



# Teaching Ergonomic Training Skills to Reduce the Fall Risk in an Elderly Patient - A Case Study

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## Case Report

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## Abstract

**Background:** Ergonomics is a study in the efficiency of movement. This can be an important tool when examining a patient to determine what a root cause of a patient's dysfunction is. And then, what can be done to resolve that dysfunction. Accepting a patient's medical diagnosis, age, or self-report as to what their problem is, may not be the best measure of a patient's loss of function. This is especially true when the clinician may be biased against a patient due to their advanced age.

**Case Description:** The following is a case report of a 68-year-old man named 'Casey' (not his real name), who was diagnosed with vertigo and with shoulder pain due to arthritis. Casey had fallen several times in the recent past and his physician had advised him to stop playing sports to protect him from injury. The shoulder evaluation was revealing for loss of motion and weakness. However, Casey's balance and coordination skills were primarily intact. There did not seem an obvious cause for a history of falling. On taking Casey out to the parking lot, he could easily field, catch, and throw a ball without difficulty. It was noted that Casey was left handed and further noted that he had recently started playing third base. As a left handed player, Casey needed to pivot almost 180 degrees every time he threw the ball to first base. This was a difficult movement pattern for Casey, and he lost his balance every time he had to field a ball, pivot 180 degrees and throw the ball to 'first base'. It was likely that Casey did not have as much of a problem with vertigo as he did with learning an efficient movement pattern that would allow him to play third base as a left handed player. Casey was seen 5 times in physical therapy and was taught lower extremity movement patterns so he could safely throw a ball to first base without losing his balance. Casey accomplished this very quickly, which then let us focus on his limitations in shoulder pain and weakness, which also recovered quickly.

**Discussion:** A Medical Diagnosis will usually offer an incomplete description of the patient. The Physical Therapist needs to be mindful in studying the patient's movement, which will be helpful in revealing a root cause of a patient's loss of function. This is especially true in the elderly, who we expect to have limited abilities.

**Keywords:** Vertigo; Shoulder pain; Physical Therapy; Elderly athlete; Ergonomics; Bias

## Demographics

"Casey" is a 68-year-old male reporting left (L) shoulder pain for several years. His pain was not a problem until he started playing softball this spring. He reports an unsatisfactory visit to physical therapy and has requested

an evaluation at our facility. He is playing in a 70-year and older league. Due to league rules, a team is allowed a single player under age 70, but over the age of 65. Casey is the youngest player on the team. Even though he usually plays outfield, on joining the team Casey started playing third base because, "I have the best reflexes on the team." Casey's chief

complaint is L shoulder pain when throwing to first base. Casey also reports falling several times while fielding a ball. He blames his episodes of falling on vertigo. Casey is left hand dominant. He is 70 inches tall and weighs 195 pounds. An important concern is that Casey lives 90 minutes from our clinic. Casey requested coming to our clinic as we had a positive reputation for working with middle aged athletes and also that his local physical therapist was encouraging Casey to stop playing sports.

### Medical History

Patient reports years earlier of having two rather severe episodes of vertigo, each lasting for several months. He has not had problems with vertigo in 10+ years. Patient reports no dizziness, nausea or other symptom associated with his recent falls. His physician, (like his local physical therapist), advises him to quit softball as falling will likely lead to serious injury. Regardless of the risk, patient prefers to keep playing softball.

Patient reports diagnoses of arthritis of his neck, back, hips and shoulders, high cholesterol, and hypertension. He denies problems with his heart, lungs, or other internal medical disorders. Medications include Lipitor, Hydrochlorothiazide, and Celebrex. Patient has a prescription for Antivert but has not had it filled. He also takes a daily multi-vitamin and uses

a glucosamine/chondroitin supplement.

Casey lives independently in his own home with his elderly mother, for whom he is the primary caregiver. Casey's wife died of heart disease several years ago. Casey reports being independent in daily activities, including cooking, laundry and all aspects of home maintenance. He jogs 6-8 miles a week. He reports having several family members living nearby if he needs assistance.

Patient health coverage is via Medicare, Blue Cross, and a four-dollar co-payment per visit.

Patient's medical diagnoses are Impingement Syndrome L shoulder, Arthritis L shoulder, and Vertigo. His PT diagnoses are L shoulder pain, weakness, and stiffness and a history of falling.

### Examination/System Review

The data gathered in the examination of the L shoulder is contained in Table 1. The data are consistent with a diagnosis of shoulder impingement syndrome with soft tissue irritations throughout the shoulder joint. The presence of a forward head posture might indicate the added diagnosis of 'upper crossed syndrome', meaning his impaired posture could relate to his shoulder pain and to his dizziness [1,2].

Examination Left (L) Shoulder	
•	Passive Range of Motion Left (L) Shoulder
○	Flexion: Active 130°/Passive 145° (limited by pain)
○	Abduction: Active: 80°/Passive 85° (limited by pain)
○	External Rotation: 60°/Passive 70° (limited by pain)
•	Manual Muscle Testing
○	L Shoulder: Flexion: 3-/5, Abduction: 3-/5, External Rotation: 3-/5
•	Increased muscle tone/spasm in the L pectoral muscle.
•	Tenderness to palpation/pressure in the L biceps tendon, the L pectoral muscle and the L supraspinatus muscle.
•	Skin color and temperature about the L shoulder girdle is normal.
•	No muscle tremors noted in any extremity.
•	Pain Rating Scale: Reports 7/10 sharp pain when throwing a softball. Otherwise 1-2/10 ache intermittently throughout the day, occurring with activity or when at rest.
•	Shoulder Outcome Measures*: SPADI: 14.62%. Quick DASH: 15.90%.
•	Posture: Craniovertebral angle of -45° of neutral. Can correct to -30° of neutral. (Self-report: has had this problem for 20+ years. His wife used to always tell him to stand up straight.)
•	* The SPADI (Shoulder Pain and Disability Index) and Quick DASH (Disabilities of the Arm and Shoulder) are valid and reliable outcomes measurement tools [3,4].

**Table 1:** Examination Left (L) Shoulder.

The data gathered in the examination of balance and coordination is contained in Table 2. There is a strong inconsistency in this information. Most of the data indicate that patient's balance and coordination skills are intact. His Johns Hopkins Fall Risk Assessment score, however, indicates

that patient is at a high risk of falling. As patient reported falling only while fielding a ball when he was playing third base, more information was needed to better assess the risk of falling.

<b>Examination of Balance/Coordination/Vertigo</b>
<ul style="list-style-type: none"> <li>• Bilateral Single leg stance: Intact x 10 seconds without loss of balance.</li> </ul>
<ul style="list-style-type: none"> <li>• Gait: Could walk 12 meters (40 feet heel/toe), laterally, laterally with a braided gait and backwards without difficulty or need of assistive device.</li> </ul>
<ul style="list-style-type: none"> <li>• Dynamic Gait Index: 28/28</li> </ul>
<ul style="list-style-type: none"> <li>• Johns Hopkins Fall Risk Assessment Score: 16 (High risk of falling.)</li> </ul>
<ul style="list-style-type: none"> <li>• Romberg Balance Test: Eyes open: intact x 30 seconds. Eyes closed: intact x 30 seconds.</li> </ul>
<ul style="list-style-type: none"> <li>• Dix-Hallpike Test: Negative. No complaint of dizziness or signs of nystagmus with testing.</li> </ul>
<p>The Dynamic Gait Index [5], Romberg Balance Test [6] and Dix-Hallpike Test [7] are all valid and reliable indicators for Balance and Coordination. The Johns Hopkins Fall Risk Assessment [8] is a valid and reliable indicator for probability of patient falling.</p>

**Table 2:** Examination of Balance/Coordination/Vertigo.

Casey was taken outside to a parking lot to observe him actually fielding and throwing a ball. Initially he could easily catch and throw a ball back and forth without incident, (however, he threw the ball with an awkward sidearm motion). When we progressed the drills to catching a ball and turning to throw the ball, similar to what a left-handed third baseman would have to do, Casey moved awkwardly, throwing the ball without getting his feet set, which caused him to stagger on every attempt. This activity seemed to reveal that Casey's problem involved the system dynamics of throwing a baseball [9-11].

An effective throw requires the fielder to first establish an optimal throwing position, that being with his torso and hips in line with the direction of the throw, with the throwing hand and leg positioned away from the target and his glove hand and leg directed towards the target. Then the thrower must shift his body weight onto his back foot as he is preparing to throw the ball, and then shifting his body weight onto

his front foot as he completes the task by throwing the ball across his body. As left-handed third basemen, Casey's torso and pelvic alignment were the opposite of what was needed for proper throwing mechanics. To complete a successful throw Casey needed to rotate his postural alignment 180 degrees before he threw the ball. Instead, Casey threw the ball from a compromised throwing posture (with his trunk and hips only partially turned into proper alignment). This resulted in a cascade of uncoordinated trunk motions, a loss of balance, and frequent episodes of falling.

A brief assessment was made of patient's cardiorespiratory performance to see if aerobic fitness was intact, or if early fatigue somehow impacted functional performance. The results of that assessment, (Table 3), indicate that patient does not have problems with his cardiorespiratory performance. Also, early fatigue did not impair functional performance.

<b>Assessment Cardiorespiratory Status</b>
<ul style="list-style-type: none"> <li>• Resting Heart Rate (HR) in sitting: 63 beat per minute (bpm), Respiratory Rate (RR): 16 bpm. Blood Pressure (BP) in sitting: 125/80. Peripheral Capillary Oxygen Saturation (SpO<sub>2</sub>): 96% (via pulse oximetry).</li> </ul>
<ul style="list-style-type: none"> <li>• 6-minute run on treadmill at 8.0 kph (5.0 mph), which patient identified as comfortable. Patient ran with a relaxed, balanced gait.</li> </ul>
<ul style="list-style-type: none"> <li>• Patient could breathe easily and answer questions without difficulty while running.</li> </ul>
<ul style="list-style-type: none"> <li>• Post Exercise: HR: 106 bpm Respiration rate: 23 bpm, BP: SpO<sub>2</sub>: 95%.</li> </ul>

**Table 3:** Assessment Cardiorespiratory Status.

Casey scored 3/15 on the Geriatric Depression Scale (short) [12]. Patient reports that he does not feel depressed

though he is a little afraid that he may have to give up playing sports. He reports that he will be very depressed if he has

to stop playing softball. On the VMAC/SLUMS examination Casey scored 28/30, indicating normal cognition [13].

## Review of Systems

A general review of patient health concerns was unrevealing. Patient wore glasses, but he could track and throw a softball without difficulty. His hearing was intact for general conversation. His skin condition was normal, including eyes, nose and mouth. He denied gastrointestinal or genitourinary problems. He denied problems with sex, though he had not had intimate relations with anyone since his wife passed away. Overall, he reported being in good health.

## Evaluation

### Prognosis

There were three major problems physical therapy was going to address with this patient. The biggest one was due to the fact that Casey lived 90 minutes away from the clinic. Casey planned to attend PT for only one or two visits to simply learn a shoulder exercise program. Casey believed he understood exercise well enough that he could monitor himself, (which did not appear to be the case). A problem with some in an elderly population is that having lived a successful life being self-sufficient, they believe they can be self-sufficient in almost everything. Respecting their decisions but convincing them, alternate strategies if often a problem needing to be addressed by healthcare professionals [14]. The Geriatric Depression Scale offered insight as to Casey's internal motivation. If Casey was significantly depressed, he may not believe that his status could be improved, which would affect adherence to his treatment. Fortunately this was not a problem we needed to address, although Casey did require supervision and guidance to make optimal decisions regarding his rehabilitation. His prognosis for a successful experience was going to be quite poor if he did not commit to regular treatment sessions which allowed ongoing re-evaluation, supervision and instruction. If Casey could be convinced to attend PT regularly, there was an excellent chance in resolving both the problems of shoulder pain and of falling.

A second problem was the inconsistency in the balance and coordination outcomes measurement tools, which presented an interesting conflict. The Johns Hopkins Fall Risk Assessment accurately predicted that Casey was at a high risk of falling. There was a good chance, however, that Casey's falling episodes were primarily due to an impairment of coordination because learning to play third base as a left-handed infielder was essentially being placed in a new environment. Even though Casey had played

baseball/softball all of his life, playing third base was a new experience. A new or unfamiliar extrinsic environment is a significant cause of falling in the elderly [15,16]. Eliminating the high risk of falling for Casey might be simple if he was able to focus on proper body mechanics before throwing the ball to first base. If on future visits Casey was unable to show progress in his balance and coordination skills, then it might be time to discuss stopping sports and investing time in a balance and coordination rehabilitation program. Casey was informed of this during his first visit, with the consideration that this was not only for Casey's health, but also for the well-being of his mother who was dependent on him.

The third problem to be addressed was the primary reason Casey was attending treatment, his complaint of L shoulder pain and stiffness making it difficult to throw a ball to first base. Providing Casey stayed motivated with his home exercises, the prognosis for resolving this problem was good. Neither his neither pain nor were his physical limitations were severe. Early intervention in orthopedic shoulder irritations shows a high rate of success [17].

## Goals

Casey was to attend PT a minimum of 1 time a week. He was going to do his home exercises every day. He would respect his pain complaints. He would not exercise with more than mild discomfort. If he could not do his exercises or he had any problem with his exercises, he was to contact his physical therapist as soon as possible. Casey needed to stay motivated to exercise, and if he could not, he was to contact his PT and explain any problem he was having [18].

Casey was to focus on his balance and coordination while throwing a softball. He needed to stop falling, as eventually a fall would lead to a more serious injury than shoulder pain. Casey needed to accept that he could, indeed, stop falling if he paid attention to his impaired coordination. Casey was to develop pain free range of motion and strength, allowing for comfortable left shoulder mechanics when fielding and throwing a softball.

## Interventions

Casey was scheduled one time a week for eight weeks with the expectation of talking to him the on the telephone one time weekly, as well. Telephone contact was going to be used as a communication tool; a tool for problem solving, to keep Casey motivated, and to offer any needed advice on his home exercise program. (Casey was unable to participate in Zoom sessions.) Casey was informed that PT would likely last for two or three months, so he should not get discouraged if he did not see instant results. As, his pain was slow to develop, it would likely be slow to go away.

On the very first day of PT Casey was taught proper foot placement and throwing dynamics for a left-handed third baseman [19]. Casey was taught to focus on slowing down and adjusting his foot placement to rotate his torso and pelvis 180 degrees before making a throw to first base. His stagger/loss of balance immediately changed from significant to negligible.

Also, on the first day of physical therapy Casey learned a simple two handed shoulder flexion exercise which involved active shoulder flexion, then active assisted shoulder flexion, and then stretching into shoulder flexion. This was chosen as an easy to perform exercise Casey could do throughout the day, thus making compliance easier to achieve. A more complete shoulder program would be added later so as not to overwhelm Casey with too many exercises on the first day of treatment [20]. Most importantly, Casey needed to focus on his foot placement exercises, as fall prevention took precedence over shoulder pain.

Casey responded extremely well to his first visit. A week later, on his second visit, patient stated, "I'm not falling anymore. Physical Therapy is like magic." During his second PT visit Casey was instructed in six strengthening exercises (Shoulder Flexion, Extension, Abduction, Combined Horizontal Adduction / Internal Rotation, Combined Horizontal Abduction / External Rotation, and Elbow Flexion). These exercises were to be done with both upper extremities using 3-5# hand weights, 25 times each, 2-3 sets daily. These exercises were chosen for ease of understanding and ease of performance, and as always, with a focus of improved patient compliance. Even though Casey only showed significant weakness in three shoulder motions, all shoulder motions were addressed in his exercise program to ensure muscle balance and control. Casey also started practicing proper throwing mechanics using a comfortable overhead technique. He could mimic throwing indoors by using a hand towel and practicing his foot mechanics turning 180° before 'throwing' his towel. Casey was to practice up to 50 throws daily, and he should reduce throws or stop throwing if this became uncomfortable.

The immediate success of the balance/coordination exercises very likely gave Casey the motivation he needed to drive 90 minutes (both ways) to attend PT and see his shoulder exercises through to a successful conclusion. This was extremely important. Casey did not think anything could be done for his vertigo. When he was able to 'fix' a problem that he thought could not be fixed, he was more powerfully motivated to attend PT so he could fix something that he believed could be fixed.

His shoulder progress was slower, but every visit Casey could see gains in range of motion and strength. Casey

cancelled his visit to PT on his 4th week, and then on his 5th week's visit, he reported that his vertigo was returning. He noted mild dizziness and nausea in the last few innings of his games (In a recheck of his status there was no sign of diminished balanced skills or nystagmus.). On discussion Casey admitted to not drinking much water during games so he would not have to rush to the bathroom between innings. Casey was instructed on the importance of proper hydration [21]. Casey scheduled to return to PT two weeks later, which turned out to be his last visit. Casey reported that his dizziness stopped being a problem if he kept hydrated, but it was a bother having to run to the bathroom all the time. He reported no pain throwing a ball and that he had not fallen since he started therapy. Patient believed that he was ready to discharge with satisfactory rehabilitation. A review of his shoulder outcomes testing showed the scores of: SPADI: 5.38%, Quick DASH: 2.27%. A surprising result was Casey's posture improved simply via his upper body strength exercises. Resting posture showed a Craniovertebral Flexion Angle of -350 from neutral and he could correct this to -100 from neutral.

Plan of Care: Patient was seen 1 time weekly (for a total of 5 visits) with a program of Hot Pack [22], Massage [23], Manual Therapy [24], Shoulder Stretching Exercises [25], Shoulder strengthening Exercises [26], and Throwing Exercises 15 for his complaint of L shoulder pain. He was also trained in components of Balance and Coordination when fielding and throwing a softball [27] and given instruction in proper diet (hydration) [28] for his complaints of falling, nausea and dizziness.

### Discharge Instructions

Casey was encouraged to continue his shoulder exercise program throughout the year, so he would be ready for spring softball every year. Casey had a latent problem with vertigo and/or impaired balance that was subliminal until exacerbated by dehydration, fatigue and/or physical stress. Casey needed to stay aware of this and maintain proper hydration and rest. If Casey noticed a problem with his vertigo returning, he should contact his physician or physical therapy as soon as possible.

Casey reported having arthritic issues with his back and hips, which we did not explore in PT due to a patient-imposed time constraint. Stiffness of his back and hips may have been part of the reason Casey had difficulty maintaining his balance when fielding, turning and throwing a softball. At the successful completion of PT, Casey was given contact information for a PT clinic located near his home. He was advised to attend therapy at that clinic to address problems with stiffness in his low back and hips. He was told to expect to go to PT 2-3 times a week, probably for a minimum of two

months, which should help him both avoid problems with falling and have an easier time playing softball.

## Discussion

As health professionals we likely have a bias against elderly athletes who have functional problems that we might automatically blame on age. While this may be true in many patients, it will also be true that many other patients simply need instruction in body mechanics, dynamic motion and optimal wellness. We are failing our patients and failing ourselves when we do not take the time to fully examine a patient to try to understand their loss of ability and then try to find the best way to resolve that loss. Telling an elderly patient to stop exercising is likely never the best course of action. The best course of action is to try to find a way to keep the elderly patient involved in daily activity.

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