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연수보고

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I. Biomechanics Research Laboratory

Helping physicians to make clinical decisions

- Human performance
- Mechanical testing
- Computer modeling

Performance Studies

- Provide insight into the basic mechanisms underlying performance
  - Performance enhancement
  - Identify injury mechanisms
- Localize deficits more precisely and assist in planning interventions
- Allows an accurate assessment of the efficacy of a specific intervention

Performance Tasks

- Gait, Jumping, Landing, Cutting
- Throwing, Golfing, Rehab

Methods

- High speed video : Angle
- Force measurement : Vertical ground reaction forces
- Inverse dynamics : Torque
- Electromyography

Ⅱ. Upper Extremity Biomechanics

Outline of Presentation

- Performance studies
- Point cluster technique
- Kinematics of the U/E using bone pins

Performance Studies

- Major League Pitchers
- Little League Pitchers
- MLB Mound Height
- NFL Quarterbacks
- High School Pitchers?

Little League Pitcher Study

- Rationale : Determine if pitching biomechanics cause soft tissue and/or bony adaptations of the shoulder
- Methods : ROM, MRI, and pitching biomechanics

Point Cluster Technique : Rationale

- To understand motion at the joint, need better description of bony motion
- Want to eliminate effects of skin motion on resulting bony kinematics

Shoulder Dissection Study

- Anatomical dissection of muscles of the shoulder girdle.
  - Muscle lengths, Volume, pennation angles
  - Tendon lengths Input to Current Model

Shoulder Bone Pin Study

- Rationale
  - Kinematics of shoulder girdle during simple motions not well understood
  - Many skin marker techniques exist, but best technique is not established
- Methods
  - Insert bone pins with markers attached to shoulder girdle bones
  - Apply surface markers on the skin
  - Subject performs simple motions
  - Compare date from surface markers to that from bone pins
- Placing the pins : Five major articulating bones
  - Clavicle - distal 3rd
  - Scapula - medial spine
  - Humerus - distal deltoid

- Radius - styloid
- Sternum

● Secondary Goal

- Identify shoulder motions for the model to use as constraints

● Reconstructing Bony Geometry

- External forces : GRF's
- Kinematics : Bony motion
- Bone geometry
  - CT scan in 1mm slices
  - All segments with pins

Determine Muscle Geometry

1) External forces
2) Kinematics
3) Bone geometry
4) Muscle geometry
   - Substitute our subject' s CT data for visual human project geometry
   - Constrain the model with our measured kinematics

Future Work

● Better quantification of upper extremity motion

● Improved model of shoulder girdle

● Compute forces in rotator cuff muscles, tendons, and capsule in static positions, rehabilitation exercises, etc.

Modeling

● Model : mathematical representation of bone, ligament, and muscle used to calculate loads in the bones and soft-tissues during rehabilitation exercise and the activities of daily living

● Biomechanical extension of methods developed for the analysis of complex systems such as robotics and spacecraft

Future Directions

● 3D model of the upper extremity including the muscles spanning the shoulder, elbow, and wrist

● Possible applications

- Calculate the loads at shoulder for rehabilitation exercises

- Show how insufficiency of the subscapularis muscle affects shoulder joint load

● Development

- Move the existing University of Texas model to an accessible computer platform
- Verify model kinematics and muscle parameters using data from the upcoming bone-pin study at SHSMF

Ⅲ. Clinical Approaches :

Current Recommendations of the Glenohumeral Instability

The Instability

● Little Instability(eg. Little Bankart) = Little Operation (Arthroscopic)

● Big Instability = Big Operation

(eg. Big Bankart and Capsular Laxity)

Anterior Instability

● Arthroscopic labral repair (if necessary)

● Arthroscopic capsular plication of inferior and middle glenohumeral ligaments

● Thermal capsulorraphy (grid or cornrow pattern)

Revision Anterior Instability

● Arthroscopic operation if failed open or first revision

● Open operation if failed arthroscopic or multiple revision

Postop. Arthroscopic Anterior Instability

● Weeks 0-3 : No Rehab

● Weeks 4-5 : Phase I (ER 0 and ER 30)

● Weeks 6-7 : PhaseⅡ

● Weeks 8-12 : PhaseⅢ

Posterior Instability

● Arthroscopic labral repair (if necessary)

● Arthroscopic capsular plication(usually 2 sutures)

● Thermal capsulorraphy

Revision posterior instability

● Arthroscopic operation if failed open or first few revisions

● Open procedure only if capsular tissue extremely poor quality and patulous

Postop. Arthroscopic Posterior Instability

- Weeks 0-6 : No Rehab in Gunslinger
- Week 7 : Phase I (scapular plane elevation only)
- Week 8 : Phase II
- Weeks 9-12 : Phase III

Multidirectional Instability

- Arthroscopic anterior and posterior capsular plication
- Anterior and posterior termal capsulorraphy
- Occasionally augment open shift with arthroscopic thermal and/or suture plication

Revision MDI

- Open inferior capsular shiftPostop. Arthroscopic MDI
- Occasionally augment open shift with arthroscopic thermal and/or suture plication

Postop. Arthroscopic MDI

- Weeks 0-8 : No Rehab (Gunslinger)
- Weeks 9-10 : Phase II
  (No Passive ROM or stretching and scapular plane elevation only)
- Week 11 : Phase III

ARTHROSCOPIC REPAIR

- ***Anterior = High Failure Rates***
  - Walch (Arthroscopy, 1995) : 49% poor, 44% recurrence
  - Koss (AJSM, 1997) : 30% recurrence
  - Geiger (CORR, 1997) : 44% recurrence
  - Buss (AJSM, 1996) : 33% recurrence

- Recent advent of arthroscopic techniques for shoulder instability (ie. Bankart repair) have high failure rates *Why ?*
- Higher failure with arthroscopic Bankarts are due to inability to effectively address capsular laxity

Thermal Capsulorraphy

- Advantages of arthroscopic procedure
- Technically easy

- Decrease capsular laxity

Thermal Capsulorraphy

- Lu and Markel, 2000 : return to normal histology by 6 weeks after procedure
- Wallace, 2000 : initial shortening augmented during period of immobilization
- ?? Long-term biomechanical property of heated capsular tissue??

Role of Immobilization

- Cannot be overemphasized
  - Hayashi, 1996-1999
- Length of time controversial
- Most shrinkage within first 6 weeks
  - Lu and Markel, 2000

Thermal Capsulorraphy in the Throwing Athlete

- Augment arthroscopic treatments
- No violation of the subscap
- ?? Role of anterior laxity in SLAP lesions and Internal Impingement??

Ⅳ. Impingement Versus Instability : A Diagnostic Dilemma