ULTRASOUND GUIDANCE: IMPROVED OUTCOMES?

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Ultrasound guidance: Improved Outcomes?

• DISCLOSURES

None
2011-04-26 — Snowbird Sets All Time Single Season Snowfall Record!

FOR IMMEDIATE RELEASE:
SNOWBIRD, UTAH – Snowbird Ski and Summer Resort hit a 40-year all time record for single season snowfall this afternoon (April 26), reaching the 690-inch mark thanks to a spring storm that has brought two feet to Little Cottonwood Canyon in the last 48 hours. Snowbird’s previous single season official record was 688 inches, set in the 1983-84 season. The resort’s mid-mountain base currently stands at 190 inches, with more snow forecasted through the weekend.
LEARNING OBJECTIVES

- Very brief overview of Musculoskeletal Ultrasound

- Ultrasound use in Interventional Procedures
  - Why talk about image guidance?
  - Does US guidance improve accuracy?
  - Does US guidance improve outcome?
Why talk about Musculoskeletal Ultrasound

- Pubmed search for musculoskeletal ultrasound → 1122 results since the year 2000

- MSK US studies increased 316% from 2000 to 2009

- MSK US procedures increased 717% over same time period (19,000 -> 158,000)
  - Podiatrists – 51.5% of growth
    Sharpe 2012
WHAT IS MUSCULOSKELETAL ULTRASOUND (MSK US)?

- High frequency sound waves used to image soft tissues and bony surfaces
- Higher resolution than MRI for superficial structures
**MSK US**

- **Advantages**
  - Safe
  - Dynamic and interactive
  - Allows visualization of soft tissues
  - Convenient
  - No radiation or contrast

- **Disadvantages**
  - Initial cost
  - Limited field of view
  - Operator-dependent quality
MSK US Uses

- **Diagnostic**
  - Tendon or ligament injury
    - Similar sensitivity to MRI for RTC tears
  - Muscle strains and contusions
  - Nerve entrapment
  - Joint effusions

- **Interventional**
  - Joint, tendon, bursa - focus of this talk
  - Axial procedures
  - Neurotoxin guidance
  - Nerve blocks
Do we need image guidance at all for interventional procedures?
Blind Injections are Inaccurate

- Subacromial: ~70% accurate  

- AC joint: ~40%  
  Pichler 2009, Bisbinas 2006

- Glenohumeral joint: 42%  
  Eustace 1997
Blind Injections

- **Knee**
  - 66-80% accurate
    - Jones 1993, Jackson 2002

- **Ankle**
  - 81% accurate
    - Heidari 2010
Blind Injections: Unsafe depending on location

- Hip (cadaver study)
  - Anterior approach – 60% accuracy, 27% contacted femoral nerve
  - Lateral approach – 80% accurate

Leopold 2001
Does Ultrasound Guidance Improve Accuracy?
YES!

- Almost universally
US Guidance Superior to LMG

- Superior accuracy to landmark guided (LMG)
  - AC joint
    - Peck 2010, Sabeti-Aschraf 2011
  - Glenohumeral
    - Rutten 2009
  - Subacromial
    - Daley 2011
  - Bicep tendon sheath
    - Hashiuchi 2011
Superior Accuracy with US Guidance

- Hip
  Smith 2009

- Knee
  Wiler 2010, Im 2009

- Proximal tib-fib
  Smith 2010

- Tibiotalar and Sinus Tarsi
  Wisniewski 2010

- ...
- Videos
ACCURACY

- Experienced operators with equivalent accuracy using LMG in the knee
  - Novice operators with better accuracy using US
    
    Curtiss 2011

- Subacromial injection with same accuracy blind versus US guided (confirmed w MRI)
  
  Rutten 2007
ACCURACY

- US guidance superior to fluoroscopy
  - Glenohumeral joint, piriformis, subacromial
  - Better soft tissue visualization

Finnoff 2008, Rutten 2009, Mathews
Does Ultrasound Guidance Improve Outcome?
Does US Guidance Improve Outcome: Premise

- Injections have been shown to improve pain, function, ROM in osteoarthritis, tendinopathy, bursitis

- Blind injections often miss target, may be unsafe
Does US Guidance Improve Outcome?

- Needle visualization confirms placement in joint or other targeted tissue
  - Should allow for accurate placement of specific targeted therapies – biologics, tenotomy
  - Should improve safety -> avoiding neurovascular structures, tendon, less needle trauma, ability to dilate/hydrodissect with local prior to injection
  - Better ability to see effusions to allow aspiration
Does US Guidance Improve Outcome?

- More difficult to answer than accuracy question
  - Not a lot of large RCT’s
  - Inherent limitations in many studies – patients not really blinded (in most)
  - Not much long term follow up
What conditions have been looked at?

- Joint pain
- Bursitis
- Inflammatory arthritis
- Chronic tendinopathy
- Calcific tendinitis
Different Procedures

- Steroid and local anesthetic
- Viscosupplementation
- Platelet Rich Plasma (PRP)
- Tenotomy
- Needle aspiration and lavage
What outcomes have been measured?

- Pain
- Function and Disability
- ROM
- Procedural time and discomfort
- Cost
OUTCOMES BY REGION/STRUCTURE

- Shoulder
- Knee
- Hip
- Multiple joints
- Tendon
SHOULDER

“Painful shoulder”
- Improved pain and function US guided versus blind subacromial steroid injection
- Short term (6 week follow up) RCTs
  - Naredo 2004, Unucu 2009
Painful Shoulder

- Improved ROM
  - Unucu 2009

- Less procedural pain and time
  - Hashiuchi 2010

- No difference in outcome blind versus US guided subacromial steroid injection for shoulder pain
  - Panditaratne 2010
Shoulder

- Bursitis (US confirmed)
  - Improved ROM with US guided steroid injection vs blind – 1 week follow up
    - Chen 2006

- Less procedural time, less pain versus fluoroscopy guidance
  - Glenohumeral joint - Rutten 2009
Frozen Shoulder

- Less pain, improved function and ROM with US guided steroid injection and 5 weekly sodium hyaluronate injections vs series of blind injections
  - 6 week follow up

Lee 2009
KNEE – US Guidance

- Knee effusion - decreased procedural pain, increased amount of aspirate, better 2 week outcome with US guidance
  
  Sibbit 2012

- Less pain with procedure and decreased procedural time with US
  
  Wiler 2010

- **Baker’s cyst** – US drainage, steroid injection improves symptoms, cyst size
  
  Di Sante 2010, Bandinelli 2011
HIP

- Positive effect for US guided steroid injection versus baseline and age-matched control group
  - Walking pain, severity index, synovial hypertrophy improved at 1 and 3 months

Micu 2010

http://www.glasersportsmedicine.com
HIP

- Pain and function improved with US guided steroid injection vs control group, saline injection, hyaluronate
  - Maintained up to 8 weeks
- Greatest effect is early

Atchia 2011
MULTIPLE JOINTS: US guided steroid injection

- Decreased pain, increased responder rate, decreased procedural pain, increased volume of aspirated fluid vs blind injection
  
  Sibbit 2009

- Improved accuracy, no improvement in clinical outcome vs blind injection
  
  Cunnington 2010
Decreased Procedural Pain

**WHY?**

- Better control; direct needle away from pain-sensitive structures
- Distraction effects
  - Cooling effect of gel
  - Pressure from transducer
  - Ability to view images, interaction with provider
CHRONIC TENDINOPATHY

- Gluteus medius tendinopathy (“bursitis”)
  - Steroid injection blind versus fluoro guidance with equivalent outcomes
    - Cohen 2009
  - US-guided peritendinous steroid injection improved pain
    - Labrosse 2010
Does US guidance matter in the lateral hip?
CHRONIC TENDINOPATHY

- Chronic recalcitrant tendinopathy
  - Multiple sites
  - Tenotomy improved VAS at 4 and 12 week follow up vs baseline
    Housner 2009

- Lateral epicondylosis: >90% of patients reported excellent or good results at 22 months
  McShane 2008
CHRONIC TENDINOPATHY

- Chronic Achilles tendinopathy
  - US guided Tenotomy survey: 75% of 63 patients reported good or excellent results
  - Avg. follow up 51 months
CHRONIC TENDINOPATHY

- US guided PRP injection plus tenotomy
  - Improved function, decreased pain, improved US appearance of affected tendon
  - Multiple locations, mean follow up 14 months
    Finnoff 2011
CHRONIC TENDINOPATHY

- US Guided PRP injection for chronic lateral epicondylitis
  - Trend towards improvement with PRP compared to whole blood injection for both pain and function
  - Improvement in pain at 6 weeks only significant difference
    Thanasas 2011
Figure 1. Pain visual analog scale score distribution (95% confidence interval). 0, no pain; 10, max pain. *Indicates significant difference between groups.
CALCIFIC TENDINITIS

- Rotator cuff calcific tendinitis
  - Fluoro guided needle fragment irrigation equivalent results to burscoscopy (24 month follow up)
    - Maugars 2009
  - Improved pain, function, and ROM with US-guided percutaneous lavage and aspiration up to 1 year after procedure
    - Serafini 2009 (vs control), del Cura 2007
COST

- 244 patients with inflammatory arthritis
  - Randomized to palpation vs US guidance
  - Improved pain, responder rate, therapeutic duration, decreased procedural pain
  - Overall 8% cost reduction per patient per year
  - Increased procedural cost for outpatients ($183)

Sibbitt 2011
COST

- Cost estimates dependent on reimbursement rates, reduced utilization of health care resources
- Doesn’t take into account societal benefit
- Goal is to deliver better clinical outcomes
CONCLUSIONS

- Blind injections inaccurate
- Data for improved accuracy with US guidance consistent
- Data for efficacy less impressive, though safety alone may be incentive enough
- Variable methodological quality
  - Lack of large, blinded RCTs
  - Lack of long term outcome assessment
  - Different treatments
  - Different outcome assessments
ADVANTAGES OF ULTRASOUND

- Several options for needle guidance
- Why not fluoroscopy, CT, MRI for guidance?
  - Better visualization of soft tissues
  - No radiation or contrast exposure
  - Portability
  - Ease of repeat exams
  - Expense (?)
  - Better patient experience
DOWNSIDES

- Takes longer to perform than palpation-guided
  - Sibbitt reported 100% increase in procedure time
  - But less time than fluoroscopy
- Increased procedure cost
  - Only a better value if duration of effect is sufficient
- Limited field of view
- Investment in equipment
- Investment in training
QUESTIONS?


References