to the disturbances in cortical connectivity, asymmetrical distribution of sodium and potassium ions across the plasma membrane, and regulated expression of the NMDA receptor.<sup>3</sup> Although no studies have directly investigated boxers with a history of seizure disorder, it is likely not safe to let a patient participate in boxing if they are susceptible to seizures. Given the results of this literature review, it is unclear as to whether or not this patient's diagnosis of polymicrogyria with no history of seizures ought to be an absolute contraindication to boxing. However, a discussion with his pediatric neurologist prior to further participation in combat sports is likely warranted.

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Aggleton JP. Understanding anterograde amnesia: disconnections and hidden lesions. *QJ Exp Psychol*. 2008;61(10):1441-1471. <http://search.ebscohost.com/login.aspx?direct=true&db=pbh&AN=34168185&site=ehost-live> Accessed March 18, 2010.

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#### Journal Article with No Named Author or Group Name:

Centers for Disease Control and Prevention (CDC). Licensure of a meningococcal conjugate vaccine (Menveo) and guidance for use--Advisory Committee on Immunization Practices (ACIP), 2010. *MMWR Morb Mortal Wkly Rep*. 2010;59(9):273.

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Rantucci MJ. *Pharmacists Talking With Patients: A Guide to Patient Counseling*. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2007.

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Solensky R. Drug allergy: desensitization and treatment of reactions to antibiotics and aspirin. In: Lockey P, ed. *Allergens and Allergen Immunotherapy*. 3rd ed. New York, NY: Marcel Dekker; 2004:585-606.

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