Objectives

- Review key concepts related to Brachial Plexus injuries in Football
  - Anatomy
  - Incidence
  - Mechanism of Injury
  - Differential Diagnosis
  - On Field Physical Exam
  - Return to Play decision making
  - Sideline vs Chronic
  - Prevention strategies
  - Rehabilitation
- Case Study experiences

Incidence of Injury

- Up to 50% of all football players have at least one stinger in career. (Daly et al 2016)
  - Incidence rate of approx 7.7%
- Up to 70% of collegiate FB player experience burners or stingers during a 4-year career (AAOS – 2014)
- Up to 70% of collegiate FB players that had a stinger did not report it to medical personnel. (Salis et al 1992)
  - 87% had recurrence

Anatomy Review

- Dermatomes
  - C5-C6 – Thumb, radial forearm, biceps, deltoid
  - C6-C7 – 2-4 phalanges, wrist, central forearm
  - C7-C8 – 4th-5th finger

- Muscle innervation
  - Deltoid – Axillary nerve (C5, C6)
  - Supraspinatus – suprascapular nerve (C5, C6)
  - Infraspinatus – suprascapular nerve (C5, C6)
  - Biceps – musculocutaneous (C5, C6)
  - Triceps – radial nerve (C6, C7)
Incidence of Injury

- NCAA-ISP data: FB 2009/10 – 2014/15
  - 2/10,000 athlete exposures
    - Competition – 11.6/10,000 AE
    - Practice – 1/10,000 AE
  - 80% Regular Season
  - 18% Pre-Season
  - 93% from “player contact”
  - Position:
    - 26% DE/LB, 23.5% OL, 17.5% DB, 13% RB

Mechanism of Injury

- Stretch/Traction
- Direct Impact
- Hyperextension
  - Erb’s Point
  - Nerve Root Compression @ neural foramina
  - Results in significantly greater time loss
    - (Duly et al 2016)

Injury Pathophysiology

- Seddon’s Classifications (1943)
  - Grade 1 - Neurapraxia: selective demyelination of nerve sheath
    - Remyelination within 3 weeks. EMG typical WNL
  - Grade 2 - Axonotmesis: disruption of the axon and the myelin sheath.
    - Typically show EMG deficits within 2-3 weeks
  - Grade 3 - Neurotmesis: complete disruption of endoneurium.
    - Permanent nerve damage

Injury Severity

- NCAA-ISP data: FB 2009/10 – 2014/15
  - Time Loss
    - 64%: < 24Hrs
    - 18%: 1-6 Days
    - 10%: 7-21 Days
    - 5.7%: > 21 Days
  - 0 Surgeries
  - 19% were “Recurrent”
  - No athlete reported >2 Stingers in a season

Differential Diagnosis

- C-spine Fracture
- C-spine Dislocation
- Disc herniation
- Spinal cord contusion
- Nerve Root impingement
- Nerve Root avulsion
  - Horner’s Response – T1 avulsion
  - Miosis (constriction of pupil)
  - Ptosis (drooping of eyelid)
- Congenital abnormalities (stenosis)
- Subclavian arterial injury
- Concussion

On-Field Physical Exam

- Neck Pain?
- C-spine central pain to palpation?
- AROM painful?
- Spurlings Test
  - High specificity(95%)/Low sensitivity (30%)
    - (Tong 2002)
- Sensation deficits?
- Motor deficits?
  - C5,C6:Upper Trunk most commonly affected
  - Deltoid, SS, IS, Biceps
  - 1st Tests: ABD, Empty can, ER, elbow Flexion
  - 2nd Tests: IR, Triceps, Grip, Finger/thumb Ext
  - “Protect yourself...”
Diagnostic Study Indications

- X-ray (A/P, Lat, Obl, Flex/Ext Lat)
  - Severe neck pain
  - Focal C-spine tenderness
  - Limited C-spine motion

- MRI
  - Bilateral or Quad symptoms
  - Persistent neurological deficits

Kulhman, G (2015)

CT Scan

- Quantify spinal stenosis

EMG

- Prolonged neurological deficits
  - EMG deficits often delayed
  - Consider waiting 3 weeks + for optimal results
  - Deficits may persist after sensation/strength WNL.
    - Therefore not a strong RTP correlation

Kulhman, G (2015)

Return to Play

- "General Criteria"
  - Full / Pain free C-spine AROM
  - WNL Sensation
  - WNL Strength

- MMT vs Devices

Watkins et al - 1990

Point rating system for risk level and RTP

3 Factors

- Type/Extent of Neurological Deficit
  - Unilateral, bilateral, multiple limb, Tran. Quadriplegia
  - Tran. Quadriparesis etc
  - Duration of Neurological Deficit
    - <2hrs, <1hr, <24hrs, <1wk, >1wk
  - Central diameter of Neural Canal
    - >12mm, 10-12mm, 10mm, 8-10mm, 8mm
  - Total Score
    - >6 pts = Minimal Risk
    - 6-10 pts = Moderate Risk
    - 10-15 pts = Severe Risk

Torg and Ramsey-Emrhein - 1997

No Contraindication: no increase in risk of serious injury.

Relative Contraindications: no clear evidence of increased risk but possible recurrent injury noncatastrophic injury.

Absolute Contraindication: a clear increased risk of severe injury.
  - Neck Pain, Limited ROM, Neurological Sx

General criteria for RTP: No pain, Full ROM, WNL strength, No Neuro injury.

Vaccaro et al – 2002

No Contraindications

2 stingers within same or multiple seasons

Relative Contraindications

3 or more stingers in same season

Previous transient quadriplegia or quadriparesis – Must have WNL MMT, Full ROM, imaging of mild to mod stenosis or less.

Absolute Contraindications

More than 2 episodes of transient quadriplegia or quadriparesis.

Continued neck pain or neurological deficit or decreased ROM after injury.
Return to Play

- Cantu et al – 2013
- **No contraindications**
  - Less than 3 stingers with symptoms less than 24hrs that meet General Criteria
  - 1 episode transient quadripareisis that meets General Criteria
- **Relative Contraindications**
  - Prolonged symptomatic stinger or transient quadripareisis longer than 24hrs.
  - 3 or more stingers or 2 episodes of transient quadripareisis that meet General criteria.
- **Absolute Contraindications**
  - Transient quadripareisis episode that does NOT meet General Criteria (still symptomatic) or has evidence of canal stenosis on exam.

Prevention

- Stretching (muscular vs nerve?)
  - Neck, Traps, Posture assessment
- Strengthening
  - Neck, Traps, RTC
- Padding
  - Risk v Reward
- Technique
  - Wrapping up v Launching

Rehabilitation

- **Grade 1 Injury** – Relatively minor rehab
  - Heat vs ice
  - Modalities
  - Massage
  - Oral NSAIDS vs corticosteroids
  - AROM/PROM C-spine
    - (Begin w/ pain free ROM)
  - Strengthen Neck, traps, RTC
  - Goals: Reduce pain, prevent recurrence

Rehabilitation

- **Grade 2 Injury**
  - PROM/AROM/RROM C-spine
  - AROM/RROM Shoulder/RTC
  - Corticosteroids Rx
  - Expect slow recovery (“weeks not days”)
  - Goal: General Criteria prior to RTP

Rehabilitation

- **Grade 3 Injury**
  - D/C Sports
  - Nerve grafts and/or transfers
  - Goal: ADL

Case Study #1

- RS-SR DB
- Removed from play after stinger 1Q
- RTP in 2Q w WNL MMT/sensation per Ortho MD
- Eval next day at Injury report
  - 3/5 IR, 1-2/5 ABD, FF, ER
  - MRI shoulder WNL
  - MRI c-spine – Degenerative changes, C5-C6 central bulge, 7mm canal, cord normal. Mild foraminal stenosis bilateral at C5-C6 but no nerve root impingement
- Progressive Increased MMT over next 5 wks
  - Non-contact practice allowed once 3/5 MMT
  - RTP @ 5 wks with padded shirt
  - Strength: Approx 60%+ deficits decreased to 20-30%
  - No recurrences in last 4 games
Case Study #2
- SO DB
- No History of stingers/neck injury
- Making tackle – good head position
- WR speared into Erb’s point
- On Field – LOC?
- No sensation, No motor
- Horner’s Response
- Spine Boarded
- Dx: Subclavian artery tear and 5 nerve root avulsions
- Immediate surgery for arterial repair
- Delayed surgery for 3 nerve transfers
- No motor return.
- D/C Football

Case Study #3
- SR OL
- History of multiple stingers.
- In-game injury Week 2
  - 1Q mild stinger. Resolved. RTP
  - 4Q hit to side of head. LOC?
- Dx: Concussion and Right sided stinger
- Did not RTP
- CT scan head/neck WNL
- Did not RTP remainder of season (11 games)
  - Chose not to return for RS-SR season.
- Progressive increased strength Bi, Delt, RTC
- No long term strength deficits

Case Study #3
- Previous History
  - April: spring practice – R arm involuntary muscle contraction of forearm/hand
    - After R sided c-spine compression pain in drill.
    - MRI – multiple mild to mod disc bulges, no other issues
  - September – Tuesday practice of game week
    - Facial/neck/shoulder involuntary muscle spasm/contractions
    - Mild stinger earlier in practice not reported.
    - No MOI directly prior. (confirmed by practice video)
    - ER = Head MRI WNL. Neck MRI unchanged.
  - Wednesday: Multiple concussion-like symptoms, SAC/BESS WNL
    - IMPACT abnormal - Concussion? EEG Normal.
    - Dx: Likely atypical migraine vs simple partial seizure
    - Cleared to play in game

Citations
Kuhlman G. Burns (stingers): Acute brachial plexus injury in the athlete. In: UpToDate, Waltham, MA (updated on 9/22/2013)

Thank you
- Dr Andrews
- UT Sports Med Staff
- KOC Physicians