



Research in **O**steo**C**hondritis of the **K**nee

OCD OF THE KNEE PROSPECTIVE COHORT
Manual of Procedures

Version 5.0
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SECTION A: PROTOCOL

A1. Introduction

Osteochondritis dissecans (OCD) is a focal condition of an articular surface, which involves separation of a fragment of subchondral bone and often the overlying cartilage as well. This osteochondral fragment may be in situ, incompletely detached, or completely detached at presentation. The knee is the most commonly affected joint (~75%). Symptoms typically arise in the second decade of life. Long-term (15 year) outcomes of OCD of the knee are frequently poor. Treatment strategies vary widely and are based primarily on retrospective studies and expert opinion.

Consequently, we have founded the OCD Study group, ROCK (Research in OsteoChondritis of the Knee) which is dedicated to determining the optimal treatment of OCD through clinical research. This multi-center network is comprised of both private and academic institutions.

Treatment of OCD of the knee ranges broadly from no intervention to non-operative treatment to various surgical techniques; ranging from early knee surgeries to late knee surgeries. Through this cohort, we will collect data and outcomes for all patients with a confirmed diagnosis of osteochondritis dissecans and/or focal articular cartilage defect of the knee, hereby referred to collectively as OCD/FCD. We will follow their course of care for the duration they seek treatment, up to 50 years if applicable.

A2. Study Objectives

This prospective cohort aims to collect data and outcomes for all patients with a confirmed diagnosis of OCD or FCD of the knee and follow their course of care for the duration they seek treatment, up to 50 years if applicable. There are three primary objectives:

- 1) To develop a comprehensive all-inclusive prospective cohort study and relational database for patients of all ages with osteochondritis dissecans and/or focal articular cartilage defects of the knee.

- 2) To identify the historical characteristics of the patient, physical, and radiographic characteristics of the knee, and components of care that predict the success of treatment of an OCD lesion and/or focal articular cartilage defect, as assessed by radiographic lesion healing and patient-reported outcomes at 2 years, 5 years, 10 years, and 25 years' post-treatment, if applicable.
- 3) To determine the optimal treatment of osteochondritis dissecans and/or focal articular cartilage defects with an emphasis on preventing the progression to osteoarthritis and minimizing variation in treatments for this condition.

Each institution will maintain links between the individual patients and the data sent to the Cohort for purposes of follow-up care and data collection, as data will be collected from eligible patients over the course of their treatment, over several years. We expect to have the Cohort open over a 50-year period, during which the study ID link will be maintained for the purpose of truly assessing the long term effects of OCD on future outcomes, with periodic research studies based on the data collected for the Cohort along the way.

Data will be captured on hard copy case report forms (CRFs) or directly into the research-focused electronic data capture system, REDCap. A specific multi-site electronic database for this study will be created in REDCap to store and maintain all data. Data collected on hard copy case report forms will subsequently be entered into this electronic database by study staff at each participating site. The database will be password-protected with a password known only to study staff who need to enter or access data. Participating sites will only have access to their own site-level data. Penn, as the data coordinating center, will have access to all data entered in the REDCap. As other investigators or centers join ROCK, access to the REDCap will only be granted after the site obtains IRB approval.

SECTION B: DATA COLLECTION OVERVIEW

B1. Sequence of Activities

The following section outlines the sequence of activities required to enroll and follow patients in the Prospective Cohort.

STEP 1: Patient screening and determination of eligibility

Possibly eligible subjects should be identified by a coordinator through clinical or surgical schedule review, or be brought to the coordinator's attention by an attending surgeon. The cohort of possibly eligible patients includes all patients with a diagnosis of knee OCD. All patients should be screened for eligibility by a coordinator. The Screening and Eligibility Form should be completed for all of these patients to collect basic information about the patients and document their eligibility. All enrolled patients should be entered into the ID log and assigned an ID (see STEP 2).

There are two scenarios that can play out during the screening process:

1. **Patient eligible at first visit:** in this scenario, a patient meets the inclusion criteria at the first visit, and is eligible for the study. Patient is then consented, and assigned a study ID (see STEP 2). Once the patient provides informed consent, and the Screening and Eligibility Form is complete, the baseline questionnaires (Form 3A/3B and 3C) are completed by the patient and surgeon, respectively, and the appropriate imaging forms (X-Ray, MRI or both) are completed as well.
2. **Patient ineligible at first visit:** in this scenario, a patient does not meet the inclusion criteria (i.e. no imaging has yet confirmed the diagnosis of OCD of the knee) at the first visit, and is not eligible for the study at this time. This patient can return at his or her next visit with imaging confirming the diagnosis, and then be eligible for enrollment.

STEP 2: Informed Consent of Patient

Every patient screened who meets the inclusion criteria is eligible to be consented for the Prospective Cohort. The Informed Consent process requires:

- Disclosure of relevant information to eligible patients about the research;
- The patient's comprehension of the information; and
- The patient's voluntary agreement to research participation without coercion or undue influence;
- Re-consenting of child/adolescent subjects at the time they turn 18 years of age.

Informed consent is a process that involves:

- Providing patients with adequate information concerning the study procedures and scope;
- Providing adequate opportunity for the patient to consider all available options;
- Responding to the patient's questions and concerns;

- Ensuring that each patient understands all information provided;
- Obtaining the patient's written voluntary consent to participate.

The PI or the PI's designee will explain the study in detail, allowing ample time for questions and answers. **The patient should be told that s/he does not have to participate in the Prospective Cohort.** The individual obtaining consent should give a copy of the informed consent document to the patient and s/he must allow the patient sufficient time to read the document in full. The individual obtaining consent should also record the final consent status (consented: yes/no) on the Screening and Eligibility Form. Only patients who consent will be assigned an ID for purposes of the Cohort. For patients who do not consent, also record the primary reason for non-participation on the Screening and Eligibility Form.

If the patient agrees to participate, s/he must sign the informed consent form. In some cases, the informed consent form also has a place for the person obtaining the consent to sign. If so, the person obtaining consent must sign this immediately after the patient signs it. For patients in this Cohort who will be minors, the informed consent document must be signed and dated by a parent/guardian, and the patient must sign indicating his/her assent. At the time a minor patient turns 18 years of age, he or she will be re-consented.

This consent form (and assent form, if applicable) should be placed in a research file, separate from all other patient forms. If required by the site's IRB, a copy should also be placed in the patient's medical record. A second copy of the consent form (and assent form, if applicable) should be signed and dated by all parties and given to the patient/family for their records. [The International Committee on Harmonization (ICH) Good Clinical Practice (GCP) guidelines require that the patient or legal representative receive a copy of the signed and dated informed consent form]. If your institution has an electronic medical record, please check your institution's policies and procedures to determine if a copy of the consent form needs to be placed in the EMR. If your institution does not have an EMR, make an additional copy and place it in the patient's paper medical file.

STEP 3: Assigning study IDs

Every patient screened for this Cohort should **not** be assigned a study ID. A patient is assigned an ID only if s/he consents to participate. Once a patient is enrolled, the research coordinator should assign the patient the next available unique study ID by recording his/her name and

medical record number on the Patient ID Assignment Log (see Appendix G Patient ID Assignment Log). Each patient has two possible study IDs, one for each knee. Each site will maintain its own ID Log. It should be the only study document that contains the link between the patient's ID, name and MRN. This log must be stored in a secure location that is separate from all patient study forms.

Patient IDs are made up of five digits and one character:

1. The first two digits represent the site number (see Figure B1 for Site IDs and Surgeon IDs)
2. The next three digits are sequential and represent the patient, e.g., the first patient screened at U Penn would be assigned 15-001, the second 15-002, etc.
3. The character represents the affected side (i.e. if a patient has OCD of the right knee, the study ID would end in -R).

If a patient has bilateral OCD, both sides of which may be eligible for the study, that patient will have two Study IDs, one to be recorded on forms completed for the right knee, and one to be recorded on forms completed for the left knee, and will be treated as two study subjects. The first 5 digits of the study ID will be the same with the final character being -R for the right leg and -L for the left leg. If a patient is bilateral and being seen for care of both knees at one visit, please make sure that the forms filled out for the right knee are labeled with the Study ID for the right knee, not the left, and vice versa.

The Patient ID Assignment Log given to each institution contains patient IDs. As sites screen more patients than the numbers provided, add additional IDs to the Log and continue assigning them according to protocol.

Figure B.1 Site and Surgeon IDs (in order of Surgeon's joining the ROCK group)

Site Name	Site #	Surgeon Name	Surgeon ID
Intermountain Orthopaedics	11	Kevin G. Shea, M.D.	111
Cincinnati Children's Hospital	12	Eric J. Wall, M.D.	121
Children's Hospital of Philadelphia	13	Theodore J. Ganley, M.D.	131

Children's Hospital of Boston	14	Mininder S. Kocher, M.D., M.P.H.	141
		Benton E. Heyworth, M.D.	142
Hospital of the University of Pennsylvania	15	James L. Carey, M.D., M.P.H.	151
Rady Children's Hospital	16	Henry G. Chambers, M.D	161
		Eric W. Edmonds, M.D.	162
		Andrew T. Pennock, M.D.	163
Children's Health Andrews Institute	17	John D. Polousky, M.D.	171
Kaiser Permanente Los Angeles Medical Center	18	Jennifer M. Weiss, M.D.	181
Medical College of Wisconsin	19	Roger M. Lyon, M.D.	191
Connecticut Children's Medical Center	20	Carl W. Nissen, M.D.	201
		Matthew D. Milewski, M.D.	202
Tennessee Orthopaedic Alliance	21	Christian N. Anderson, M.D.	211
Washington University of St. Louis	22	Rick W. Wright, M.D.	221
		Jeffrey J. Nepple, M.D.	222
University of Gothenburg	23	Lars Peterson, M.D., Ph.D.	231
Altona Children's Hospital	24	Norbert M. Meenen, M.D., Ph.D.	241
The Hospital for Sick Children	25	M. Lucas Murnaghan, M.D., M.Ed.	251
National University Health System	26	James Hui, M.D.	261
Hospital for Special Surgery	27	Daniel W. Green, M.D., M.S., FAAP, FACS	271
		Peter Fabricant, M.D.	272
Children's Orthopaedics of Atlanta	28	Michael T. Busch, M.D.	281
		S. Clifton Willimon, M.D.	282
University of Minnesota / TRIA	29	Bradley J. Nelson, M.D.	291
		Jutta M. Ellerman, M.D.	292
Texas Scottish Rite Hospital	30	Philip L. Wilson, M.D.	301
		Henry B. Ellis, M.D.	302
Children's Mercy, Kansas City	32	Kevin H. Latz, M.D.	321
Cleveland Clinic	33	Paul Saluan, M.D.	331
Children's Hospital of Colorado	34	Jay Albright, M.D.	341
		Stephanie Mayer, M.D.	342

STEP 4: Study visits

There is no specific number of visits for which we are interested in collecting data, as patients can potentially be followed for duration of 50 years. Data will therefore be collected from Baseline Visit through Visit “x” (potentially 50 years later). We would like to at least collect data at the **following mandatory time-points: 2 years, 5 years, 10 years, and 25 years after a patient is enrolled in the study**; however, numerous clinical visits may take place during the study between these time-points; these can be scheduled or unscheduled and are referred to as Follow-Up Visits. **Specifically, we are interested in collecting data from 3 months, 6 months, 9 months, and 1 year post-operatively or after the initiation of intervention** (for non-operative patients). Procedures and details and the specific forms required for each visit are specified below. (See Figure B.2 for an overview of the visits). Surgeons’ clinic schedules and/or patients’ visit schedules should be monitored so as to not miss a scheduled follow-up visit. Additional tracking measures can be carried out as seen necessary by individual institutions to make sure patient visits are not missed. If a patient is unavailable for follow-up in clinic, then Remote Follow-Up is acceptable. Remote Follow-Up consists of contacting the patient by phone to let him/her know survey material is being emailed / mailed to him/her. The Prospective Cohort REDCap has a feature in which coordinators can send surveys to patients through email.

Baseline: Baseline will consist of the visit during which a patient is diagnosed with OCD of the knee, confirmed by MRI or x-ray imaging. The first study visit, or “baseline,” will consist of consent and the collection of demographic information and a brief medical history (Form 2A/2B, patient’s medical history and Form 2C, surgeon-completed patient medical history) and eligibility (Screening and Eligibility Form). Note that the Screening and Eligibility Form is filled out for all patients, whether or not it is simply a “screening” visit or the official “baseline” visit.

If a patient is deemed eligible at the first visit, consent will be obtained, the Screening and Eligibility Form will be completed, a physical exam will be performed by the surgeon (Form 2C), and the patient will be asked to fill out the Outcome Questionnaires (Form 2A/2B). X-Ray and

MRI forms will be filled out based on the x-ray and/or MRI used to determine the patient's eligibility. The patient may get x-ray and MRI at this baseline visit or not depending on if s/he has recent images or not. If the Investigator feels the images are recent enough to diagnose the patient, then they may be used as the patient's inclusion criteria imaging studies. Once again, the x-ray and MRI forms should be completed **for the specific images used to determine eligibility**. In some cases, multiple imaging forms will need to be completed.

If a patient is not yet eligible due to needing confirmation by imaging, s/he is not eligible for consent and forms should **not** yet be filled out for Baseline Visit, other than the Screening and Eligibility Form, which will include an indication of why the patient was not eligible or did not consent.

Surgery Form: As part of the Cohort, a patient may or may not have surgery. A patient who has been enrolled in the ROCK Drilling RCT should also be enrolled in the Prospective Cohort (if patient/family provides informed consent and assent, if applicable). Please note that subject numbers and content of the Surgery Form (Form 3) will differ between the RCT and the Cohort. Each site is responsible for keeping track of linking data between subjects and study numbers. A Surgery Form should be filled out any time a patient undergoes surgery for treatment of his or her OCD. In some cases, more than one form will need to be completed, depending on the patient's course of care.

Surgery forms have been created for each of the following:

- Drilling
- Microfracture/Nanofracture/Marrow Stimulation
- Cartilage Biopsy
- OATS
- ACI
- Osteochondral Allograft
- Malalignment
- Meniscus Injury
- Ligament Injury
- Patellofemoral Malalignment Instability
- Removal of Loose Bodies
- Chondroplasty

- OCD Fixation

Non-operative and Operative Rehabilitation Forms: Patients may undergo physical therapy with or without having surgery. Following each surgery, patients will be placed on a physical therapy regime agreed upon by the ROCK group. Appendix A contains protocols for the following types of non-operative and operative rehabilitation:

- Non-Operative Rehabilitation Progression for Articular Cartilage Lesions of the Knee
- Post-Operative Rehabilitation Progression for Cell-Based Management* of Articular Cartilage Lesions of the Knee
- Post-Operative Rehabilitation Progression for Cell-Based Management* of Articular Cartilage Lesions of the Knee
- Post-Operative Rehabilitation Progression after Knee Arthroscopy*
- Post-Operative Rehabilitation Progression for Structural Management* of Articular Cartilage Lesions of the Knee

Post-Operative Rehabilitation Progression for Structural Management* of Articular Cartilage Lesions of the Knee

Follow-Up Visits (Clinical – Form 4A/4B and Form 4C): At all clinical follow-up visits (not just the mandatory visits), a surgeon will perform a physical exam and follow-up assessment (Form 4C). Patients may have had new imaging such as x-rays or MRIs as clinically indicated and as part of standard of care, and forms must be completed to capture this data. **If a patient does not have new imaging, the “no” box can be selected on the page dedicated to imaging.** The patient should fill out the appropriate Outcome Questionnaires (Form 4A/4B) **no more frequently** than every 12 weeks. Efforts should be made to at least capture data at the following timepoints: 2 years, 5 years, 10 years, and 25 years post-operatively or after the initiation of intervention (for non-operative patients).

Close-Out Form: The patient should be closed out using the Close-Out Form when applicable.

At each visit, if there is indication for close-out as outlined on the Close-Out Form, that form should be filled out. Based on the follow-up assessment, a new Adverse Event Form should be completed as appropriate. All adverse events, new, ongoing, or ended, should be recorded at

each clinic visit as needed. A patient may end up with several Adverse Event Forms completed throughout the follow-up period. If the only adverse event noted at a clinic visit is noted as “resolved”, a new Adverse Event Form for that clinic visit should still be completed noting the status.

Figure B.2 Overview of Visits and Forms by Visit

Prospective Cohort		
Baseline (Visit 0)	<u>Pre-Consent</u> Form 1: Screening and Eligibility Form (Coordinator)	<u>Post-Consent</u> If patient is over age 18, Form 2A: Adult Baseline Questionnaire (Patient) If patient is under age 18, Form 2B: Child Baseline Questionnaire (Patient) Form 2C: Surgeon Baseline Questionnaire (Surgeon)
Surgery	Form 3: Surgery Form (Surgeon)	
Follow-Up Visits (Clinic)	If patient is over age 18, Form 4A: Adult Follow-Up (Patient) If patient is under age 18, Form 4B: Child Follow-Up (Patient) Form 4C: Surgeon Follow-Up (Surgeon)	
Follow-Up Visits (Remote)	If patient is over age 18, Form 4A: Adult Follow-Up (Patient) If patient is under age 18, Form 4B: Child Follow-Up (Patient)	

- ¹ Record data from PE performed at baseline visit once patient is eligible and has provided consent/assent
- ² Patient should complete questionnaire(s) no more frequently than every 12 weeks
- ³ Record data from x-ray taken to confirm eligibility
- ⁴ Record data from MRI taken to confirm eligibility

STEP 5: Closeout

Patients meet the criteria for study closeout if/when either of the following events occurs. 1) A patient completes the study, e.g., completes study visits for 50 years. 2) A patient is withdrawn from the study for reasons outlined on Form 5 or other. To close-out a patient, fill out the Close-Out Form.

B2. Visit Protocols

The following table outlines the details of what needs to be completed and when for each visit. The numbers for each part of each visit indicate the order in which events should occur.

Figure B.3 Protocol by visit (NOTE: This protocol may have to be adjusted to fit your clinic)

	Patient	Research Coordinator	Surgeon
Baseline Visit(s): Form 1 - Screening and Eligibility Form, Form 2A/2B – Baseline (Adult/Child Patient), Form 2B – Baseline (Surgeon)			
Before visit	**Patient may already have usable x-rays and MRIs	1. Identify potential subjects 2. Enter patient into Patient ID Assignment Log and give Study ID	1. Identify potential subjects
During visit	**Patient may need x-ray and MRI to determine eligibility 1. Consent 2. Complete Form 2A or 2B depending on patients age. If 18+, complete 2A. If under 18, complete 2B.	1. Determine eligibility using Screening and Eligibility Form 2. Consent 3. Give Form 2C to surgeon 4. Give Form 2A or 2B to patient depending on patients age. If 18+, complete 2A. If under 18, complete 2B.	1. Determine eligibility using Screening and Eligibility Form 2. Complete Form 2C 3. Mention RCT to patient if eligible
After visit		1. Complete Screening and Eligibility Form (Form 1) if not already completed	1. Complete Form 2C, and MRI/X-Ray/Both pages based on images used to determine eligibility 2. Return forms to

			Coordinator
Enter data into REDCap		Enter all data from forms into the REDCap system. https://redcap.med.upenn.edu/	
Surgery (if applicable): Form 3 – Surgery			
Before surgery		1. Give surgeon Form 3	
During surgery			1. Complete Form 3
After surgery			1. Return forms to Coordinator
To REDCap		Enter all data from surgery form into the REDCap system. https://redcap.med.upenn.edu/	
Clinical Follow-Up Visits: Form 4A/4B – Follow-up (Adult/Child Patient); Form 4C – Follow-up (Surgeon); MRI/X-ray/Both Forms			
Before visit		1. Give surgeon labeled Form 4C, including applicable MRI/X-ray/Bothpages 2. Give patient labeled Form 4A or 4B depending on their age. If patient is older than 18, give Form 4A. If patient is younger than 18, given Form 4B.	
During visit	1. Get x-ray / MRI (as clinically indicated, will not be for each visit) 2. Complete Form 4A or 4B depending on age. (no more frequently than every 12 weeks)		1. Complete Form 4C 2. Complete MRI/X-ray/Both pages (if applicable)
After visit			1. Complete Form 4C (if not already done) and MRI/X-ray/Both pages for imaging

			obtained at or new images obtained prior to visit
To REDCap		Enter all data from surgery form into the REDCap system. https://redcap.med.upenn.edu/	
Close Out/Withdrawal of Patient: Form 5 Only			
During Visit		1. Complete form 5	
To REDCap		Enter all data from surgery form into the REDCap system. https://redcap.med.upenn.edu/	

SECTION C: FORM OVERVIEW

C1. Form Overview

All doctors and research coordinators should make themselves familiar with the forms and when each form should be completed so as not to miss any of the data collection points.

Forms are organized in “Packets” numbered 1 through 5 in order to eliminate confusion over which forms are to be administered at which visit.

The Forms are:

STAGE 1: SCREENING AND ELIGIBILITY

Form 1: Screening and Eligibility Form (Coordinator)

STAGE 2: BASELINE VISIT

Form 2A: Adult Baseline (Patient)

Form 2B: Child Baseline (Patient)

Form 2C: Surgeon Baseline (Surgeon) (Includes X-Ray and MRI pages)

STAGE 3: SURGERY

Form 3: Surgery Form (Surgeon)

STAGE 4: FOLLOW-UP

Form 4A: Adult Follow-Up (Patient)

Form 4B: Child Follow-Up (Patient)

Form 4C: Surgeon Follow-Up (Surgeon) (Includes X-Ray and MRI pages)

Form 4D: Adverse Event Form (Surgeon)

STAGE 5: CLOSE-OUT FORM

Form 5: Close-Out Form (Coordinator)

SECTION D: Appendices

Appendix A: Physical Therapy Protocol

Non-Operative Rehabilitation Progression for Articular Cartilage Lesions of the Knee

Initial Phase (0-6 wks)

Weight bearing guideline: NWB x 4-6 weeks then progress to FWB when the patient presents with:

- Full knee extension
- Sufficient knee flexion to demonstrate a normal gait pattern
- Minimal effusion and pain
- Sufficient quadriceps control to eccentrically control lowering the body's center of mass with knee flexion from 0-30 degrees

Bracing: Immobilization to protect healing tissues is recommended through the use of bracing or cylinder cast

Continuous Passive Motion: Once immobilization precautions are lifted, early ROM is advocated with a goal to progress to full ROM. The use of mechanical CPM is not required.

ROM Progression: Once immobilization precautions are lifted, ROM is progressed as tolerated with no limitations

Strengthening:

- Early quadriceps and hamstrings muscle activation is initiated immediately after surgery.
- NWB lower extremity strengthening is initiated immediately and progressed to more closed kinetic chain activities as WB restrictions permit
- Core stability strengthening is initiated immediately as tolerated by pain

Balance/Proprioception Training:

- Initiate double leg balance weight shifting and proprioception activity once permitted to PWB
- Advance to single leg balance/proprioception exercises as permitted by WB status

Modalities:

- NMES (Neuromuscular electrical stimulation) to enhance recruitment of quadriceps musculature, PRN
- Cryotherapy/Vasopneumatic therapy to assist with maintenance of potential effusion, PRN

Intermediate Phase (6-12 wks)

Weight Bearing Progression: FWB is permitted when above criteria met with a progression of intervention, as needed to enhance normal ambulation

Bracing: All bracing discontinued. Optional to use varus or valgus unloading brace with progression to return to activity

Strengthening:

- Progression of closed kinetic chain strengthening of the lower extremity consistent with WB status
- Progression of hip and core stability strengthening.
- Target on residual asymmetries in lower extremity strength

Balance/Proprioception:

- Progression to advanced single limb balance from stable to unstable surfaces
- Initiation of agility activities on stable surfaces

Cardiovascular Conditioning:

- Initiation of PWB CV conditioning including biking and swimming
- No impact activities permitted at this time

Modalities:

- Continuation of NMES if limitations in quad activation persist
- Continuation of cryotherapy if residual effusion persists

Advance Phase (3-6 months)

The advanced/transition to function phase is designed to address residual strength deficits, normalize movement patterns and to help transition the patient back to pre-injury activity. Once sufficient healing has occurred, the focus of this phase is to progressively re-introduce pre-injury activity to the patient in a progressive, systematic fashion. All impact activity is introduced after a minimum of 3 month, to insure sufficient healing. Once the patient completes a return to function/return to play progression, a consideration is made to release the patient to activity.

Return to play following these procedures is typically restricted until 3-6 months to allow sufficient healing to occur. In addition to adequate healing, the patient must present with the following objective criteria:

1. No residual effusion
2. Full ROM and normal patellofemoral mobility

3. Strength of quadriceps and hamstring musculature >90% of the contralateral limb
4. Demonstration of performance on lower extremity functional performance testing >90% contralateral leg.
5. Completion of a return to play progression with no signs of pain, swelling or instability.

Post-Operative Rehabilitation Progression for Cell-Based Management* of Articular Cartilage Lesions of the Knee

**Cell Based Management includes: Microfracture and autologous chondrocyte implantation.*

Patellofemoral Compartment

Acute Phase (0-6 wks)

Weight bearing guideline: NWB x 2 weeks; PWB x 2 weeks, then progress to FWB when the patient presents with:

- Full knee extension
- Sufficient knee flexion to demonstrate a normal gait pattern
- Minimal effusion and pain
- Sufficient quadriceps control to eccentrically control lowering the body's center of mass with knee flexion from 0-30 degrees

*** Recommendation to use ROM brace locked in full extension during WB progression.*

PO Bracing: PO ROM bracing recommended for use during WB progression. Open ROM during NWB activities

ROM Progression: Knee flexion limited to 0-90 degrees x 2 weeks, then incrementally progress 10 degrees per week until full ROM attained.

Continuous Passive Motion: Early ROM is advocated immediately following surgical intervention with a goal to progress to full ROM within 6 weeks post-operative. Repeated PROM early in rehabilitation is used to facilitate synovial fluid movement through the knee joint as a means to nourish the healing tissues. The use of mechanical CPM is recommended, but not required.

Strengthening:

- Early quadriceps and hamstrings muscle activation is initiated immediately after surgery with care to protect the PF joint.
- Early PF joint protection is recommended with restrictions on all squatting activities and activities which result in compression and shearing at the PF joint
- NWB lower extremity strengthening is initiated immediately following surgery and progressed to more closed kinetic chain activities as WB restrictions permit
- Core stability strengthening is initiated immediately following surgery as tolerated by pain

Balance/Proprioception Training:

- Initiate double leg balance weight shifting and proprioception activity once permitted to PWB
- Advance to single leg balance/proprioception exercises as permitted by WB status

Cardiovascular Conditioning:

- Initiation of PWB CV conditioning including biking and swimming
- No impact activities permitted at this time

Modalities:

- NMES (Neuromuscular electrical stimulation) to enhance recruitment of quadriceps musculature, post-operatively
- Cryotherapy/Vasopneumatic therapy to assist with maintenance of post-operative effusion

Sub-acute Phase (6-12 wks)

Weight Bearing Progression: FWB is permitted when above criteria met

PO Bracing: All bracing discontinued. Optional to use varus or valgus unloading brace with progression to return to activity

Strengthening:

- Progression of closed kinetic chain strengthening of the lower extremity consistent with WB status
- Continue to protect patellofemoral joint with limited squatting and repetitive shearing/compression loads on the PF joint
- Progression of hip and core stability strengthening
- Target on residual asymmetries in lower extremity strength

Balance/Proprioception:

- Progression to advanced single limb balance from stable to unstable surfaces
- Initiation of agility activities on stable surfaces

Cardiovascular Conditioning:

- Progression of PWB CV conditioning including biking and swimming
- No impact activities permitted at this time

Modalities:

- Continuation of NMES if limitations in quad activation persist
- Continuation of cryotherapy if residual effusion persists

Advanced Strengthening/Transition to Function (3-6 months)

The advanced strengthening/transition to function phase is designed to maximize return of lower extremity strength and to help transition the patient, once sufficient healing, progression of strength and functional mobility has occurred. The focus of this phase is two-fold. First, a progressive strengthening program is necessary to bring the patient to a level of strength, sufficient to support the knee during dynamic functional activities. Secondly, this phase is designed to progressively re-introduce pre-injury activity to the patient in a progressive systematic fashion. All impact activity is introduced after a minimum of 3-6 months PO, to insure sufficient healing. Once the patient completes a return to function/return to play progression, a consideration is made to release the patient to activity.

Return to Play (6+months)

Return to play following these procedures is typically restricted until 4-9 months post-operative for microfracture procedures and 12-18 months following ACI procedures to allow sufficient healing to occur. In addition to adequate healing, the patient must present with the following objective criteria:

6. No residual effusion
7. Full ROM and normal patellofemoral joint mobility
8. Strength of quadriceps and hamstring musculature >90% of the contralateral limb
9. Demonstration of performance on lower extremity functional performance testing >90% contralateral leg.
10. Completion of a return to play progression with no signs of pain, swelling or instability.

Post-Operative Rehabilitation Progression for Cell-Based Management* of Articular Cartilage Lesions of the Knee

**Cell Based Management includes: Microfracture and autologous chondrocyte implantation.*

Tibiofemoral Compartment:

Acute Phase (0-8 wks)

Weight bearing guideline: NWB x 6 weeks; PWB x 2 weeks, then progress to FWB when the patient presents with:

- Full knee extension
- Sufficient knee flexion to demonstrate a normal gait pattern
- Minimal effusion and pain
- Sufficient quadriceps control to eccentrically control lowering the body's center of mass with knee flexion from 0-30 degrees

PO Bracing: No specific PO bracing unless needed for comfort or stability during ambulation

Continuous Passive Motion: Early ROM is advocated immediately following surgical intervention with a goal to progress to full ROM within 6 weeks post-operative. Repeated PROM early in rehabilitation is used to facilitate synovial fluid movement through the knee joint as a means to nourish the healing tissues. The use of mechanical CPM is recommended, but not required.

ROM Progression: Progress ROM as tolerated with no limitations in ROM

Strengthening:

- Early quadriceps and hamstrings muscle activation is initiated immediately after surgery.
- NWB lower extremity strengthening is initiated immediately following surgery and progressed to more closed kinetic chain activities as WB restrictions permit
- Core stability strengthening is initiated immediately following surgery as tolerated by pain

Balance/Proprioception Training:

- Initiate double leg balance weight shifting and proprioception activity once permitted to PWB
- Advance to single leg balance/proprioception exercises as permitted by WB status

Cardiovascular Conditioning:

- Initiation of PWB CV conditioning including biking and swimming
- No impact activities permitted at this time

Modalities:

- NMES (Neuromuscular electrical stimulation) to enhance recruitment of quadriceps musculature, post-operatively
- Cryotherapy/Vasopneumatic therapy to assist with maintenance of post-operative effusion

Sub-acute Phase (8-12 wks)

Weight Bearing Progression: FWB is permitted when above criteria met

PO Bracing: All bracing discontinued. Optional to use varus or valgus unloading brace with progression to return to activity

Strengthening:

- Progression of closed kinetic chain strengthening of the lower extremity consistent with WB status
- Progression of hip and core stability strengthening.
- Target on residual asymmetries in lower extremity strength

Balance/Proprioception:

- Progression to advanced single limb balance from stable to unstable surfaces
- Initiation of agility activities on stable surfaces

Cardiovascular Conditioning:

- Progression of PWB CV conditioning including biking and swimming
- No impact activities permitted at this time

Modalities:

- Continuation of NMES if limitations in quad activation persist
- Continuation of cryotherapy if residual effusion persists

Advanced Strengthening/Transition to Function (3-6 months)

The advanced strengthening/transition to function phase is designed to maximize return of lower extremity strength and to help transition the patient, once sufficient healing, progression of strength and functional mobility has occurred. The focus of this phase is two-fold. First, a progressive strengthening program is necessary to bring the patient to a level of strength, sufficient to support the knee during dynamic functional activities. Secondly, this phase is designed to progressively re-introduce pre-injury activity to the patient in a progressive systematic fashion. All impact activity is introduced after a minimum of 3-6 months PO, to insure sufficient healing. Once the patient completes a return to function/return to play progression, a consideration is made to release the patient to activity.

Return to Play (6+months)

Return to play following these procedures is typically restricted until 4-6 months post-operative for microfracture procedures and 9-18 months following ACI procedures to allow sufficient healing to occur. In addition to adequate healing, the patient must present with the following objective criteria:

11. No residual effusion
12. Full ROM and normal patellofemoral joint mobility
13. Strength of quadriceps and hamstring musculature >90% of the contralateral limb
14. Demonstration of performance on lower extremity functional performance testing >90% contralateral leg.
15. Completion of a return to play progression with no signs of pain, swelling or instability.

Post-Operative Rehabilitation Progression after Knee Arthroscopy*

**Knee Arthroscopy includes: Diagnostic arthroscopy, loose body removal, chondroplasty*

Acute Phase (0-2 wks)

Weight bearing guideline: WB as tolerated with restrictions limited to patients without...

- Full knee extension
- Sufficient knee flexion to demonstrate a normal gait pattern
- Minimal effusion and pain
- Sufficient quadriceps control to eccentrically control lowering the body's center of mass with knee flexion from 0-30 degrees

PO Bracing: No specific PO bracing

Continuous Passive Motion: Early ROM is advocated immediately following surgical intervention with a goal to progress to full ROM within 2-3 weeks post-operative. The use of mechanical CPM is not required.

ROM Progression: Progress ROM as tolerated with no limitations in ROM

Strengthening:

- Early quadriceps and hamstrings muscle activation is initiated immediately after surgery.
- NWB lower extremity strengthening is initiated immediately following surgery and progressed to more closed kinetic chain activities as WB restrictions permit
- Core stability strengthening is initiated immediately following surgery as tolerated by pain

Balance/Proprioception Training:

- Initiate double leg balance weight shifting and proprioception activity once permitted to PWB
- Advance to single leg balance/proprioception exercises as permitted by WB status

Modalities:

- NMES (Neuromuscular electrical stimulation) to enhance recruitment of quadriceps musculature, post-operatively
- Cryotherapy/Vasopneumatic therapy to assist with maintenance of post-operative effusion

Sub-acute/Intermediate Phase (2-6 wks)

Weight Bearing Progression: FWB is permitted when above criteria met

PO Bracing: All bracing discontinued.

Strengthening:

- Progression of closed kinetic chain strengthening of the lower extremity consistent with WB status
- Progression of hip and core stability strengthening.

- Target on residual asymmetries in lower extremity strength

Balance/Proprioception:

- Progression to advanced single limb balance from stable to unstable surfaces
- Initiation of agility activities on stable surfaces

Cardiovascular Conditioning:

- Initiation of PWB CV conditioning including biking and swimming
- Limited impact activities permitted at this time

Neuromuscular Re-education:

- Progression of lower extremity muscle activation and muscle coordination activities
- Implementation of progressive interventions to normalize lower extremity movement patterns

Modalities:

- Continuation of NMES if limitations in quad activation persist
- Continuation of cryotherapy if residual effusion persists

Transition to Function/Return to Play (6+ weeks)

The transition to function phase is designed to help transition the patient, once sufficient healing, progression of strength and functional mobility has occurred. The focus of this phase is to progressively re-introduce pre-injury activity to the patient in a progressive systematic fashion. Once the patient completes a return to function/return to play progression, a consideration is made to release the patient to activity.

Return to play following these procedures is typically restricted post-operatively to allow sufficient healing to occur. In addition to adequate healing, the patient must present with the following objective criteria:

16. No residual effusion
17. Full ROM and normal patellofemoral mobility
18. Strength of quadriceps and hamstring musculature >90% of the contralateral limb
19. Demonstration of performance on lower extremity functional performance testing >90% contralateral leg.
20. Completion of a return to play progression with no signs of pain, swelling or instability.

Post-Operative Rehabilitation Progression for Structural Management* of Articular Cartilage Lesions of the Knee

**Structural Management includes: Osteochondral autograph transplantation (OAT's), osteochondral allograft transplant, osteochondral fragment fixation, trans-articular drilling and retro-articular drilling.*

Patellofemoral Compartment:

Acute Phase (0-6 wks)

Weight bearing guideline: NWB x 2 weeks; PWB x 2 weeks, then progress to FWB when the patient presents with:

- Full knee extension
- Sufficient knee flexion to demonstrate a normal gait pattern
- Minimal effusion and pain
- Sufficient quadriceps control to eccentrically control lowering the body's center of mass with knee flexion from 0-30 degrees

*** Recommendation to use ROM brace locked in full extension during WB progression.*

PO Bracing: PO ROM bracing recommended for use during WB progression. Open ROM during NWB activities

Continuous Passive Motion: Early ROM is advocated immediately following surgical intervention with a goal to progress to full ROM within 6 weeks post-operative. The use of mechanical CPM is not required.

ROM Progression: Progress ROM as tolerated with no limitations in ROM

Strengthening:

- Early quadriceps and hamstrings muscle activation is initiated immediately after surgery with care to protect the PF joint.
- Early PF joint protection is recommended with limitations in squatting and activities which result in compression and shearing at the PF joint
- NWB lower extremity strengthening is initiated immediately following surgery and progressed to more closed kinetic chain activities as WB restrictions permit
- Core stability strengthening is initiated immediately following surgery as tolerated by pain

Balance/Proprioception Training:

- Initiate double leg balance weight shifting and proprioception activity once permitted to PWB
- Advance to single leg balance/proprioception exercises as permitted by WB status

Modalities:

- NMES (Neuromuscular electrical stimulation) to enhance recruitment of quadriceps musculature, post-operatively
- Cryotherapy/Vasopneumatic therapy to assist with maintenance of post-operative effusion

Sub-acute Phase (6-12 wks)

Weight Bearing Progression: FWB is permitted when above criteria met

PO Bracing: All bracing discontinued. Optional to use varus or valgus unloading brace with progression to return to activity

Strengthening:

- Progression of closed kinetic chain strengthening of the lower extremity consistent with WB status
- Continue to protect patellofemoral joint with limited squatting and repetitive shearing/compression loads on the PF joint
- Progression of hip and core stability strengthening
- Target on residual asymmetries in lower extremity strength

Balance/Proprioception:

- Progression to advanced single limb balance from stable to unstable surfaces
- Initiation of agility activities on stable surfaces

Cardiovascular Conditioning:

- Initiation of PWB CV conditioning including biking and swimming
- No impact activities permitted at this time

Modalities:

- Continuation of NMES if limitations in quad activation persist
- Continuation of cryotherapy if residual effusion persists

Transition to Function/Return to Play (3-6 months)

The transition to function phase is designed to help transition the patient, once sufficient healing, progression of strength and functional mobility has occurred. The focus of this phase is to progressively re-introduce pre-injury activity to the patient in a progressive systematic fashion. All impact activity is introduced after a minimum of 3 months PO, to insure sufficient healing. Once the patient completes a return to function/return to play progression, a consideration is made to release the patient to activity.

Return to play following these procedures is typically restricted until 3-6 months post-operative to allow sufficient healing to occur. In addition to adequate healing, the patient must present with the following objective criteria:

21. No residual effusion
22. Full ROM and normal patellofemoral joint mobility

23. Strength of quadriceps and hamstring musculature >90% of the contralateral limb
24. Demonstration of performance on lower extremity functional performance testing >90% contralateral leg.
25. Completion of a return to play progression with no signs of pain, swelling or instability.

Post-Operative Rehabilitation Progression for Structural Management* of Articular Cartilage Lesions of the Knee

**Structural Management includes: Osteochondral autograph transplantation (OAT's), osteochondral allograft transplant, osteochondral fragment fixation, trans-articular drilling and retro-articular drilling.*

Tibiofemoral Compartment:

Acute Phase (0-6 wks)

Weight bearing guideline: NWB x 4 weeks; PWB x 2 weeks, then progress to FWB when the patient presents with:

- Full knee extension
- Sufficient knee flexion to demonstrate a normal gait pattern
- Minimal effusion and pain
- Sufficient quadriceps control to eccentrically control lowering the body's center of mass with knee flexion from 0-30 degrees

PO Bracing: No specific PO bracing unless needed for comfort or stability during ambulation

Continuous Passive Motion: Early ROM is advocated immediately following surgical intervention with a goal to progress to full ROM within 6 weeks post-operative. The use of mechanical CPM is not required.

ROM Progression: Progress ROM as tolerated with no limitations in ROM

Strengthening:

- Early quadriceps and hamstrings muscle activation is initiated immediately after surgery with care to protect the PF joint.
- NWB lower extremity strengthening is initiated immediately following surgery and progressed to more closed kinetic chain activities as WB restrictions permit
- Core stability strengthening is initiated immediately following surgery as tolerated by pain

Balance/Proprioception Training:

- Initiate double leg balance weight shifting and proprioception activity once permitted to PWB
- Advance to single leg balance/proprioception exercises as permitted by WB status

Modalities:

- NMES (Neuromuscular electrical stimulation) to enhance recruitment of quadriceps musculature, post-operatively
- Cryotherapy/Vasopneumatic therapy to assist with maintenance of post-operative effusion

Sub-acute Phase (6-12 wks)

Weight Bearing Progression: FWB is permitted when above criteria met

PO Bracing: All bracing discontinued. Optional to use varus or valgus unloading brace with progression to return to activity

Strengthening:

- Progression of closed kinetic chain strengthening of the lower extremity consistent with WB status
- Progression of hip and core stability strengthening
- Target on residual asymmetries in lower extremity strength

Balance/Proprioception:

- Progression to advanced single limb balance from stable to unstable surfaces
- Initiation of agility activities on stable surfaces

Cardiovascular Conditioning:

- Initiation of PWB CV conditioning including biking and swimming
- No impact activities permitted at this time

Modalities:

- Continuation of NMES if limitations in quad activation persist
- Continuation of cryotherapy if residual effusion persists

Transition to Function/Return to Play (3-6 months)

The transition to function phase is designed to help transition the patient, once sufficient healing, progression of strength and functional mobility has occurred. The focus of this phase is to progressively re-introduce pre-injury activity to the patient in a progressive systematic fashion. All impact activity is introduced after a minimum of 3 months PO, to insure sufficient healing. Once the patient completes a return to function/return to play progression, a consideration is made to release the patient to activity.

Return to play following these procedures is typically restricted until 3-6 months post-operative to allow sufficient healing to occur. In addition to adequate healing, the patient must present with the following objective criteria:

26. No residual effusion
27. Full ROM and normal patellofemoral joint mobility
28. Strength of quadriceps and hamstring musculature >90% of the contralateral limb
29. Demonstration of performance on lower extremity functional performance testing >90% contralateral leg.
1. Completion of a return to play progression with no signs of pain, swelling or instability

Appendix B: References

- 1) Linden B. Osteochondritis dissecans of the femoral condyles: a long-term follow-up study. *J Bone Joint Surg Am* 59, 769-76 (1977).
- 2) Linden B. The incidence of osteochondritis dissecans in the condyles of the femur. *Acta Orthop Scand* 47,664-7 (1976).
- 3) Anderson AF, Pagnani MJ. Osteochondritis dissecans of the femoral condyles: long-term results of excision of the fragment. *Am J. Sports Med.* 25, 6 (1997).
- 4) Wright RW, McLean M, Matava MJ, Shively RA. Osteochondritis dissecans of the knee: long-term results of excision of the fragment. *Clin. Orthop. Relat. Res.*424, 239-243 (2004).
- 5) American Academy of Orthopaedic Surgeons: The Diagnosis and Treatment of Osteochondritis Dissecans: Guideline and Evidence Report. December 4, 2010. http://www.aaos.org/research/guidelines/OCD_guideline.pdf. Accessed December 30, 2013.
- 6) Institute of Medicine of the National Academies: Clinical Practice Guidelines We Can Trust. March 23, 2011. <http://www.iom.edu/Reports/2011/Clinical-Practice-Guidelines-We-Can-Trust.aspx>.
- 7) American Academy of Orthopaedic Surgeons: Clinical Practice Guidelines. <http://www.aaos.org/Research/guidelines/guide.asp>
- 8) American Academy of Orthopaedic Surgeons: Appropriate Use Criteria. http://www.aaos.org/research/Appropriate_Use/auc_new.asp
- 9) Harrell F. Regression modeling strategies : with applications to linear models, logistic regression, and survival analysis. New York: Springer, 2001.

***Appendix C: Delegation of
Responsibilities Log***

SIGNATURE AND DELEGATION OF RESPONSIBILITY LOG

Investigator: _____

Site: _____

Ef

Protocol Number/Title: _____

Name (Please Print)	Title	General Responsibilities*	C.V. Available	Dates of Responsibilities		Signature
				From (mm/dd/yy)	To (mm/dd/yy)	
			<input type="checkbox"/> Yes <input type="checkbox"/> No			
			<input type="checkbox"/> Yes <input type="checkbox"/> No			
			<input type="checkbox"/> Yes <input type="checkbox"/> No			
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			<input type="checkbox"/> Yes <input type="checkbox"/> No			
			<input type="checkbox"/> Yes <input type="checkbox"/> No			

This log should include the investigator and sub-investigator(s), study coordinator(s) and all other clinic staff who routinely see study subjects and who have specific data collection/interpretation responsibilities. This log should also include any contracted specialists performing protocol required examinations. New or replacement staff should be added as appropriate.

* Please see Legend (page 2 of 2)

PLEASE MAINTAIN THIS LIST WITH YOUR REGULATORY FILES

SIGNATURE AND DELEGATION OF RESPONSIBILITY LOG

Legend

Use legend to complete the "General Responsibilities" column. Please enter the letter(s) (i.e. ace) in column that corresponds to the responsibilities of the individual. For responsibilities that are not already indicated in the legend, please add them in the empty spaces provided below.

- a Obtains consent*
- b Completion of CRFs
- c Correction of CRFs
- d Review of CRFs (must be investigator or sub-investigator)
- e Communication with Ethics Committee*
- f Physical exam*
- g Calculation of dosage*
- h Titration and prescription
- i Dispensing of medication
- j Drug compliance assessments
- k Drug accountability
- l Inter-rater reliability assessments
- m _____
- n _____
- o _____
- p _____
- q _____
- r _____
- s _____
- t _____

* Identifies functions which are significant trial-related duties and for which curriculum vitae of personnel MUST be