

Original Research

Evaluating Functional Performance Tests in those with Non-arthritic Intra-articular Hip Pain: An International Consensus Statement

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Background

Non-arthritic intra-articular hip pain, caused by various pathologies, leads to impairments in range of motion, strength, balance, and neuromuscular control. Although functional performance tests offer valuable insights in evaluating these patients, no clear consensus exists regarding the optimal tests for this patient population.

Purpose

This study aimed to establish expert consensus on the application and selection of functional performance tests in individuals presenting with non-arthritic intra-articular hip pain.

Study Design

A modified Delphi technique was used with fourteen physical therapy experts, all members of the International Society for Hip Arthroscopy (ISHA). The panelists participated in three rounds of questions and related discussions to reach full consensus on the application and selection of functional performance tests.

Results

The panel agreed that functional performance tests should be utilized at initial evaluation, re-evaluations, and discharge, as well as criterion for assessing readiness for returning to sports. Tests should be as part of a multimodal assessment of neuromuscular control, strength, range of motion, and balance, applied in a graded fashion depending on the patient's characteristics. Clinicians should select functional performance tests with objective scoring criteria and prioritize the use of tests with supporting psychometric evidence. A list of recommended functional performance tests with varying intensity levels is provided. Low-intensity functional performance tests encompass controlled speed in a single plane with no impact. Medium-intensity functional performance tests involve controlled speed in multiple planes with low impact. High-intensity functional performance tests include higher speeds in multiple planes with higher impact and agility requirements. Sport-specific movement tests should mimic the patient's particular activity or sport.

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Conclusion

This international consensus statement provides recommendations for clinicians regarding selection and utilization of functional performance tests for those with non-arthritic intra-articular hip pain. These recommendations will encourage greater consistency and standardization among clinicians during a physical therapy assessment.

INTRODUCTION

Non-arthritic intra-articular hip pain can result from multiple pathologies including femoroacetabular impingement syndrome (FAIS), acetabular dysplasia, and/or capsular/ligamentous laxity.¹⁻³ These pathologies may lead to chondrolabral damage with associated pain, abnormal hip range of motion (ROM), decreased hip and lumbopelvic strength, and impaired neuromuscular control.^{1,3,4} As a result, individuals with non-arthritic intra-articular hip pain report decreased function and quality of life.¹ During an examination, functional tests are utilized to compliment patient reported outcome measures (PROMs) and assessments of strength and ROM.⁵⁻⁸ While a large number of functional performance tests have been proposed for the lower extremity,⁸⁻²¹ there is currently no agreement on which functional performance tests are optimal for use in individuals presenting with non-arthritic intra-articular hip pain.

Functional performance testing may allow for a simultaneous assessment of muscle flexibility, ROM, strength, balance, and neuromuscular control.²²⁻²⁴ These tests may provide clinicians with valuable information regarding the impact of the impairments and allow for assessing patient progress over the course of treatment. However, there is a lack of high-quality evidence and consensus supporting the use of specific functional performance tests during a physical therapy assessment of an individual presenting with non-arthritic intra-articular hip pain.

The purpose of this modified Delphi study was to present an international consensus statement that provides clinicians guidance regarding the use of functional performance tests in individuals presenting with non-arthritic intra-articular hip pain. It was hypothesized that consensus could be achieved on when to utilize functional performance tests, how to determine which functional performance tests should be implemented, and which functional performance tests may be most useful for an individual presenting with non-arthritic intra-articular hip pain.

METHODS

STUDY PARTICIPANTS

Panelists were identified as experts in physical therapy management of non-arthritic intra-articular hip pain by the senior author from the physiotherapy section of International Society for Hip Preservation (ISHA) membership. Panelists were chosen to represent five continents with representation from Asia, Australia, Europe, North America, and South America. Of the 14 identified individuals, 100% agreed to participate in the current study. The panelists were all specialists in sports/orthopedic physiotherapy and represented five countries with an average of 25

years (range: 9-40) experience. A summary of the panelist's attributes can be found in [Table 1](#).

STUDY DESIGN

This study utilized a modified Delphi technique to establish group consensus on use of functional performance tests for individuals with non-arthritic intra-articular hip pain.^{25, 26} Methods for the current study are similar to those described in Disantis et al.²⁷ Briefly, a list of relevant questions regarding the use of functional performance tests was determined and consensus was reached over three survey rounds. During round one, panelists were presented with list of potential topics via email. The senior author collected and organized all of the feedback to create an updated topic list. The second round included a face to face meeting with all the panelists where the updated topic list was presented with specific questions and responses being generated by the group. In the third and final round, the final question list and responses were emailed to all to panelists approval. A priori, consensus was defined as being $\geq 80\%$.

RESULTS

After the first two rounds the panelists agreed (14/14) that the following questions needed to be answered:

1. At what time points do you utilize functional performance tests in an individual presenting with non-arthritic intra-articular hip pain?
2. How and why do you determine which functional performance tests should be utilized?
3. Which functional performance tests are most useful for an individual presenting with non-arthritic intra-articular hip pain?

A consensus statement to each question was achieved by 14/14 panelists after the third round.

DISCUSSION

At what time points do you utilize functional performance tests in an individual presenting with non-arthritic intra-articular hip pain?

CONSENSUS STATEMENT

Physical therapists should utilize functional performance tests during the initial evaluation, subsequent re-evaluations, and discharge. Functional performance tests should also be utilized as criteria during return to sport testing in individuals presenting with non-arthritic intra-articular hip pain.

Table 1. A Summary of Panelist Attributes

Name	Year of experience	No. of hip-specific consultations per week	Academic post	Actively involved in research
Amir Takla	25	40	Yes	Yes
Ashley Campbell	12	30	Yes	Yes
Ashley Disantis	9	30	No	Yes
David Kohlrieser	15	35	No	Yes
Keelan Enseki	21	10	Yes	Yes
Liran Lifshitz	28	30	No	Yes
Louise Grant	30	50	No	Yes
Mario Bizzini	35	6	Yes	Yes
Mike Voight	40	10	Yes	Yes
Mark Ryan	30	20	No	Yes
RobRoy Martin	32	NA	Yes	Yes
Ryan McGovern	13	N/A	No	Yes
Timothy Tyler	35	11	No	Yes
Yael Steinfeld	25	30	Yes	Yes

Currently, there is a paucity of high-quality literature supporting the utilization of functional performance tests in individuals with non-arthritic intra-articular hip pain. The Academy of Orthopedic Physical Therapy clinical practice guidelines (CPG) recommend using functional performance tests during examination to identify activity and participation limitations in those with musculoskeletal conditions, including non-arthritic hip pain.^{1,28-34} Based on limited evidence, the CPG recommendations include evaluation of sitting, ambulation on level surfaces, stair negotiation, and sit-to stand performance.¹ However, these activities do not represent the full spectrum of functional activity. Specifically, these tests do not assess single leg control or sport specific activities, which are common pre-injury functional demands of this patient population.

Returning to sport is a common goal of individuals with non-arthritic intra-articular hip pain. Criteria to determine when an individual is ready to return to sport remains difficult. Determining readiness to return to sport should not be based solely on strength and ROM impairments.³⁵⁻³⁸ Measures of pain, strength, and ROM should be complemented with functional performance tests to help identify when individuals with non-arthritic intra-articular hip pain are ready to return to pre-injury activity.³⁹

How and why do you determine which functional performance tests should be utilized?

CONSENSUS STATEMENT

Physical therapists should utilize functional performance tests as part of a multimodal assessment of neuromuscular control, strength, and ROM. They should be progressed in a graded fashion, depending on the patient's identified impairments, level of irritability, individual characteristics, and individual goals.

Functional performance tests are a valuable tool for simultaneously evaluating strength, ROM, balance, and neuromuscular control,¹ and an essential component of physical therapy evaluations. In individuals with non-arthritic intra-articular hip pain, studies have specifically supported functional performance tests as assessments of muscle strength,⁴⁰⁻⁴² ROM,^{43,44} balance,⁴⁴⁻⁴⁸ and neuromuscular control.^{3,16,49} The specific functional performance tests utilized by the clinician should be dependent on current level of activity, irritability of the hip joint, and individual patient goals.

Another important consideration when selecting appropriate functional performance tests are their associated psychometric properties, including reliability, validity, and responsiveness. Reliability refers to the consistency of the test over time, while validity refers to the ability of the test to measure what it intends to measure. Responsiveness refers to the ability to identify expected clinical changes over time.^{50,51} Selecting functional performance tests with psychometric evidence may allow for interpretation of patients' improvement over time.

Which functional performance tests are most useful for an individual presenting with non-arthritic intra-articular hip pain?

CONSENSUS STATEMENT

Physical therapists should determine functional performance tests that challenge lumbopelvic and lower extremity neuromuscular control. Clinicians should choose functional performance tests based on intensity with low, medium, high, and sport specific tests that challenge limb support, speed, ROM, multiplanar control, and impact loading.

The panel recommends separating functional performance tests by level of intensity and classifying tests into

Table 2. Examples of Functional Performance Tests

Intensity	Criteria	Examples of Functional Performance Tests
Low	Minimal/controlled speed	Sit to Stand Test
	Single plane	Timed Single-Leg Stance Test
	No impact	Pain Free Double Leg Squat
	Double leg support with movement or single leg static	
Medium	Controlled speed	Y-Balance and SEBT
	Low impact	The Timed Stairs Ascent Test
	Limited/ Controlled ROM	Timed Walking Test
		Deep Squat Test
High		Single Leg Squat and Step-Down Test
	Fast speed	Hop Lunge Test
	Multi planar	Medial/ lateral triple hop
	High impact	Modified Agility T-test
Sport Specific Activity	3-4 clinician-selected sport specific activities	

categories of low, medium, high, and sport specific. Low intensity functional performance tests challenge neuromuscular control in a single plane, with no impact, and utilize a controlled speed. Specifically, low intensity tests should include single leg static tasks and those with double leg support and controlled ROM. Medium intensity functional performance tests should challenge neuromuscular control with multiplanar low impact movements at a controlled speed in a pain free ROM. High intensity functional performance tests progress to multiplanar, high-speed tests that incorporate greater impact and agility. Tests during this phase should mimic the activity or sport related goals of the patient. A summary of panelist recommend actions can be found in [Table 2](#).

In addition to providing criteria to define low, medium, high, and sport specific functional performance tests, the panelists agreed upon examples of specific tests for each level of intensity. These example tests and available psychometric evidence are provided below. Note the function performance tests listed in [Table 2](#) are meant to serve as example tests that meet the criteria at each intensity. Other tests that meet each criteria may be selected at a clinician's discretion.

LOW INTENSITY FUNCTIONAL PERFORMANCE TESTS

SIT TO STAND TEST

The Sit to Stand Test (STS) is performed by having the individual standing up and sitting down five times as quickly as possible while keeping the arms crossed over the chest.⁵² Individuals with FAIS and acetabular dysplasia have been shown to demonstrate poor performance on sit-to-stand tests compared to asymptomatic controls.^{52,53} Deficits on the STS test are also strongly associated with scores on the Patient-Reported Outcomes Measurement System (PROMIS), Hip Disability and Osteoarthritis Outcome Score (HOOS), International Hip Outcome Tool (iHOT-33), and Modified Harris Hip Score (mHHS).⁵³ The psychometric properties of the STS test in individuals with hip dysplasia

have also been explored, with Scott et al.⁵² reporting excellent inter-rater (MDC=0.36 seconds) and intra-rater reliability (MDC=4.71 seconds).

TIMED SINGLE-LEG STANCE TEST

The Timed Single-Leg Stance Test requires individuals to place their hands on their hips and stand on one leg for a duration of up to 30 seconds.⁵⁴ In individuals with FAIS, hip abductor strength has been shown to be reduced in those who perform the timed single-leg stance test with poor pelvic control compared to those who performed the activity with good pelvic control.⁴⁰ Additionally, those who perform poorly also scored lower on the Hip Outcome Score-Activities of Daily Living (HOS-ADL) subscale.⁴⁰ The timed single-leg stance test demonstrated good inter-rater and intra-rater reliability in individuals presenting with hip osteoarthritis and FAIS.^{40,54}

MEDIUM INTENSITY FUNCTIONAL PERFORMANCE TESTS

STAR EXCURSION BALANCE TEST AND Y-BALANCE TEST

The SEBT requires subjects to maintain a single-leg stance on the test leg while reaching the opposite leg in eight directions. The star excursion balance test (SEBT) and the Y-Balance test (YBT) are utilized to assess dynamic control of the lower extremity.⁴⁵ Individuals with FAIS demonstrate lower reach distances in the posteromedial and posterolateral directions of the SEBT on the symptomatic lower extremity when compared the asymptomatic lower extremity.⁴⁶ Additionally, reach distance in the posteromedial and posterolateral direction highly correlate with Hip and Groin Outcome Score (HAGOS) symptom and pain intensity subscale scores.⁴⁶ Similarly, Palsson et al.⁴⁷ found patients with hip-related pain demonstrate decreased reach distance on the SEBT in the anterior, posteromedial, and posterolateral directions compared to healthy controls. The YBT was found to have high intra-rater reliability in all three directions in individuals with non-arthritis hip re-

lated groin pain.⁴⁶ Furthermore, hip strength as well as hip internal rotation and flexion ROM contributed to reach distance in all directions on the YBT.^{44,48}

SINGLE LEG SQUAT TEST AND STEP-DOWN TEST

The single-leg squat and step-down tests assess an individual's ability to squat and step down on one leg, respectively, with the rater monitoring for lower extremity deviations.¹⁶ The single leg squat test (SLST) and step-down test (SDT) are utilized to assess single leg lumbopelvic and lower extremity neuromuscular control. A literature review by McGovern et al.³ found moderate-to-excellent inter-rater reliability for both tests in assessing neuromuscular control for the trunk, pelvis, hip and knee. Crossley et al.⁴² reported individuals who passed the SLST and SDT exhibited strong hip abduction strength and earlier onset timing activation than those who fail the SLST and SDT. Furthermore, a study by McGovern et al.¹⁶ found the tests to be reliable and valid, as there were significant differences in pain VAS, HOS-ADL, and HOS-sport scores between those that passed and failed the SLST and SDT on initial assessment. Also, patients with non-arthritis hip pain who demonstrate improvements on the SLST and SDT after undergoing a rehabilitation program demonstrated lower pain VAS scores and higher scores on the HOS-ADL and HOS-Sport than those who did not improve on the SLST and SDT.⁴⁹

THE TIMED STAIRS ASCENT TEST

The Timed Stairs Ascent Test (TSA) measures the time for the individual to ascend 12 of stairs as quickly as possible.⁵² Individuals with FAIS and acetabular dysplasia demonstrated poorer performance on the TSA test compared to asymptomatic controls.^{52,53} Performance on the TSA test has been shown to have a strong correlation with the PROMIS, HOOS, iHOT-33, and mHSS and a moderate correlation with the iHOT-12.^{52,53} Scott et al.⁵² found excellent inter-rater reliability with MDC value of 0.87 seconds and intra-rater reliability with MDC value of 1.81 seconds for the TSA test, when used to assess individuals with acetabular dysplasia.

TIMED WALKING TEST

In the Timed Walking Test, individuals walk a 20-meter distance at a comfortable speed, and the time taken to cover the central 10 meters is recorded.^{52,53} Individuals with FAIS and acetabular dysplasia performed worse speed on the timed walking test compared to asymptomatic controls.^{52,53} In individuals with acetabular dysplasia, Scott et al.⁵² found excellent inter-rater reliability (MDC=0.09 m/s) and intra-rater reliability (MDC=0.35 m/s)

DEEP SQUAT TEST

Deep squat test requires individual to squat down as deeply as possible. The deep squat test is a measure of both lumbopelvic and lower extremity neuromuscular control. Ayeni et al.⁵⁵ found a sensitivity and specificity of 75% and 41%,

respectively, in identifying individuals with a CAM-type deformity using the deep squat test. Those with FAIS display altered biomechanics during the deep squat test, including reduced hip internal rotation ROM, a posterior pelvic tilt, and hip extensor muscle activity during decent.⁵⁶ Additionally, individuals with FAIS demonstrated reduced squat depth and altered lumbopelvic kinematics compared to healthy controls.⁵⁷⁻⁵⁹

HIGH LEVEL FUNCTIONAL PERFORMANCE TESTS

HOP TESTS

The hop lunge test assesses lower body strength, power, and control by requiring participants to hop forward and lunge deeply. The hop lunge test has demonstrated good inter and intra-rater reliability when used to assess individuals with FAIS, based on visual assessment.⁴⁰ Poor performance on this test has been associated with reduced hip abductor strength in patients with FAIS.⁴⁰ The medial and lateral triple hop tests evaluate the individual's ability to consecutively perform three hops on a single leg, with the total distance covered being recorded. A systematic review has shown good reliability of hop tests including the medial triple hop and lateral triple hop tests performed on dancers with FAI.⁸ Another study found dancers with FAI perform worse during medial and lateral hop triple tests compared to healthy dancers.⁶⁰ Additionally, healthy women with weak hip muscles have been found to have altered coordination between the hip, knee, trunk and pelvis during hopping when compared to individuals with strong hip muscles.⁴¹

MODIFIED AGILITY T-TEST

The modified agility T-test assesses an individual's capacity for rapid change in direction and may be an important assessment tool for those returning to sports requiring agility, quickness, and speed.⁶¹ Males with FAIS demonstrated significantly lower speeds during the modified agility T-test compared to healthy controls.⁶² Sassi et al.⁶³ found excellent test-retest reliability of the modified agility T-test in healthy athletes.

SPORT SPECIFIC TESTING

Sport specific testing should be individualized to the patient's goals and required demands of their chosen sport(s). Specifically, sport specific testing should be tailored to mimic movements that pertain to the patient's activity or sport.⁶⁴ Sport-specific retraining represents a crucial final phase in the rehabilitation process to determine an athlete's readiness for return to sport.⁶⁴⁻⁶⁶ Sport specific tests can have a positive impact on the athlete's psychological readiness for return to their sport. Psychological readiness has become increasingly recognized as an important component of optimal performance and timely return to pre-injury performance levels.^{37,67} Jochimsen et al.² found low self-efficacy and high kinesiophobia were associated with increased pain and decreased function in individuals with

FAIS. The panel in this current study recommended utilization of 3-4 sport specific activities coupled with a PROM to assess fear of physical activity and fear avoidance, such as the Tampa Scale of Kinesiophobia and Hip-Return to Sport after Injury Scale, when assessing for readiness for return to sport.^{68,69}

LIMITATIONS

There are several limitations to this study. First, there is a paucity of high-quality literature supporting the use of functional performance tests in individuals with non-arthritic intra-articular hip pain. Initial study questions may be biased as they were generated by the panel of selected experts. To minimize bias, the senior author selected an international panel of experts in the management of these disorders. This panel of experts may not encompass all international opinions.

CONCLUSION

This international consensus statement provides recommendations for clinicians regarding selection and utilization of functional performance tests for use in this population. These recommendations will encourage greater consistency and standardization among clinicians during

a physical therapy evaluation of an individual presenting with non-arthritic intra-articular hip pain. Further research is needed to validate the categorization of tests and offer psychometric evidence to allow better interpretation of test results in subjects with non-arthritic intraarticular hip pathology.

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CONFLICTS OF INTEREST

The authors certify that they have no affiliations with or financial involvement in any organization or entity with a direct financial interest in the subject matter or materials discussed in the article.

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