

**Citation:** Gugliotti M, Cohen D, Hernandez A, Hinrichs K, Osmundsen N. Impact of shoulder internal rotation on normal sensory response during ulnar nerve-biased neurodynamic testing of asymptomatic individuals. *Journal of Manual & Manipulative Therapy*. 2016;25(1):39-46. doi:10.1080/10669817.2016.1173317.

**Review Submitted By:** Jon Lester

**Objective:** To compare the effectiveness of ulnar nerve sensory response of the traditional version of the ULPT 3 to an alternative version of the ULPT 3 with shoulder internal rotation.

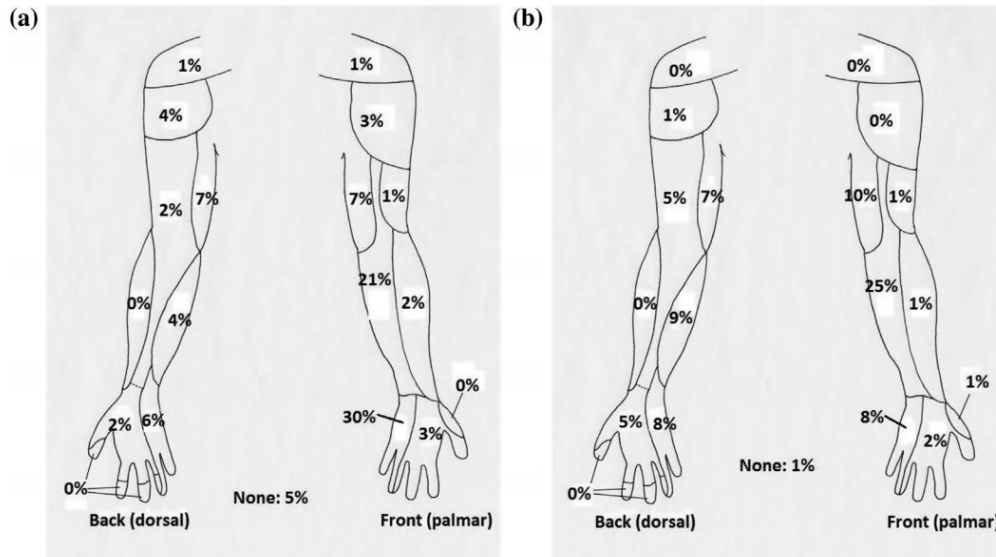
**Methods:** All 50 subjects (25.9 +/- 8.1 years) were asymptomatic. Subject's were excluded if they have ROM limitation in the cervical spine or UE, (+) neurological signs, (+) Spurling's, or associated cervical spine injury/surgery. Group randomization was performed; blinding was not by subject's or assessors. The two independent variables were traditional ULPT 3 (wrist/finger extension, forearm pronation, elbow flexion, shoulder ER, scapular depression, shoulder abduction) and an alternative version of the ULPT 3 (all positions the same with exception of IR in place of ER). The subject's were put through one of these sequences and reported when they first felt symptoms and then when they hit their limit of tolerance. After 60 sec, the opposite testing sequence was performed. The authors utilized a 10 cm VAS to determine the extent of symptoms. Symptoms included stretching, burning, tingling, and numbness. The authors also assessed the degree of motion at the shoulder and elbow during which symptoms arose, as well as the location of symptoms.



**Results:** In Table 1 (below), the mean ROM measurements at the limit of tolerance are presented. In Figure 2, you can see the distribution of symptoms as reported during each procedure. The stretching intensity was found to be moderately correlated (ICC = 0.61) between the two procedures (p = .001). The burning intensity was found to be strongly correlated (ICC = 0.74) between the two procedures (p = .001). The tingling intensity was found to be strongly correlated (ICC = 0.86) between the two procedures (p = .001). The numbness intensity was found to be moderately correlated (ICC = 0.51) between the two procedures (p = .001).

**Table 1 Upper extremity ROM during traditional upper limb neurodynamic test (ULNT<sub>3</sub>) and experimental maneuver**

	Traditional mean ± SD	Experimental mean ± SD
Elbow flexion (°)	131.6 ± 5.7	107.6 ± 12.2
Shoulder external rotation (°)	87.0 ± 4.8	
Shoulder internal rotation (°)		76.5 ± 10.3
Shoulder abduction (°)	116.8 ± 16.4	75.1 ± 13.3



**Figure 2** Body charts divided into nine areas in which sensory response was felt during the traditional (a) and experimental (b) versions of ULNT<sub>3</sub>.

**Conclusions:** The results of this study show that an alternative version of the ULPT 3 that substitutes IR for ER of the shoulder reproduces similar sensory response as compared to the traditional ULPT 3.

**Commentary:** The reason that I chose this study is because I have been working with a patient with adhesive capsulitis, who is still fairly restricted into ER. She has had a recent increase in medial forearm pain that appeared to be of neurogenic origin. This alternative to the ULPT 3 would be more appropriate for her and other patients without sufficient ER. The findings of this study that describes either moderate or strong correlation of sensory symptoms (burning, tingling, numbness, stretching) between the two versions of the ULPT 3 shows that this variation can be of similar effectiveness for reproducing ulnar nerve directed neurodynamic testing, which bodes well for its utility in the clinic. However, this study was performed on asymptomatic subject's, so further research should be performed on a symptomatic population to truly assess the relation to the traditional ULPT 3. I plan on utilizing this version of the test for the patients that I have with significant ER ROM loss who I suspect ulnar nerve irritation/neurodynamic mobility loss.

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**Hagmeijer et al. (2019) Long-term Results After Repair of Isolated Meniscal Tears Among Patients Aged 18 Years and Younger. An 18-Year Follow-Up Study. American Journal of Sports Medicine. 799 - 806.**

**Review Submitted by:** Erik Kreil, PT, DPT, CSCS

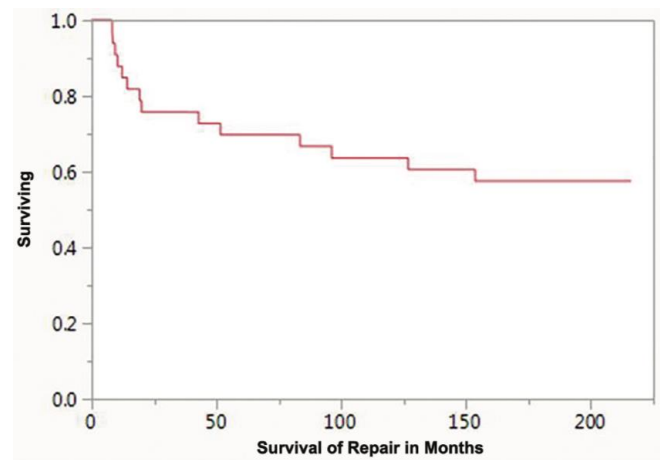
**Objective:** 1) To obtain long-term follow-up data regarding the success of meniscal repairs among pediatric and adolescent age patients, 2) To compare data of this study to previously reported mid-term follow-up data, 3) To define relevant risk factors for failure or worse outcome.

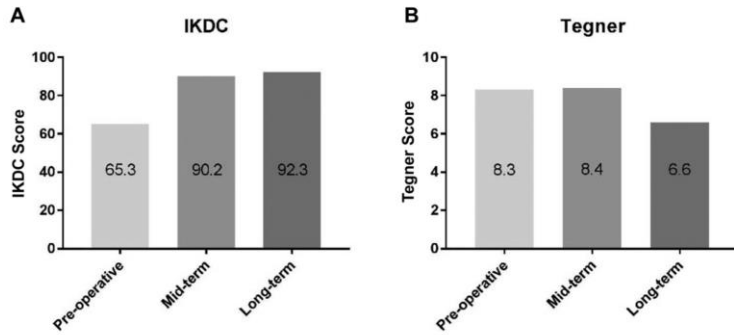
**Methods:** This is a case study demonstrating level 4 grade evidence. A retrospective collection of information on reinjuries and reoperations was performed from the patient group reported in a clinical study by Krych et al, 2008. Inclusion criteria are as follows: having an isolated meniscal repair at the same institution between the years 1990-2005 and the patient is 18 years old or younger at the time of operation. International Knee Documentation Committee (IKDC) and Tegner activity scores were also collected.

The study by Krych included meniscal tears if they were full thickness > 1cm in length and under 6 mm of the meniscosynovial junction. Tears were placed into 3 categories arthroscopically as either simple, bucket-handle, or complex. A postoperative protocol was included in this study. Surgical techniques are described further in the Surgical Procedures component of the research authored by Hagmeijer.

Repair failure is defined as either reinjury, reoperation of the same repair, or by having sought further treatment for the same meniscus. Clinical success is considered those who denied that pain was interfering with their activities. All information was collected subjectively by phone. Statistical analysis features are described in this study.

**Results:** Of the 44 patients available for contact, 33 were included with a mean age of 16.1 years at the time of meniscal repair. Bucket-handle tear incidence was the highest (n=17), followed by simple (n=11), and complex (n=5) tears. 14 of these 33 “failed” between surgical operation and mid-term follow-ups. The 14 included 8/17 bucket-handle tears, 4/5 complex tears, and 2/11 simple tears who met this criteria. See figure (Right) for overall survival rates compared to postoperative months.





Mean IKDC score at final follow up was significantly increased when compared with preoperative (92.3 vs 65.3,  $P < .0001$ ) and midterm (90.2,  $P = .01$ ) scores. “The mean Tegner score (6.5) was significantly lower than both preoperative (8.3,  $P < .0001$ ) and midterm (8.4,  $P < .0001$ ) scores.” See figure (Left) for

illustration.

There was no difference in Tegner or IKDC score for patients with successful versus failed repair. See (Right) for potential risk factors’ effect of long-term Tegner and IKDC scores. Older age meets  $p < 0.05$  criteria for statistical significance.

TABLE 2  
Spearman Analysis to Assess for Correlation Between Different Factors and Clinical Outcome Scores<sup>a</sup>

Factor	Tegner Score		IKDC Score	
	Spearman Correlation	<i>P</i> Value	Spearman Correlation	<i>P</i> Value
Older age	-0.3528	.04 <sup>b</sup>	-0.3066	.08
Older age at injury	-0.5540	.0008 <sup>b</sup>	-0.2578	.15
Rim width	-0.0213	.91	-0.0620	.74
Follow-up time	-0.1568	.38	-0.2174	.22
Time to repair	-0.1288	.48	0.0824	.65

**Conclusions:** Although 42% met failing criteria, particularly in early months, IKDC and Tegner scores demonstrated good to excellent long term clinical outcomes for this population regardless of first surgery failure. The type of meniscal tear has a big impact on failure rate (complex tears demonstrating as much as 80% in this study). Long-term outcome measure scores were not variable when comparing tear types, however. Older age may be related to differing Tegner scores at long-term follow up, though no other significant risk factors were identified in this cohort.

**Commentary:** Preservation of meniscus tissue is the primary goal for pediatric and adolescent cohorts due to the high incidence of postmeniscectomy arthritis. This study demonstrates good to excellent long term (~18 years) outcomes measured by IKDC and Tegner scores, and it did not find associated risk factors that may serve as contraindications (e.g rim width, laterality, etc). Older age demonstrates a p-value of 0.4 with significance to long-term Tegner score outcome, however sports activity has a negative relationship with age and may be an independent factor. Tear complexity may be a risk factor for repeat surgery, though long term outcomes were similar regardless of initial repair failure further indicating a relevant margin of clinical success. This study’s demonstration of good to excellent long-term outcomes without significant identifiable

risk factors may help clinicians make optimal decisions for their patients with long-term consideration.

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**Shi, X., Han, J., Witchalls, J., Waddington, G., & Adams, R. (2019). Does treatment duration of manual therapy influence functional outcomes for individuals with chronic ankle instability: A systematic review with meta-analysis?. *Musculoskeletal Science and Practice.***

**Review Submitted by:** Cameron Holshouser, PT, DPT

**Objective:** To study if manual therapy will improve functional outcomes for individuals with chronic ankle instability.

**Methods:** Systematic review with meta-analysis of randomized controlled trials; participants included individuals with chronic ankle instability; intervention was manual therapy which was defined as joint mobilization and/or joint mobilization with movement; primary outcome measures were patient reported function (PRF) questionnaire scores, ankle dorsiflexion ROM and balance control.

**Results:** Four studies (206 subjects, mean age = 24.4 years) were included in the meta-analysis with moderate to high quality on the PEDro scale (range 6-8). For patient reported function questionnaires, two studies reported significant improvement after six-sessions of manual therapy measured by foot and ankle ability measures sport subscale (FAAMS) and Cumberland ankle instability tool (CAIT). For dorsiflexion ROM, one session of manual therapy had no significant effect while six-sessions of manual therapy showed significant positive effect on dorsiflexion ROM. For the star-excursion balance test one session of manual therapy had no significant effect while qualitative analysis of 2 studies showed significant improvement of both the star excursion balance test and single limb balance test.

**Conclusions:** Six-sessions rather than one session of manual therapy improves ankle functional performance for individuals with CAI.

**Commentary:** This systematic review with meta-analysis found that six sessions vs one session of manual therapy (joint mobilization) can improve functional performance for individuals with CAI. This study also found low to moderate evidence that six sessions vs one session can improve ankle dorsiflexion ROM. Balance was also shown to improve following manual therapy. Individuals with CAI have shown to have decreased ankle ROM, poor functional performance and decreased balance which all contribute to a higher risk of re-injury when playing sports. Manual therapy has shown to improve ROM, functional performance and balance in this population. However, the mechanisms behind the benefit of manual therapy is still being studied. Joint mobilizations may improve balance and function by improving the arthrokinematics of the talocrural joint which allow normal mechanics during functional activity. Joint mobilizations may also improve balance and function by contributing to a neurophysiological input to the central nervous system which may also help with proprioception. Despite the proposed theories, manual therapy has shown to be beneficial and should be considered as an intervention for CAI. Previous research has shown that manual therapy in combination with other interventions such as balance/proprioception training rather than in isolation has improved functional outcomes. One limitation

of this study was the publication bias was not assessed, population size, limited amount of studies included in this study, and lack of long-term (< 6 weeks) results. The population average age was 24 years old which may affect the generalizability of this study.

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**Citation:** Ithurburn MP, Longfellow MA, Thomas S, Paterno MV, Schmitt LC. Knee function, strength, and resumption of preinjury sports participation in youth athletes following anterior cruciate ligament reconstruction. *J Orthop Sports Phys Ther.* 2019;49(3):145-153.

**Review Submitted by:** Matt Fung PT, DPT, CSCS

**Objective:** To examine differences in knee function and strength at time of return-to-sport clearance between young athletes who successfully resumed preinjury sports participation, those who did not resume preinjury sports participation, and those who sustained a second anterior cruciate ligament (ACL) injury by 1 year following return-to-sport clearance.

**Methods:** Prospective cohort study collected data on 124 young athletes (included participants from a previous study; ACL-reconstruction long-term outcomes in adolescent and young adults) at the time of return-sport clearance post ACLR. Participants had to have been previously cleared by their orthopedic surgeon and rehabilitation specialist, and to have planned to return to regular participation in cutting and pivoting sports >50 hours per year. Participants were excluded if they had a history of low back pain or lower extremity injury or surgery in either limb (other than primary ACL) requiring the care of a physician in the past year or sustaining a concomitant knee ligament injury > grade 1 MCL injury with their primary ACL injury. Measures included the Knee injury and Osteoarthritis Outcome Score (KOOS), single-leg hop tests, isokinetic quadriceps and hamstring strength, and limb symmetry during hop tests and strength tests. Participants were allocated to 3 groups: resumed preinjury sports participation, did not resume preinjury sports participation, or sustained a second ACL injury. Group differences were compared using Kruskal-Wallis tests and Mann-Whitney U post hoc tests.

**Results:** Seventy (56%) participants successfully resumed preinjury sports participation, 28 (23%) did not resume their preinjury level of sports participation 1-year later. 26 (21%) sustained a second ACL injury by 1-year post return-to-sport clearance. Participants who successfully resumed preinjury sports participation demonstrated greater absolute performance at return-to-sport clearance in the involved and uninvolved limbs on the triple hop and crossover hop, and in the involved limb on the single hop, compared to those who did not. Participants who sustained a second ACL injury demonstrated greater absolute performance at return-to-sport clearance in the involved and uninvolved limbs on the triple hop compared to those who did not resume preinjury sports participation. There were no group differences between those who successfully resumed preinjury levels of sports participation and those who sustained a second ACL injury.

**Conclusions:** Following ACLR, the small proportion of young athletes who successfully resumed preinjury levels of sports participation 1 year after return to sport demonstrated greater absolute functional performance at the time of return-to-sport clearance. No differences were identified between those who successfully resumed preinjury sports participation and those who

sustained a second ACL injury. Measures of limb symmetry did not differ among any of the groups.

**Commentary:** Return-to-sport following ACLR is one of the most highly researched topics in physical therapy and there is not shortage of information or articles out there looking at rehabilitation strategies to reduce secondary injury risk. This article found that while we have validated test and measures in place to determine readiness to return to sport, there were no significant differences between those who successfully resumed preinjury sports participation and those who sustained a second ACL injury. Thus, these measures are not great indicators of successful return to preinjury levels or secondary injury prevention as demonstrated by this study and others before it.

With new studies looking at psychological factors such as fear of reinjury and lack of confidence as potential barriers to successful return to sport, it reiterates the importance of a multifaceted approach, treating the person in front of us and not another ACLR. Every patient is going to be different and while on paper they may be passing these test and measures with flying colors there are many other personal factors that need to be taken into consideration while helping these individuals recover and hopefully successfully return to sport.

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**Citation:** Hamrin Senorski E, Svantesson E, Baldari A, et al. Br J Sports Med 2019;53:410–417.

**Review Submitted By:** Jeff Peckins

**Objective:** The purpose of the systematic review was to determine which factors affected patient-reported outcomes after anterior cruciate ligament (ACL) reconstruction.

**Methods:** The study included 35 articles about patients undergoing ACL reconstructions. All studies included contained either the Knee injury and Osteoarthritis Outcome Score (KOOS), European Quality of Life- 5 Dimensions (EQ-5D), or the Tegner Activity Scale as their outcome assessments.

**Results:** The systematic review found that women had decreased outcomes compared to men at all follow-up points for KOOS sports and recreation. Younger patients had improved Tegner and KOOS scores compared to older patients (>30 years) at every follow-up time. Individuals who smoked reported worse KOOS and EQ-5D outcomes at every time period except for pre-operatively for the EQ-5D VAS.

Individuals who had an ACL reconstruction within three months of their injury reported improved KOOS scores in all subscales besides symptoms at two years post-reconstruction, compared to those who waited longer. Patients who had a hamstring graft reported superior KOOS sports and recreation subscale scores and Tegner scores compared to patients who had a patellar tendon graft. Those who had a double-bundle ACL reconstruction reported better KOOS quality of life subscale scores at 5 years follow-up.

Patients who had an ACL reconstruction reported superior KOOS for all subscale categories and follow-ups compared to patients who had an ACL injury who did not have theirs reconstructed.

Patients who had a meniscal injury reported inferior KOOS inferior preoperative and one year follow-up KOOS scores, as well significantly decreased scores in five year follow-up for sports and recreation KOOS subscale.

**Conclusion:** The main factors that affected improved patient reported outcomes following ACL reconstruction were hamstring graft selection, not smoking, younger age, male sex, non-meniscal involvement.

**Commentary:** This systematic review helps us educate both ourselves and our patients on their prognosis and outcomes following ACL reconstruction surgery. The findings support educating our patients on the importance of not smoking for proper tissue healing and improvement in their outcomes. If a patient has an injury and comes to PT via direct access preoperatively, the research suggests that outcomes after surgery are improved if surgery occurs soon after the initial injury, and we can educate our patients about this.

We can't change certain factors such as sex and if there was or was not meniscal involvement, but it can help us give more realistic prognoses and realize that not everyone who undergoes ACL reconstruction will have similar outcomes. For example, a patient who has meniscal involvement may warrant us to have a longer prognosis for how long they can expect to be in PT. Along the same line, the systematic review suggests that a patient who is older or a woman may have worse outcomes when it comes to returning to sports, so this may also warrant additional PT visits compared to a younger or male patient.

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**Citation:** Napier C, MacLean C, Maurer J, Taunton J, Hunt M. **Real-Time Biofeedback of Performance to Reduce Braking Forces Associated with Running-Related Injury: An Exploratory Study.** *J Orthop Sports Phys Ther* 2019;49(3):136–144.  
**DOI:10.2519/jospt.2019.8587**

**Review Submitted By:** Casey Moler

**Objective:** Investigate whether peak braking forces could be decreased following gait retraining in 8 sessions in recreational female runners using real-time biofeedback with self-selected kinematic strategies.

**Methods:** 12 female recreational runners with high PBF completed a 8 session gait re-training program with real-time biofeedback of braking forces over the course of a half marathon training program. Participants were instructed to keep a peak on a rolling graph below a level of 0.245BW with no other cues. The primary kinetic outcome measure of interest was PBF (maximum posterior force observed from initial contact to 50% of stance). Secondary variables were as followed for kinetic data: vertical impact transient, AVLRL, and IVLR. Kinematic outcomes included step length, step frequency, the horizontal distance from the heel to the sacrum, shank angle at initial contact, and foot-strike angle. Baseline and follow-up kinetics and kinematics were analyzed with a repeated measures analysis of variance.



**Results:** There was an average reduction of 15% of in peak braking forces compared to baseline values after 8 training session. There was also increase in step frequency (7%) and a decrease in step length (6%) from baseline values. There was also a non-statistically significant reduction in AVLR and IVLR.

**Conclusions:** The gait retraining program (8 sessions over 14 weeks) using real-time biofeedback of braking forces lead to a reduction in PBF by 15% through a combination of increased step frequency and decreased step length in recreational female runners.

**Commentary:** In the spirit of running medicine I chose this article to improve my knowledge on gait retraining for the recreational female runner. Although this study used real-time biofeedback, I think the results are still very clinically applicable for many reasons. The authors found that 75% of the participants reported their strategy for achieving the modified gait pattern (to stay below 0.245 BW) was to either by “increasing step frequency” or “taking shorter steps”. Therefore, when giving verbal cues during gait retraining using 1 of these simple cues could be effective in your retraining session. I also would argue that giving an external cue to focus on like a metronome could be used to achieve similar self-corrective strategies. Therefore, I think it is extremely appropriate to calculate your patients cadence or steps per minute and prescribe a pace with the goal to achieve a 7% increase (probably go for 10% for simplicity) in step frequency to implement in their training sessions and community running. The other aspect of this gait training program that I learned to appreciate is when and how to decrease feedback to improve learning and retention. Starting at session 5 their feedback tapered off and continued until their last session. This faded feedback strategy may have contributed to the results they found with improvement in the confidence of the participants ability to maintain their gait pattern in the community. I appreciated the simplicity of the cueing to the participants during the retraining sessions, one goal, stay under this line. I will no plan on implementing a one goal-oriented cue in the future versus several. I also think it is important to note the inclusion of participants regardless of foot strike types. Those with a higher foot-strike angle did inherently through this training reduce their angles at follow up, therefore suggesting less emphasis on foot striking patterns to decrease PBF.