

Use of the Patellar-Pubic Percussion Test in the Diagnosis and Management of a Patient with a Non-Displaced Hip Fracture

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Abstract: This case report describes the diagnosis and subsequent medical and physical therapy management of a 68-year-old patient with an undiagnosed non-displaced hip fracture. Initial plain film radiographs and a computed tomography (CT) scan of the involved hip were both interpreted as negative. One of the findings on the physical examination included a positive patellar-pubic percussion test (PPPT). This finding in a female patient of this age raised the suspicion of an occult hip fracture and she was referred back to her primary care physician. Repeat radiographs revealed a non-displaced hip fracture and the patient was treated surgically. The PPPT is an easy-to-implement clinical examination tool that may be extremely useful in physical therapy practice to guide the decision-making process for patients with suspected hip fractures. The utilization of the PPPT by the treating physical therapist for the patient in this case report contributed to a timely diagnosis, potentially preventing the disabling sequelae associated with a displaced femoral fracture.

Key Words: Differential Diagnosis, Physical Therapy, Femoral Neck Fracture, Patellar-Pubic Percussion Test

The *Guide to Physical Therapist Practice*¹ described referral to another health care practitioner as one possible outcome of the physical therapist's examination. The literature has provided several such examples where patient referral by the physical therapist to a physician led to a more timely diagnosis of a variety of serious diseases and disorders. A number of these cases involved patients with hip pain who were subsequently diagnosed with a hip fracture²⁻⁵. For example, Gurney, Boissonnault, and Andrews³ described a patient referred to physical therapy for right hip pain with probable osteoarthritis. Radiographs taken prior to the initial physical therapy visit revealed mild degenerative joint disease with some osteophytosis and a normal femoral neck/shaft an-

gle. Patient presentation and examination led the therapist to suspect a diagnosis other than osteoarthritis. Subsequent magnetic resonance imaging (MRI) revealed a femoral neck and head stress fracture that was confirmed by bone scan.

Hip fractures can be difficult to diagnose and misdiagnosing an occult hip fracture is not unique to patients referred to physical therapy. Perron et al⁶ described a case of a 79-year-old female who presented at the emergency department after a fall onto her left side. Plain films were obtained and interpreted as negative. Three days after her fall she returned to her primary care physician complaining that her symptoms were worse. Again, plain films did not show any fracture; however, a bone scan showed significant uptake suggestive of a hip fracture. A subsequent MRI confirmed a femoral neck fracture. File et al⁷ discussed an 85-year-old woman with a traumatic right hip injury 12 hours prior to evaluation. Examination was negative for physical deformities or discrepancies, as were initial radiographs. At five days post-accident, she returned to the emergency department with progressively worse hip pain. Follow-up radiographs revealed a Garden type III fracture of her right femoral neck.

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In the United States, hip fractures have a yearly incidence of about 300,000^{6,8}. With the aging of the population, this incidence is expected to double or even triple by the year 2040⁶. Morbidity and mortality after a hip fracture are reported to be as high as 14–36% in the first year after injury^{6,8}. Table 1 provides signs and symptoms associated with femoral neck/head fractures^{2,4,5,9-12}. Most patients with hip fractures present with observable deformity and are definitively diagnosed with plain film radiographs⁶⁻⁸. However, in 2–10% of the patients presenting with a painful hip after trauma, initial radiographs may not show the occult fracture¹³. An occult fracture is defined as one that is suspected clinically but that is not seen on radiographic examination¹⁴. These patients may have a history of a relatively minor trauma, absence of observable deformities, and relatively normal range of motion⁷. Generally they will be able to ambulate; however, they will most likely have an antalgic gait pattern. Patients with an occult, non-displaced hip fracture are at risk for a displaced fracture that often leads to avascular necrosis and the need for surgical intervention. Once these complications arise, return to full pre-injury activity level is often not attainable. Timely diagnosis might minimize morbidity and mortality and prevent the progressive loss of function typically associated with a hip fracture^{6,8,13}.

File et al⁷ reported a positive patellar-pubic percussion test (PPPT) as an additional clinical examination sign helpful for the diagnosis of occult hip fractures. The purpose of this case report is to describe a patient with hip pain receiving care from a physical therapist and the influence that a positive finding on the PPPT had on the therapist's decision-making, culminating in the diagnosis of a non-displaced femoral fracture.

TABLE 1. Signs and symptoms associated with hip fracture^{2,4,5,9,10,14,18}.

Presenting patient signs and symptoms

- Groin pain
- Hip pain
- Thigh pain
- Buttock pain
- Abnormal hip range of motion
- Tenderness around the hip
- Antalgic gait

Absent or untested signs and symptoms

- Abnormal spine ROM
- Pain with straight leg raise
- Coxa vara (diagnosed by radiograph)
- Total hip or knee arthroplasty
- Night pain
- Positive patellar-pubic percussion test

History

A 68-year-old female was referred to physical therapy by her primary care physician for a right hip contusion secondary to falling eight days prior. The patient had tripped and fallen on a concrete floor, landing on her right hip. She was taken to the emergency room where plain radiographs of the hip were taken (two views including frontal pelvis) followed by a computed tomography (CT) scan (without contrast) of the right hip. Both tests were noted to be negative for fracture.

At the initial visit, the patient reported that her symptoms were unchanged from the day she fell. On initial examination, the patient's chief complaint was difficulty walking; pain in the groin, hip, thigh, and buttock region; and paraesthesiae down the posterolateral thigh and into the lateral right foot. She reported feeling like the leg was "jammed up in the joint." She also reported only minor bruising over her hip region since her fall. The current pain was constant, including at night, and the patient described it as aching, stabbing, steady, and throbbing. The patient rated her current pain as an 8 on a 0–10 Visual Analog Scale (VAS); she noted this was the best it had been since her injury. The test-retest reliability of the VAS has been established as sufficient for clinical measures (ICC = 0.97–0.99)^{15,16}. Lying down with her knees bent (hook-lying) or with a pillow under her knees alleviated her symptoms. Factors aggravating the pain included any prolonged position with standing more painful than sitting.

The Therapeutic Associates Outcome System (TAOS) functional index questionnaire was used to assess the patient's initial functional status (Table 2). Test-retest reliability for items of the TAOS ranged from moderate to sufficient for clinical measures (ICC = 0.69–0.96; mean ICC = 0.85)¹⁷. The patient was to choose the answer that best described her current status for a series of functional activities. She indicated the following problems for the stated functional domain:

- Recreation/sports: Inability to do any recreational activities.
- Squatting: Not able to squat due to symptoms.
- Sleeping: Significant difficulty with sleeping due to pain (3–5 hours per night).
- Stairs: Difficulty maneuvering stairs (only single step or stairs).
- Standing: Difficulty standing (for greater than 10 minutes).
- Walking: Difficulty walking without an assistive device.
- Work: Difficulty doing housework without an assistive device.
- Uneven ground: Difficulty walking on uneven ground even with an assistive device.
- Sitting: Difficulty sitting greater than a half hour.

TABLE 2. Copy of patient's initial visit Therapeutic Associates Outcomes System (TAOS) Functional Index page 1. Portland (OR): Therapeutic Associates, Inc., 1996 (Copyright Therapeutic Associates, Inc.).



LOWER EXTREMITY

NAME _____
 DATE _____ Initial Visit Discharge Visit

FUNCTIONAL INDEX

Choose the one answer in each section that best describes your condition.

WALKING

- Symptoms do not prevent me walking any distance.
- Symptoms prevent me walking more than 1 mile.
- Symptoms prevent me walking more than 1/2 mile.
- Symptoms prevent me walking more than 1/4 mile.
- I can only walk using a stick or crutches.
- I am in bed most of the time and have to crawl to the toilet.

WORK

- (Applies to work in home and outside)*
- I can do as much work as I want to.
 - I can only do my usual work, but no more.
 - I can do most of my usual work, but no more.
 - I cannot do my usual work.
 - I can hardly do any work at all (only light duty).
 - I cannot do any work at all.

PERSONAL CARE

- (Washing, Dressing, etc.)*
- I can manage all personal care without symptoms.
 - I can manage all personal care with some increased symptoms.
 - Personal care requires slow, concise movements due to increased symptoms.
 - I need help to manage some personal care.
 - I need help to manage all personal care.
 - I cannot manage any personal care.

SLEEPING

- I have no trouble sleeping.
- My sleep is mildly disturbed (less than 1 hr. sleepless).
- My sleep is mildly disturbed (1-2 hrs. sleepless).
- My sleep is moderately disturbed (2-3 hrs. sleepless).
- My sleep is greatly disturbed (3-5 hrs. sleepless).
- My sleep is completely disturbed (5-7 hrs. sleepless).

RECREATION/SPORTS

- (Indicate Sport if Appropriate _____)*
- I am able to engage in all my recreational/sports activities without increased symptoms.
 - I am able to engage in all my recreational/sports activities with some increased symptoms.
 - I am able to engage in most, but not all of my usual recreational/sports activities because of increased symptoms.
 - I am able to engage in a few of my usual recreational/sports activities because of my increased symptoms.
 - I can hardly do any recreational/sports activities because of increased symptoms.
 - I cannot do any recreational/sports activities at all.

STAIRS

- I can walk stairs comfortably without a rail.
- I can walk stairs comfortably, but with a crutch, cane, or rail.
- I can walk more than 1 flight of stairs, but with increased symptoms.
- I can walk less than 1 flight of stairs.
- I can manage only a single step or curb.
- I am unable to manage even a step or curb.

UNEVEN GROUND

- I can walk normally on uneven ground without loss of balance or using a cane or crutches.
- I can walk on uneven ground, but with loss of balance or with the use of a cane or crutches.
- I have to walk very carefully on uneven ground without using a cane or crutches.
- I have to walk very carefully on uneven ground even when using a cane or crutches.
- I have to walk very carefully on uneven ground and require physical assistance to manage it.
- I am unable to walk on uneven ground.

STANDING

- I can stand as long as I want without increased symptoms.
- I can stand as long as I want, but it gives me extra symptoms.
- Symptoms prevent me from standing for more than 1 hour.
- Symptoms prevent me from standing for more than 30 minutes.
- Symptoms prevent me from standing for more than 10 minutes.
- Symptoms prevent me from standing at all.

SQUATTING

- I can squat fully without the use of my arms for support.
- I can squat fully, but with symptoms or using my arms for support.
- I can squat 3/4 of my normal depth, but less than fully.
- I can squat 1/2 of my normal depth, but less than 3/4.
- I can squat 1/4 of my normal depth, but less than 1/2.
- I am unable to squat any distance due to symptoms.

SITTING

- I can sit in any chair as long as I like.
- I can only sit in my favorite chair as long as I like.
- My symptoms prevent me sitting more than 1 hour.
- My symptoms prevent me sitting more than 1/2 hour.
- My symptoms prevent me sitting more than 10 minutes.
- My symptoms prevent me from sitting at all.

* Lumbar questions adapted from Oswestry.

ACUITY

(Answer on initial visit.)
 How many days ago did onset/injury occur? 7 days

Please complete opposite side

- Personal care: Reduced speed with careful precision needed for personal care.

The patient's medical history included lumbar stenosis with a foraminotomy several years previous. At the time of the examination, the patient was still experiencing back pain and right leg weakness; she indicated this was why she fell. Surgical history also included a hysterectomy, lumpectomy, and cholecystectomy. The patient had a past history of smoking but had not smoked for 2 years. She reported high blood pressure, controlled with medication. Medication history also included analgesic medication for pain relief. She denied any further history of significant illnesses, recent surgeries, or hospitalization. She also denied any recent unexplained weight changes, fever, chills, bowel or bladder dysfunction, night sweats, nausea, and fatigue. The patient's goal was to improve her ability to perform activities of daily living, specifically driving and walking. She reported walking for exercise and stretching regularly prior to injury.

Physical Examination

The patient walked to the examination room using a standard walker with weight-bearing as tolerated on the right extremity. Her gait was antalgic with decreased stance time on the right lower extremity. The patient had difficulty transferring from stand to sit and needed moderate assistance with the transfer from sit to supine and supine to sit.

Examination of standing posture and formal goniometric testing of lower extremity active range of motion (AROM) was deferred due to the patient's report of a high level of pain. A limited visual assessment of her right hip AROM revealed approximately 85° of hip flexion, 5° of internal rotation, and 30° of external rotation (the latter two measurements with the hip in neutral); the patient reported an increase in symptoms at end-range for all motions. Passive overpressures at the hip were not completed on any motions because of the high level of pain at rest and with the AROM assessment. With the patient supine, isometric resisted testing revealed strong and painful hip adduction; right hip abduction, hip extension, and hip flexion were strong and painless.

Minimal yellow discoloration approximately 6 x 4 (cm) in area was noted somewhat distal to the greater trochanter. There was no swelling noted. The patient reported severe tenderness to palpation over the gluteus minimus muscle, mild tenderness over the ischial tuberosity, and no tenderness over the adductor insertion or the trochanteric bursa. All further testing was deferred due to the high level of pain.

Initial Diagnosis

Based on the examination findings, the patient fit into the *Guide to Physical Therapist Practice* preferred practice pattern 4E: Impaired joint mobility, motor function, muscle performance, and range of motion associated with localized inflammation¹. However, even at the time of this initial examination, the reported VAS pain score of 8; the patient's age, gender, and traumatic etiology of the current hip pain, pain that significantly worsened with walking; the absence of improvement since the injury, and the fact that the patient presented with 8 of the signs and symptoms associated with hip fracture (Table 1) caused the treating therapist concern with regard to the possible presence of an occult hip fracture. Decreasing the likelihood of this diagnosis was the absence of test findings for 5 of the commonly reported manifestations and the negative initial radiographs and CT. The patient's medical history suggested no red flags that would indicate systemic disease including cancer, infection, or progressive neurological condition that warranted immediate physician referral¹⁸. Based on this information, the decision was made to initiate the intervention plan and assess the patient's response to intervention.

Initial Intervention

Intervention during the initial visit included electrical stimulation and 20% pulsed ultrasound over the lateral hip, followed by pain-free active and passive range of motion. On the next visit, three days after the initial visit, the patient reported no significant change in symptoms or function. No additional examination components could be completed due to the continued high level of pain. The patient was seen for two more visits with the emphasis on pain control; interventions consisted of electrical stimulation with pulsed ultrasound, passive and active assisted hip ROM, and ice with interferential current. By the third visit, she had switched to using a single-point cane due to increased pain in her back from using the walker but no other changes in symptoms or function were noted.

Fortuitously on the weekend prior to the fifth visit, 19 days after the initial visit, the primary therapist attended a continuing education seminar where she was instructed in the performance and interpretation of the PPPT. During the patient's fifth visit then, a PPPT was performed and noted positive on the involved lower extremity. A second therapist was asked to complete the test without knowing the patient's history or the results of the PPPT done by the primary therapist. This second therapist also found the PPPT to be posi-

tive. This positive finding on the PPPT prompted the primary therapist to immediately contact the patient's primary care physician. The therapist spoke directly with the physician and explained the PPPT and its results and also discussed the statistics on undiagnosed hip fractures with initial imaging.

Subsequent Medical and Physical Therapy Management

The primary care physician saw the patient later that same day and ordered repeat plain film radiographs. These revealed a healing non-displaced right sub-capital neck fracture (Figure 1). The following day (20 days after her initial physical therapy visit), the patient had an open reduction and internal fixation done on the right hip.

The patient received physical therapy at home for one month after surgery and was then seen back at the original physical therapy clinic for continued outpatient treatment for 19 visits over 11 weeks; these visits consisted of lower extremity strengthening, range of motion, gait training, and functional exercise. She was discharged with the ability to squat, walk without an assistive device, and function independently with all activities of daily living at home.

Discussion

Currently, MRI is the only diagnostic imaging procedure that has been found to be 100% sensitive, meaning that a negative MRI can be used with absolute confidence to rule



Fig. 1. Radiograph showing a healing non-displaced right sub-capital neck fracture.

out a non-displaced hip fracture. However, an MRI is not always available or performed in the emergency department. Any additional method of improving the screening process for the presence of an occult non-displaced hip fracture would be a welcome addition to the physical therapist's clinical examination.

Osteophony or auscultatory percussion is the assessment of bone integrity by analyzing its vibrations through use of a stethoscope and bony prominence percussion¹¹. The pitch of the sound heard through the stethoscope represents the resonant frequency that is then compared to the contralateral structure being tested. A difference in pitch may signify bony interruption of the structure being tested. Osteophony has been historically demonstrated to be a useful adjunct in the physical examination of the shoulder. The olecranon-manubrium percussion sign has been shown reliable for assessing shoulder injuries, specifically dislocations and clavicular fractures¹². The use of osteophony has also

been described for the assessment of fractures of the femoral neck and hip¹¹. In 1977, there was mention in the medical literature of the historical evolution of the auscultatory percussion technique, which began with the use of a stethoscope in auscultating crepitation over a fracture site in 1824 by Lisfranc and continued through the 1840s to identify the diminution of sound conduction across fractured bones. Despite its documented long history, many current textbooks on clinical examination fail to mention auscultatory percussion techniques^{7, 11}.

The PPPT is an application of osteophony performed with the patient supine and the bell of the stethoscope placed on the pubic symphysis, held in place by the patient (Figure 2). The patient's legs are positioned symmetrically and extended while the clinician percusses each patella. The clinician stabilizes the patella, thereby making sure the leg being tested remains in the neutral position. The clinician compares the sounds from each leg for differences in pitch and loudness.



Fig. 2. Physical therapist performing the patellar-pubic percussion test.

In the case of normal bony structure, these sounds should be equal. If there is a bony disruption, the affected side will have a duller, more diminished sound as compared to the unaffected side. A patient who is noted to have an abnormal PPPT should be suspected of having bony pathology.

In a study with 41 patients, Adams and Yarnold¹² reported an interrater agreement of 90.2% for the PPPT ($P < 0.0001$). In 19 patients with radiological confirmation of fractures, interrater agreement was 84.2% ($P < 0.0001$). Validity analysis was restricted to those patients on whom the physicians agreed in scoring the PPPT. In these 37 patients, diagnostic accuracy was 89.2% ($P < 0.001$). In a study of 290 patients with post-traumatic hip pain, inability to ambulate due to pain, and negative radiographs, Tiru et al¹¹ found a sensitivity of 0.96 and a specificity of 0.86 for the PPPT in the diagnosis of femoral neck fractures.

The PPPT is a simple, easy-to-use clinical test. With a documented high specificity, a positive finding on the PPPT indicates that further diagnostic testing is warranted. Abnormal results are not specific to fractures and may reveal other musculoskeletal abnormalities that hinder the transmission of sound that results in a positive PPPT. These abnormalities may include but are not limited to joint effusion, bilateral

injury, non-traumatic lesions (i.e., cysts and tumors), and Paget's disease¹².

Conclusion

The key component of the physical examination of this patient leading to the diagnosis of an occult hip fracture was a positive finding on the PPPT. Physical therapists perform diagnostic tests because the test results should guide the decision as to whether intervention is appropriate and, if so, what intervention will be the most appropriate for that particular patient¹⁹. Occult hip fractures are common and place the patient at risk for significant morbidity and mortality. The PPPT is a simple, easy-to-use clinical test. With a documented high specificity, a positive finding on the PPPT indicates that further diagnostic testing is warranted.

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