The Complicated Knee in Rehabilitation

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1: Advances in Diagnosis
Associated Other Procedure

- Chondral Lesions (OCD)
- Meniscus Pathology
- Patellar Dislocation
- Vascular damage
- Nerve Damage
- Bone Bruise 100%
- Fracture

Ultimate Failure: Dislocated Knee

Treatment Varies Based on Structure
Early accurate diagnosis to critical to initiate program

ACL age related influence
rule of 3rd’s (Noyes, Mangine)
PCL injuries are often diagnosed late (Bergfeld, Cain, Cross)
MCL conservative management standard of care (Bergfeld)
LCL infrequent but difficult (Clancy, Harner)

WHAT HAPPENS WHEN YOU GET THEM ALL?

Long Term Outcome Non-Predictable

Not well-described in literature
Tendency for progressive attenuation of posterolateral quadrant, with increase in laxity over time
Development of patellofemoral and medial compartment arthritis

Medial Compartment Collapse
The Kinematic Chain

A. Any change in the kinematic chain such as altered neurosensory or neuromuscular function will affect all joints in the kinematic chain.
B. A change in biomechanical alignment such as increased valgus at the ankle can have significant effects on all other joints in the chain.
C. Increased valgus at the ankle results in increased varus at the knee and vice versa.

2: Advances in Surgical Technique
Rehabilitation Considerations

- Tissue Strength
- Grafts Utilized
- Fixation Method and Strength
- Patient Morphology
- Follow Woolf’s law

The Kinematic Chain

MCL may allow MCL to heal first prior to ACL, PCL surgery

Bergfeld in the 1980’s established the fact that with a period of immobilization and rehabilitation, grade 1 through 3 sprains respond appropriately

Issue is more concern for the LCL, fix all

Theory of Natural History of the MCL

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Varus Stability

Advances in Rehabilitation

- Biomechanical studies
- Clinical studies
- Histological Data
The Early Post Surgical Dilemma

Little information exists in the literature on Rehabilitation

Rational Approach Evaluation Based Model

A designed pathway to allow the clinician to:
1. Account for patient variability
2. Relies on the clinician’s evaluation skills
3. Results in the patients safest, efficient, speediest return to play

Noyes, Mangine, DeMaio; Journal of Orthopedics Rehabilitation series 1993, a sequence of three articles outlining a algorithm approach

Protocol Design For Post-surgery Rehabilitation for the Majority

Rehabilitation attempts to profile patient pre operatively and during post surgical course

PCL ACL and PLC Repair Most Complex

Start early protective motion to avoid scar tissue development
Initiate quad training to avoid patella dysfunction
Resolve the influence of post surgical effusion
Protected close chain training to advance gait mechanics

Protect grafts integrity in early phase of the process

Rehabilitation Goals Stage I Day 1 to Week 4

Goals of Modalities: Protocol Step 1 Post-Surgical Pain Management

- Hold motion at 30 degrees for 7 to 10 days
  - out of splint daily for PROM
- Restore Quadriceps control
- After 7 to 10 days establish knee flexion to functional level within 4 weeks
- Prevent scar tissue in patellar gutters and posterior capsule
- Reduce post surgical Pain and Hemarthrosis
- Hold hamstring activity for 8 weeks

- Primary acute phase goal, control pain
- Utilizes two interventions; pain modulation and narcotics, and pain pump system
- Implement at time of surgery and monitor closely, our data suggests decrease narcotic use
Day 1 to Week 4

- Multi-angle isometrics (range specific exercise)
- 6 step electrical stim. protocol
- Electrical stimulation in the shortened range to aid quadriceps in developing force
- Superior mobilization to stretch patellar tendon low force early and often, a good extensor contraction aids this with out manual impute

Protocol Step 2

Day 1 to Week 4 (cont)

- Soft tissue techniques to infrapatellar space and scar for adaptation and mobility
- If multiple ligament control weight bearing TT 3 weeks increase 25% week 4
- Control swelling aggressive home program

Range of Motion and Articular Cartilage: Science vs. Reality

- Salter, Butler: positive outcome on articular cartilage
- Noyes, Mangine: positive influence on capsule, without graft disruption
- Garret, Wyke: positive influence on muscle and neural unit

Early Evidence of Immobilization on Cartilage

Functional Properties of Knee Ligaments; Noyes, 1976

- Side effects include; Articular cartilage degradation, Capsular shortening, Muscle atrophy, Muscle length changes, Bone demineralization

Effect of Continuous Passive Motion On Articular Cartilage After ACL

- Butler, Funk UC - OSU JBJS

Long term effects of quadriceps inhibition

- Inferior patellar position
- Posterior capsule contracture
- Altered gait mechanics
- Increased joint forces
Re-establish ROM

Motion PCL = 30 – 90 after the first 7 days
Motion PLR = 30 – 60 after the first 10 to 14 days
Limit motion to 4 to 6 times a day
Passive motion controlled by patient

Slow titration based on manual exam of soft tissue response to surgery

Motion Extension concepts

Re-establish = Quad control of extension motion

Extension means Extension
Even in a locked brace the Knee tends to be at -10

Loss of Motion

Occurs at the periarticular level vs. muscular tendon level
Differentiate between physiological shortening vs. morphological shortening
Post surgical arthrofibrosis varies dependent of body part

Flexion progression occurs after 3 weeks to regain 135 degrees by 8 weeks

Patella Mobilization Critical

Initiate within 2 to 3 days to assure patient will avoid morbidity of patellar scarring
Do it often: 6 times per day
Do it right: avoid inferior scarring

With Posterior drop back Patella stress increases

Clinical and Home Stimulation

Week 2/3
Week 5/6
Week 4/5
Week 7/8

4 to 6 sessions per day

Phase I Swelling Control

Polar Care program
BREG
GameReady
Pressure dressing
Electrical modalities
NSAI's
**Therapeutic Exercise**

*Early Stage*
- Straight leg raise
  - Flexion
  - Extension
  - Adduction
- Progress weight and sets and reps, this is based on swelling and compartment pain

**Week 4 Augmenting Range of Motion**
- Passive motion on the Biodex if stiffness develops, performed on clinical days for 60 minutes
- Recumbent stationary bike with no resistance, can be done on home basis

**Pain Management at 3 to 4 Weeks**
- Oral Steroids
- Non-Steroidal
- Lidocaine patches 5%
- Nerve blocks

This is an infrequent complaint evaluate for Sympathic Maintained Pain

**Goals**
*Phase I, week 4 to 8*
- ROM 0-115 degrees
- Adequate extensor mechanism contraction to control extension to 0 degrees
- Pain management
- Post Surgical Hemarthrosis control
- Maintain weight bearing status

**Rehabilitation Stage II Pathway**
*Week’s 3 through 8*
- Complete motion program if limitation exist, implement motion loss program if necessary
- Close chain program advancement
- Control swelling prevent synovial changes
- *Discontinue assistive devices*
- May consider alternative bracing

**Weight Bearing Advancement**
- Week 1 through 2 Toe touch to give patient balance support
- Week 3 through 4 Initiate ¼ % body weight
- If multiple ligament Week 6 Advance 25 % per week till D/C assistive devices
- Lateral Meniscus lesions may delay weight bearing by 2 weeks
Electrical Stim in Functional Position

Continued use of neuromuscular re-education in a functional close chain position is critical to establishing normal mid stance mechanics.

Retrain Gait and Proprioception

- Balance training
  - wt. shift-side/side
  - wt. shift-forward/back
  - lateral step-ups/2 to 4 inches
  - Heel/toe raises
  - Initiate as early as 3 weeks but control the weight on involved Knee

Gait Retraining

Phase II, Week 8 to 10 weeks

- Motion should not be compromised
- Gait skill training
  - cup drills
  - stepping drills
- Mini-squats - resistance based on ROM
  - sets x reps
- Femur vs. Trochlear groove

Close Chain Gait Retraining

- Emphasis on terminal range of extension
- Aids patients gait pattern by training the heel strike portion of the cycle
- Low force on graft

Gait Retraining Brace Consideration

- D/C post surgical brace in the 6 to 8 week time period
- Fit with Un-loader and decompress the compartment of repair

Progressive Close Chain Strengthening

- Mini squats 6 wk’s
- Mini squats with exercise bands 7 wk’s
- Lunges 8wk’s
- Step-ups 9wk’s
- Leg Press pick appropriate angle

These are initiated gradually over 6 to 12 week time period control symptoms, eval for joint effusion with exercise.
Single Leg Balance

- Proprioception training required in early intervention
- Studies have shown compensation can occur for up to a year

Phase II Aerobic Reconditioning

- Progressive treadmill work, level for the first 4 weeks then gradual increase in elevation to 3 to 4%
- Speed vs. timing, this is a critical element in weight and aerobic training

Point 3 What's Safe For Aerobic Exercise Pool Exercise

Shoulder-deep = 90% reduction of WB Forces
Chest-deep = 70-75% reduction of WB Forces
Waist-deep = 50% reduction of WB Forces

Aerobic Reconditioning

- Stationary Bike
  - High seat
  - Low tension
  - Gradual progression with time the key element
  - 10 minutes initiation to 60 minutes by 12 to 13 weeks

Phase III Advance Reconditioning

- Training must consider the patient goals:
  - These are complex interventions that failure may result in salvage surgery
  - Functional Progression

- SKILL
- PHYSICAL FITNESS
- TACTILE SENSING
- PSYCHOLOGY

THANK YOU
Electrical Stimulation for Postoperative Pain Management

Effectiveness of transcutaneous electrical nerve stimulation on postoperative pain with movement:
  - TENS reduces pain intensity during walking and deep breathing and increases walking function postoperatively when used as a supplement to pharmacologic analgesia.
  - Effects of TENS frequency, intensity and stimulation site parameter manipulation on pressure pain thresholds in healthy human subjects.
  - The role of TENS frequency, intensity and site are pivotal to achieving optimal hypoalgesic effects, during and after stimulation.
  - TENS and AL-TENS are shown to be effective in pain control over placebo in this review. Heterogeneity of the included studies was observed, which might be due to the different study designs and outcomes used.