

# PERIACETABULAR OSTEOTOMY CLINICAL PRACTICE GUIDELINE

## Background

The Periacetabular Osteotomy (PAO) is a hip preservation surgery for management of developmental dysplasia of the hip (DDH). DDH involves abnormal morphology of the size and shape of the acetabulum, resulting in inadequate bony coverage of the femoral head and hip joint instability. DDH is a known cause of osteoarthritis in young patients when left untreated (Jimenez 2022). The purpose of a PAO is to limit progression of early OA, optimally realign the acetabulum to provide more stability, improve hip joint mechanics, and improve load distribution across articular surfaces. A PAO is recommended for symptomatic DDH in skeletally mature adolescents to middle aged adults with chronic pain, radiographic evidence of DDH, and minimal evidence of degenerative changes in the joint (Alrashdi, 2021). A PAO procedure improves the orientation of the acetabulum through a series of hexagonal cuts through the acetabulum, while maintaining the integrity and stability of the posterior column of the pelvis. Screws are placed to maintain the new position of the acetabulum, resulting in improved stability of the hip joint (Tibor, 2012). Often a concomitant hip arthroscopy is performed as there is a high prevalence of intra-articular pathology in the setting of AD which can affect outcomes if left untreated.

## Disclaimer

Progression is time and criterion-based, dependent on soft tissue healing, patient demographics, and clinician evaluation. If you are working with an Ohio State Sports Medicine patient and questions arise, please contact the author by calling our office at (614) 293-2385.



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## Summary of Recommendations

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|--|--|
| <b>General</b>                                 | <ul style="list-style-type: none"> <li>• PAO requires extensive rehabilitation and can often exhaust insurance approved PT visits. Consider decreasing initial visit frequency, emphasizing patient/family self- ROM assistance, postural modifications, and home program.</li> </ul>  |
| <b>Weight Bearing</b>                          | <ul style="list-style-type: none"> <li>• Foot flat weight bearing &lt;25% for 4 weeks with assistive device. Pending clearance and xray stability, progressing weight bearing through 6 weeks.             <ul style="list-style-type: none"> <li>◦ Continue to normalize gait pattern; shortened stride length recommended to prevent stress on anterior hip structures</li> </ul> </li> <li>• Progression to full weight bearing at 6 weeks is dependent on radiographic healing and appropriate pelvic stability maintained in stance phase of gait.</li> <li>• Crutch weaning may extend up to 12-14 weeks</li> </ul>                                  |
| <b>Patient Reported Outcomes (PRO)</b>         | <ul style="list-style-type: none"> <li>• Lower Extremity Functional Scale (LEFS) at each visit</li> <li>• Consider collecting the Modified Harris Hip Score (mHHS) or Hip Outcome Score (HOS) (ADL and Sports subscales) at 1st visit, monthly, and discharge</li> </ul>   |
| <b>Criteria to Discharge Assistive Device</b>  | <ul style="list-style-type: none"> <li>• Normalized gait with no increase in pain</li> <li>• SLS for at least 10 seconds without pain or pelvic/trunk compensation</li> <li>• 1x10 prone hip extension and hip abduction test</li> <li>• Full progression of crutches requires MD clearance to progress based on X-ray evidence of boney stability</li> </ul>  |
| <b>Criteria to Initiate Plyometric Program</b> | <ul style="list-style-type: none"> <li>• Full, functional, pain free ROM</li> <li>• 10 forward and lateral step downs from 8" step with proper mechanics</li> <li>• Squat &gt;150% body weight (barbell squat or leg press)</li> <li>• &gt;80% quadriceps, hamstring (isokinetic testing if available), and hip strength compared to uninvolved leg</li> </ul>   |
| <b>Criteria to Initiate Running Program</b>    | <ul style="list-style-type: none"> <li>• Full, functional, pain-free ROM</li> <li>• &gt; 80% quadriceps, hamstring (isokinetic testing if available), and hip strength compared to uninvolved leg</li> <li>• Squat &gt;150% BW (barbell squat or leg press)</li> <li>• 10 forward and lateral step downs from 8" step with proper mechanics</li> <li>• Hop and hold with proper mechanics (uninvolved → involved)</li> <li>• Ability to tolerate approximately 335 plyometric foot contacts (equivalent to nearly ½ mile) without reactive pain</li> <li>• No gross visual asymmetry with treadmill/over ground running</li> </ul>                         |
| <b>Criteria for Return to Sport</b>            | <ul style="list-style-type: none"> <li>• Functional testing:             <ul style="list-style-type: none"> <li>◦ &gt;90% Limb Symmetry Index (LSI) with hop testing</li> </ul> </li> <li>• Isokinetic testing (or handheld dynamometer)             <ul style="list-style-type: none"> <li>◦ &gt;90% strength LSI at 60°/sec, 180°/sec, and 300°/sec testing</li> <li>◦ Hamstring to quadriceps strength ratio of 55-65% bilaterally</li> </ul> </li> <li>• Strength: &gt;90% body weight with SL leg press</li> <li>• Functional Performance: to date, no return-to-sport criteria have been tested and published for patients undergoing PAO</li> </ul> |



- Patients participating in sports activities should complete a number of sport specific tasks demonstrating symmetric, pain free loading on affected LE and reporting confidence in limb with performance prior to clearance for return to sport.
- PROs: Score  $\geq$  90%
- No increase in symptoms with sport-specific progression or testing
- Physician clearance

## Phase I: Early Post-Operative Protective Phase (0-4 weeks)

|   |  |
|---|--|
| <b>Goals</b>                            | <ul style="list-style-type: none"> <li>● Protect osteotomy sites</li> <li>● Control pain and edema</li> <li>● Ensure safe gait pattern with assistive devices</li> </ul>   |
| <b>Appointments</b>                     | <ul style="list-style-type: none"> <li>● Starting at 2 weeks</li> <li>● Will see Dr. Smith 2 weeks post operatively</li> <li>● PAO requires extensive rehabilitation and can often exhaust insurance approved PT visits. Consider decreasing initial visit frequency, emphasizing patient/family self- ROM assistance, postural modifications, and home program.</li> </ul>  |
| <b>Precautions</b>                      | <ul style="list-style-type: none"> <li>● Foot flat weight bearing &lt;25% for 4 weeks with assistive device. Pending clearance and xray stability, progressing weight bearing through 6 weeks. <ul style="list-style-type: none"> <li>○ Continue to normalize gait pattern; shortened stride length recommended to prevent stress on anterior hip structures</li> </ul> </li> <li>● ROM: <ul style="list-style-type: none"> <li>○ Avoid hip flexion &gt;90 degrees x6 weeks</li> <li>○ external rotation limited to 20 degrees with hip flexion at or below 90 degrees for 6 weeks</li> </ul> </li> <li>● Avoid long lever arm lower extremity exercises, especially in OKC <ul style="list-style-type: none"> <li>○ 4-way hip on plinth should not be performed in phases 1 and 2</li> </ul> </li> <li>● Avoid active hip flexion, even in short lever arm</li> <li>● Notify MD staff if significant ROM limitations, incisional concerns, or difficulty with pain management noted prior to 6 week appt</li> </ul> |
| <b>Therapeutic Exercises</b>            | <p>Suggested interventions:</p> <ul style="list-style-type: none"> <li>● Submaximal isometrics <ul style="list-style-type: none"> <li>○ Glute sets</li> <li>○ Quad sets</li> <li>○ Hip abd/add in hooklying</li> </ul> </li> <li>● Pain control – Vasopneumatic cold and compression</li> <li>● Circumduction PROM x6 minutes clockwise and counterclockwise</li> <li>● Gait Training – Ensure proper gait mechanics (FFWB)</li> </ul>   |
| <b>Criteria to Progress to Phase II</b> | <ul style="list-style-type: none"> <li>● Pain well controlled <ul style="list-style-type: none"> <li>○ Reactive pain is described as mild or rated 3/10 or less</li> </ul> </li> </ul>   |



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*Communicate early with the MD's and PA's with concerns, questions, and any pertinent updates needed prior to each follow up*

## Phase II: Weightbearing Progression Phase (4-6 weeks)

|  |  |
|--|--|
| <b>Goals</b>                             | <ul style="list-style-type: none"> <li>● Protect repair</li> <li>● Control pain and edema</li> <li>● Restore ROM</li> </ul>  |
| <b>Appointments</b>                      | <ul style="list-style-type: none"> <li>● Will see Dr. Ryan or Dr. Vasileff at 6 weeks</li> <li>● PAO requires extensive rehabilitation and can often exhaust insurance approved PT visits. Consider decreasing initial visit frequency, emphasizing patient/family self- ROM assistance, postural modifications, and home program.</li> </ul>  |
| <b>Precautions</b>                       | <ul style="list-style-type: none"> <li>● Progressive weightbearing with bilateral axillary crutches <ul style="list-style-type: none"> <li>○ Progression to full weightbearing may take up to 14 weeks</li> <li>○ *MD clearance for WBing progression; needing x-ray stability</li> </ul> </li> <li>● ROM: <ul style="list-style-type: none"> <li>○ Avoid OKC hip flexion &gt;90 degrees x6 weeks</li> <li>○ External rotation limited to 20 degrees while in hip flexion at 90 degrees for 6 weeks</li> </ul> </li> <li>● Avoid long lever arm lower extremity exercises, especially in OKC <ul style="list-style-type: none"> <li>○ 4-way hip on plinth should not be performed in phases 1 and 2</li> </ul> </li> </ul> |
| <b>Therapeutic Exercises</b>             | <p>Suggested interventions:</p> <ul style="list-style-type: none"> <li>● Weight shifts progressing time in static position pending weight bearing status</li> <li>● Pelvic tilts</li> <li>● SAQ</li> <li>● Quadruped cat-camel</li> <li>● Quadruped rock backs</li> <li>● Standing hip abduction</li> <li>● Hooklying hip flexor/core isometrics</li> <li>● Upright biking (at 6 weeks)</li> </ul>   |
| <b>Criteria to Progress to Phase III</b> | <ul style="list-style-type: none"> <li>● Pain well controlled (&lt;3/10) and minimal with PWB gait</li> <li>● Physician clearance with evidence of radiographic healing to begin WBAT</li> </ul>   |

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## Phase III: D/C Crutches to Pain free with ADLs (6-10 weeks)

|   |   |   |
|---|---|---|
| <b>Goals</b>                            | <ul style="list-style-type: none"> <li>● Protect repair</li> <li>● Control pain and edema</li> <li>● Promote normal proprioceptive and neuromotor control</li> <li>● Weightbearing progression and normalize gait</li> <li>● Avoid soft tissue and joint irritation</li> </ul>  |   |
| <b>Appointments</b>                     | <ul style="list-style-type: none"> <li>● Will see Dr. Ryan or Dr. Vasileff at 6 weeks</li> <li>● Frequency: Ok to start increasing frequency of appointments as necessary and pending insurance visit limitations</li> </ul>  |   |
| <b>Precautions</b>                      | <ul style="list-style-type: none"> <li>● Progressive weightbearing with bilateral axillary crutches               <ul style="list-style-type: none"> <li>○ Progression to full weightbearing may take up to 12-14 weeks</li> <li>○ *MD clearance for WBing progression; needing x-ray stability</li> </ul> </li> <li>● ROM:               <ul style="list-style-type: none"> <li>○ Increase active and passive ROM to tolerance</li> </ul> </li> <li>● Notify MD staff if ROM concerns, significant WB concerns, or pain management concerns present prior to 12-week visit</li> </ul>  |   |
| <b>Therapeutic Exercises</b>            | <p>Suggested interventions</p> <p><b>Early (6-8 weeks):</b></p> <ul style="list-style-type: none"> <li>● Cardio- progressive upright biking               <ul style="list-style-type: none"> <li>○ Ensure patient can bike for 30 minutes with no resistance and without symptoms before adding resistance</li> <li>○ Aqua walking</li> </ul> </li> <li>● Gait training</li> <li>● Weight shifts progressing time in static position</li> <li>● Long arc quad</li> <li>● Bridges</li> <li>● Open chain hip abduction, adduction, and extension</li> <li>● Prone hip extension</li> <li>● Hooklying butterfly</li> <li>● Physioball assisted hip flexion</li> <li>● Standing and prone TKE</li> <li>● Leg press- DL</li> <li>● Sit to stand progressing to squats</li> <li>● Clamshells with resistance and reverse clamshells</li> <li>● Quadruped hip extension, fire hydrants, donkey kicks</li> <li>● Tall kneeling chops/lifts/paloff press (emphasizing good stability in tall kneel position)</li> <li>● Modified side plank</li> </ul> | <p><b>Late (8-10 weeks):</b></p> <ul style="list-style-type: none"> <li>● Initiating hip flexor progressions – see progressions</li> <li>● Prone IR/ER isometrics to AROM</li> <li>● TRX DL squats</li> <li>● RDLs - DL progressing to SL</li> <li>● Half kneel progressions chops/lifts/paloff press</li> <li>● Single leg balance</li> <li>● Bird dog</li> <li>● Modified prone plank</li> <li>● Leg press- SL</li> <li>● Step up/down</li> </ul> |
| <b>Criteria to Progress to Phase IV</b> | <ul style="list-style-type: none"> <li>● Pain free ADLs</li> <li>● Normalized gait without Trendelenburg</li> <li>● Community ambulation without fatigue or symptoms</li> <li>● Single leg stance &gt; 30 seconds with good pelvic control</li> </ul>   |   |



## Phase IV: Isotonic Strengthening to Initiating Impact Activities (10-12 weeks)

|  |   |
|--|---|
| <b>Goals</b>                           | <ul style="list-style-type: none"> <li>● Avoid provocation of symptoms with progressions</li> <li>● Promote rotational stability</li> <li>● Correct abnormal/compensatory movement patterns with higher level strengthening activities</li> <li>● Normalize strength of hip musculature: hip extensors, hip abductors, hip adductors, hip external rotators, trunk musculature and endurance</li> </ul>   |
| <b>Appointments</b>                    | <ul style="list-style-type: none"> <li>● Will see Dr. Smith at 12 weeks</li> </ul>  |
| <b>Precautions</b>                     | <ul style="list-style-type: none"> <li>● Crutch weaning may progress into this timeframe, if so, continue interventions in previous phase until criteria are met.</li> <li>● May still have reactive soreness</li> </ul>  |
| <b>Therapeutic Exercises</b>           | <p>Suggested interventions:</p> <ul style="list-style-type: none"> <li>● Graded progressive strengthening (to tolerance)</li> <li>● Multi-directional hip and lower extremity strengthening program</li> <li>● Single leg RDLs</li> <li>● Lunges</li> <li>● Core stabilization program – multiple positions</li> <li>● Squats (including goblet, front and back squats)</li> <li>● Deadlifts (dumbbell, KB, and barbell)</li> <li>● Cardio             <ul style="list-style-type: none"> <li>○ Progressing upright bike as tolerated</li> <li>○ Aqua jogging</li> <li>○ Walking program</li> </ul> </li> </ul> |
| <b>Criteria to Progress to Phase V</b> | <ul style="list-style-type: none"> <li>● Bird dog isometric hold for 45 seconds</li> <li>● Forward and side plank for 45 seconds</li> <li>● Heel tap for 10 repetitions off 8” step with good neuromuscular control</li> <li>● Symmetrical and pain-free ROM to meet the demands of patient’s activities</li> <li>● Symmetrical squat to 90 degrees without discomfort</li> <li>● Walking 1 mile without increased pain</li> <li>● Symmetrical stair use (ascending/descending)</li> </ul>  |



## Phase V: Return to Full Impact/Running (12-16 weeks)

|   |   |
|---|---|
| <b>Goals</b>                            | <ul style="list-style-type: none"> <li>● Terminal stretches</li> <li>● Restoring non-impact cardiovascular fitness; increasing volume/intensity of aerobic activities</li> <li>● Progressing single to multiplanar movements requiring increased load accepting capabilities</li> </ul>   |
| <b>Therapeutic Exercises</b>            | <ul style="list-style-type: none"> <li>● Normalize hip musculature strength and endurance</li> <li>● Adductor strengthening             <ul style="list-style-type: none"> <li>○ Copenhagen adductor progression</li> </ul> </li> <li>● Progressive LE/core strengthening: slow to fast, simple to complex, stable to unstable, low to high force</li> <li>● Core stability tasks with emphasis on rotational and side-support tasks</li> <li>● Proprioception: vary surfaces, add perturbations, include variety of positions</li> </ul>   |
| <b>Criteria to Initiate Plyometrics</b> | <ul style="list-style-type: none"> <li>● Cardio             <ul style="list-style-type: none"> <li>○ Elliptical and stair climber – 12-16+ weeks</li> <li>○ Swimming- 16+ weeks</li> <li>○ Hiking – 14-16+ weeks</li> </ul> </li> <li>● Criteria to initiate plyometrics:             <ul style="list-style-type: none"> <li>○ Full, functional, pain-free ROM</li> <li>○ 10 forward and lateral step downs from 8” step with good lumbopelvic and knee control</li> <li>○ Squat 150% BW (barbell squat or leg press)</li> <li>○ &gt;80% quadriceps, hamstring, and hip strength compared to uninvolved leg- abductors, adductors, extensors, external rotators</li> </ul> </li> <li>● Partial weight bearing plyometrics on shuttle (DL → SL)</li> <li>● Low impact plyometrics -16+ weeks             <ul style="list-style-type: none"> <li>○ Forward hop and hold (uninvolved → involved)</li> <li>○ DL mini hops/place jumps</li> <li>○ Lateral hops → shuffles</li> </ul> </li> <li>● Proper take off/landing mechanics emphasized</li> </ul> |
| <b>Criteria to Progress to VI</b>       | <ul style="list-style-type: none"> <li>● Full, functional, pain-free ROM</li> <li>● 10 forward and lateral step downs from 8” step with good lumbopelvic and knee control</li> <li>● Squat 150% BW (barbell squat or leg press)</li> <li>● &gt;80% quadriceps, hamstring, and hip strength compared to uninvolved leg-abductors, adductors, extensors, external rotators</li> <li>● Tolerating DL and SL plyometrics prior to initiating power-focused or resisted, explosive training</li> </ul>   |



## Phase VI: Return to Running, Sports, Full Activity (16-24+ weeks)

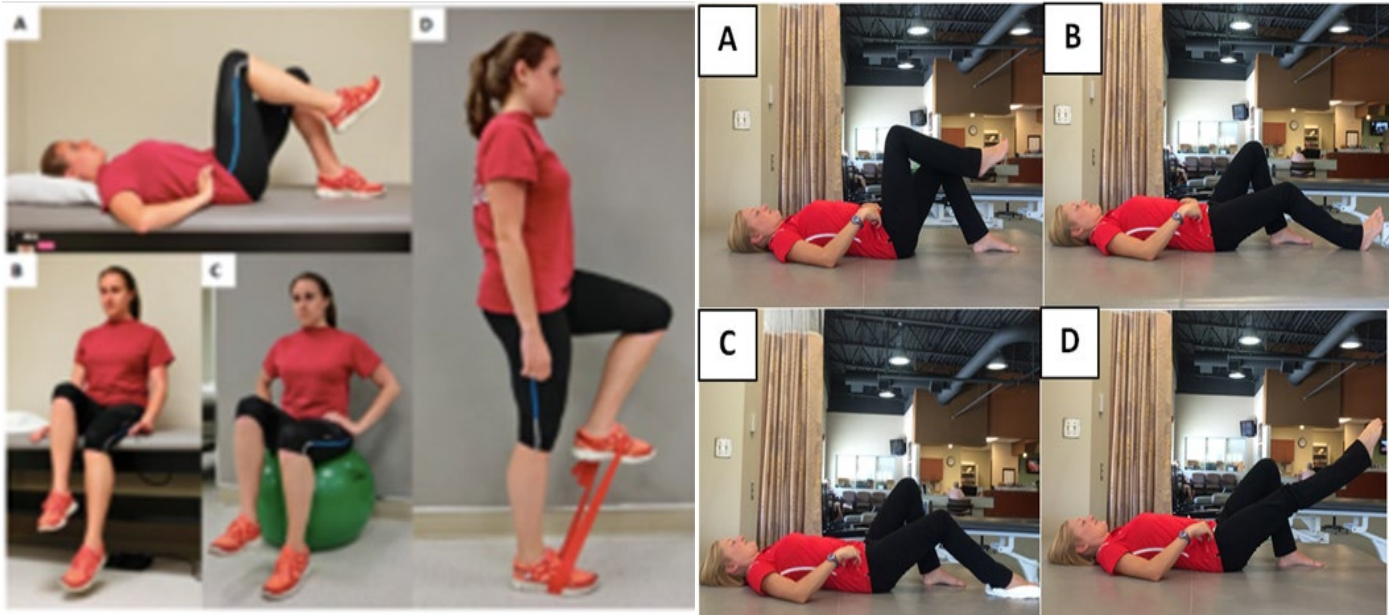
|  |  |
|--|--|
| <b>Goals</b>                                       | <ul style="list-style-type: none"> <li>● Progressing multi-directional and advanced plyometrics</li> <li>● Sport specific drills</li> <li>● Physician clearance for return to sport</li> <li>● Timeline for full return to sport likely to be 6+ months post-op</li> </ul>   |
| <b>Appointments</b>                                | <ul style="list-style-type: none"> <li>● Will see Dr. Ryan or Dr. Vasileff at 4-5 months</li> </ul>  |
| <b>Therapeutic Exercises</b>                       | <ul style="list-style-type: none"> <li>● Return to running program             <ul style="list-style-type: none"> <li>○ Perform prior to sport-specific drills</li> <li>○ Must be able to complete without reactive pain/inflammation</li> </ul> </li> <li>● Progressing to multidirectional running</li> <li>● Resisted forwards running</li> <li>● Initiating sport specific drills             <ul style="list-style-type: none"> <li>○ Progress from 50% to 75% to full speed/effort</li> <li>○ Progressing agility and plyometrics: forwards/backwards hopping, side shuffles, carioca, cutting, box drills, T drills, tuck jumps, DL/SL jump turns</li> </ul> </li> </ul>  |
| <b>Criteria to Initiate Running</b>                | <p>Return to running – 5+ months</p> <ul style="list-style-type: none"> <li>● Full, functional, pain-free ROM</li> <li>● &gt; 80% quadriceps, hamstring (isokinetic testing if available), and hip strength compared to uninvolved leg</li> <li>● Squat &gt;150% BW (barbell squat or leg press)</li> <li>● 10 forward and lateral step downs from 8” step with proper mechanics</li> <li>● Hop and hold with proper mechanics (uninvolved → involved)</li> <li>● Ability to tolerate approximately 335 plyometric foot contacts (equivalent to nearly ½ mile) without reactive pain</li> <li>● No gross visual asymmetry with treadmill/over ground running</li> </ul>  |
| <b>Criteria for Discharge and Return to Sports</b> | <ul style="list-style-type: none"> <li>● Physician clearance</li> <li>● Functional testing:             <ul style="list-style-type: none"> <li>○ &gt;90% Limb Symmetry Index (LSI) with hop testing</li> </ul> </li> <li>● Isokinetic testing (or handheld dynamometer)             <ul style="list-style-type: none"> <li>○ &gt;90% strength LSI at 60°/sec, 180°/sec, and 300°/sec testing</li> <li>○ Hamstring to quadriceps strength ratio of 55-65% bilaterally</li> </ul> </li> <li>● Strength: &gt;90% body weight with SL leg press</li> <li>● Functional Performance: to date, no return-to-sport criteria have been tested and published for patients undergoing PAO             <ul style="list-style-type: none"> <li>○ Patients participating in sports activities should complete a number of sport specific tasks demonstrating symmetric, pain free loading on affected LE and reporting confidence in limb with performance prior to clearance for return to sport.</li> </ul> </li> <li>● PROs: Score ≥ 90%</li> <li>● No increase in symptoms with sport-specific progression or testing</li> </ul> |





## Appendix A: Psoas Progression

Clinicians may choose either of the two iliopsoas strengthening progressions based on clinician/patient preference. **All exercises are performed with simultaneous abdominal drawing in maneuver and lumbar spine in neutral alignment.**



|  |   |
|--|---|
| A) Supine short-lever hip flexion  | A) Marching   |
| B) Seated hip flexion  | B) Walk Outs  |
| C) Seated hip flexion on Swiss ball  | C) Heel Slide (cue pt not to dig heel into table OR perform without touching the table)   |
| D) Standing hip flexion with theraband resistance  | D) Heel Slide with SLR (can raise leg from step/bolster if pain is present or if too difficult to lift from ground); raise leg only to height of opposite leg |
| Tyler TF, Fukunaga T, Gellert J. Rehabilitation of soft tissue injuries of the hip and pelvis. <i>Int J Sports Phys Ther.</i> 2014;9(6):785-797. | Dewitt, JD. Non-surgical/post-op management. Presented at: APTA's NEXT Conference & Exposition; June 5, 2015; National Harbor, MD.                            |

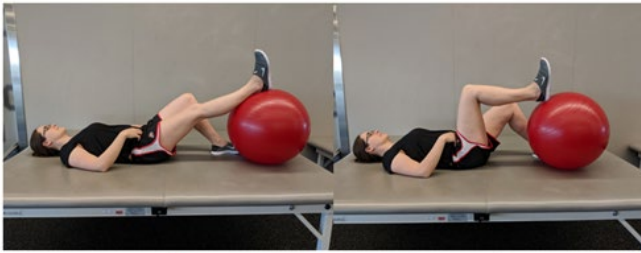


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## Appendix A: Psoas Progression (additional exercises)

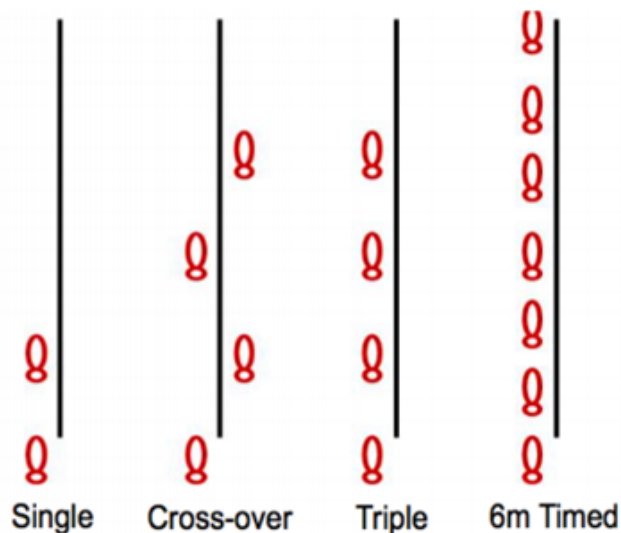


Hip flexor strengthening



## Appendix B: Single Leg Hop Series

- 1) **Single hop for distance:** Have the subject line their heel up with the zero mark of the tape measure, wearing athletic shoes. The subject then hops as far as he/she can, landing on the same push off leg, for at least 3 seconds. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on each leg. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index:  $\text{Involved limb distance} / \text{Uninvolved limb distance} \times 100\%$ .
- 2) **Cross-over hop for distance:** The subject lines their heel up with the zero mark of the tape measure and hops 3 times on one foot, crossing fully over the center line each time. Each subject should hop as far forward as he/she can on each hop, but only the total distance hopped is recorded. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on each leg. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index:  $\text{Involved limb distance} / \text{Uninvolved limb distance} \times 100\%$ .
- 3) **Triple hop for distance:** The subject lines their heel up with the zero mark of the tape measure and hops 3 times on one foot. Each subject should hop as far forward as he/she can on each hop, but only the total distance hopped is recorded. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on two legs. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index:  $\text{Involved limb distance} / \text{Uninvolved limb distance} \times 100\%$ .
- 4) **Timed 6-meter hop:** The subject lines their heel up at the zero mark of the tape measure and hops, on cue with the tester, as fast as they can the length of the 6-meter tape. The arms are allowed to move freely during the testing. Allow him/her to perform 2 practice hops on each leg. Then, have the subject perform 2 testing trial, recording each distance from the starting point to the back of the heel. Average the distanced hopped for each limb. The Limb Symmetry Index:  $\text{Involved limb time} / \text{Uninvolved limb time} \times 100\%$ .

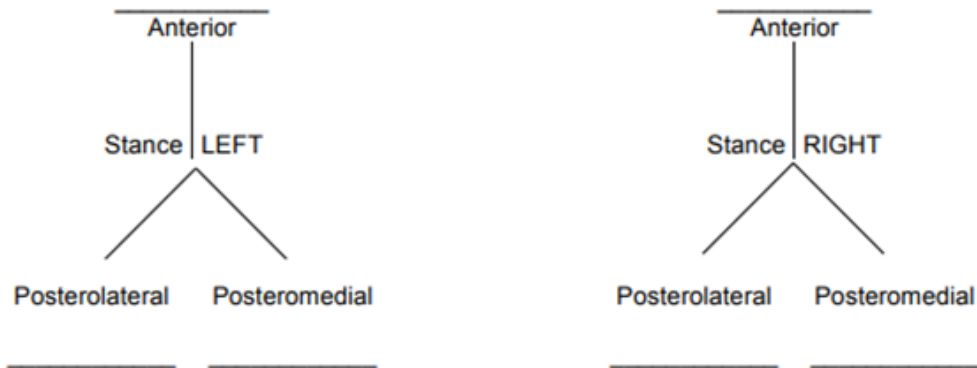


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## Appendix C: Y Balance



|                | Left | Right | Difference |
|----------------|------|-------|------------|
| Anterior       |      |       |            |
| Posteromedial  |      |       |            |
| Posterolateral |      |       |            |

*Difference should be less than 4 cm for return to sport and preparticipation screening.*

$$\text{Composite Score} = \frac{(\text{Anterior} + \text{Posteromedial} + \text{Posterolateral})}{(3 \times \text{Limb Length})} \times 100$$

|       |  |
|-------|--|
| Right |  |
| Left  |  |



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## Appendix D: Copenhagen Adductor Strengthening Progression

Start with Level 1 and then gradually progress to Level 3

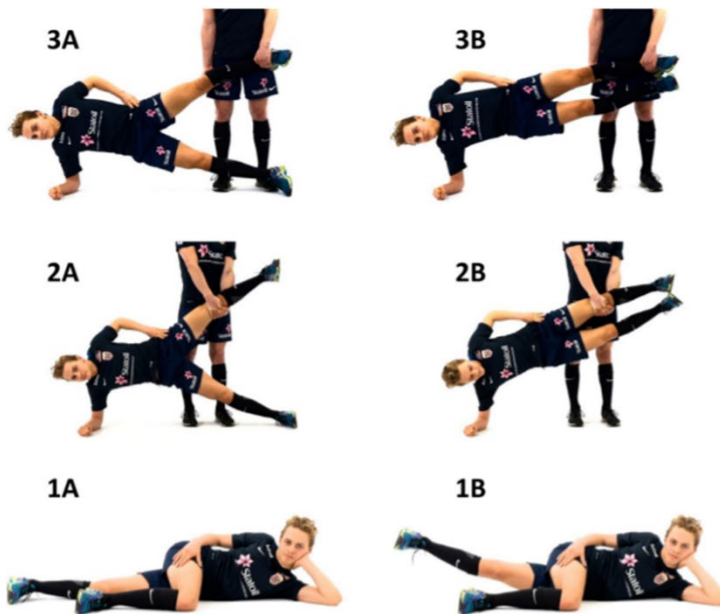


Figure 1 (A) Starting/ending position and (B) mid position for the different levels of the Adductor Strengthening Programme.

Haroy J, Clarsen B, Guldahl Wiger E, et al. The adductor strengthening programme prevents groin problems among male football players: a cluster-randomised controlled trial. *Br J Sports Med.* 2019;53:145-152.

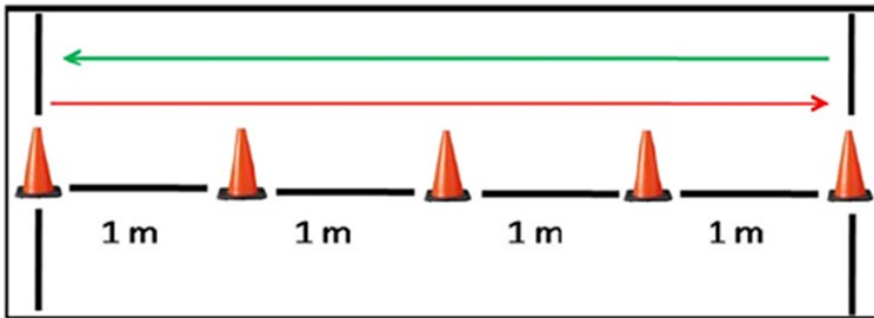


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## Appendix E: Edgren Side Step Test

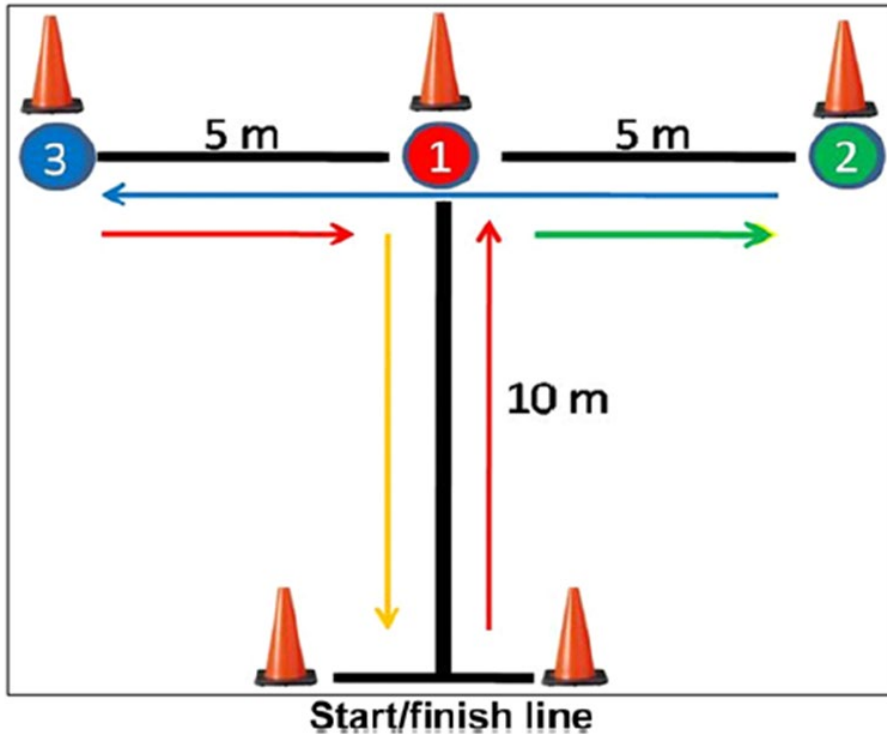


**Figure 1.**  
Edgren Side Step Test.

- Begin with 5 cones spaced in 1 m increments
- Start standing at far left cone
- On “go” command, participant sidesteps to the right until his right foot touches or crosses the outside cone or tape mark
- Participant then sidesteps left until his left foot has touched or crossed the left outside cone
- Continue sidestepping back and forth as rapidly as possible for 10 seconds
- Participant is given 1 point per completion of each 1m increment marked by a cone. If the far end lines were not reached these points were not awarded. Subject given a score of 0 if he failed to keep his trunk and feet pointed forward at all times, crossed his legs, or did not complete the course successfully

Raya MA, Gailey RS, Gaunard IA, et al. Comparison of three agility tests with male servicemembers: Edgren Side Step Test, T-Test, and Illinois Agility Test. *JRRD*. 2013;50(7):951-960.

## Appendix F: T-Test

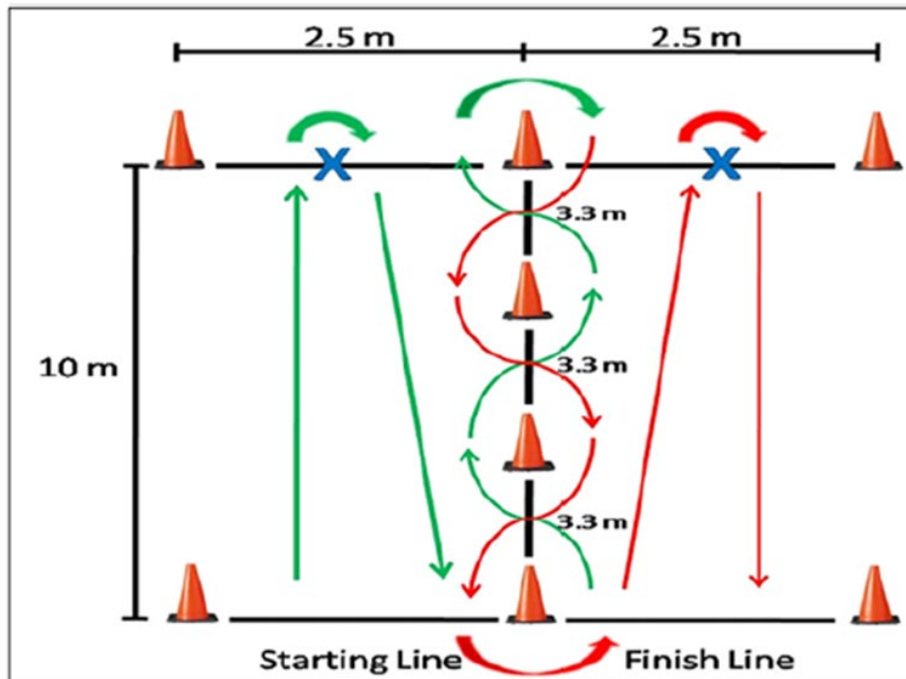


**Figure 2.**  
T-Test.

- On the “go” command, participant runs as quickly as possible forward to the center cone
- Participant then sidesteps to the right 5 m to the right cone
- Participant then sidesteps to the left 10 m to the far left cone
- Participant then sidesteps to the right 5 m back to the center cone
- Participant runs backwards as quickly as possible to cross the finish line
- Can also perform starting with the sidesteps to the left first

Raya MA, Gailey RS, Gaunard IA, et al. Comparison of three agility tests with male servicemembers: Edgren Side Step Test, T-Test, and Illinois Agility Test. *JRRD*. 2013;50(7):951-960.

## Appendix G: Illinois Agility Test



**Figure 3.**  
Illinois Agility Test.

- Participant begins test lying prone on the floor behind the starting line with his arms at his side and his head turned to the side or facing forward
- On the “go” command, the participant ascends to his feet and runs as quickly as possible to the first tape mark. Participant is required to touch or cross the tape mark with their foot
- Participant turns around and moves back to first center cone, where he weaves up and back through the four center cones
- Participant runs as quickly as possible to the second tape mark on the far line, where required to touch or cross the end-line tape marks with their foot
- Participant then turns around and runs as quickly as possible across the finish line
- Test disqualified if participant failed to run the course as instructed, failed to reach the end lines, failed to complete the course, or moved any cones

Raya MA, Gailey RS, Gaunard IA, et al. Comparison of three agility tests with male servicemembers: Edgren Side Step Test, T-Test, and Illinois Agility Test. *JRRD*. 2013;50(7):951-960.



Appendix H: Modified Illinois Agility Test (performed in both directions):

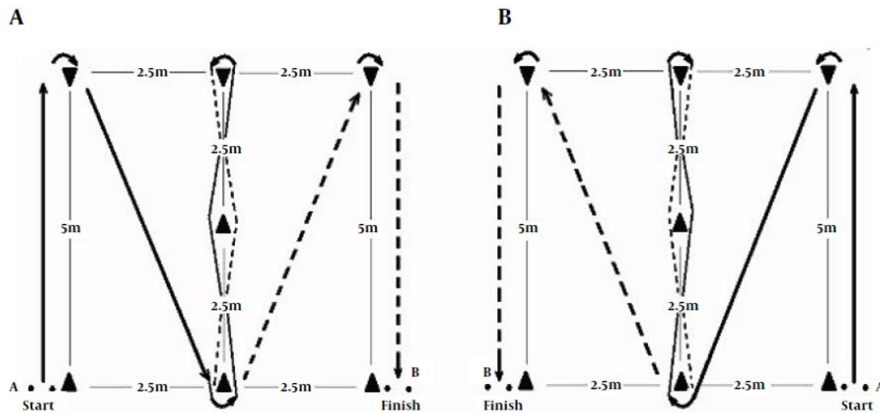


Figure 1.A, Diagram of the modified illinois change of direction test (MICODT); B, the inverted modified illinois change of direction test (IMICODT).

Rouissi M, Chtara M, Berriri A, et al. Asymmetry of the modified Illinois change of direction test impacts young elite soccer player's performance. *Asian J Sports Med.* 2016;7(2):e33598.



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**Completion date:** August 2022

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Raya MA, Gailey RS, Gaunard IA, et al. Comparison of three agility tests with male servicemembers: Edgren Side Step Test, T-Test, and Illinois Agility Test. *JRRD.* 2013;50(7):951-960.

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