

ADVANCED MENISCAL REPAIR CLINICAL PRACTICE GUIDELINE

Background

Types of Tears

Meniscal root/radial tears range from partial to complete avulsion.

Impact on Knee Health

- Root and radial tears can significantly affect articular cartilage health.
- Potential for meniscal extrusion and accelerated arthritic degeneration if untreated.
- Horizontal cleavage tears can lead to advanced degeneration of meniscus tissue and underlying cartilage, especially during high-impact activities.

Clinical Practice Recommendations

- More conservative than traditional meniscus repair protocols due to the complexity of the surgical technique.
- Direct attachment of hamstring and popliteus tendons to the menisci necessitates limited knee flexor active contraction during the protection phase of recovery.
- Extended non-weight bearing precautions and special consideration of closed kinetic chain (CKC) knee flexion due to biomechanical stresses on healing tissues.

Surgical Techniques and Literature

- As surgical techniques evolve, literature on rehabilitation protocols is still limited.
- The clinical practice guideline is based on anatomical, biomechanical, and surgical principles with criterion-based progressions.

Disclaimer

- Time and criterion-based, dependent on soft tissue healing, patient demographics, and clinician evaluation.
- For questions, contact Dr. Sujan Gogu's clinic

Recommendations

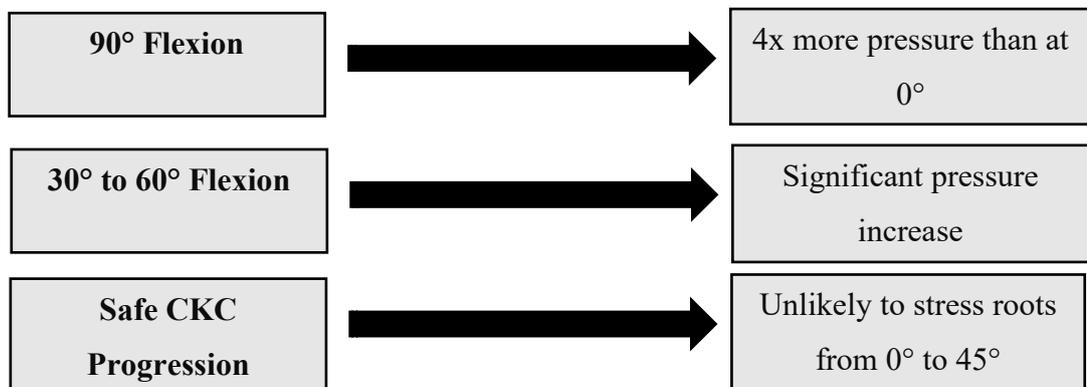
Meniscal Root Classification System

Types of Tears:

- 1** Type 1: Partial stable root tear
- 2** Type 2: Complete radial tear within 9mm from the bony root attachment
- 3** Type 3: Bucket-handle tear with complete root detachment
- 4** Type 4: Complex oblique or longitudinal tear with complete root detachment
- 5** Type 5: Bony avulsion of the root attachment

Meniscal Loading

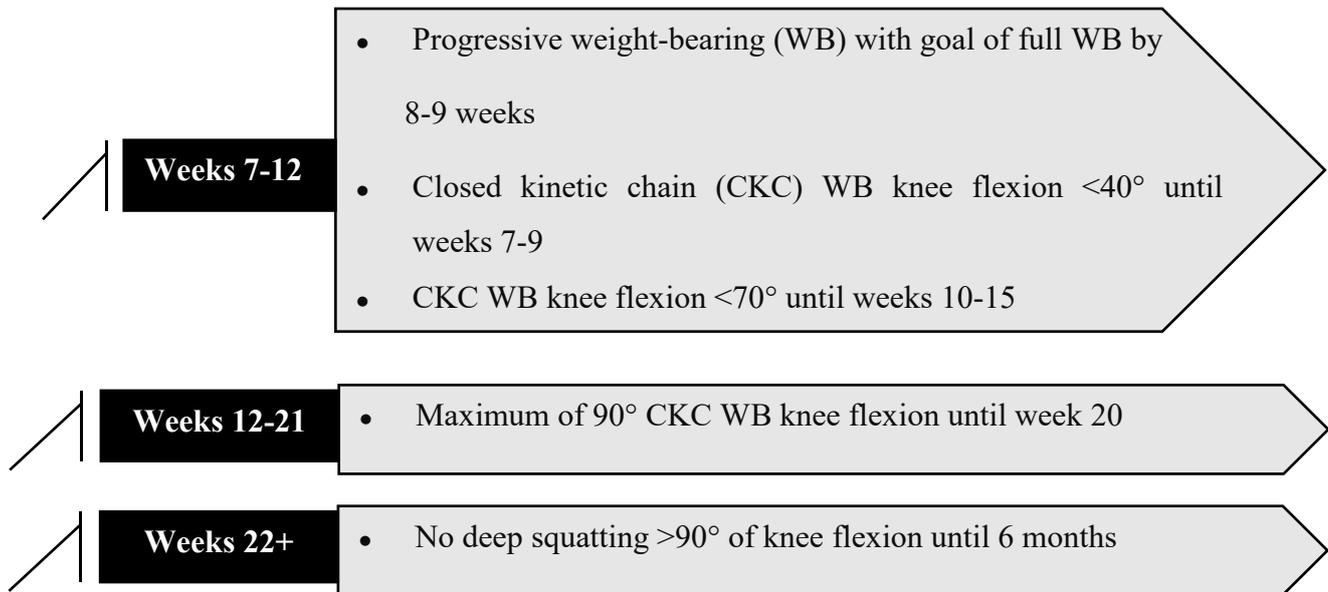
Studies report CKC loading to medial and lateral posterior horns:



Weight Bearing Precautions

Weeks 0-6

- Non-weight bearing (NWB)
- Brace with total range of motion (TROM) locked in knee extension for 4-6 weeks



Hamstring Precautions (Root/Radial Repair ONLY)

Restrictions:

- *For 7 weeks:* No isometric hamstring activity
- *For 12 weeks:* No isotonic isolated hamstring interventions
- No hamstring precautions for horizontal cleavage repairs (HCT)

Outcome Tools

- Collect at least one of the following at initial evaluation, every 6 weeks, and at discharge:
 1. IKDC
 2. Tegner Activity Level
 3. Lysholm Knee Score

Strength Testing

- **Isometric Testing:**

HCT	<i>3 months</i>
Root/Radial Repairs	<i>4 months</i>

- **Isokinetic Testing:**

HCT	<i>4 months</i>
Root/Radial Repairs	<i>6 months</i>

Isokinetic Testing

- Only necessary if the patient's goal is to return to sports.
- Many patients may aim to return to low-impact activities (e.g., IADLs, recreational walking, biking).

Criteria to Discharge Assistive Device

- **Timeline:**

1. NWB for 6 weeks
2. Full weight-bearing without assistive device by week 8-9.

- **Criteria:**

1. **ROM:** Full active knee extension; no pain on passive overpressure.
2. **Strength:** Strong quad isometric with full tetany and superior patellar glide; able to perform 2x10 SLR without quad lag.
3. **Effusion:** 1+ or less is preferred.
4. **Weight Bearing:** Pain-free ambulation without visible gait deviation for 3 minutes at self-selected speed.

Criteria to Initiate Running and Jumping

- **Criteria:**

1. **ROM:** Full, pain-free knee ROM, symmetrical with the uninvolved limb.
2. **Strength:** Isokinetic testing 80% or greater for hamstring and quad at 60°/sec and 300°/sec.
3. **Effusion:** 1+ or less.
4. **Weight Bearing:** Normalized gait and jogging mechanics.

5. **Neuromuscular Control:** Pain-free hopping in place.

Criteria for Return to Sport

• **Criteria:**

1. **ROM:** Full, pain-free knee ROM, symmetrical with the uninvolved limb.
2. **Strength:** Isokinetic testing 90% or greater for hamstring and quad at 60%/sec and 300%/sec.
3. **Effusion:** No reactive effusion \geq 1+ with sport-specific activity.
4. **Weight Bearing:** Normalized gait and jogging mechanics.
5. **Neuromuscular Control:** Proper mechanics and force attenuation strategies with high-level agility, plyometrics, and high-impact movements.

6. **Functional Testing:**

- Vail Sports Test: >46/54
- Anterior reach on Y-Balance test: <5cm difference
- Y Balance composite score: >94%
- Modified Agility T Test: >90% of uninvolved
- Single-leg hop series: proper mechanics and force attenuation strategies

Phase 1 (Weeks 0-6): Protection, ROM, Muscle Activation

Goals	<ul style="list-style-type: none">• Protect surgical repair• Resolve joint effusion to 1+ or less• Restore full ROM
Precautions	PROM: <ul style="list-style-type: none">• 0-90 degrees for 2 weeks• Progress ROM as tolerated thereafter• No isolated hamstrings activation for radial/root repairs
Pain and Effusion	Target:

	<ul style="list-style-type: none"> • $\geq 1+$ (using Modified Stroke Test)
ROM	<p>Extension:</p> <ul style="list-style-type: none"> • Full knee extension immediately post-surgery • Contact surgeon if not achieved by 4 weeks <p>Flexion:</p> <p style="text-align: center;"><i>Root/Radial Only</i></p> <ul style="list-style-type: none"> • Limited to PROM due to hamstring/popliteus attachment to meniscus • First 2 weeks: Limited to 0-90 degrees • First 2 weeks: Gentle full PROM allowed
Therapeutic Exercise	<ul style="list-style-type: none"> • Emphasis on quad activation without gluteal co-contraction • Restore patellar mobility • Achieve symmetrical ROM • Decrease effusion
Suggested Interventions	<p>Extension ROM:</p> <ul style="list-style-type: none"> • Bag hangs or prone hangs <p>Flexion ROM (Root/radial only):</p> <ul style="list-style-type: none"> • Supine wall slides with PROM, self-monitoring for hamstring activation <p>Patellar mobilization:</p> <ul style="list-style-type: none"> • Superior • Inferior • Medial • Lateral <p>Quad Isometrics:</p> <ul style="list-style-type: none"> • SLR 4-way <p>TKE:</p> <ul style="list-style-type: none"> • Prone <p>Initiate open chainknee extension exercises:</p> <ul style="list-style-type: none"> • Unweighted SAQ • LAQ • Protected range with isotonic progression

	<ul style="list-style-type: none"> • Neuromuscular re-education using NMES at 60° knee flexion
NMES Parameters	<p>Pad Placement:</p> <ul style="list-style-type: none"> • Proximal and distal quadriceps <p>Patient Position:</p> <ul style="list-style-type: none"> • Seated with knee in at least 60° flexion, shank secured with strap, back support with thigh strap preferred. Ankle pad/belt two finger widths superior to lateral malleoli <p>Instruction:</p> <ul style="list-style-type: none"> • Patient relaxes while e-stim generates at least 50% of their max volitional contraction against fixed resistance OR maximal tolerable amperage without knee joint pain <p>Settings:</p> <ul style="list-style-type: none"> • 10-20 seconds on/50 seconds off x 15 min • Frequency = 75 pps, Pulse Width = 400 microseconds
Criteria to Discharge Assistive Device	<p>ROM:</p> <ul style="list-style-type: none"> • Full active knee extension; no pain on passive overpressure <p>Strength:</p> <ul style="list-style-type: none"> • Able to perform strong quad isometric with full tetany and superior patellar glide; able to perform 2x10 SLR without quad lag <p>Effusion:</p> <ul style="list-style-type: none"> • 1+ or less preferred (2+ acceptable if all other criteria are met) <p>Weight Bearing:</p> <ul style="list-style-type: none"> • Pain-free ambulation without visible gait deviation
Criteria to Progress to Phase 2	<p>ROM:</p> <ul style="list-style-type: none"> • Symmetrical to uninvolved limb <p>Strength:</p> <ul style="list-style-type: none"> • Quadriceps set with normal superior patellar

	<p>translation, SLR x 10 seconds without extensor lag</p> <p>Effusion:</p> <ul style="list-style-type: none"> • 1+ or less with Modified Stroke Test
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Phase 2 (Weeks 7-9): Weight Bearing Tolerance

Precautions	<ul style="list-style-type: none"> • Gradually progress to full weight bearing without an assistive device by weeks 8-9 • Keep knee flexion <40 degrees during closed kinetic chain (CKC) activities • Limit CKC activities to the weight-bearing status
Pain and Effusion	<ul style="list-style-type: none"> • Use cryotherapy/compression as needed for reactive effusion.
ROM	<ul style="list-style-type: none"> • Monitor and advance knee ROM, patellar mobility, and lower extremity (LE) flexibility • Use more intensive techniques to achieve/maintain full knee extension (e.g., weighted bag hang) as necessary • Continue using a bike for ROM and warmup • Contact surgeon if full active ROM (AROM) knee extension is not achieved by 4 weeks
Suggested Interventions and Timelines	<ul style="list-style-type: none"> • Multi-angle knee isometrics from 60-90° for patients unable to tolerate high-intensity NMES • Progress weight-bearing quadriceps and hamstring exercises, emphasizing proper LE mechanics • Root/Radial Repairs: No isometric hamstring activity until 8 weeks, no isolated hamstring isotonic until 12 weeks • Advance gluteal and lumbopelvic strength and stability • Improve single-leg balance • Continue NMES (see parameters in Weeks 0-6)
Criteria to Progress to Phase 3	<ul style="list-style-type: none"> • Achieve full weight-bearing • Normalize gait pattern on flat ground • Maintain trace to zero joint effusion

	<ul style="list-style-type: none"> • Tolerate 25 minutes of standing and walking activity
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Phase 3 (Weeks 10-15): Endurance

Precautions	<ul style="list-style-type: none"> • Limit knee flexion to less than 70 degrees during closed kinetic chain (CKC) activities.
Pain and Effusion	<ul style="list-style-type: none"> • Effusion may increase with activity; ensure it remains $\leq 1+$ and/or non-reactive for progression of endurance activities.
ROM	<ul style="list-style-type: none"> • Full and symmetrical to the contralateral limb, pain-free with overpressure.
Therapeutic Exercise	<ul style="list-style-type: none"> • Perform exercises focusing on dynamic stability of the quadriceps, hamstrings, and trunk with low load and high repetitions.
Suggested Interventions	<p>Therapeutic Exercise/Neuromuscular Re-education:</p> <ul style="list-style-type: none"> • Double-leg squats (less than 70 degrees) • Stationary lunges progressing to walking lunges • Step-downs, starting at 2" and progressing to 6" <p>Cardiovascular Conditioning (starting at week 12):</p> <ul style="list-style-type: none"> • Stationary biking with resistance • Treadmill walking • Freestyle swimming (no fins until week 16)
Criteria to Discontinue NMES	<ul style="list-style-type: none"> • Less than 20% quadriceps deficit on isometric testing or, if a Biodex machine is not available: • Perform 10 straight leg raises (SLR) without quadriceps lag • Demonstrate a normal gait
Criteria to Progress to Phase 4	<ul style="list-style-type: none"> • 90-second hold in a single-leg squat position at 45 degrees of knee flexion.

Phase 4 (Weeks 16-21): Strength

Precautions	<ul style="list-style-type: none"> Limit knee flexion to a maximum of 90 degrees during CKC activities until week 20.
Pain and Effusion	<ul style="list-style-type: none"> Effusion may increase with activity; ensure it remains $\leq 1+$ and/or non-reactive.
ROM	<ul style="list-style-type: none"> Full and symmetrical to the contralateral limb, pain-free with overpressure.
Therapeutic Exercise	<ul style="list-style-type: none"> Perform exercises focusing on dynamic stability of the quadriceps, hamstrings, and trunk with high resistance and low repetitions.
Suggested Interventions	<ul style="list-style-type: none"> Therapeutic Exercise/Neuromuscular Re-education: Single-leg squats Single-leg deadlifts Single-leg sit-to-stand Multi-directional lunges
Criteria to Progress to Phase 5	<ul style="list-style-type: none"> Quadriceps index greater than 80% (isokinetic testing) Anterior reach on Y balance test, less than 8 cm difference compared to the uninvolved side

Phase 5 (Weeks 22-Return to Sport (RTS)): Power, Running, and Return to Sport

Precautions	<ul style="list-style-type: none"> No deep squatting for 6 months Expected RTS by 9 months
Pain and Effusion	<ul style="list-style-type: none"> Effusion may increase with activity Ensure it remains $\leq 1+$ and/or non-reactive for progression of plyometrics.
ROM	<ul style="list-style-type: none"> Full, symmetrical to the contralateral limb, and pain-free with overpressure.
Therapeutic Exercise	<ul style="list-style-type: none"> Perform exercises focusing on dynamic stability of the quadriceps, hamstrings, and trunk with sports-specific

	activity.
Suggested Interventions	<ul style="list-style-type: none"> • Therapeutic Exercise/Neuromuscular Re-education: • Double and single-leg jump training • Ladder drill agility • Lateral hops with and without resistance • Progressive cutting activities
Criteria to Progress to RTS	<ul style="list-style-type: none"> • Pass Vail Sport Test, >46/54 • Anterior reach on Y balance test, <5 cm difference • Y balance test composite scores, >94% • Quadriceps index >90% (isokinetic) • Modified Agility T Test >90% of contralateral limb • Single-leg hop series >90% LSI • SL hop for distance • Triple hop • Cross over hop • Timed 6m hop

Appendix A: Vail Sports Test

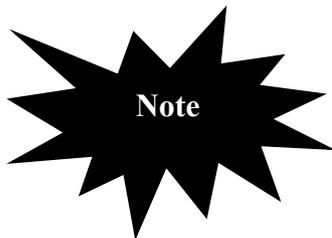
Total Points: ____/54 (Patient must score 46/54 to pass)

Single Leg Squat (Goal: 3 minutes)

Procedure: Perform each repetition at a cadence of 1 second up and 1 second down against the resistance of a sportcord placed under the testing leg's foot.

Criteria	Yes (1)	No (0)	Minute 1	Minute 2	Minute 3
Knee flexion angle between 30° and 60°					
Repetitions without dynamic knee valgus					
Avoids locking knee during extension					
Patella does not extend past the toe during knee flexion					
Maintains upright trunk during knee flexion					

Single Leg Squat Total Points: ____/15



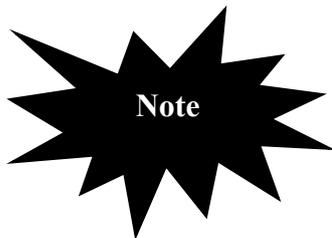
If the patient repeats an error on 3 consecutive repetitions after correction, they are not eligible to receive a point for that particular standard (within each 1-minute timeframe).

Lateral Bounding (Goal: 90 seconds)

Procedure: Perform lateral hopping motion against the resistance of a sportcord attached to the waist and an immovable object. Hop from one leg to the other, absorbing energy by bending at the knee and hip.

Criteria	Yes (1)	No (0)	1st 30 seconds	2nd 30 seconds	3rd 30 seconds
Knee flexion angle is 30° or greater during landing					
Repetitions without dynamic knee valgus					
Repetitions within landing boundaries					
Landing phase does not exceed 1 second in duration					
Maintains upright trunk during knee flexion					

Lateral Bounding Total Points: ____/15



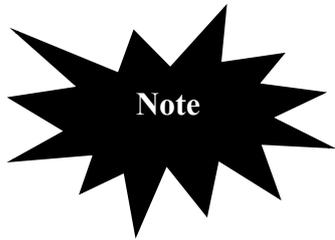
If the patient repeats an error on 3 consecutive repetitions after correction, they are not eligible to receive a point for that particular standard (within each 30-second timeframe).

Forward Jogging (Goal: 2 minutes)

Procedure: Perform forward jogging against the resistance of the sportcord with the belt around the waist, hopping from one leg to the other while maintaining proper form.

Criteria	Yes (1)	No (0)	Minute 1	Minute 2
Knee flexion between 30° and 60°				
Repetitions without dynamic knee valgus				
Repetitions within landing boundaries				
Avoids locking knee during extension				
Landing phase does not exceed 1 second in duration				
Maintains upright trunk during knee flexion				

Forward Jogging Total Points: ____/12



If the patient repeats an error on 3 consecutive repetitions after correction, they are not eligible to receive a point for that particular standard (within each 1-minute timeframe).

Backward Jogging (Goal: 2 minutes)

Procedure: Perform backward jogging against the resistance of the sportcord with the belt around the waist, hopping from one leg to the other while maintaining proper form.

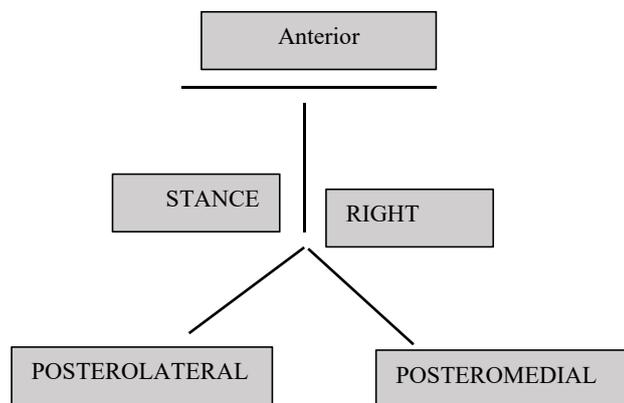
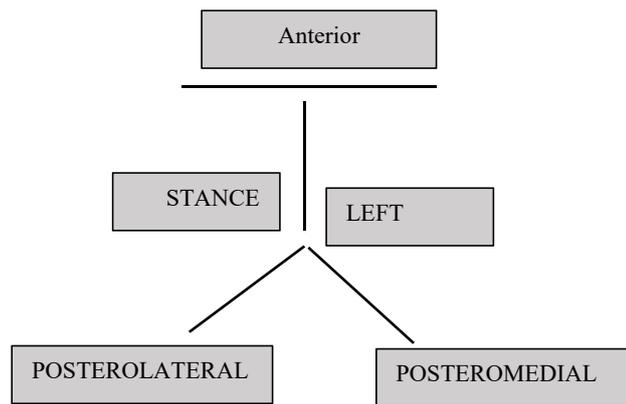
Criteria	Yes (1)	No (0)	Minute 1	Minute 2
Knee flexion between 30° and 60°				
Repetitions without dynamic knee valgus				
Repetitions within landing boundaries				
Avoids locking knee during extension				
Landing phase does not exceed 1 second in duration				
Maintains upright trunk during knee flexion				

Backward Jogging Total Points: ____/12



If the patient repeats an error on 3 consecutive repetitions after correction, they are not eligible to receive a point for that particular standard (within each 1-minute timeframe).

Appendix B: Y Balance Test



	Left	Right	Difference
ANTERIOR			
POSTEROMEDIAL			
POSTERLATERAL			

Return to sports: Difference <4

$$\text{Composite score} = \frac{\text{Anterior} + \text{Postermedial} + \text{Posterlateral}}{3 \times \text{Limb length}} \times 100$$

Left	
Right	

Appendix C: Modified Agility T-Test

Purpose: Assess lower extremity side-to-side differences in cutting and running maneuvers.

Procedure:

1. Participant is guided through the course by the test administrator.
2. Emphasize shuffling movement; avoid running or crossover steps during lateral movements.
3. Perform the test in both directions after a 2-minute rest.

Timing:

- Record total time for each direction.
- Compare times between limbs to determine involved and uninvolved limb.
- **Involved Time:** _____
- **Uninvolved Time:** _____

Appendix D: Single Leg Hop Series

Single Hop for Distance

- Align heel with zero mark of tape measure.
- Hop as far as possible on the same leg; land and hold for 3 seconds.
- Perform 2 practice hops per leg, then 2 test trials.
- Measure distance from start to heel; calculate average distance.
- Compute Limb Symmetry Index: $(\text{Involved limb distance} / \text{Uninvolved limb distance}) \times 100\%$.

Cross-Over Hop for Distance

- Heel aligned with zero mark; hop 3 times on one foot, crossing center line each time.
- Record total distance hopped; perform 2 practice and 2 test trials.
- Measure and average distances for each leg.
- Compute Limb Symmetry Index: $(\text{Involved limb distance} / \text{Uninvolved limb distance}) \times 100\%$.

Triple Hop for Distance

- Heel aligned with zero mark; perform 3 consecutive hops on one foot.
- Record total distance hopped; perform 2 practice and 2 test trials.
- Measure and average distances for each leg.
- Compute Limb Symmetry Index: $(\text{Involved limb distance} / \text{Uninvolved limb distance}) \times 100\%$.

Timed 6-Meter Hop

- Heel at zero mark; hop as fast as possible for 6 meters on cue.
- Perform 2 practice and 2 test trials.
- Record time taken; measure and average distances for each leg.
- Compute Limb Symmetry Index: $(\text{Involved limb time} / \text{Uninvolved limb time}) \times 100\%$.