To comply with professional boards/associations standards:

- I declare that I (or my family) do not have a financial relationship in any amount, occurring in the last 12 months with a commercial interest whose products or services are discussed in my presentation. Additionally, all planners involved do not have any financial relationship.
- Requirements for successful completion are attendance for the full session along with a completed session evaluation.
- Vyne Education and all current accreditation statuses does not imply endorsement of any commercial products displayed in conjunction with this activity.

Session 103: Weighing the Evidence on Treating the Arthritic Knee: Surgery or Not?

Sue Dupont, MS, MBA, PT, ATC, LAT

DISTURBING STATISTICS

- Degenerative Meniscus tears = early signs of knee osteoarthritis (OA)
- Partial meniscectomy: most common procedure in the U.S.
- 700,000+ partial meniscectomies in US each year
- 4 million procedures worldwide
- Direct medical costs = $4 billion
- Other costs: Lost wages, time off work, lost productivity, etc.

Heidari, 2013; Sihvonen et al, 2013
ATHLETES WITH KNEE INJURIES

- Risk of developing OA increases 100X in athletes who sustain knee injuries
- 80% of ACL injured knees may show radiographic evidence of OA at 5-15 years after injury
- **WHY?**
  - Secondary injuries
  - Altered biomechanics
  - Increased mechanical stress on other tissues
  - Meniscus, cartilage, ligaments, subchondral bone, etc.

Simon et al, 2015

CASE STUDY: “DAN” 53 y.o. LAB MANAGER, S’P L TKA

- 1986: ACL injury to L knee in college football s/p reconstruction
- Eventually, 2 arthroscopies on L knee; 2 on R knee
- Dan became body builder after college
- Lost competitions due to “unequal” quadriceps definition
- 2011: increased knee pain; opted for non-surgical treatment for 5 years
  - “Chicken Juice” injections (hyaluronic acid)
  - PRP injections
- 2016: Dan underwent L TKA at age 53 y.o.

END-STAGE KNEE OA = TKA

- Estimated need for TKA increases 6X by 2030!!!
- Due to aging population & increased life expectancy
HOW DO WE DETERMINE KNEE OA?

KELLGREN-LAWRENCE SCALE

- Method of classifying severity of knee osteoarthritis (OA) using 5 grades, 0-4.
- Proposed by Kellgren et al. in 1957
- Based on degree of joint space narrowing (JSN), symptoms, and presence of osteophytes.
- Recently criticized for:
  - characterizing progression of Knee OA as a linear process
  - combining osteophyte & JSN measurements; they could also develop independently.

(0) No sx's.
(1) No sx; min. JSN, possible osteophytic lipping
(2) definite osteophytes, possible JSN on A/P weight-bearing radiograph
(3) multiple osteophytes, definite JSN, sclerosis, possible bony deformity
(4) large osteophytes, marked JSN, severe sclerosis and definite bony deformity

(Dr. Vivek Pai, et al. Radiopaedia.org)
KNEE OA
GRADE 2 VS. GRADE 4

KNEE PAIN ON X-RAYS
• Typically attribute Knee pain in OA to joint structural damage
• Presence of OA on x-rays can influence decision for surgery.
• BUT Evidence shows lack of association between knee pain & x-ray evidence of knee OA
• Most studies agree: evidence of osteophytes is better predictor of knee pain vs JSN

Bedson and Croft, 2008; Heidari, 2011

FACTORS THAT MAY ALSO CONTRIBUTE TO KNEE PAIN
• Synovial hypertrophy
• Synovial effusions
• Subchondral bone defects
• Joint effusion
• Synovitis
• Cartilage defects
• Meniscal and/or Ligament tears
• Subchondral sclerosis
• Neuropathic pain
WHO GETS KNEE OA?

In study of patients with Knee OA—predicting factors (94% sensitivity, 93% specificity):
- Older age
- Female
- Higher BMI
- Absence of whole leg pain
- Difficulty descending stairs
- Palpable effusion
- Fixed-Flexion deformity
- Restricted Flexion ROM
- Crepitus

RISK FACTORS FOR KNEE OA

- **Age***
- **Genetic***
- Obesity
- Female gender
- Trauma
- Repetitive knee trauma
- Muscle Weakness
- Joint laxity
- Mechanical forces
- Kneeling
- Squatting
- Meniscal injuries

GAIT CHANGES IN KNEE OA

- **3 Groups**: Asymptomatic, Moderate (K-L 2-3), Severe (K-L 3-4)
- **Trends**:
  - BMI increased with Moderate to Severe OA
  - OA groups were older
  - Gait speed decreased incrementally with severity

Heidari B, 2011

Astephen, et al. 2008
GAIT CHANGES IN KNEE, HIP & ANKLE

Progressive Gait Changes:
- < knee flexion angles during stance
- < knee extension in early stance
- Decreased late-stance hip IR moments
- Decreased late-stance Ankle DF moments
- Increased late stance Hip flexion moments
- Decreased late stance Hip extension moments

KNEE OA: NOT JUST STRUCTURAL

- Apoptosis = genetically-regulated cell death
  - With aging, apoptotic responses to DNA damage are less controlled & escalated
  - contributes to degenerative disease
- Key players in knee OA pathogenesis:
  - Cytokines
  - Chemokines
  - Oxygen Free Radicals

• Current knee OA research is concerned with how these pro-inflammatory substances interact on genetic level.
• Limits chondrocyte proliferation, & leads to damage in cartilage matrix.
• Key to treatment lies in early detection & intervention BEFORE irreversible stages of OA.

Kandahar, A, et al. 2015

KNEE OA: SURGERY OR NOT?

• Multicenter RCT, double-blind, sham-controlled trial
• N = 146, Age 35-65 y.o.
• Deg. Meniscus tear, but NO Knee OA (grade 0-1 K-L)
• WOMET score (Western Ontario Meniscus Eval Tool); 100 best, 0 worst
• Lysholm knee score (0-100); > score = less symptoms
• 0-10 VAS for pain
• Outcomes for surgery NO BETTER than those after sham procedure!
APM vs. SHAM SURGERY

<table>
<thead>
<tr>
<th>Measure</th>
<th>APM</th>
<th>Sham</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysholm Score</td>
<td>60.1</td>
<td>56.4</td>
</tr>
<tr>
<td>WOMET Score</td>
<td>55.4</td>
<td>52.8</td>
</tr>
<tr>
<td>Pain after ex</td>
<td>5.8</td>
<td>6.0</td>
</tr>
<tr>
<td>Pain at rest</td>
<td>4.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Pain provoked by forced flexion</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

NO EVIDENCE: APM + PT vs. PT ONLY

- Designed “METEOR” (Meniscal Tear in Osteoarthritis Research) trial in 7 U.S. treatment centers.
- Two Groups: APM + PT vs. PT only, (n=351; age 45 y.o. +)
- Used WOMAC score (range 0-100; > scores = worse)
- KOOS Score (> score = worse)
- PT attend 1-2x/week for avg. 6 weeks
- Assessed at 6 & 12 months.
- No better relief of symptoms in surgery group!

ARTROSCOPIC PARTIAL MENISCECTOMY (APM) + PT vs. PT

Total Score 12 months

- WOMAC APM
- WOMAC PT
- KOOS APM
- KOOS PT
NO EVIDENCE FOR APM vs. CONTROLS

Thorlund, et al. 2015. Systematic review of evidence
- 3-24 months follow-up
- Mean age 49 – 62 y.o.
- Control groups = sham surgery, exercise, medical tx

RESULTS:
Arthroscopy *slightly better* than controls for pain relief
- Only at 3 & 6 months, but *not* later time frame
- Pain levels were < 2.4 mm on VAS
- Is that a clinically significant change???
- No *significant evidence* to support APM!

IF NOT SURGERY, THEN WHAT?
- Cortico-steroid injections
- Hyaluronic acid injections
- PRP injections
- Stem Cell implantation

TARGETS FOR TREATMENT OF KNEE OA
- Decrease pain
- Increase functional mobility
- Prevent or correct joint deformity
- Slow progression of disease process

Raeissadat, et al. 2015
CORTICO-STEROID INJECTIONS

- Intra-articular Cortico-steroid injections (IAC) are common treatment for joint pain
- Are they effective?
  - IAC vs. sham or no treatment for Knee OA
- Benefits:
  - Moderate @ 1-2 weeks post tx.
  - Small-to-moderate @ 4-6 weeks
  - No evidence of effect @ 13 weeks or 26 weeks
- Diff. in Pain score of 1.0 cm on a 10-cm VAS
- Diff. in WOMAC functional score -0.7 units (0-10 scale)
- Is this clinically significant??? Meaningful difference???

Juni, et al. 2015

HYALURONIC ACID (HA), aka “CHICKEN JUICE”

- Extracted from rooster combs or made synthetically
- HA = provides viscoelasticity and lubrication
- HA concentration is reduced in OA knee.
- HA injections used for visco-supplementation

HA INJECTIONS FOR KNEE OA

- Plays role in joint mechanical support & metabolic effects:
  - Stimulates chondrocyte metabolism
  - Synthesis of cartilage matrix
  - Inhibits chondro-degeneration enzymes
  - Inhibits inflammatory process
EFFECTIVENESS OF HA INJECTIONS

• **HA vs Steroids:**
  - Steroid injections more effective up to 4 wks
  - HA more effective after 4 weeks up to 8 weeks

• **HA:**
  - Modest effect on early to moderate knee OA
  - Effect peaks at around 6-8 weeks
  - Doubtful effect at 6 months

Trigkilidas & Anand, 2013;

IMAGINE... NO MORE ARTHRITIS?

• **Orthobiologics**
  - Biologic substances derived from a living system
  - Molecules can signal or generate immune response in tissues

• **In Knee OA, orthobiologics used to:**
  - Halt or reverse the inflammatory process
  - Reverse cellular apoptosis
  - Promote connective tissue repair & regeneration

Smith, et al. 2015

PRP (PLATELET-RICH PLASMA) THERAPY

• Drawn from patient’s own blood
  - Centrifuge into components:
    - Platelet-poor plasma
    - Platelet-rich plasma
    - Growth factors
    - Red blood cells

• **Growth factors stimulate:**
  1. Tissue repair & regeneration
  2. Production of HA

• **High levels of RBC in PRP:**
  - Increase cell apoptosis!!
  - Increase production of cytokines!!
PRP vs HA

- n = 160, grade I to IV K-L knee OA
- 12 month follow-up
- Used WOMAC, & SF-36 questionnaire (quality of life)
- **PRP group:** 2 I-A injections @ 4-week intervals
- **HA group:** 3 doses I-A injection @ 1-week intervals
- **RESULTS:**
  - Pain improved in both groups, but greater in PRP
  - Function and QOL improvement only in PRP group!

Raeissadet, et al. 2015

**EVOLUTION & EFFECTIVENESS OF PRP THERAPY**

- Currently, able to process PRP & inject back into living tissue in one treatment
- **Systematic review on effect of PRP on Knee OA:**
  - N=1,423 subjects, over 14 RCT's
  - Control groups = placebo, HA, ozone and I-A corticosteroids
  - Follow up 12 to 24 months
  - Used WOMAC scores @ 3, 6, 12 mo. (MCI = 10 points)
    - Pain, Physical Function, and Total

Shen, et al. 2017

**PRP VS. CONTROLS– SYSTEMATIC REVIEW**

Mean Change in WOMAC scores PRP vs controls

![Graph showing mean change in WOMAC scores](chart.png)

- WOMAC Pain (0-10)
- WOMAC Phys Function (0-68)
- Total WOMAC (0-96)

- 3 mo 6 mo 12 mo
**PRP CONCLUSIONS**

- Probably **more effective** in knee OA for Pain relief & Physical Function vs. control treatments @ 3, 6, & 12 months.
- Mean duration of clinical improvement = **9 months**
- Still significant improvement over baseline up to 24 months.
- Only **temporarily disrupts** OA process, but does **NOT** affect joint structure or progression of OA!!

Shen, et al. 2017

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**FUTURE: PLATELET GEL IMPLANTS**

- Animal research trials only
- Rabbits, Minipigs and sheep
- Osteochondral defects filled with platelet (PR) gel
- **At 6 months showed improvement in:**
  - Cell morphology
  - Surface regularity
  - Chondral thickness
  - Repair tissue integration


---

**PLATELET-RICH FIBRIN (PRF)**

- Prepared without biochemical blood handling
- Similar to PRP, but more natural
- **More proficient cell mobilization** for healing
- Combined with *Stromal cell-derived factor-1 (SDF)*:
  - Regulates stem cell activity
  - Controls inflammatory response
  - Released by Bone marrow near chondro-osseous junction

---
PROMISING RESEARCH WITH PRF & CHEMOKINES IN RABBITS

- PRP vs PRF with SDF1 to induce hyaline cartilage regeneration of rabbit knee
- Create articular defect


MESENCHYMAL STEM CELLS (MSC)

- Controversial, but promising treatment for early stage OA
- Why MSCs?
  - Can differentiate into different types of cells (e.g. chondrocytes)
  - Can divide & make copies of themselves—“self-renewal”
- Adult sources of SCs limited in ability to differentiate
- Amniotic membrane SC better option vs. Embryonic
  - Less controversial, no destruction of fetal tissue

SOURCES OF STEM CELLS

- Bone marrow concentrate (BMC)*
  - typically from post. iliac crest
- Adipose tissue (ADSC)
- Synovial tissue (SDSC)
- Peripheral blood (PBSC)
- Amniotic membrane SC (AMSC)
MSC: SYSTEMATIC REVIEW FOR KNEE OA

• 60 studies reviewed
  • 26 were **injection** method
  • 33 were **surgical** implantation

**Cell sources:**
- BMSC
- ADSC
- BMC
- PBSC

Kim et al, 2015.

MSC: INJECTION VS IMPLANTATION

• n=102, arthroscopic implant of MSCs for Knee OA (grades I to III)

**Two groups:**
- **Injection + PRP** group
- **Implantation MSC** group (on fibrin glue scaffold)

**Results:**
- 12-month follow-up arthroscopy: both groups improved
- 26-month follow-up: only implantation group saw further improvement

Kim et al, 2015.
MSC CONCLUSIONS

1. No major adverse events related to treatment or harvest site
2. A clinical benefit of using MSC therapies found in most studies, regardless of cell source or administration method.
   - Positive MRI & macroscopic findings
   - Controversial histologic findings
3. Better outcomes associated with:
   - Younger age
   - Lower BMI
   - Smaller lesion size
   - Earlier stage OA


MEASURING CLINICAL OUTCOMES

- Patient Reported Outcomes (PROs)
- Functional Performance Tests

COMMON PROS FOR KNEE OA

- WOMAC (Western Ontario & McMaster Universities OA Index)
  - 17 items
  - 3 section: Pain, Stiffness, Physical Function
  - Max 96 points; higher score > disability
  - MDC 10 points
- KOOS-PS (Knee Injury & OA Outcome-Physical Function Short Form)
  - 7 items
  - Score 0-4; Max score 100; higher score > disability
  - MDC not reported

www.orthopaedicscore.com; www.koos.nu
COMMON PROS FOR KNEE OA

- **KOS ADL (Knee Outcome Survey- ADLs)**
  - 2 sections: Symptoms, Functional limitations with ADLs
  - Rated 0-5; Max Score 70; higher score > disability
  - MDC 7 points

- **KOS SAS (Knee Outcome Survey- Sports Activities Scale)**
  - 2 sections: Symptoms, Functional limitations with Sports Activities
  - Rated 0-5; Max Score 55; higher score > disability
  - MDC 7 points

BEST PERFORMANCE TESTS

- **High Impact**
  - One-Leg Hop Test
  - 6M Tired Hop Test
  - 30 sec Knee Bend Test

- **Low Impact**
  - Single Leg ¼ Squat
  - 30 sec Chair Sit to Stand Test
  - 6M Walk Test
  - Four Square Step Test

EXERCISE THERAPY FOR KNEE OA

Lower kinetic chain function
NEMEX program
NATIONAL STRATEGY FOR OA

GOAL for TREATMENT:
• Control pain
• Minimize joint damage
• Improve or maintain function & quality of life

TREATMENTS:
• Medications
• Nonpharmacologic therapies:
  • Physical or occupational therapy
  • Splints or joint assistive aids
  • Patient education
  • Weight loss
• Surgery

FACTORS THAT LIMIT SUCCESS W/ EXERCISE THERAPY
• Knee flexion contracture > 5 deg
• Weaker quads @ start of Ex Therapy
• Knee Varus malalignment

TARGET BIOMECHANICAL CONTRIBUTORS FOR KNEE LOADING
• Strength exercise
  • Increase force output of key muscles
• Neuro-Muscular exercise
  • Improve dynamic alignment, function & control
  • Focus on QUALITY of movement!
KINETIC CHAIN REHAB PRINCIPLES

• **The CORE drives kinetic chain function!!!**
• Pelvis functions to **transfer load** between trunk & LE’s.
• **GOAL:** re-establish optimal LOAD TRANSFER, not strength!

Vleeming, 1995; Sciasca & Cromwell, 2012

EVIDENCE FOR BIOMECHANICS

1. Poor hip strength assoc. with knee pain vs. controls (no knee pain)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>% Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Ext</td>
<td>&lt;52%</td>
</tr>
<tr>
<td>Hip Abd</td>
<td>&lt;27%</td>
</tr>
<tr>
<td>Hip Ext Rot</td>
<td>&lt;30%</td>
</tr>
</tbody>
</table>

2. 87% of ACL Recon. Athletes w/ Ant. Knee pain had:
   • Weak Hip ABD
   • Tight IT Band

Robinson & Nee, 2007; van Dillen, 2000

CORE STABILITY & LE INJURY RISK

• 80 college track & basketball athletes
• Tested Hip strength, Abdominal function, & Core endurance pre-season
• Assessed injury rates post-season
• Athletes without injuries had stronger Hip ABD & Ext ROT:

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Abd</td>
<td>&gt;31.6%</td>
<td>&gt;28.6%</td>
</tr>
<tr>
<td>Hip Ext Rot</td>
<td>&gt;20.6%</td>
<td>&gt;17.9%</td>
</tr>
</tbody>
</table>

Leetun et al, 2004
HIP WEAKNESS W/ KNEE OA

- n=89; >50 y.o. with knee OA vs. n=23 controls (Hinman, et al. 2010)
- Adj. Mean Strength Diff b/w Knee OA vs. Controls

MYOFASCIAL SLINGS

- Anterior Oblique & Lateral System
- Posterior Oblique
- Deep Longitudinal Subsystem

Identifying Dysfunction:
- Hip ABD weakness
- Hip ADD weakness
- Hip EXT weakness

Ipsilateral Injuries:
- Low back pain
- Hamstring strain
- Ankle sprain
- Knee pain/PPFS
- Plantar fasciitis
**ISSUES IN POSTERIOR OBLIQUE SLING**

"Gluteal Amnesia":
- Inhibition of Gluteal muscles
- Inhibition of Lat. Dorsi
- Overuse (facilitation) of TLF

**COMMON DYSFUNCTIONS IN LATERAL SLING**

- Tight TFL
- Excess Hip IR
- Overactive Quad. Lumborum
- Inhibited Gluteus Medius
- Inhibited Internal Oblique

**Contributes to Injuries:**
- Ant Knee Pain
- Ant Hip Impingement
- Low Back Pain

**BEST KNEE OA PROGRAM**

- Should address:
  - Sensori-motor function
  - Functional stabilization
- **Components:**
  - Strength
  - ROM
  - Proprioceptive acuity
  - Muscle activation deficiency
  - Biomechanics during functional movements

Swart, et al. 2014
RX Program

Muscle Strength

Rebalance muscle activation patterns

Improve articular surface loading

Knee OA Symptom Relief

Independent Living & QOL Improved

RX PROGRESSION FOR KNEE OA

• Only change ONE variable @ a time (reps, resistance)
• Do NOT increase training volume >5% per week
• Do NOT perform RX for same muscle on consecutive days
• Ceiling Effect: training level where pain increases; do not increase volume!
• Add or Substitute other exercises to provide stimulus
• Consider severity of Knee OA; keep pain <3/10
• No Limping allowed after exercise!!

Vincent & Vincent, 2013

EVIDENCE FOR EX THERAPY

• n=20 age 38-58 y.o. with knee OA
• Progressive program for strength & n-m function
• 12-week program, 14-32 sessions; 1 year follow-up
• Exercises:

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Reps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike warmup</td>
<td>3 x 10</td>
</tr>
<tr>
<td>Dbl Leg Curl w/ legs on stab. Ball</td>
<td></td>
</tr>
<tr>
<td>SL Squat</td>
<td></td>
</tr>
<tr>
<td>SL Leg Press</td>
<td></td>
</tr>
<tr>
<td>SL Knee extension &amp; Curl</td>
<td></td>
</tr>
<tr>
<td>Step UP</td>
<td></td>
</tr>
<tr>
<td>Skating</td>
<td></td>
</tr>
<tr>
<td>Quick Kicks on balance pad</td>
<td></td>
</tr>
<tr>
<td>Low Level Plyometric hops over line</td>
<td></td>
</tr>
</tbody>
</table>

RESULTS OF 12-WK TRAINING

<table>
<thead>
<tr>
<th>Strength</th>
<th>Improvement</th>
<th>1-yr Followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee Ext</td>
<td>5-74%</td>
<td>50%</td>
</tr>
<tr>
<td>Knee Flex</td>
<td>3-80%</td>
<td>7 pts</td>
</tr>
<tr>
<td>Knee Flex (0-pt MDC)</td>
<td>80% of patients</td>
<td></td>
</tr>
</tbody>
</table>

Performance Testing:

<table>
<thead>
<tr>
<th>Test</th>
<th>Improvement</th>
<th>1-yr Followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL Hop</td>
<td>70% patients</td>
<td>1-65%</td>
</tr>
<tr>
<td>6M Timed Hop</td>
<td>80% patients</td>
<td>4-125%</td>
</tr>
<tr>
<td>30-sec Knee bends</td>
<td>95% patients</td>
<td>5-133%</td>
</tr>
</tbody>
</table>

KEY EXERCISES FOR KNEE OA

VMO Exercises

1. Lateral Step UP
2. Standing Lunge
3. “Dynamic Edge” (Resist lateral slide)
4. Prone Bridge
5. Side Bridge/Plank
6. Unilateral Bridge

Hamstring Exercises

1. Unilateral Bridge
2. Quadruped Arm/Lower extremity lift
3. Bridge
4. Side Bridge/Plank
5. Standing Lunge
6. Lateral Step UP

Ekstrom, et al. 2007
### TOP 10 GLUT MED & GLUT MAX EXERCISES

#### Glut Medius Top 10
1. Side Plank
2. Single Leg Squat
3. Clamshell (Progression)
4. Front Plank w/ Hip extension
5. SL Hip Abduction
6. Lateral Step Up
7. Skater Squat
8. Pelvic Drop
9. Hip Circumduction w/ SL stance
10. SL Deadlift (aka “Dunking Bird”)

#### Glut Max Top 10
1. Front Plank w/ Hip Ext
2. Gluteal squeeze
3. Side Plank
4. SL Squat
5. SK Hip Abduction
6. Lateral Step Up
7. Quadruped Hip extension
8. SL Deadlift (Dunking Bird)
9. Forward Step Up
10. SL Bridge

---

### BEST GLUT MEDUIS EXERCISES?

#### % MVIC Glut Med EMG amplitude

- NWB Standing flexed Hip ABD
- NWB Standing Hip ABD
- NWB SL Hip ABD
- NWB Opp Hip ABD (Quick Kicks)
- NWB w/ Opp Hip ABD flexed hip (Quick Kicks)
- Pelvic Drop

Bolgla & Uhl, 2005

- WB increases EMG activity
- Trunk lean decreases EMG w/ WB exercises

---

### GLUT MEDINIUS VS. TENSOR FASCIA LATA (TFL)?

#### %MVIC during Lateral STEP UP w/ 3 Hip positions

- Quad Lumborum
- TFL
- Glut Medius


**RESULT:** Hip NEUTRAL is BEST w/ TFL & QL compensation
NEMEX PROGRAM

• “NEMEX” = Neuro-Muscular Exercise Program for Knee OA
• **Goal:**
  - Decrease pain
  - Increase physical function
• **Provides:**
  - Individualized program
  - Gradual progression
  - Supervision to correct biomechanics & muscle activation patterns

Ageberg, et al. 2013

NEMEX PROGRAM THEORY

1. Knee injuries lead to:
   • functional instability
   • impaired neuromuscular function
2. Need to control trunk & lower extremity alignment **BEFORE** progressing!
3. Focus on ALL aspects of **sensori-motor function:**
   • Postural perturbation
   • Reactive control
   • Dynamic joint alignment on various surfaces

CIRCUIT PROGRAM: 4 PARTS

• Part 1: Core stability & Postural Function
• Part 2: Postural Orientation
• Part 3: LE Muscle Strength
• Part 4: Functional Exercises for ADLs
NEMEX PART 1:  CORE STABILITY & POSTURAL FUNCTION

- 3 Levels each in Supine
1. Bridging - feet on floor, legs on ball w/ knees flexed; unilateral bridge and/or bridge w/ balance disc under scapulae
2. Deep abdominals - Curl up (McGill Style!!!): Bilateral shoulder flexion w/ weights; Bilat. Shoulder flexion w/ weights w/ legs on ball

UNILATERAL BRIDGING

Level 2 Bridge - on balance disc @ scapulae
Bridge in Figure-4 position

DEEP ABDOMINAL TRAINING

McGill’s “Curl Up”
Advanced Abd Training
PROGRESS POSITION & CORE CHALLENGE

Prone Twister on Ball

Forward Lunge & Hold on Unlevel Surface

NEMEX PART 2: POSTURAL ORIENTATION

- Emphasis on dynamic alignment of hip, knee and ankle
- 3 Levels:
  1. Slide exercise back & side lunge - single leg; alternate legs for wt shift
  2. Slide exercise w/ unlevel surface on stance leg
  3. Forward lunge & Side Lunge - level surface, unlevel surface, add Kettlebell

SLIDING BACK & SIDE LUNGE

Sliding Side Lunge

Alternating Sliding Side Lunge
LUNGE ONTO UNLEVEL SURFACES
Side Lunge onto BOSU–add Chop & Lift w/ Kettle bell

SIDE LUNGE PROGRESSIONS

Skater Low Level Plyometric

NEMEX PART 3: LOWER EXTREMITY STRENGTH
• Emphasis on open & closed chain exercise for hip & knee
  3 Levels for Each Muscle Group
1. Hip Abductors/adductors/ER
   • Quick Kicks (or Taps over stick)– no resistance; add resistance band; add unlevel surface under stance leg
2. Knee Extensors/ Flexors
   • Seated knee extension/flexion – submax isometrics; eccentric resistance (isotonic machine vs. bands for tendon strength); concentric resistance
GLUT MEDIUS– SIDELYING CLAM
• good trunk & hip alignment

QUICK KICKS ON UNLEVEL SURFACE
• Activates Glut Medius
• Dynamic loading
• Holding KB on ipsilateral side for loading trunk stabilizers

GLUT MAX STRENGTHENING
Quadruped w/ knee flexed
Quadruped w/ knee extended
Gain Mobility for Stride Length & Pushoff

Wall stretch w/ slant board
• Reaching up wall w/ ipsilateral arm
• Extend myofascial connections through core, hip flexor, gastric
• Activation of gluteals & core

NEMEX Part 4: Functional Exercises

- Simulate activities of daily life (ADLs)
- 3 levels for each exercise group:
  1. Chair stands- load both legs w/ hand support; staggered foot position w/ hand support; staggered foot position w/o hand support
  2. Step Ups- concentric/eccentric low step; higher step w/ or w/o weights; eccentric step down/up w/ or w/o weights

Monitor Dynamic Alignment

Poor Alignment

Good Alignment
LATERAL STEP UPS

• Level & Unlevel Surfaces
• Holding KB on ipsilateral side for loading trunk stabilizers
• Dynamic alignment on eccentric loading

MINI SQUAT & HOLD – LEVEL & UNLEVEL SURFACES

“DUNKING BIRD” - SL DEADLIFT

• Single Leg Stance w/ Dynamic Postural Perturbation
• Eccentric loading & Proprioception
• Core control
• Dynamic stretch on hamstring
PATIENT SUCCESS

- High Fall Risk initially
- Bilateral Foot & Knee pain
- Mini BEST score 14/28 initial
- Final Mini BEST score 23/28

SUMMARY & CONCLUSIONS

Imagine no more Total Knee Replacements
BOTTOM LINE: WHAT TO KNOW

- Degenerative Meniscus tears = early signs of knee osteoarthritis (OA)
- Older age, higher BMI, female, & previous trauma increase risk for OA
- Very little evidence to support Arthroscopy for Degen. Meniscus tears

TREATMENT STRATEGIES:

- Steroid injections effective for pain relief up to 4 wks
- HA more effective vs. CS after 4 weeks up to 8 weeks
- PRP more effective vs. HA in treating pain, function & QOL
- MSCs may reverse or stop the Degenerative process
- Exercise therapy recommended at any stage to patient tolerance
- Rehab should address Strength & Neuromuscular Control

THANK YOU

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- Full reference list available on request.