Updates On ACL Reconstruction

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DISCLOSURES

• Consultant Linvatec, Arthrex
• Educational Support
  – Arthrex
  – DonJoy
  – Linvatec
  – Ossur
GOALS OF THE LECTURE

• Conservative Treatment vs Bracing
• Anatomic vs Non Anatomic
• The Quad Tendon Graft
• Graft Selection
• ACL Repair
CONSERVATIVE MANAGEMENT

• Many studies….Poor results
  – Recurrent instability
  – Meniscal damage
  – Degenerative joint changes
  – Decreased Activity level

  • McCarroll et al. AJSM 1988
  • Kannus & Jarvinen: JBJS Br 1988
  • Angel & Hall. Arthroscopy 1989
  • Graf et al. Arthroscopy 1992
  • Mizuta et al: JBJS Br 1995

POOR RETURN TO SPORT

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WHY DOES CONSERVATIVE TX FAIL?

ROTATIONAL INSTABILITY

- Must Limit Pivot Shift
- Activity Modification Difficult
  - No cutting sports, etc
- MUST KNOW YOUR PATIENT!
DO BRACES WORK?

• TRANSLATION
  • YES - OK

• ROTATION
  • NO

COST $800 - $2000
LEVEL “10” EVIDENCE

• HOW MANY ATHLETES TEAR AN ACL,

• WEAR A KNEE BRACE AND

• HAVE SURGERY AT THE END OF THE SEASON?
TWO TYPES OF ACL RECONSTRUCTIONS

• NON-ANATOMIC

• ANATOMIC
ALL ACL RECONSTRUCTIONS
NON-ANATOMIC ACL RECONSTRUCTION

• TRANS TIBIAL
• 25 year history
• Most utilized technique in world
TRANS TIBIAL RECONSTRUCTION

• NON-ANATOMIC

• DRILL THROUGH TIBIA INTO FEMUR

• NO ATTENTION TO ANATOMIC FOOTPRINT
PROS

• Reproducible
• Easy to teach
• Easy to perform
PROBLEMS

• ROTATIONAL INSTABILITY

Normal Lachman
Abnormal Pivot Shift

“Does not act like normal ACL”
OUTCOMES OF TRANS TIBIAL ACL RECONSTRUCTION

- 37 publications over 10 years
- Common variables:
  - IKDC
  - Lysholm scores
  - Tegner scores
  - % return to previous activity
  - Lachman’s
  - Pivot shift
  - KT-1000
OUTCOMES (CONT)

• Results
  – Average 2 yr F/U
  – 86% normal or nearly normal knees (IKDC)
  – 70% returned to previous level activity
  – 88% normal/Grade I Lachman
  – 92% normal/Grade I Pivot Shift
  – 70% KT < 3mm side-to-side difference
GOOD RESULTS

WE CAN DO BETTER!
HOW?

ANATOMIC ACL RECONSTRUCTION
Two Bundle ACL Anatomy

Anterolateral view

Anteromedial view

AM, PL
FEMORAL INSERTION SITE ANATOMY

90°

AM
PL

90°
NORMAL ANATOMY

TRANS TIBIAL

ANATOMIC
ANATOMIC ACL OUTCOMES

X – Experience
- 11 years (prospectively followed, retrospectively compared)
- N > 2000

- KT = improved (not significant)
- Pivot shift = improved (significant)
- Revision Rate = 5.5% (primary)

WHAT DOES THIS MEAN?
ANATOMIC ACL RECONSTRUCTION

• More normal knee kinematics

• Less force taken up by joint
  – Less meniscal/chondral injury?
  – Less DJD?

• More force taken up by ACL
  – Increased ACL re-injury?
ACL GRAFT OPTIONS

• AUTOGRAFTS
  • PATELLAR TENDON
  • HAMSTRING
  • QUAD TENDON

• ALLOGRAFTS
  • VARIOUS TISSUES
ALLOGRAFT

• MAARS DATA
  • Higher failure rate in patients 20 and younger
  • Level 1 multi center study

• Emory Data
  4.5% re-operation rate in last 1500 patients
  (compared to 5.5% in autografts)
  * 95% performed in patients 25 and over
WHY DO ALLOGRAFTS FAIL

- Tissue
  - Rejection
  - Damage
    - Radiation
    - H2O2 (Bioclense etc)
    - Fresh Frozen
WHY DO ALLOGRAFTS FAIL

• Pain
  – Decrease Pain
  – No Harvest Morbidity

• Biology
  – Slow incorporation
WHY DO ALLOGRAFTS FAIL

• Surgeon
  – Technique
  – #/year
NON COMPLIANCE
SO WHEN DO I USE AN ALLOGRAFT?

- Age > 30, 40, 50
- Multi ligament injury
- Non athletic
THE QUADRICEPS TENDON AS AN ACL GRAFT OPTION
WHAT AM I TALKING ABOUT?
THE PERFECT AUTOGRRAFT OPTION

- Superior Histology
- Superior Biomechanics
- Predictability
- Superior size
- Good for all ages (6 and older)
- Fastest Harvest
- Percutaneous Harvest  
  - (Cosmesis)
- Equal Outcomes
- Least Morbidity

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HISTOLOGY

QUAD TENDON VS B-PT-B

• Quad Sig >
  – fibril-interstitium ratio
  – higher fibroblast density

• 20% more collagen

## BIOMECHANICS RESULTS

**ARTHROSCOPY, JAN 2016**

<table>
<thead>
<tr>
<th></th>
<th>Native ACL*</th>
<th>Quad Ten</th>
<th>B-PT-B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ultimate Load (N)</strong></td>
<td>2160</td>
<td>2186</td>
<td>1580</td>
</tr>
<tr>
<td><strong>Modulus (Mpa)</strong></td>
<td>278</td>
<td>255</td>
<td>337</td>
</tr>
</tbody>
</table>

*  Woo et al 1988
Quad Graft Length

- 73.5 ± 12.3 mm in females
- 81.1 ± 10.6 mm in males

- Direct correlation to height
  - Like PT

- People over 5 feet
  - Graft > 7 cm 90% of time
QUAD TENDON THICKNESS
(XEROGEANES ET AL, AJSM OCT 13)

- 6-10 mm
- Mid sagital measurement
  - 3 cm prox to patella
  - .2% variation over 6 cm of tendon
SIZE OF GRAFT

- **Length**

- **Volume**
VOLUME PT VS QT

\[ V = L \times W \times D \]

- 10mm width graft
- 3 cm of graft in joint
VOLUME PT VS QT
(XEROGEANES ET AL, AJSM OCT 13)

Volume = L x W x D

- \( L_{QT} = L_{PT} = 3 \) cm
- \( W_{QT} = W_{PT} = 10 \) mm
- \( D = QT \times 1.8x > PT \) average thickness

- QT **88%** more intra articular graft volume
DIMENSIONAL ANALYSIS OF THE QUADRICEPS TENDON IN SKELETALLY IMMATURE PATIENTS:
A NOVEL PREDICTIVE MODEL

TODD, D, GHASAM A, XEROGEANES, J
AJSM, 2014

• 151 subjects
  – 76 Male
  – 75 Female
• 298 quadriceps tendons measured
• Age Range 4-16

• Variables
• Height, weight, age
PEDIATRIC QUAD TENDON

Average 6 year old

- 5.5 cm in length
- 3.2 mm thick

Adult PT thickness?  
Hamstring size ????
HARVEST TIME

- Patellar Tendon = 22 minutes
- Hamstring Tendon = 13 minutes
- Quad Tendon = 8 minutes
COSMESIS

• 1-1.5 cm incision
CLINICAL OUTCOMES (SOFT TISSUE QUAD GRAFTS)

- Shelton et al, Arthroscopy, 2012
- Geib et al, Arthroscopy 2009

Equal to other grafts!
MY CLINICAL RESULTS

- >600 ACLs (primary and revision)
- DC all meds
  - QT 1 days sooner than B-PT-B
- NO early non traumatic failures (< 3 months)
- Failure Rate 2.5% (short term follow up)
- KT-1000 6 month
  - No sig change from 6 week – 6 month
KEY THERAPY POINT

MUST GET FULL EXTENSION!

- 2-5% cyclopse lession
- 2-3 in 15-22 y/o females
## MORBIDITY

<table>
<thead>
<tr>
<th>Graft type</th>
<th>Numbness</th>
<th>Patellofemoral Pain</th>
<th>Residual Weakness</th>
<th>Tendon Rupture</th>
<th>Patella Fracture</th>
<th>Hematoma</th>
<th>Increased Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>?</td>
<td>↑↑</td>
</tr>
<tr>
<td>BPTB</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
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</tr>
<tr>
<td>Hamstrings</td>
<td>✓</td>
<td></td>
<td>✓</td>
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THE PERFECT AUTOGRAPH

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• Outcomes
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• QUAD
• QUAD
• QUAD
• QUAD
• QUAD
• QUAD
• QUAD
• EQUAL
• QUAD
ACL REPAIR

Doctors Experiment With New Way of Fixing the A.C.L.
• Suture together
• Sponge (to hold growth factors)
• PRP growth factors
IS IT NEW?

• Suture together
  NO

• Sponge (to hold growth factors)
  Yes/No

• PRP growth factors Yes/No
DOES IT WORK?

- N < 10
- No data release
TYPE OF TEAR

Remnants:

Colombet et al., *Orthop Trauma* 2010; 96S

- 418 patients
- 50% gone
- 16% PL intact
- 23% to PCL
- 11% AM intact

- Remnant quality
good 17%, bad 83%
TYPE OF TEAR

Remnants:
Sherman et al., AJSM 1991 (19):3

- Landmark paper on acute, open ACL repair.
- 50 patients
- Defined 4 types of tears.
- Remnant tissue quality G/E 62%
- Type 1, proximal tears correlated with best results.
TYPE OF TEAR
TYPE OF TEAR

- ABC NEWS
- REALITY
ACL Repair - update

- To date 35 patients, all comers with MRI & scope confirmed Type 1, proximal ACL tears.
- Swivelock primary repair
  - Approx. 1/3 with Internal Bracing (fibertape)
- Age 15 – 57
- Delay to surgery 10 days – 10 years.
- F/U 6 weeks to 6 years
- 3 Failures: 1 non-compliant, 2 traumas at 11 months
- 2 elected to live with it. 16 yo F simple autoB TB revision.
- Recently submitted first 11 consecutive patients with 100% f/u at 2-6 yrs:
- 91% stable knees, including excellent outcome assessments, KT1000 data
TECHNIQUE
TECHNIQUE
CURRENT ALGORITHM

• Repair proximal tears
• Consider age and athlete level
• Discussion with patient/family
• Normal ACL rehab
• N = 4
QUESTIONS?

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