

Background

- Firearm injuries are the leading cause of death in children.¹
- Upper extremity (UE) gunshot wounds (GSWs) can have long-term functional deficits and create significant economic burdens on victims and families.^{2,3}
- There is a paucity of literature describing these injuries within the pediatric population, specifically regarding the upper extremity.

Research Question

- The aim of our study was to determine the etiology, management, and outcomes of children presenting with UE gunshot wounds at a large academic level one pediatric hospital.

Methods

- A retrospective review of 120 patients who presented from 2011-2024 with UE GSWs was conducted following IRB approval.
- Descriptive analysis was completed.



Figure 1. One-year-old male who sustained a GSW after a drive-by shooting to the posterior right upper arm (top left) and wrist (top right) requiring open reduction and external fixation of the humerus (bottom left) and radial nerve reconstruction (bottom right – 4 cable grafts, 5cm in length).

Results

Table 1. Patient Demographics (N=120)

Characteristic	Number (%)
Sex	
Male	98 (81.67%)
Female	22 (18.33%)
Age	
Mean	12.8 years
Youngest	0.75 years
Oldest	19 years
Race	
Black	61 (50.83%)
Hispanic	45 (37.5%)
White	12 (10%)
Asian	1 (0.83%)
American Indian	1 (0.83%)
Number of GSW	
Single	98 (81.67%)
Multiple	22 (18.33%)
Injury Etiology	
Assault	76 (63.33%)
Unintentional	37 (30.83%)
Unknown	6 (5%)
Self-Inflicted	1 (0.83%)

Abbreviations: GSW, gunshot wound

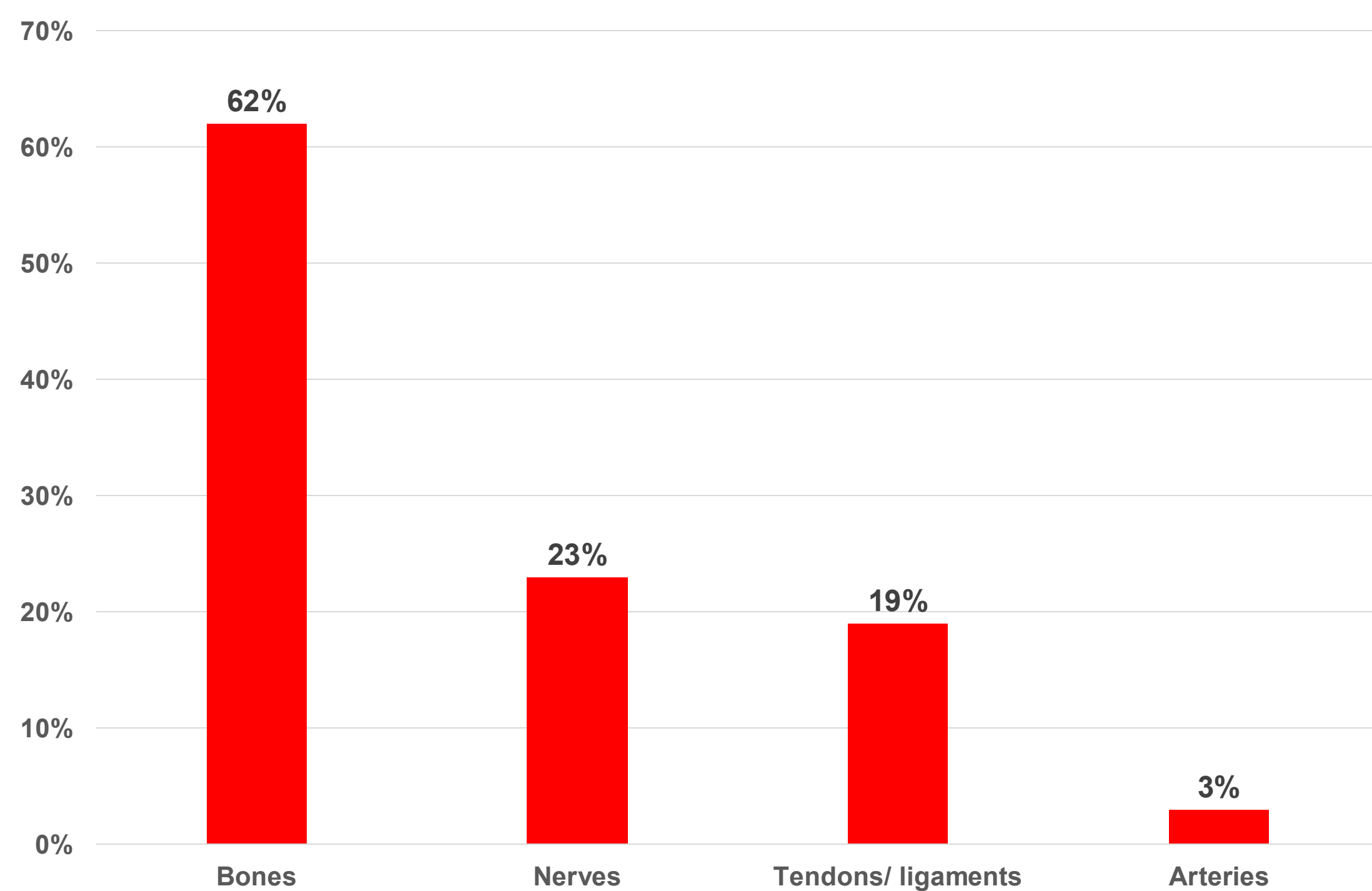


Figure 1. Injured structures (N=120). Fractured bones included phalanges, metacarpals, humerus, ulna, radius, carpals, clavicle and scapula. Injured nerves included digital, median, ulnar, radial, anterior/posterior interosseous nerves and the brachial plexus. Flexor and extensor tendons were injured along with various UE ligaments. Injured arteries included the brachial and radial arteries.

Results cont.

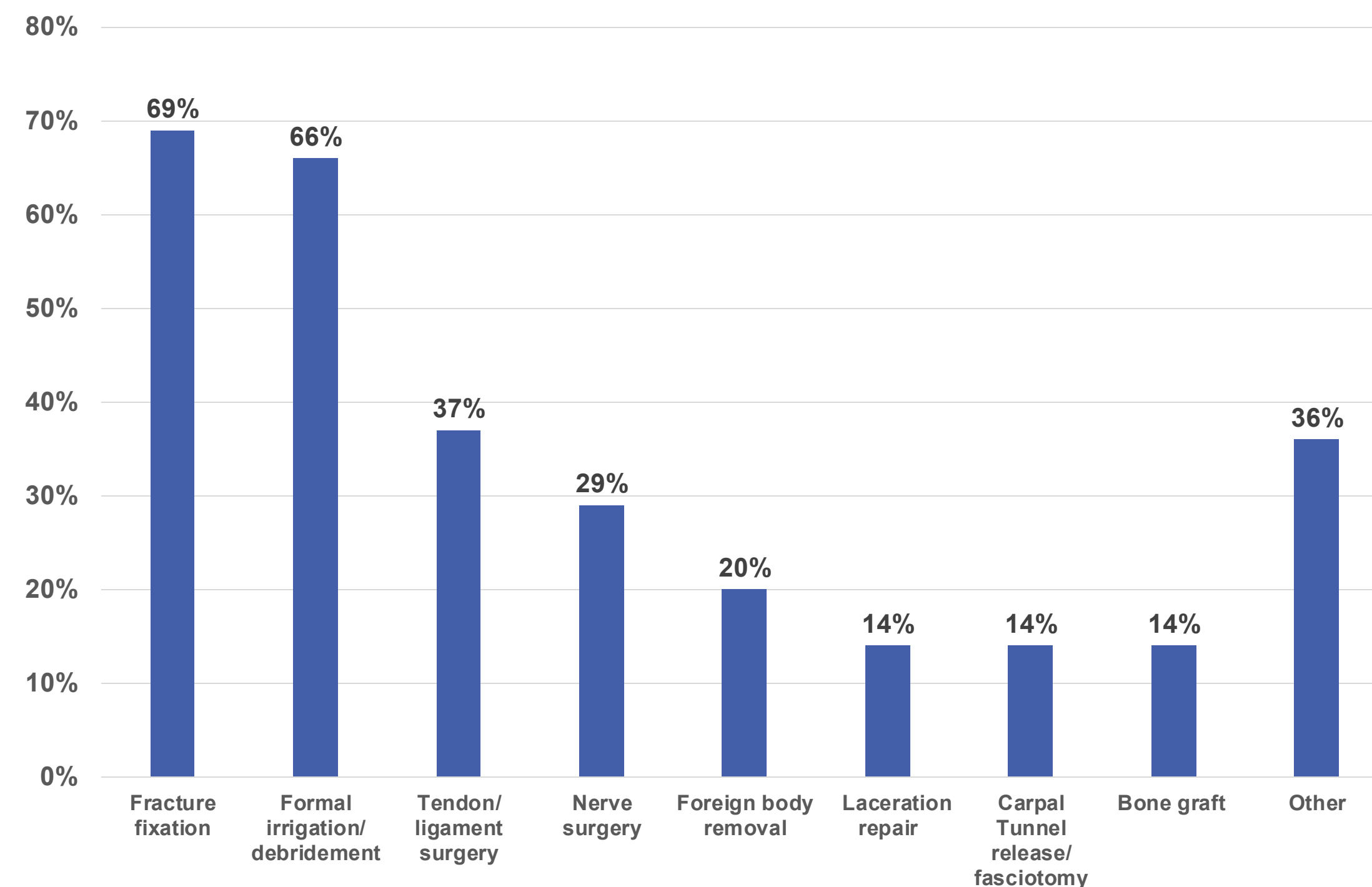


Figure 2. Formal operative interventions (N=59). Fracture fixation included open and closed reduction and internal fixation, open and closed reduction and percutaneous pinning and external fixation. Tendon/ ligament surgery included repair, tenolysis, and tendon transfer. Nerve surgery included repair, neurolysis, grafting and neuroma excision. Other interventions included skin grafting, flap coverage, arthrodesis, digit amputation, arthroscopy, retinacula repair and arterial repair or ligation.

Table 2. UE Outcomes/Complications (N=120)

Outcomes/Complications	Number (%)
Limited ROM	37 (30.83%)
No complications	36 (30%)
Sensory deficit/paresthesia	28 (23.33%)
No follow-up	23 (19.17%)
Strength deficit	11 (9.17%)
Stiffness	8 (6.67%)
Fine motor deficits	4 (3.33%)
Psychological sequelae	4 (3.33%)
Finger malrotation	2 (1.67%)
Infection	2 (1.67%)
Pseudoaneurysm	2 (1.67%)
Pneumothorax	1 (0.83%)
Pneumomediastinum	1 (0.83%)

Abbreviations: ROM, range of motion

Results cont.

- Key Findings:
 - Average age on presentation was 12.8 years.
 - 82% were male and 51% were Black or African American.
 - Assault (63%) and unintentional injury (31%) were the most common etiologies.
 - Injured structures included bones (62%), nerves (23%), tendons/ligaments (19%), and arteries (3%).
 - Hand bones were most injured, (phalanges (22%) and metacarpals (18%)) followed by the humerus (17%).
 - Forty-nine percent underwent operative intervention, most frequently for fracture fixation (69%), formal irrigation and debridement (66%), tendon/ ligament surgery (37%), and nerve surgery (29%).
 - Limited range of motion and sensory deficits (31% and 23%, respectively) were the most common long-term morbidities.
 - Follow-up was an average of 19 weeks (Range: 0-226), with 19% of patients having no follow-up.

Discussion

- UE GSWs most frequently affect the hand.
- Operative intervention is often required.
- UE GSWs are associated with high morbidity and functional debilitation and sensory loss are common complications.
- Nearly one-third of injuries were unintentional.
- A limitation of our study is a relatively high rate of no follow-up, 19% of patients.
 - GSWs disproportionately affect impoverished communities who may face barriers to completing/receiving adequate post-trauma care.²
 - Increased healthcare outreach within lower socioeconomic status communities may improve patient follow-up and may help long-term UE GSW morbidity.
- Firearm type was unable to be reliably determined from medical records; however, most GSWs in the civilian setting result from low-velocity weapons.²
 - Future studies on type of firearm can further delineate injury characteristics and severity in the pediatric population based on weapon type.
- To mitigate risk of GSWs in the pediatric population, especially incidental injuries, increased educational initiatives prioritizing safe storage should be pursued.

1. Wooten RB, Stevens A, Delgado-Bell L, et al. Firearm Injuries: Adolescent and Pediatric Gunshot Trauma in the Real World. *J Am Acad Orthop Surg*. 2024;32(10):1010-1020. doi:10.5435/JAAOS-D-23-00172

2. Fowler KA, Dahlborg LJ, Hultgren T, Anwar H. Firearm injuries in the United States. *Proc Acad*. 2015;7(5):5-14. doi:10.1016/j.pacad.2015.06.002

3. Ouellet R, Shaw MA, Zakaria CC, Morlock GS. Gunshot Wounds in the Upper Extremity. *J Am Acad Orthop Surg*. 2015;23(7):e501-e510. doi:10.5435/JAAOS-D-13-00026