Rehabilitation of the Knee: when can I return to sport?

Thank You

Thank you to RUSH 2016 CHICAGO SPORTS MEDICINE SYMPOSIUM for the kind invitation to present this information.

It is indeed an honor and privilege to be invited to participate and share information.

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Professor of Physical Therapy, ASU, Savannah, GA. (2004-)
Professor Emeritus UW-LaCrosse, WI. (1975-2004)
Consultant, Clinician, Co-Director Clinical and Research Services, Sports PT Residency Program, GLSM, La Crosse, WI. (1995-present)
Sports PT, Coastal Therapy, Savannah, GA. (2004- present)
JOSPT - Co-Founder & Co-Editor, 1979
JOSPT - O'Donoghue Excellence in Clinical Research Award, 2004
Fellow, APTA, 2005, Hall of Fame Award, SPTS-APTA, 2006
NATA, President's Award, 2007, NATA, Most Distinguished Athletic Trainer, 2009
Sports Health - Co-Founder & Co-Editor, 2009
ACSM - Hall of Fame Award, 2013
A Quantitative and Qualitative Functional Testing Algorithm for clinical decision making to return athletes back to Sports following a Knee Injury

Questions

- What are the very specific criteria we use to discharge a patient from rehabilitation back to a high risk activity like competitive sports?
- Do we have absolute confidence in our decision making?
Clearance to Return to Sports

- If a physician, physical therapist or athletic trainer allows an athlete to return to sports, they may be legally held responsible if the athlete encounters a reinjury.


- One method is to have baseline pre-participation information, and have the athlete return back to “normal” for all the parameters

So how do we do it ???

- One way is to perform a task analysis of the specific sport
- Try to establish a performance metric
- Check epidemiology information for MOI
- Then determine if there are appropriate tests with good psychometric properties to test and evaluate the specific “tasks” for the sport
So how do we do it ???

- One area that seems to be overlooked in a lot of the literature with RTP testing is:
  - Performing the testing in a **“fatigued state”**

Clinical Decision-Making

- So, what else can we do???
- Because whatever we are doing at the present time, we are NOT doing as well as many have advocated over the years!

Return to Play

- 69 articles
- 7556 participants
- 55% RTS - competitive level
- RTS: LSI-hop test, younger age, male gender, playing elite sport, positive psychological response

Arden, CL, et.al. 55% RT competitive sport following ACL-R surgery: an updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. 
BJSM 48:1543-1552, 2014
Return to Play

Literature Review

Clinical Article

- Functional progression of a patient through a rehabilitation program

RTP-after ACL-R

- Barber-Westin, SD, Noyes, FR. Factors used to determine return to unrestricted sports activities after ACL-R.
- Arthroscopy. 27:1697-1705, 2011
- (Systematic Review)
RTP-after ACL-R

- Systematic review:
- 264 studies:
  - 105 (40%) failed to provide any criteria for RTP
  - 84 (32%) amount of time post-op was only criteria
  - 40 (15%) time and subjective criteria
  - 35 (13%) objective criteria
  - Muscle strength, stability, neuromuscular control, function

RTP-after ACL-R

- Systematic review:
- 264 studies:
  - 35 (13%) objective criteria
  - 9% - muscle strength criteria 80-90% of Q & H
  - 6% - effusion/ROM
  - 4% - single leg hop
  - 1 study - stability
  - 1 study - validated questionnaires

HOT TOPIC 2016

Literature State of the Art-RTS
The evidence emerging from this study suggests that the majority of patients who are 6 months after ACLR require additional rehabilitation to pass RTS criteria.

The RTS battery described in this study may serve as a framework for future studies to implement multivariate models in order to optimize the decision-making regarding RTS after ACLR with the aim to reduce incidence of second ACL injuries.

Young, active anterior cruciate ligament (ACL) reconstructed (ACLR) athletes who return to high level sports sustain a disproportionately greater incidence of second ACL injuries within the first 2 years after ACLR.

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**Key take home messages regarding definitions for return to sport (RTS)**

1. The minimum information required to define RTS is:
   - the sport and the level of participation the athlete aims to return to.
2. RTS is a continuum comprising three elements:
   - return to participation,
   - return to sport
   - return to performance.
3. In certain situations the RTS decision may be reversed to a removal from sport decision.
4. The RTS decision should be shared among all stakeholders (except in the case of health risk to the athlete).

**Arden, CL, et.al. 2016 Consensus statement on return to Sport from the First World Congress in Sports Physical Therapy. BJSM. May, 2016**


The evidence in the literature indicates that the ACLR athletes do not regain baseline, or not significantly different from baseline, knee joint biological health and function until approximately 2 years after ACLR.

The incidence of second ACL injuries will significantly decrease if ACLR athletes delay a return to high-level activity until 2 years after ACLR.

Conclusion: As the degrees of functional performance, subjective outcome scores and recovery of extensor strength are correlated with LSI for vertical jump test which clinician can easily assess with a computerized system in clinical offices, we suggest vertical jump test as a functional test after ACLR to determine the return to sports.
Patients who return to level 1 sports had a 4.32 times higher injury rate than those who did not.

Re-injury rate was reduced by 51% for each month RTS was delayed until 9 months after surgery.

After 9 months, no further risk reduction was observed.


Those who failed RTS criteria: 38.2% re-injury rate

Those who passed RTS criteria: 5.6%

More symmetrical quadriceps strength prior to RTS significantly reduced the knee re-injury rate.


Functional Testing Algorithm for clinical decision making For Return to Sports following a Knee Injury
Davies Functional Testing Algorithm

( ~ 36 years, [APTA-CSM, 1980] )

- Sports Specific Tests
- Lower Extremity Functional Tests
- Functional Hop Tests
- Functional Jump Tests
- OKC Isokinetic Tests
- CKC Isokinetic Tests
- Kinesthetic/ Balance Tests
- KT 1000 Tests
- Basic Measurements

FTA Specific Guidelines

- LEFT - M-1:30; F-2:00 minutes
- HOP - < 10% Ht.; < 10% bilat. Comp.; Norms/ various hops
- JUMP - < 15% / Ht.; Norms
- OKC Isokinetics - < 25% bilateral comparison/ other criteria
- CKC Isokinetics - < 30% bilateral comparison
- Kinesthetic/ Balance Testing - Bilat comp
- KT 1000 - < 3 mm bilateral comparison
- Basic Measurements - < 10% bilateral comparison

Functional Testing Algorithm - Knee

- Objective, quantitative (and qualitative), systematic testing and rehabilitation method to safely and rapidly progress a patient from immediate post injury/ post-op to return to full functional activities and return to play in sports
Progression to the next higher level of testing difficulty is predicated upon passing the prior test in the series...

Each successive test and its associated training regimen places increasing stress on the patient while at the same time decreasing clinical control.

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Competitive Athletes

Recreational Athletes

General Orthopaedic Patients

Functional Testing Algorithm

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Basic Measurements

- Time/soft tissue healing
- VAS (0-10 scale)
- Anthropometric measurements
- AROM, PROM
- Special Tests
- Qualitative & Quantitative Movement Assessment
- Knee Rating scales: IKDC, etc.
- MD Clearance & Approval

Functional Testing Algorithm

TIME:
Soft tissue healing from the injury or from a post-surgical condition
ACL Quad Tendon Graft Healing

Time Zero 1 month PO 6 months PO

We still have not answered this Question?

- Biologics and “mother nature” and the:
  - Neoangiogenesis
  - Maturation
  - Ligamentization

Clinical Decision Making

“Ligamentization” in Hamstring Tendon Grafts After Anterior Cruciate Ligament Reconstruction: A Systematic Review of the Literature and a Glimpse Into the Future

Les Pouliot Barber, M.D., Stefano Sylf, M.D., and Mark Schurr, M.D.

Clinical Decision Making
ACL Quad Tendon Graft Healing

Time Zero | 1 month PO | 6 months PO | 1 year PO

Functional Testing Algorithm - Knee - 2016

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Biodex Balance Stabilometer
ACL-R

- More flexion - WB on ACL-R side
- More external weight - WB on ACL-R side

3 months: unweighted ACL-R side
6 months: unweighted ACL-R side
12 months: normalized WB - ACL-R side

Majority of patients felt like they were performing equal WB on both legs

Functional Testing Algorithm - Knee - 2016

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2001

CLOSED KINETIC CHAIN EXERCISE
A Comprehensive Guide to Multiple-Joint Exercises

TODD S. ELLENBECKER
GEORGE J. DAVIES

Linea Bi-lateral Tandem Concentric/ Eccentric Exercises

Linea Bi-lateral Reciprocal Concentric Exercises

CKC
PWB
Isokinetic Testing
Shuttle - kinetic and kinematic analysis for CKC L.E. exercises
Merritt, AC, et.al. ACSM, Boston, MA, 2016

CKC - Testing

With CKC testing everything is being tested and we do NOT KNOW which muscles are contributing to the force production;
Or which muscles are NOT contributing to the force production

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So why do we have to test “each link” in the kinematic chain?

Advantages of OKC/Isolated Exercises
- Check for proximal and distal muscles compensating for weak areas.
- Check to see if there are deficits distant from the actual injury site.
- Prevent compensations from other muscle groups in the kinetic chain from “masking” weaknesses
- You know you are specifically “targeting” a muscle group when you test it
- There is a correlation between OKC testing and functional activities

Isokinetic Testing
- PubMed Search: 7/1/16
- Isokinetics: 5,460 references
- Isokinetics and Knee: 2,629 (48%)
Those who failed RTS criteria: 38.2% re-injury rate

Those who passed RTS criteria: 5.6%

More symmetrical quadriceps strength prior to RTS significantly reduced the knee re-injury rate


Isokinetic Data

- What information do we use from isokinetics? - ALLOMETRIC SCALING
Data Analysis
(Davea, G. A Compendium of Isokinetics, 1984, 1992)
- Bilateral comparison
- Unilateral ratio of agonist/antagonist
- Torque to body weight (relative/normalized data)
- TAS, TBS
- Angle specific torques
- Torque to (POWERS)
- Endurance analysis
- Normative data
- Functional correlation
- Sport specific correlation

Return to Play: Importance of Quads
- Early resolution of quadriceps strength deficits may be important for improving confidence and knee-related function.
- Interestingly, QSBW with isokinetic testing, had a stronger association with function in patients who did not RTS at 6 months


OKC Testing and Correlation to Functional Performance
Isokinetic Testing and Correlation to Functional Performance

- Preoperative quadriceps strength is a significant predictor of knee function three years after ACL-R. J Sports Med Phys Fitness. 52:27-30, 2012
- Functional Testing Algorithm

**Functional Testing Algorithm**

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**June, 2000**

The Benefits and Controversy of the Parallel Squat in Strength Training and Rehabilitation

- The rate of force development as an adjunctive outcome measure for return-to-sport decisions after ACL-R. JOSPT. 42:772-780, 2012
- The impact of quadriceps femoris strength asymmetry on functional performance at return to sport following ACL-R. JOSPT. 42:750-759, 2012
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CKC WB Isokinetic Testing

Functional Testing Algorithm - Knee - 2016
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Competitive Athletes
Recreational Athletes
General Orthopaedic Patients

SINGLE LEGGED HOP TESTS
- STANDARDIZED INSTRUCTIONS
- MULTIPLE VARIATIONS BASED ON SPECIFIC FUNCTION OF ATHLETE / PATIENT BEING TESTED
Performance

- Quantitative analysis is part of assessment (LSI)
- But, also important to perform qualitative assessment of the concentric power performance phase
- And most importantly, eccentric deceleration phase

IKDC ONE LEG HOP TEST

- Bilateral comparison & normative data

<table>
<thead>
<tr>
<th>Table 4.4 Functional (Relative/Normalized) Jump and Hop Test</th>
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</thead>
<tbody>
<tr>
<td>Males (distance as % of height)</td>
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<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Jump test (R + L)</td>
</tr>
<tr>
<td>Hop test (uninjured leg)</td>
</tr>
<tr>
<td>Hop test (injured leg)</td>
</tr>
</tbody>
</table>

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LE FUNCTIONAL TESTS

**Single Leg Hop Tests**
- Single leg forward hop
- Triple hop for distance
- Single leg timed hop
- Cross-over hop for distance

**Agility Tests**
- Shuttle run
- Side step
- Carioca
- LEFT

LEFT (Lower Extremity Functional Test)
- Sprint-Front
- Sprint - Retro Run
- Side Shuffles - Both Ways
- Cariocas - Both Ways
- Figure 8's - Both Ways
- 45° Angle Cuts - Both Ways
- 90% Angle Cuts - Both Way
- Cross-Over Steps - Both Ways
- Sprint - Front
- Sprint - Retro Run

Simulation of multiple sports performance characteristics in an in-clinic functional test
Lower Extremity Functional Test

10% “Puke Factor”!!!

ICCs .95-.97
LOWER EXTREMITY
FUNCTIONAL TEST (LEFT)

Return to Play

Lower Extremity Functional Test

Brumitt, J, Heiderscheidt, BC, Manske, RM, Niemuth, PE, Rauh, MJ.
Functional testing and predication of LE or low back injury among D-III collegiate athletes.

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Recreational Athletes
General Orthopaedic Patients
Specificity Testing

This is individualized to the patient and his/her specific ADL’s vocational or recreational activities

FUNCTIONAL TESTS-Applicability

LE Specific Outcome Scales (PROs)

- Smith, MV, et.al.
- Lower extremity-specific measures of disability and outcomes in orthopaedic surgery.
Outcome Scales-PROs

- KOOS
- IKDC
- Lysholm
- Cincinnati Knee Rating Scale
- Tegner Activity Scale
- ACL Quality of Life
- Marx Activity Scale

ACL-RSI (return to Sport after Injury)

Return to Play-Psychosocial Measures

Elevated pain-related fear of movement/re-injury, quadriceps weakness, and reduced IKDC scores distinguish patients who are unable to return to pre-injury sports participation because of fear of re-injury/lack of confidence.

Functional Testing Algorithm

- After passing the tests, the athlete returns to:
- Sport specific training programs
- Practice simulations
- Practices
- Scrimmages
- Competition

Summary

And

Conclusions

Functional Testing Algorithm - Knee - 2016

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Clinical decision making (CDM) (based on history, subjective exam, objective physical exam, imaging, etc.) states the athlete is ready to return to activity.

But if we also have all the functional tests to support the CDM, it strengthens the argument to return the athlete back to activity safely.

Clinical Implications

As Davies has said for the last 51 years, it MUST be an INTEGRATED APPROACH for testing and rehabilitation !!!

Thanks To Rush Sports Medicine Symposium