Boxing

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Key Points

- Boxing is an ancient and unique combat sport.
- Continued competition in the sport remains controversial.
- Injury patterns differ between professional and amateur boxing, given the differences in protective equipment.
- Common injuries include those to the head/neck region and upper extremities.
- The ringside physician plays the role of both health-care provider and health advocate for the athlete.

Introduction

History

Boxing has a long and rich history, dating back to between 1500 and 3000 BC, when few rules existed and combat was bare-fisted. After spreading throughout the Mediterranean, boxing first appeared as an Olympic event in 688 BC where boxers wore headgear and leather hand wrappings for protection. With the collapse of the Roman Empire, the sport largely disappeared until the eighteenth century when it gained popularity in Britain. In 1743, John Broughton, commonly considered the "father of modern boxing," created new rules, further developed by the introduction of the Queensbury Rules in 1867. These rules converted boxing from bare-fisted contest into the timed, gloved sport similar to that which we recognize today [1, 2]. Boxing appeared in the modern Olympic Games in 1904, with women participating in exhibition games in the same year. Despite its long history, boxing as a sport remains controversial. This comes as no surprise given direct blows and therefore infliction of injury upon one's opponent is fundamental to success (Fig. 49.1).

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Sports Medicine in Boxing

Medical personnel have been an integral part of boxing since its early days. The role of the ringside physician has evolved over time, culminating with the Professional Boxing Safety Act in 1996 mandating on-site physician coverage at each event. Given the combat nature of boxing, the ringside physician has a particularly important role, not only as a medical provider but also as a true advocate for the safety of the athlete.

Professional Versus Amateur Boxing

Amateur and professional boxing differ in areas of protective equipment, timing, refereeing, scoring, and allowed medical interventions.

Amateur boxing is governed by the International Amateur Boxing Association (AIBA). Males and females age 15–40 are eligible for competition as amateur boxers [3]. Professional boxing has no universal governing body. Rules and regulations are specified by individual countries and even differ within one country [4].

Protective Equipment and Injury Prevention

In amateur boxing, the use of certain protective equipment is mandated to ensure the health and well-being of boxers. Ring size and protective padding is standardized. Amateur

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Fig. 49.1 Boxing. (Reprinted with permission by iStock# 591825788)

boxers wear 10 or 12 ounce (283–340 g) padded gloves (depending on weight category); use hand wraps of specified length (2.5 m) and width (5.7 cm); must dress in light boots, shorts, and singlet/top; use a cup protector (males); and use a form-fitted gumshield. Female boxers may wear a form-fitted breast protector [3]. All amateur boxers also wore protective headguards up until 2013 when the AIBA removed headguards for elite amateur boxers citing internal evidence that it would reduce the rate of concussion in this groups [3]. The vast majority of studies on injury patterns in boxers is prior to this change. It was written as of 2018, the AIBA plans to ban headguards for all amateur boxers [5].

In contrast, professional boxing ring size varies depending on location, the use of headguards and wearing of singlets/tops is prohibited, and glove size depends on the jurisdiction.

Injury Epidemiology

Boxing is often considered a dangerous sport with high injury rates. High-quality prospective research on the epidemiology of boxing injuries is limited and studies vary greatly in reported injury statistics.

Injury risk is much higher during competition for both professional and amateur boxers (Table 49.1). During training, more protective hand wrappings and heavier gloves may be utilized; punches are thrown in a more controlled setting; sparring is less intense than competition; and many punches are "pulled" (i.e., not making full contact) [6]. Despite this, training hours vastly outnumber those of competition, so both settings contribute significantly to injuries with 42.9–65% of injuries occurring during training [7, 8].

Table 49.1 Injury rates in competition and training between amateur and professional boxers [9–12]

	Training (per 1000 hours)	Competition (per 1000 hours)
Amateur	0.5	920–1221.4
Professional	0.7–1.8	250.6–1081

Table 49.2 Injury patterns in amateur and professional boxing [6]

	Amateur (%)	Professional (%)
Head/neck	9–75	74–96
Upper extremity	14–55	0–22
Lower extremity	4–24	0–2
Trunk/other	0–16	2–5

The overall injury rate for combined amateur and professional boxing in both training and competition has been reported as 2.0 per 1000 hours [11].

Injury patterns differ between professional and amateur boxing, likely due to differences in protective equipment (e.g., headguard prior to 2013) and stricter refereeing in amateur boxing (Table 49.2). Studies show a wide range of injury patterns likely due to vast differences in methods and injury definitions. Overall, there is a trend toward higher rates of head/neck injuries in professional boxers, with very few upper extremity, lower extremity, or trunk injuries. In contrast, while head/neck injuries still predominated in amateur boxers, there was a higher proportion of upper and lower extremity injuries as compared to professional boxers [6]. Again, this is thought to be due to headguard use in amateur boxing prior to 2013, stricter refereeing in amateur boxing, and more liberal handwrapping allowed in professional boxing [9].

Head/Neck Injuries

The most common injuries within the head/neck region include facial and scalp lacerations and contusions, and concussions. Facial/scalp lacerations and contusions are the most common head/neck injuries, although rates vary widely between studies – 7–93% in amateur boxers and 12–96% in professional [6, 10]. These injuries are traditionally more common in professional boxing than in amateur boxing secondary to longtime use of headguards in amateur boxing [8, 9, 12]. This appears to be changing with the aforementioned removal of headguards in amateur boxing [6, 9].

The second most common head/neck injury in boxing is concussion. Reported rates of concussion vary in the literature (12–52% of total injuries in prospective studies) [9]. Studies suggest differences in concussion criteria/diagnosis as contributing greatly to the variability in rates [6]. Concussions occur more often in competition than in training. The removal of headguards from amateur boxing was done to hopefully decrease rates of concussion, the theory being that removal of protective headguards will decrease the severity with which opponents throw punches and therefore reduce the force transmitted to the brain. This is reportedly based on internal evidence within the AIBA [5]. Further research is needed to follow concussion rates.

Less-frequent injuries in the head/neck region include periorbital hematoma, tympanic membrane rupture, epistaxis, nasal bone fractures, retinal detachment, intracerebral hematoma, epidural hematoma, and subdural hematoma.

There have been case reports of death in boxing, thought likely due to vertebral artery dissection. These are exceedingly rare, such that prospective epidemiologic studies of injury risks have failed to capture these.

Upper Extremity Injuries

The majority of upper extremity boxing injuries occur at the hand (11–53%) and wrist (19–49%) according to prospective studies [6]. The types of upper extremity injuries do not appear to differ significantly between amateur and professional boxing.

One of the most common acute injuries is "boxer's knuckle," which is a traumatic injury to any of the second through fifth MCP joint capsules with injury to the extensor apparatus, comprising up to a third of upper extremity amateur boxing injuries [12]. The third MCP joint is most at risk for this injury, given its prominence in a clenched fist. Symptoms include arthralgia, swelling, limitation in range of motion at the MCP joint, and tendon subluxation. Boxer's knuckle can be career threatening if not properly diagnosed. Management depends on injury severity, degree of instability, and athlete level [13]. Conservative management involves buddy taping or splinting in extension, often employed for injuries without instability [13]. The use of intra-articular corticosteroid injections for this injury has not been studied in the literature. Surgical management is often required for injuries with instability, those that have failed conservative management, and high-level athletes for whom quick return to play is necessary [13].

Tearing of the ulnar collateral ligament (UCL) of the MCP joint of the thumb ("skier's thumb") comprises 13–30% of upper extremity injuries [6]. In boxing gloves, the thumb lies adjacent to the PIP joint of the second digit, which is a particularly vulnerable position for adduction injury [14]. Skier's thumb often presents with pain at the ulnar aspect of the first MCP joint and laxity with valgus stress at the joint.

Fractures account for 9–47% of upper extremity injures in boxing [6]. The classic "boxer's fracture," (transverse fracture of the neck of the fifth metacarpal); Bennet's fracture (fracture of the base of the first metacarpal bone with extension in the CMC joint); other metacarpal fractures, and proximal phalangeal fractures of the fingers are most common [8, 9, 12].

Other upper extremity injuries in boxing include contusions; wrist, elbow, or shoulder sprains; shoulder impingement; and biceps muscle or tendon tears [8, 9].

Lower Extremity and Trunk Injuries

Acute lower extremity and trunk injuries in boxing are uncommon. The most common lower extremity injuries include thigh tears, adductor tears, meniscal or ligamentous tears of the knee, ankle sprains, and lower extremity contusions [8, 12]. Fractures are rare [8].

The most common trunk injuries are rib contusions [8, 9]. There is one report of pneumothorax due to boxing [15]. Few reports of splenic rupture in boxing exist, though those have been reported in the setting of infectious mononucleosis [16, 17]. These are rare, so not well documented in epidemiologic studies of boxing injuries.

What Is Unique About Boxing Injuries?

- Unlike most sports, the goal of a boxer is to inflict pain, bodily harm, head blows on their opponent.
- Blows to the head and bodily fluid exposure are expected during each bout.
- Any knock-out and technical knock-out incurs an automatic medical suspension of at least 1 month.
- Unlike most other sports, physicians have the authority to stop a fight.

- Women must sign disclaimer stating they are not pregnant to the best of their knowledge [18].
- Boxers require pre- and post-fight physicals.

What Physicians Need to Know About Boxing?

The role of the ringside physician is different from that of other sports. He or she is responsible not only for the health of the athlete but also for the safety of the athlete during competition. This involves evaluations both before and after the fight, as well as care during the fight. The ringside physician should possess a valid state license for the state in which the fight occurs, and must possess experience and abilities in high acuity triage and trauma assessment. He or she must have a solid fund of orthopedic knowledge, head injury/concussion assessment experience, and airway management skills. The physician can stop a fight beforehand based on the pre-fight physical or during the fight at any time by mounting the ring apron.

The ringside physician must continuously follow the action of a bout. If called into the ring by the referee, a physician approaches the ring at the neutral corner and attends to the injured boxer. The physician should be on high alert for cervical spine injuries. Common injuries for which the ringside physician is summoned include lacerations, nosebleed, head injuries/disorientation, or joint injuries. Physicians need to know which injuries would disqualify fighters from competition and act accordingly, forcefully if necessary (Tables 49.3 and 49.4) [18].

Covering physicians should have certain medications readily available ringside. These would include albuterol, epinephrine 1 mg/ml, morphine, IV diazepam or buccal midazolam (for seizure activity), thrombin and avitene (to accelerate clot formation), and an anti-emetic [18].

Physicians covering boxing matches should have their emergency action plans and protocols in place at the time of the event. Having established relationships with local hospitals and appropriate providers is recommended (Table 49.5).

Cutman

Cutmen play an important role for boxers. They are tasked with controlling and stopping bleeding within 1 minute from nosebleeds or lacerations that would otherwise disqualify the boxer. Use of medications in controlling bleeding is barred in amateur boxing, but any topical treatment is allowed in professional boxing. Petroleum jelly is often applied pre-bout in attempts to prevent lacerations. An enswell, a smooth metal instrument often chilled, is used to control facial swelling or hematomas. In professional boxing, various topical medications, often mixed with petroleum jelly, such as avitene, epi-

Table 49.3 AIBA Medical handbook- disqualifying conditions prior to competition [18]

Severe chronic infections
Severe blood dyscrasias (e.g., sickle cell disease)
Hepatitis B/C, or HIV infection
Refractive and intraocular surgery, cataract, retinal detachment
Myopia of more than −5 diopters
Recorded visual acuity in each of: Uncorrected worse than 20/200 Corrected worse than 20/50
Exposed open infected skin lesions
Significant congenital or acquired cardiovascular, pulmonary, or musculoskeletal deficiencies or abnormalities
Unresolved post-concussion symptoms, which will need clearance from a neurologist
Significant psychiatric disturbances or drug abuse
Significant congenital or acquired intracranial mass lesions or bleeding
Any seizure activity within the last 3 years
Hepatomegaly, splenomegaly, ascites
Uncontrolled diabetes mellitus or uncontrolled thyroid disease
Pregnancy
Any implantable device that can alter any physiologic process
Women's breast protector, which protects legitimate scoring areas beside the breast

Table 49.4 AIBA disqualifying injuries during competition [18]

Excessive swelling of face or eyes that impair vision
Deep cuts (subcutaneous tissue visible) in the Inverted Bell Zone[a]
Suspected/proven fractures of nose, face, or metacarpals
Presence/history of retinal detachment
Lacerations or wounds requiring dressings for control of bleeding
Nose bleeds complicated by arterial bleed, septal hematoma, facial fracture, or excessive bleeding
Concussion
Knockout

[a]Zone including important facial structures of eyes, lacrimal ducts, nose, lips, mouth, naso-ethmoidal bones

Table 49.5 Recommended medical equipment: ringside and medical room [18]

Ringside	Medical room
Penlight	Venous cannulas
Oral/nasal airways	Infusion sets
Gloves	Wound cleansing equipment
Blood pressure cuff	Wound glue
Petroleum jelly	Absorbable/nonabsorbable sutures
Sponges	Suturing instruments
Adhesive tape	
Stethoscope	
Stretcher	
Oxygen tank	
Cervical collar	
Defibrillator	
Clean towels	
Two buckets, one with ice and one empty	
Ice and ice bags	
Scissors/trauma shears	

nephrine, thrombin, or surgical glues are used. Cutmen commonly treat aforementioned injuries prior to involvement of the ringside physician.

General Rule About Return to Play

Return to play for boxing is clearly injury specific. Following a knockout or a technical knockout, the boxer will incur a mandatory medical suspension for at least 1 month, maybe longer depending on whether there is loss of consciousness. No specific protocols are currently in place for most injuries. The physician and athlete should keep in mind the extensive demands on the body with repeated physical contact associated with boxing, and they should wait until recovered and able to withstand the repeated trauma. Whenever possible, physicians should follow standard guidelines from governing bodies, such as the NCAA, where appropriate.

References

1. Gambrell RC. Boxing: medical care in and out of the ring. Curr Sports Med Rep. 2007;6(5):317–21.
2. Jako P. Boxing. In: Kordi R, Maffulli N, Wroble RR, Wallace WA, editors. Combat Sports Medicine [Internet]. London: Springer London; 2009 [Cited 26 Feb 2017]. p. 193–213. Available from: http://link.springer.com/10.1007/978-1-84800-354-5_12.
3. AIBA Technical Rules [Internet]. AIBA; 2016. Available from: http://d152tffy3gbaeg.cloudfront.net/2015/02/AIBA_TR_2016-12-28.pdf.
4. Sammons JT, Wallenfeldt EC, Krystal A, Collins N, Poliakoff M, Olver R, et al. Boxing. In: Encyclopædia Britannica [Internet]. Encyclopædia Britannica, inc.; 2016. Available from: https://www.britannica.com/sports/boxing.
5. Dickinson P, Rempel P. Prohibiting headgear for safety in Amateur boxing? Opinion of the Canadian Boxing Community: an Online Poll. Sports Med - Open [Internet]. 2016 [Cited 30 Mar 2017];2(1). Available from: http://www.sportsmedicine-open.com/content/2/1/19.
6. Loosemore M, Lightfoot J, Beardsley C. Boxing injuries by anatomical location: a systematic review. Med Sport. 2015;XI(2):2583–90.
7. Zazryn TR, McCrory PR, Cameron PA. Injury rates and risk factors in competitive professional boxing. Clin J Sport Med Off J Can Acad Sport Med. 2009;19(1):20–5.
8. Siewe J, Rudat J, Zarghooni K, Sobottke R, Eysel P, Herren C, et al. Injuries in competitive boxing. A prospective study. Int J Sports Med. 2015;36(3):249–53.
9. Loosemore M, Lightfoot J, Palmer-Green D, Gatt I, Bilzon J, Beardsley C. Boxing injury epidemiology in the Great Britain team: a 5-year surveillance study of medically diagnosed injury incidence and outcome. Br J Sports Med. 2015;49(17):1100–7.
10. Zazryn TR, Finch CF, McCrory P. A 16 year study of injuries to professional boxers in the state of Victoria, Australia. Br J Sports Med. 2003;37(4):321–4.
11. Zazryn T, Cameron P, McCrory P. A prospective cohort study of injury in amateur and professional boxing. Br J Sports Med. 2006;40(8):670–4.
12. Porter M, O'Brien M. Incidence and severity of injuries resulting from amateur boxing in Ireland. Clin J Sport Med Off J Can Acad Sport Med. 1996;6(2):97–101.
13. Lin JD, Strauch RJ. Closed soft tissue extensor mechanism injuries (Mallet, Boutonniere, and Sagittal Band). J Hand Surg. 2014;39(5):1005–11.
14. Noble C. Hand injuries in boxing. Am J Sports Med. 1987;15(4):342–6.
15. Belham GJ, Adler M. Pneumothorax in a boxer. Br J Sports Med. 1985;19(1):45.
16. Marien B, Cullen P, Long RC. Boxing injury: rupture of spleen in infectious mononucleosis. Can Med Assoc J. 1955;73(3):213–4.
17. Lovaas M. Ruptured spleen in a boxer with infectious mononucleosis. Minn Med. 1981;64(8):461–2.
18. AIBA 2016 Medical Handbook for Ringside Doctors [Internet]. AIBA; 2016. Available from: http://d152tffy3gbaeg.cloudfront.net/2015/02/20161101_AIBA_MEDICAL_HANDBOOK.pdf.