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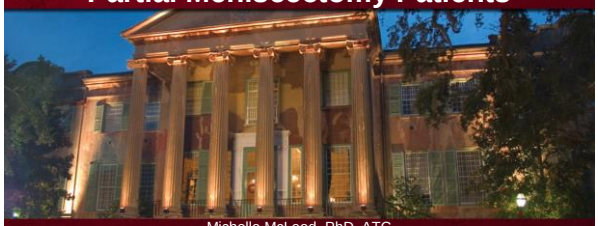
Quadriceps Strength is Associated with Self-Reported Function in Arthroscopic Partial Meniscectomy Patients



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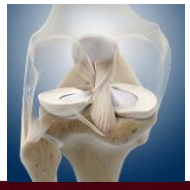
Meniscal tears…no cause for concern?

- Among the most common injuries of the knee in sport and workplace activities
  (Katz et al. *Arthritis Rheum.* 2009, Brindle et al. *J Athl Train.*2001, Englund et al. *Nat Rev Rheumatol.* 2012)
- Etiology: combined compressive and rotational forces
  - cutting, pivoting motion
- Classic signs/symptoms:
  - Joint-line tenderness
  - Clicking
  - Catching



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Surgical Management

- When a pathological meniscus contributes to pain, disability or mechanical interference:
  - Arthroscopic partial meniscectomy

2006 IDC-9-CM 80.26 Arthroscopy, knee

↓

956,000 procedures

↓

>690,000 "semilunar cartilage excision"

(Cullen et al. *National Health Statistics Reports,* 2009)

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So What's the Problem?

- Persistent quadriceps weakness
  (McLeod et al. *J Sport Rehabil.* 2012)
  - Predictor of physical function
    - Anterior cruciate ligament injury
    - Osteoarthritis

(Pietrosimone et al. *J Sport Rehabil.* 2013, Pietrosimone et al. *Int J Sports Phys Ther.* 2014, Fitzgerald et al. *Arthritis & Rheumatism.* 2004)

- Little consensus on post-procedure care
  - Accelerated v conservative therapy
  - Guided v independent

(Goodwin et al. *Phys Ther.* 2003, Stein et al. *Am J Sports Med.* 2010, Dias et al. *J Orthop Sports Phys Ther.* 2013)

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Similar Patient Populations

- Quadriceps strength predicts 61% of disability in ACL reconstructed patients
  (Pietrosimone et al. *J Sport Rehabil* 2013)
- Quadriceps weakness also predicts disability in osteoarthritic patients
  (Fitzgerald et al. *Arthritis & Rheumatism* 2004)

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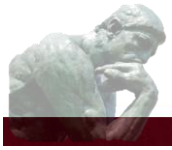
How Do Patients *Really* Function Post-APM?

"…but, you just told me post-APM patients RTP quickly…"

- Associations between quadriceps weakness and function post-APM are TBD



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Methods

Design: Cross-sectional
Setting: Controlled-laboratory environment
Procedures IRB Approved: #108243

Patient Demographics (n=9)

Sex	Age	Height	Mass	Time Since Surgery*
5 Male 3 Female	34.88 ± 14.45 years	172.24 ± 13.54 cm	105.52 ± 33.85 kg	39.38 ± 36.56 weeks

*Range: 2 weeks – 104 weeks

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Patient Recruitment

- Single orthopedic surgeon at the University of Toledo Medical Center and Main Campus community

Inclusion Criteria	Exclusion Criteria*
-- Age 15-60 years -- Unilateral, isolated meniscal injury resulting in APM	-- Other major ligamentous injury or surgery in either knee; back injury -- Smokers -- Diagnosis of neurologic disorder; peripheral neuropathy -- Altered cognitive status -- Fibromyalgia -- Inability to ambulate w/o assistive device -- BMI ≥ 40

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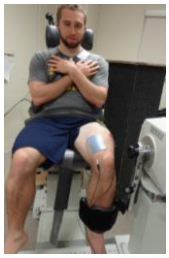
Outcome Measures

- Quadriceps Maximal Voluntary Isometric Contractions
  - Biodex System III Pro Dynamometer
  - Involved limb
  - Hips flexed 85˚ , knee flexed 90˚
  - Normalized to body mass (Nm/kg)



SYMPTOMS*:
*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1. What is the highest level of activity that you can perform without significant knee pain?

   5❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   4❑Strenuous activities like heavy physical work, skiing or tennis
   3❑Moderate activities like moderate physical work, running or jogging
   2❑Light activities like walking, housework or yard work
   1❑Unable to perform any of the above activities due to knee pain

2. During the past 4 weeks, or since your injury, how often have you had pain?

   10 9 8 7 6 5 4 3 2 1 0
   Never ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ Constant

3. If you have pain, how severe is it?

   10 9 8 7 6 5 4 3 2 1 0
   No pain ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ Worst pain imaginable

4. During the past 4 weeks, or since your injury, how stiff or swollen was your knee?

   4❑Not at all
   3❑Mildly
   2❑Moderately
   1❑Very
   0❑Extremely

5. What is the highest level of activity you can perform without significant swelling in your knee?

   5❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   4❑Strenuous activities like heavy physical work, skiing or tennis
   3❑Moderate activities like moderate physical work, running or jogging
   2❑Light activities like walking, housework, or yard work
   1❑Unable to perform any of the above activities due to knee swelling

6. During the past 4 weeks, or since your injury, did your knee lock or catch?

   1❑Yes 1❑No

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Physical Function

- 30-second chair stand test
  (Dobson 2013)
- 30-second knee bend test
  (Bremander 2007, Roos 2001)
- Stair climb test, in seconds
  (Dobson 2013)

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Statistical Analyses

- Spearman's Rho (ρ) correlations for non-normally distributed data were performed to determine associations between *quadriceps strength* and *self-reported function* and *physical function*.

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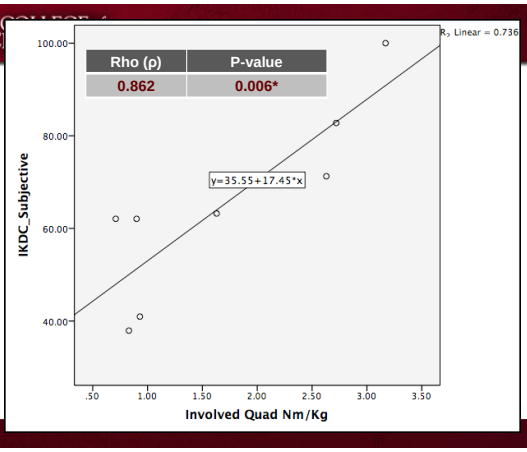
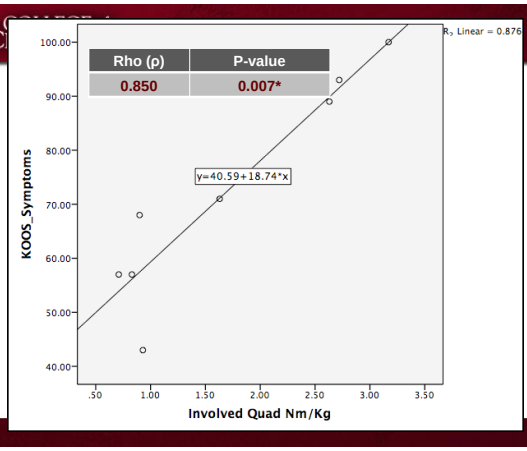
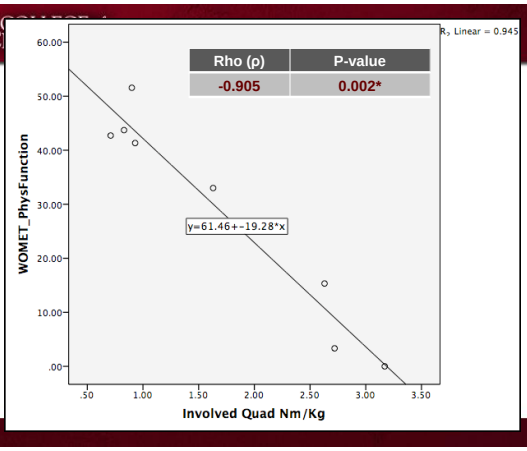
Results

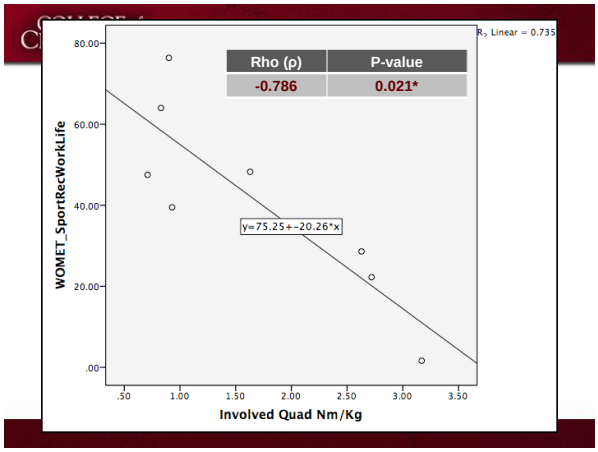
Associations Between Quadriceps Strength and Self-Reported Function

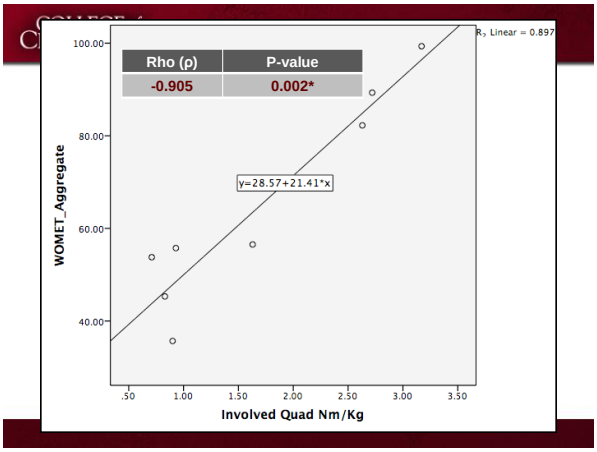
Variable	Mean ± SD	Rho (ρ)	P-value
Quadriceps MVIC	1.69 ± 1.00 (Nm/kg)		--
IKDC-Subjective	65.03 ± 20.39%	0.862	0.006*
KOOS-Pain	66.38 ± 23.42%	0.575	0.136
KOOS-Symptoms	72.25 ± 20.08%	0.850	0.007*
KOOS-ADL	78.13 ± 18.42%	0.611	0.108
KOOS-SportRec	65.00 ± 31.05%	0.347	0.399
KOOS-QOL	61.88 ± 29.24%	0.663	0.073
WOMET-PhysFunction	28.87 ± 19.89%	-0.905	0.002*
WOMET-SportRecWork	41.01 ± 23.70%	-0.786	0.021*
WOMET-Emotions	46.70 ± 32.36%	-0.690	0.058
WOMET-Aggregate	64.75 ± 22.67%	-0.905	0.002*
VAS-Pain	29.75 ± 32.63%	-0.561	0.148











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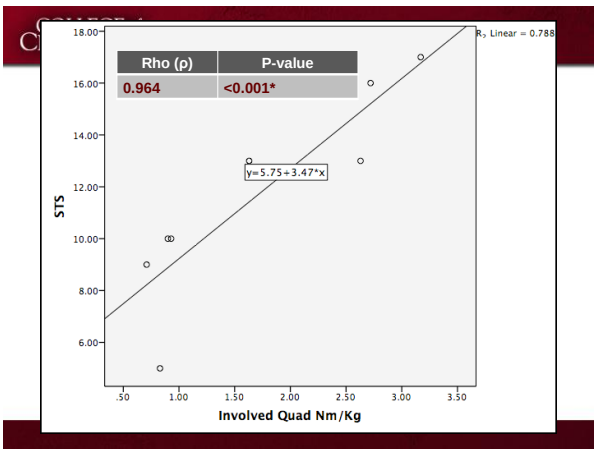
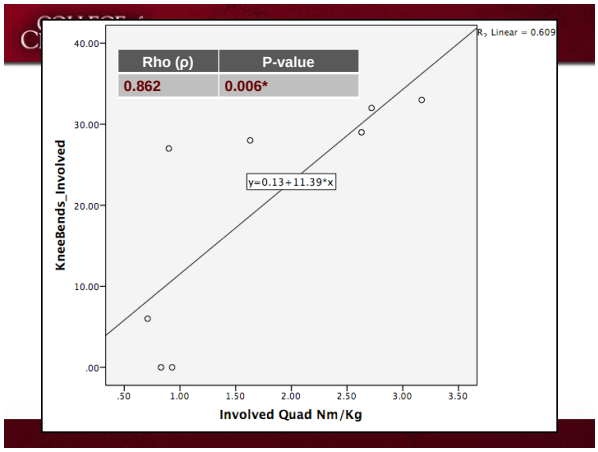
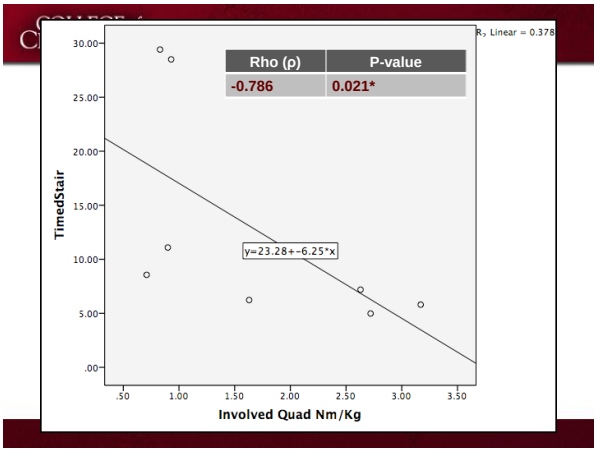
Results

Associations Between Quadriceps Strength and Physical Function

Variable	Mean ± SD	Rho (ρ)	P-value
Quadriceps MVIC	1.69 ± 1.00 (Nm/kg)	--	--
30s Chair Stand Test	11.63 ± 3.93 reps	**0.964**	**<0.001***
30s Knee Bend	19.38 ± 14.64 reps	**0.862**	**0.006***
Stair Climb Test	12.72 ± 10.20s	**-0.786**	**0.021***







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Are these results surprising?

Perhaps not

- Still important to acknowledge these findings
  - Consistent with other chronically disabled populations
    - ACL reconstruction
    - Osteoarthritis
    - Chronic obstructive pulmonary disease
    - Diabetes

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Consequences of Quadriceps Weakness

- Greater weakness→more self-reported limitations
  - At risk for decreased levels of physical activity
- Sedentary lifestyles
  - Cardiac myopathy
  - Diabetes
- Inability to walk associated with *mortality* in patients with knee and hip osteoarthritis

Nuesch et al. *BMJ* 2011

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Meniscal Patient Risk for Joint Disease

- Patients aged 17-30 may see radiographic changes consistent with OA within 15 years
- Patients aged 30 and older may exhibit radiographic changes *as soon as* 5 years

Roos et al. *Osteoarthritis and Cartilage*, 1995

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Influence of Pain

- Average pain rating at rest: 24/100
  - "Moderate" pain during test session
  - Negatively, moderately associated with strength
  - Possible driver of impaired function

Hawker et al. *Arthritis Care & Research*, 2011

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Limitations and Directions for the Future

- Sample size
- Biomechanical and neuromuscular data
  - Gait, stair navigation
  - Excitability, activation
- Generalizability of our patient population
  - Broad spectrum of patients
    - Traumatic v. degenerative

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Clinical Implications

- Although patients return to activity rapidly following APM, impairments may persist
- Strength is associated with physical activity
  - Despite this, there remains ***no current standard of care***
  - Illustrates importance of the inclusion of self-reported measures in individualized rehabilitation plans

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Conclusion

- Greater quadriceps MVIC strength moderately to strongly associated with better self-reported function and better physical performance
- Inclusion of self-reported assessments and physical function tasks may be better clinical practice to appreciate limitations not captured by disease-oriented outcomes

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Thank You

DATALYSCENTER Sports Injury Research and Prevention

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