Point-of-Care Ultrasound for injured athletes in the Taekwondo Competition

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OBJECTIVES

• Review the epidemiology of injuries in Taekwondo athletes during the competition

• Explain the pros and cons of point-of-care ultrasound (musculoskeletal and non-musculoskeletal) as a diagnostic modality

• Describe the ultrasound characteristics of fractures, dislocations and soft tissue injuries

• Explain the applications of point-of-care ultrasound in injured athletes during the competition with cases

• Discuss about the potentials, considerations and future direction of utilizing the point-of-care ultrasound in Taekwondo competition
COMPETITION INJURIES IN TAEKWONDO ATHLETES

• Total injury rates (per athlete-exposures (A-E))
  For elite men  20.6~139.5 /1000 A-E
  For elite female 25.3~105.5 /1000 A-E

➢ Competition injury rates for taekwondo: higher than American football, wrestling, and Shotokan style Karate

• Injury rates for elite men
  29.6% - head and neck
  **44.5% - lower extremities**

• Injury rates for elite women
  15.2% - head and neck
  **53.1% - lower extremities**

COMPETITION INJURIES IN TAEKWONDO ATHLETES

• Majority of all injuries: Contusions (M: 42.7% / F: 62.7%)

• Other common musculoskeletal injury types: Sprain/ Fracture/ Dislocation/ Tendon injury/ Strain

• Common non-musculoskeletal injury types: Concussion/ Epistaxis/ Laceration/ Abrasion

• Common site of injury:
  - M: LE (*foot) > head & neck > UE > trunk
  - F: LE (*foot) > UE > Head & neck > Trunk


SPORTS AND MSK ULTRASOUND

• MSK US: High-resolution sonography for the visualization of joints, tendons, ligaments, muscles, and nerves

• Delphi-based consensus paper of the European Society of Musculoskeletal Radiology in 2012 *
  - MSK US could be considered a first-line imaging modality for 72 clinical indications
    (1) hand/wrist (2) elbow (3) shoulder (4) hip (5) knee (6) foot/ankle

• More widely accepted and utilized in sports medicine: portability for immediate assessment of injuries in ski clinics, on the sidelines and in the training room **

MSK ULTRASOUND GUIDELINES, CURRICULUMS AND CERTIFICATION

• **AIUM Practice Guideline** for the Performance of a musculoskeletal examination

• **ESSR** : Musculoskeletal Ultrasound Technical Guidelines

• **EULAR** : Guidelines for musculoskeletal ultrasound in rheumatology

• **AMSSM** Recommended Sports Ultrasound Curriculum for Sports Medicine Fellowship

❖ Certifications
  - **RMSK** : ARDMS / APCA
  - **RhMSUS** : American College of Rheumatology
  - **PGCert Musculoskeletal Ultrasonography** (UK)
POINT-OF-CARE ULTRASOUND

“Diagnostic or procedural guidance ultrasound performed by a clinician during patient encounter to help guide the evaluation and management of the patient “

“Point-of-Care Revolution”

• Not a replacement to complete diagnostic ultrasound performed/or interpreted by radiologist

• Focused bedside ultrasound evaluation in suboptimal conditions with time limitations for specific clinical questions.
POINT-OF-CARE ULTRASOUND: PROS

• **Portability**: laptop size / hand-held
• **Time-efficiency**: real-time, on-site prompt eval
• **Lower cost** compared to other modalities (X-ray/ CT/ MRI)
• **High sensitivity and specificity** of detecting MSK abnormalities - comparable to MRI in many indications
• Ability to perform a **dynamic examinations**
• Point-of-Care **Ultrasound guided procedures**

POINT-OF-CARE ULTRASOUND: CONS

- **Performer dependent** – false negative or positive, scanning time
  - Needs training and proficiency
- Not many sports medicine / musculoskeletal consultants are comfortable interpreting finding on the US
- Limited evaluation of gross structural anatomy
- Limited penetration of ultrasound signal into the joint or bone.
- Cannot detect bone bruising or edema

**Anisotropy**
EXPERIENCE FROM 2017 ITSO ILLINOIS STATE TAEKWONDO CHAMPIONSHIP
2017 ILLINOIS STATE TAEKWONDO CHAMPIONSHIP – STATISTICS OF TKD INJURIES

• Total 672 participants
• Total 42 injuries and illness

  o Non-MSK related injuries / illness
    ▪ 16 Abrasions
    ▪ 9 Lacerations (3 referee calls, 2 refree-stop)
    ▪ 5 mild traumatic head injury (3 referee calls, 1 referee-stop)
    ▪ 5 Epistaxis (4 referee calls)
    ▪ 2 Dyspnea – 1 EIA
MSK RELATED INJURIES DURING THE COMPETITION

- **12 Contusion** (5 referee calls, 1 referee-stop decision)
  : 2 foot / 3 knees / 3 thigh / 3 proximal arms 1 hand

- **3 fractures** (1 head & neck / 1 foot / 1 upper extremity)
  : 1 Nasal fx/ 1 Navicular stress fx/ 1 Radial head fx of elbow

- **1 strain** (leg) : anterior tibialis muscle of the right leg

- **2 tendon injury** (1 ankle / 1 wrist)
  - 1 Flexor carpi ulnaris tendinopathy
  - 1 Peroneal tendinopathy of the ankle
MSK RELATED INJURIES DURING THE COMPETITION

- **2 Ankle sprains** (2 lateral ankle)
  - 1 ATFL + TFL (grade II) / 1 AFTL (grade I) + Acute Peroneal Tendinopathy

- **1 finger sprains** (1 Thumb)
  - 1 UCL of thumb (grade 2)

- **1 knee sprain**
  - MCL grade 2 Sprain of the knee w/o Meniscus / ACL inj.

- **1 wrist sprain** (FOOSH mechanism) - w/o tendon inj. or fx
  - Probable 1 grade 1 scapholunate sprain without instability

- **1 Shoulder sprain** : AC joint (grade 2) (w/o tendon injury)
UCL TEAR OF THE THUMB
VOLAR PLATE INJURY OF FINGER
Dynamic ultrasound exam (anterior drawer test)

https://youtu.be/lv5i7-pCFdY
MCL TEAR
MENISCUS TEAR
CONTUSSION / HEMATOMA

FEMUR

RT QUAD LAX

Post Trauma

Normal Muscle
MYOSITIS OSSIFICAN
<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Imaging Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reversible damage of the muscle fiber. No violation of the supporting connective tissue - DOMS</td>
<td>Hyperechoic hypertrophy (hyper or T2) of muscle</td>
</tr>
<tr>
<td>1</td>
<td>Irreversible damage to the muscle fiber. No violation of the supporting connective tissue.</td>
<td>Hyperechoic cloud (or hyper T2) without disruption of muscle architecture</td>
</tr>
<tr>
<td>2</td>
<td>Irreversible damage to a reduced number of muscle fibers. Reaching the supporting tissue.</td>
<td>Hyperechoic breach (or hyper T2) with blurred or irregular edges (sparks) with disorganization of muscle architecture</td>
</tr>
<tr>
<td>3</td>
<td>Irreversible damage to a large number of muscle fibers. Reaching the supporting tissue + hematoma.</td>
<td>Musculo-aponeurotic or musculotendinous disinsertion with hematoma</td>
</tr>
<tr>
<td>4</td>
<td>Partial or total rupture of a muscle.</td>
<td>Avulsion or rupture of a muscle bundle with retraction</td>
</tr>
</tbody>
</table>
GRADE I STRAIN

Grade I strain
GRADE 2 & 3 STRAIN

Grade 2 strain

Grade 3 strain
TENDON INJURY

• **Partial tear**
  - Anechoic focal defect
  - Background tendinosis

• **Complete tear**
  - Gap / absence
  - Acute: fluid
  - Chronic: scar tissue formation
AFTL SPRAIN
AITFL SPRAIN (HIGH ANKLE SPRAIN)
DELTOID LIGAMENT TEAR

[Diagram showing anatomical structures related to the deltoid ligament, with labels such as posterior tibiotalar, anterior tibiotalar, tibiocalcaneal, sustentaculum tali of calcaneum, and tibiocalcaneal.]

[Ultrasound images showing various bone structures labeled MM, TAL, MED ANKLE COR, TIB, TAL, TIB TAL LIG LAX.]
PERONEAL TENDINOSIS WITH BONY AVULSION
AC JOINT SEPARATION

Normal AC joint space

Widening and height difference
FRACTURE OF THE LONG BONE
RADIAL HEAD FRACTURE
NASAL FRACTURE
DORSAL SCAPHOLUNUNATE LIGAMENT
SCAPHOID FRACTURE
HOOK OF HAMATE FRACTURE
NON-MSK POCUS – E-FAST PROTOCOL

A) IVC Long Axis
B) FAST / RUQ
   Add Pleural View
C) FAST / LUQ
   Add Pleural View
D) FAST / Pelvis
E) Pneumothorax
   Pulmonary Edema
NON-MSK POCUS – E-FAST PROTOCOL - PNEUMOTHORAX
NON-MSK E-FAST PROTOCOL – PERICARDIAC EFFUSION
NON-MSK POCUS – E-FAST PROTOCOL: INTRA-ABDOMINAL HEMORRAGE

Morrison’s pouch
NON-MSK POCUS – MEASURING IVC TO ESTIMATE CENTRAL VENOUS PRESSURE
NON-MSK POCUS – E-FAST PROTOCOL: INTRA-ABDOMINAL HEMORRHAGE
POCUS EYE EXAM – PUPILLARY REFLEX
POCUS EXAM – SKIN AND SUBCUTANEOUS TISSUES
ULTRASOUND OF CUTANEOUS AND SUBCUTANEOUS TISSUE

Abscess

Cellulitis
CONSIDERATIONS OF POCUS IN TAEKWONDO

• **Adequate training / education is required**
  - One-on-one supervision is essential but not always available
    - recruit well-qualified and experience faculty
  - Needs to develop the educational material
    : Handbook / Manual / Video / Workshop

• **Governance**
  - Maintain ultrasound skills up to date
  - Keep up to date with the latest literatures
  - Maintenance and quality assurance review of the ultrasound equipment
FUTURE DIRECTIONS

• Development of US curriculum and US workshops for MD/DO, ATC, PT for professional development
  - TKD competition specific ultrasound protocol
  - Web-based resources
  - Simulation-based hands-on training

• Promoting the use of POCUS in the competition by organizational support and policy enhancement

• More researches on ringside point-of-care ultrasound in the TKD competition
TAKE HOME MESSAGES

• Musculoskeletal Ultrasound (MSKUS) is very cost-effective diagnostic modality with high accuracy and reliability in Sports Medicine.

• Point-of-Care Ultrasound (POCUS) can be a promising adjunct to ringside physician’s evaluation on injured TKD athletes for more accurate clinical assessment and solid management plan with confidence.

• POCUS reduces unnecessary ER transfer during the TKD competition

• POCUS can detect potentially harmful competition-related injuries which can be detrimental to TKD athletes’ performance and athletic lifespan if not properly managed in a timely manner.

• It may shorten the time-loss of the injured athletes by reducing the waiting time for specialist referral and/or more costly diagnostic modality such as MRI

• More epidemiological and clinical researches using POCUS in Taekwondo are imperative

• Developing educational training program for point-of-care sports ultrasound focusing on TKD competition will be a key component to promote the use of ultrasound in TKD competition
REFERENCES

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Thank you!