Rehabilitation

Total Knee Arthroplasty
Unicompartmental Knee Arthroplasty

Monica Clarke P.T., FCAMPT
Stittsville Sport Physiotherapy Centre
Purpose of this presentation

• A version of this presentation was presented at the 2012 National Capital Knee Symposium for physicians, surgeons, physiotherapists and other rehabilitation professionals

• It is intended for information purposes only and is not meant to replace a personalized rehabilitation program or instructions given by a surgeon for rehabilitation following a specific surgical procedure
New knee

Now what?
Patient self-report scores

Pain
Quality of life
Pain reduction is the most obvious benefit to the patient.
Real life ...

12 months post-op half the walking speed and half the stair climbing speed of age-matched groups.
Why the discrepancy between self reports and actual physical function?
It has to be about strength!
Predicting Functional Ability One Year After TKA (Mizner et al, 2005)

- 40 subjects tested 2 weeks before and 1 year after TKA (total knee arthroplasty)
- Measured isometric quad strength, pain, knee range of motion and assessed function with the timed-up-and-go test and the stair-climbing-test
- Hierarchical regression comparing pre & post-op factors and compared using paired t-tests
Pre-op quadriceps strength predicts functional ability one year after TKA
(Mizner et al, 2005)

Of all the measures compared only quad strength had predictive value
Strength

Muscle Activation

Sarcopenia
Loss of quadriceps strength is partly due to

- Failure of voluntary contraction (Mizner et al, 2003 & Stevens et al, 2003)
  - Voluntary activation of muscle accounts for 65% of the variance in loss of strength
  - In the acute/post-op period loss of voluntary activation contributes twice as much to the loss of strength compared with muscle atrophy

- Central activation ratio (CAR)
Interpretation of CAR

• Healthy 66 – 83 year olds without known knee pathology average CAR of 0.96 (0.87 – 1.00)
• Pre-op average voluntary activation failure is twice what a normal healthy older adult would be
• One month post-op TKA 0.75
• Other examples patellar contusion 0.86, 6 weeks post ACL tear 0.92
Sarcopenia

- Mean cross-sectional area (CSA) of the quadriceps in 65-81 year olds with no known OA is 63.5 – 68.1 cm
- CSA in a group aged 41 – 75 with history of OA 46.1 – 49.5 cm
- Further loss 1 month post-TKA 10 %

- Mizner et al, J Bone Joint Surg Am, 2005
- Frontera et al, J Appl Physiol, 2000
Older adults (Stevens, Binder-MacLeod, Snyder-Mackler, 2001)

- Test weaker
- Greater deficits in Central Activation Ratio (CAR)
- Greater proportion Type I contractile material secondary to atrophy of Type II fibre
- Response to fatigue testing no different from young subjects
Quadriceps weakness

• Implicated in development and progression of joint degeneration (Arthritis Rheum, 1998)
• Strong predictor of functional limitations in patients with OA (J Rhematol, 1999)
• Strength declines up to 60% in the acute post-op period (J Orthop Res, 2003)
Subjects shifted weight away from surgical leg during sit-to-stand (STS)

Quad activity and extension moments at knee and hip on the involved side were smaller

Knee excursion during weight acceptance during gait, STS difference were related to quad strength
Quadriceps Strength and Function


• Better functional scores associated with greater quadriceps strength
• Older TKA patients generated lower peak torque values than younger TKA
• Higher BMI associated with weaker quadriceps scores
• Results suggest a more thorough rehab after TKA would improve function
What can be done?
Using Neuromuscular Stimulation
Neuromuscular Electrical Stimulation

• Greater strength gains when patients were able to achieve a higher percentage of knee extension maximal voluntary isometric contraction (MVIC) with NMES (Stevens, Mizner, Snyder-Mackler 2004)

• NMES earlier than 4 weeks maybe helpful (Avramidis et al, 2003)
  – From day two post-op, to vastus medialis for 4 hours / day!

• NMES from post-op day 2 for 6 weeks with strength gains in the first month (Mintken et al, 2007)
NMES

- First 3 weeks *of use* showed the most significant and lasting gains  
  (Stevens, Mizner, Mackler 2004)
Neuromuscular Stimulation with Quadriceps Strengthening
Start early AND keep it going! (Petterson, Snyder-Mackler 2006)

- 62 year old male cyclist 12 months post simultaneous bilateral TKA
- Had completed his post-op rehab but was having trouble getting necessary strength to compete again especially of the left quadriceps
- Left quad was 26% weaker than the right
- CAR of left quad was 13 % lower than the right
- Study → Unilateral exercise routine with each lower extremity + NMES to left quad only (total 16 sessions over 6 weeks)
Results

26% improvement in strength
Left quad volitional activation went from CAR of 0.83 to 0.95
Right quad also improved in strength by 11%

Further follow-up:
3 mos after D/C (18 mos post-op) left side now only 4 % weaker than right
24 mos post-op left quad 6% stronger than right
Unilateral and Intense
Hamstring Strengthening
Hamstrings, gluteal muscles and “the core”
Average peak knee flexion angle during weight acceptance

Significantly lower
Knee excursion during weight acceptance

Also significantly lower
Address aspects of gait and knee control
Functional Unilateral Strength
Hip strength
American College of Sports Medicine

• Progressive resistive training of major muscle groups 2-3 times/week

• Aerobic training 3 times/week 30 – 40 minutes
The Reality

Patients are often discharged from 6 weeks of post-operative outpatient physiotherapy with instructions to keep strengthening and increase activity but how do they do that and do they do it?
Further Physiotherapy Follow-up

• In the first 3-4 weeks after starting a strengthening program *muscle activation* is starting to change and some gradual improvement in function is noticed

• At 6-8 weeks muscle *hypertrophy* has begun

• This is the *minimal* length of time to get a change

• OA patients and those that have had a knee replacement are starting far below “normal” when compared with age-matched healthy individuals
More is better

• If possible even a few sessions of follow-up in the community with a physiotherapist once discharged from physiotherapy at the hospital would likely be beneficial

• To answer ongoing questions regarding healing, how to progress exercises, further work on specific functional goals ie. getting back to golf/curling and possibly to get a few more sessions of NMES to maximize quad strength
12 – 16 weeks of dedicated strengthening

• We tell our ACL post-op patients (up to 6 months of strengthening!) why don’t our total knee patients do the same?

• Benefits of strengthening:
  – Improved levels of function
  – Improved balance and co-ordination → less falls and close calls
  – With better balance patients may be more confident to be more active → potential cardiovascular benefit
  – Improvement in quality and density of bone
NORMAL KNEE MOTION

4.16 Analysis of the articular movements which are combined during extension at the knee joint. (Right knee viewed from medial aspect; patella, menisci and other structural features omitted.) A. With a stationary femur, i.e. moving female tibial condylar surfaces. Notice that in each case elements of slide, roll and spin occur together. In A the roll and slide are in opposite directions, whereas in B they are in the same direction. See text for further description.
Daily requirements for Range of Motion
Common Activities of Daily Living

• Gait and average slopes 90 degrees of flexion
• In and out of regular and low chairs requires from 90 to 120 degrees of flexion
• For getting in and out of a bath tub as much as 135 degrees is needed
“... suitable goal for rehabilitation”

110 degrees of flexion is commonly cited for post-operative recovery after total knee arthroplasty
Most Total Knee Arthroplasty Patients

• Will recover 115 – 120 degrees depending on factors such as which prosthesis was used and pre-operative range of motion
Flexion

One possible manual therapy technique to improve flexion
Regaining Extension
Extension

Use of manual therapy techniques to increase range of motion
Range of Motion

• Unicompartmental knee arthroplasty (Oxford) may achieve greater than 120 degrees flexion

• Average knee flexion after Total Knee Replacement 105 – 113 degrees (Mizner, Petterson & Snyder-Mackler, 2005)
Oxford / Unicompartmental Knee Arthroplasty
Recovery tends to be faster due to factors such as a less invasive procedure with a smaller incision, only one compartment of the joint is replaced leaving the rest of the joint in relatively healthy condition and sometimes this surgery is done in a younger population which may effect recovery time and recovery of strength.
Outcomes after Unicompartmental Arthroplasty (UKA)

• Both groups (TKA and UKA) improved significantly on the operated leg (Oxford Knee Score as well as proprioception)

• UKA position sense improved twice as much as in the TKA group, dynamic aspects of proprioception improved more in UKA also (Knee 2007)
Unicompartmental Replacements

• Weale et al, 2001
• Pain and functional outcomes were similar
• Unicompartmental replacement patients were better able to descend stairs
With strength comes balance
How long should we carry on?

Much longer than 6 weeks!

Intensity of exercise needs to progress

NMES if possible

Unilateral and specific to function
Risk of a contralateral TKA within 10 years

37 %
And if not the contralateral knee → the contralateral hip is at risk too!
Thank you!

Monica Clarke P.T.
Stittsville Sport Physiotherapy