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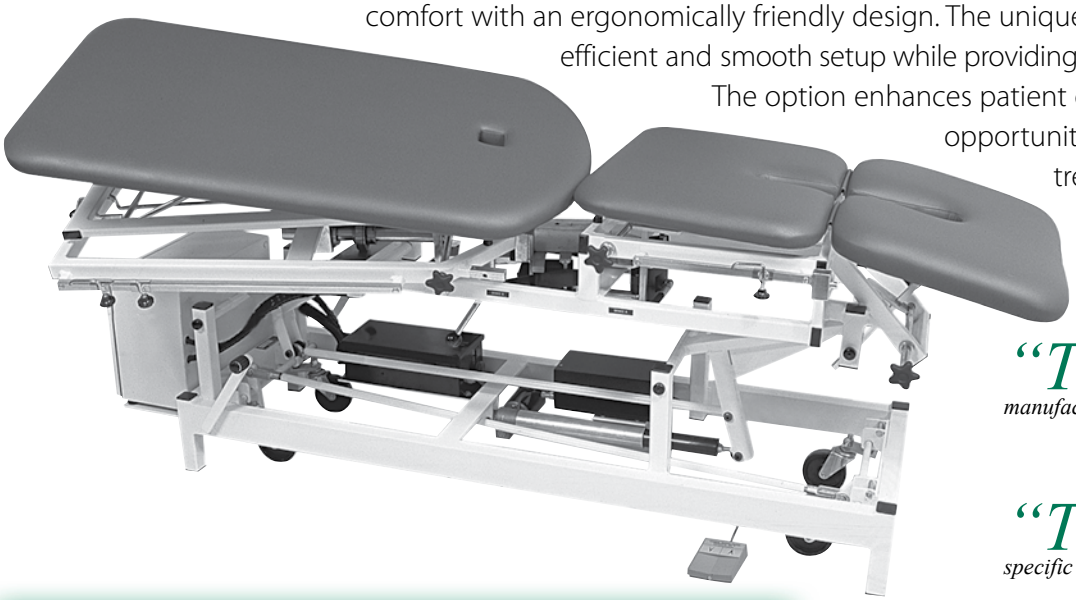

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ORTHOPAEDIC

Physical Therapy Practice

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inthisissue

regularfeatures

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The mission of the Orthopaedic Section of the American Physical Therapy Association is to be the leading advocate and resource for the practice of Orthopaedic Physical Therapy. The Section will serve its members by fostering quality patient/client care and promoting professional growth through:

- enhancement of clinical practice,
- advancement of education, and
- facilitation of quality research.

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One Patient at a Time

I can still remember the commercial from the 80s, Smith Barney's legendary spokesperson, actor John Houseman touting *"We make money the old-fashioned way. We earn it."* How fitting this message is to physical therapy. With just a few word changes the same message comes across: *"We get patients better the old-fashioned way; we work hard at it."*

This persistence in effort on a day-to-day basis by a working therapist sets the stage for our first 'theme' issue on case reports. Even though case reports do not carry the same research 'clout' when compared to other more rigorous experimental designs (case design cannot verify a cause and effect relationship[1]), case reporting does have its place. The basis of all decision-making and treatment planning starts with one patient and the success found in that effort hopefully leads to a reflection of how the therapist was able to achieve an effective outcome. This information can then be used to contribute to the treatment of the next patient. I guess that is what we call 'clinical experience.' Clinical experience combined with an evidence-based approach and an understanding of patient values (evidence-based practice) can be an extremely powerful combination for improving patient care.

Such repetition of effort can enable the treating therapist to formulate interesting researchable questions that may then be used to pursue an attempt at conducting a randomized controlled trial that both clinicians and researchers can relate to.

Sure it's nice to have a large cohort to draw conclusions from but sometimes the opportunity to collect such data is just not feasible for a working clinician. This should not stop the clinician from contributing to the literature. Case reporting focuses on specific outcomes for a specific patient. The case report illuminates a very personal experience of what one patient encountered. In other words, we can put a more personal perspective to the patient problem. We can also gain an appreciation of how that one patient fit or didn't fit the normal outcome. As a therapist our whole day is spent one-on-one with a day full of patients. Every patient has a unique circumstance that may make their condition more than just a typical diagnosis. This could be a unique past medical history or surgical procedure, a non-ordinary physical anomaly or even a unique circumstance (ie, occupation) that influences care. Approximately 60% of the patients at the clinical practice where I treat are patients with shoulder problems. However, I can honestly say that not a day goes by where I am not intrigued by the multitude of factors and clinical findings that influence any one patient's pain or disability. Treating in such a homogenous environment I can gain an appreciation for a certain type of clinical finding but I always feel that each patient presents slightly different.

Handling patients case by case keeps the clinician from getting complacent. More importantly, we see the patient for who they truly are…an individual who just happens to have been, for lack of a better term, 'labeled' with a particular diagnosis.

The authors presenting case reports in this issue have all felt that there was something unique about the patients they have treated. They felt so strongly about their experience that they have gone the extra mile to write about it and share the experience with the readership. Hopefully this issue will draw the reader into the author's world of decision-making and treatment considerations even if it's just for a snapshot in time. My thanks to all the authors who made this issue a very fun task to bring to press.

REFERENCE

1. McEwen I. *Writing Case Reports: A How-To Manual for Clinicians*. 2nd ed. American Physical Therapy Association; 2001.

UPCOMING ELECTION

Watch for the upcoming Orthopaedic Section's election!

Offices open for the 2007 election are 1 President,
1 Vice President, and 1 Nominating Committee Member.
The voting period is from November 1, 2006 – November 30, 2006.
Put this on your calendar, and **REMEMBER TO VOTE!**

BALLOTS

The Orthopaedic Section will destroy all election ballots from the most recent election within 90 days of the results being presented at the Annual Business Meeting if no one has contested the vote.

president's message

Michael T. Cibulka, PT, DPT, OCS
President, Orthopaedic Section, APTA, Inc.

Who are You?

Like the famous song by one of my favorite 70's bands 'The Who,' I just want to know "who really are you?" We are given a name at birth; this name individualizes and represents us until our death. Names along with titles have been given since the earliest of times. In ancient Rome 3 or 4 names were given. The first name was called a praenomen, this name was rarely used. The second name was called the nomen; this name distinguished the family, tribe, or gens you were from. Thus Gaius *Julius* Caesar was from the family of the Julia. The third name was the cognomen which was an epithet or nickname. The cognomen of the famous Roman orator and statesman Marcus Tullius *Cicero* was given because of a wart on his nose that looked like a 'chick pea,' which is what Cicero means in Latin. The last name, which was not always given, was the agnomen. The agnomen was given usually for some special reason, for example, Tiberius Claudius Caesar *Britannicus* was given to Rome's fourth emperor because of his conquest of Britain. Claudius also held the agnomen of *Germanicus*. In addition to the length list of nomen or names the emperor also held many titles, the first was imperator (or emperor), next pontifex maximus (or spiritual leader), and also the title of Caesar Augustus. Things could get pretty confusing with all of the different names and titles. Today we usually only have 3 given names and most are usually straight forward. Our titles, which list our academic degrees, specializations, honors, etc, have grown appreciably. In the literature I have counted up to 8 abbreviated titles after some therapist's name; I know there probably is someone out there with more than that. We have a vast cornucopia of different titles and abbreviations from which to garner and in doing so, I believe, have completely confused most of the public in whom we are trying to serve. It's hard to market yourself when you have an identity crisis.

When I first got out of physical therapy school in 1978, I noticed that 3 different titles for physical therapists were commonly used in the St. Louis area, one was the title PPT, another was RPT, and the third was LPT. In school I was never educated on the etiquette of which initials I should use after my name. I just used whatever everyone else was using around me. While this seemingly minor difference did not really bother me it did lead to some interesting problems in identification. Just to define the 3 for those of you who like me were confused; an RPT is a registered physical therapist. This was a title used before we were licensed and were simply registered by the state. The PPT title stands for professional physical therapist. A rather curious title implying that we are truly professional. I am not sure what that really meant. The last title is LPT and stands for licensed physical therapist. These titles proudly signified that we were not merely registered or are professionals but now licensed by the state. Interesting each of these titles originated from the 3 different physical therapy programs in the state of Missouri. Thus each institution of higher learning that had physical therapy programs had different professional titles or more accurate professional abbreviations for a physical therapist. One major problem I quickly encountered was the confusion these titles created. This confusion developed within our own profession, the community, and amongst the referring physicians. In 1978 I had a physician tell me that he only refers patients to LPTs because they are licensed. I think back how silly that really was, but it did happen! It illustrates an important point in our identity. Moreover I think today of the different titles that I see the MPT, the DPT, the PT. I think I made my point. We may know or not know what these initials stand for but the bottom line is that they are all just plain confusing to the general public.

Consider this hypothetical title: Michael T. Cibulka, PhD, DPT, OCS, GCS, SCS, MTC, FAAOMPT, FAPTA. Now first think like you are a non-health care person; who do you really think I am? Can you tell by the abbreviations who I really am? I don't think so. How many MDs do you see with that sort of confusion trailing behind their MD initials? Not many. Parsimony is not only elegant but easy to understand. Here is another example; this is a real title I took off the internet that I presume is a physical therapist from Australia (I did make up a fictitious name) Paul Carbono, PhD, M MedSc (HProm), GradDipH SocSc (HProm), Dip Physio**,** MAppSc(ExSpSc), BAppSc. Now can anyone make out what these abbreviated titles represent? Except for the PhD, I surely can't figure them out. The point here is that we not only have too many titles but we don't have one unifying title. An MD is an MD! Why can't we do that? This would be the best, cheapest, and easiest marketing plan physical therapy ever had. Perhaps the World Confederation of Physical Therapy (WCPT) can avoid abulia and agree on such a worldwide designation soon. How about using PT worldwide?! It's simple and easy to remember.

Another problem we have is not just the designation PT but where does this title go (in what proper order) after your name. Now with this discussion I am not trying to pick on my many friends with PhDs who put PhD first, but what is the reason for putting the PhD first? I see many who put their highest academic degree first instead

of PT. My question is again "who are you?" My next comment is how many doctors who have MD, PhD do you see sign their PhD before their MD? I have never seen this. I am not trying to create a shibboleth between PhDs and non-PhDs, but I suggest that we show everyone what we really think of our profession by putting PT first after our name. Now how about the introductions of the many new titles that add panache to our name—the OCS, the FAAOMPT, or the ATC? These are all fine, although I wonder if 4 or 5 isn't enough (but that's for another message) as long as we keep PT first!

So what are we going to do to solve this problem? Any person majoring in marketing would invoke Occam's razor. William of Occam was a 14th century theologian and philosopher who espoused the basic premise 'the law of parsimony' or in other words 'keep it simple' concept. I believe we must keep it simple and I propose, well actually not me but the APTA, a simple rule. We all put PT right behind our name! The HOD (06-99-23-29) (Program 32) approved the Position on Designation last in 1999. The statement reads, "The American Physical Therapy Association supports the recognition of the regulatory designation of a physical therapist or a physical therapist assistant as taking precedence over other credentials or letter designations. In order to promote consistent communication of the presentation of credentials and letter designations, the Association shall recognize the following preferred order:

1. PT/PTA
2. Highest Earned Academic Degree
3. Specialist Certification Credentials in alphabetic order (eg, OCS, SCS)
4. Other Credentials External to APTA
5. Other Certification or Professional Honors (eg, FAPTA or FAAOMPT)

Finally, I do know that some state laws do require a different designation. The point of this message is that we should not obfuscate our identity, we are physical therapists, and proud of it. Now lets see if anyone else agrees or disagrees with me. Email, call, or write me or better yet start up dialogue on the Bulletin Board at orthopt.org.

Last but definitely not least, I would like to congratulate all of the Orthopaedic Section PTA members who were recognized in the area of advanced musculoskeletal proficiency. You can check out all of those were recognized at www.apta.org (Communities/PTA). Congratulations!!

The Orthopaedic Section slate of candidates will be published on the Orthopaedic Section's web site one month prior to the ballot mail date.

Errors in the Clinical Decision Making in a Patient with Persistent Hip Pain: A Case Study

Mathews Thomas, PT, DPT, MSPT, CSCS, CKTP
Josephine M. Kershaw, PhD

INTRODUCTION

The purpose of this paper is to describe the types of errors and implications of these errors in the clinical decision making of a patient who experienced persistent hip pain. Errors leading to an improper diagnosis due to heuristics and 'cognitive errors' are discussed. A case study example will be used to illustrate the clinical decision making process, the cognitive errors, and the heuristics involved.

A heuristic can be defined as a rule of thumb, simplification, or educated guess that reduces or limits the search for solutions in domains that are difficult and poorly understood. Unlike algorithms, heuristics do not guarantee optimal or even feasible solutions and are often used with no theoretical guarantee.[1]

When a patient presents with certain symptoms, the physical therapist relies on the patient interview, physical examination findings, and clinical decision making skills to make a diagnosis and initiate an appropriate intervention.[2] A variety of clinical decision making models have been proposed in the literature.[3,4] It appears that in orthopaedic physical therapy practice, pattern recognition and the hypothetico-deductive model (involving hypothesis generation and testing) are used extensively.[5-7] Arriving at a diagnosis assumes that the clinician has all the required information to make a correct diagnosis.

One of the key features of clinical practice is that most of the time, clinicians (eg, emergency room doctors, nurses, physical therapists, etc.) may not have all the information necessary to arrive at the correct diagnosis. Clinicians are often making clinical judgments in situations of uncertainty (eg, the patient referred to physical therapy with a diagnosis of 'low back pain' or 'shoulder pain,' etc.). Thus, much of the time, the exact diagnosis is an informed best guess.

According to Graber and associates,[8] all forms of diagnostic errors can be grouped into 3 major categories: 'no-fault errors,' 'system errors,' and 'cognitive errors.' No fault errors include cases where the illness is silent or presents in an atypical fashion, a rare condition is misdiagnosed as something more common, or the diagnosis is missed because the patient does not present his or her symptoms clearly, or is noncompliant. System errors involve the latent flaws in the health care system such as weak policies, poor coordination of care, poor communication, etc. Cognitive errors refer to the problem of inadequate knowledge or faulty data gathering, inaccurate clinical reasoning, or faulty verification by the individual clinician. Examples of cognitive errors include flawed perception, faulty logic, falling prey to biased heuristics, and arriving at a final diagnosis prematurely.

Based on the cognitive studies by Tversky and Kahneman,[9-11] heuristics are often relied upon in uncertain decision-making situations where there is no certain answer immediately obvious and where all possible answers cannot be identified. These conditions of an uncertain decision making environment are present in patient examination/evaluation situations. Clinicians use a variety of heuristics for efficiently arriving at a diagnosis in the face of limited time or data. For example, diagnoses are established using heuristics based on representativeness, availability, or extrapolation. The drawback of using such heuristics is that there are inherent biases associated with each of these heuristics[2,8,12] (See Table 1). Some authors refer to these biases as cognitive biases or cognitive errors.[12]

In addition to the biases that found in these heuristics, there are *biases* that affect decision making that are not related to any heuristics. Examples of such biases include the *gender bias* and the *confirmation bias*. *Gender bias*[12] refers to the tendency to believe that gender is a determining factor in the probability of diagnosis of a particular disease when no such pathophysiological basis exists. Generally, it results in an overdiagnosis of the favored gender and underdiagnosis of the neglected gender (eg, osteoporosis in elderly men). The *confirmation bias*[12] is the tendency to look for confirming evidence to support a diagnosis rather than look for disconfirming evidence to refute it, despite the latter often being more persuasive and definitive.

CASE REPORT

History

The patient was a single, semi-retired African American male university professor in his late seventies. He ambulated independently in the community and prior to his injury jogged 6 miles, 3 times per week around a running track. He initially injured his left hip in January 2001 while running the third lap of the fourth mile around the running track. He reported feeling a snap in the hip followed by intense hip pain that caused him to limp. He saw his primary care physician only 1 week later. Initial plain radiographs revealed no fracture. He was then placed on Celebrex® and sent home. He reported that the medication did little to change his pain level of 7-8/10 (where 0 is 'no pain' and 10 is 'worst pain imaginable').

His primary care physician referred him to an orthopedist who rendered a diagnosis of 'hip tendonitis.' He was placed on Vioxx® and referred to out-patient physical therapy. He underwent 5 to 6 treatment sessions (due to the HMO insurance cap) which involved thermal modalities and stretching and strengthening exercises. The treatments spanned a period of 4 months. He reported minimal improvement after the physical therapy treatments.

The first author examined him *pro-bono* 6 months postinjury at the physical therapy department on campus. The patient had a family history of his father and brother having had cancer. His past medical/surgical

Table 1. The Definitions and Drawbacks of Commonly Used Heuristics that Influence Diagnostic Errors[2,8,12]

Heuristics	Definition & Drawbacks
Representativeness	This heuristic drives the clinician towards looking for the classic or typical manifestations of disease: "If it looks like a duck, walks like a duck, quacks like a duck, then it is a duck." Restraining decision-making along these pattern-recognition lines leads to atypical variations of disease being missed.
Availability	The disposition to judge things being more likely, or frequently occurring, if they readily come to mind. Thus, recent experience with a disease may inflate the likelihood of its being diagnosed. Conversely, if a disease has not been seen for a long time (is less available), it may be underdiagnosed.
Anchoring and Adjustment	The tendency to perceptually lock onto salient features in the patient's initial presentation too early in the diagnostic process, and failing to adjust this initial impression in the light of later information.
Extrapolation / Forecasting	Making predictions about an unkown condition or issue. This heuristics depends on the level of uncertainty and complexity present in a case. When the complexity of a case is low, some measure of forecasting is possible through statistical means (point estimates, confidence ranges, etc.). However, when the complexity of a case is high with multiple predictor variables that are interdependent, forecasting is less valuable and perhaps dangerous. Human forecasters tend to be *overconfident* in their single view of the future and fail to consider other alternative sufficiently. Forecasters may be basing their decisions on *distorted information* that is not representative of the real situation (eg, being overly aware of the trouble spots in the world or things that are most readily in our line of sight).
Occam's Razor	The principle where one tries to explain the entire illness—all the symptoms—with one diagnosis. This principle based on parsimony *(parsimony is defined as the adoption of the simplest assumption in the formulation of a theory or in the interpretation of data.)*[1] is flawed when considering the many patients with multiple chronic and degenerative diseases where the symptoms are due to 2 or more diseases that are present.

history involved previous right knee surgery for bursitis, and a back surgery**.** The patient was unable to recall what specific procedures were performed. He denied any previous injury or congenital problems with the hip. He also denied any personal history of smoking, drinking, heart disease, diabetes, hypertension, or cancer. A review of systems indicated high cholesterol, heartburn associated with citrus foods, and urinary urgency (after teaching long class sessions). His current medications were 2 different analgesics and one anti-inflammatory/analgesic.

Subjective & Physical Examination

Subjectively he reported pain (7/10) over the left anterior hip and groin region that radiated into the L. thigh with active movements of the hip. Sitting for more that 5 to 10 minutes causes a throbbing pain down the left hip and lateral thigh. Walking short distances (for 5 minutes) relieved the pain momentarily. The pain returned if he ambulated any longer. He also reported some left low back pain when walking and occasional paresthesia over the left posterior and medial thigh regions. He had no complaint of night pain.

Observation during physical examination revealed a very thin elderly African –American gentleman (Height: 1.6m; Weight: 51kg) with a mild thoracic kyphosis and flat lower back assuming a standing posture with the trunk partially forward flexed and side bent to the right. Weight bearing was predominantly on the right lower extremity with the left hip and knee kept slightly flexed (approximately 30^0) and the left foot in slight (approximately 20^0) plantarflexion. He was afebrile.

Measurements of hip active and passive range of motion revealed significant limitations of left hip extension (0°) and internal rotation (15°) with complaints of groin pain with overpressure in all directions of movements. The right hip active and passive range of motion was slightly better with no complaints of groin pain with overpressure.

Patient reported normal sensation to light touch in bilateral lower extremity and had slightly diminished left patellar deep tendon reflex of 1+ compared to the right patellar reflex of 2+ where 2+ is normal. The Achilles tendon reflex was symmetrical at 2+. Palpation of the femoral and posterior tibial artery pulses were normal and equal bilaterally. The patient did not report any increased pain with palpation over the posterior lumbar spine, sacroiliac joint, greater trochanters, thigh, and knee regions.

Examination of the patient's gait revealed a positive left gluteus medius limp or positive Trendelenburg's Sign and an antalgic gait pattern. The patient was unable to fully weight bear on the left and maintained the left hip and knee in flexion with the ankle in plantarflexion while ambulating. The left lower extremity swing phase and stance phase were significantly diminished compared to the right. There appeared to be some left quadriceps atrophy present on visual inspection. Passive straight leg raise (SLR) test was negative bilaterally. Special tests revealed positive quadrant (Hip Scouring) test for the left hip with the patient complaining of increased pain with passive hip flexion, adduction and internal rotation; positive modified Thomas test for left iliopsoas tightness and quadriceps tightness; positive Ober Test for left iliotibial band tightness; positive 90-90 straight leg raising test for left hamstrings tightness, and decreased dorsiflexion range of motion for plantarflexor tightness. The Anvil or percussion test (applied to the heel of the foot) and the Fulcrum test of the hip were both negative.

Evaluation of the examination data suggested that the patient had significant hip joint pathology with referred pain down the extremity. There are significant muscle

Table 2. Findings Indicating Significant Pathology or Fracture[13-17]

Patient History	Personal or family history of cancer. Noise heard/sensed during injury/trauma.* Sudden onset of post-traumatic pain.*
Pattern of Pain	Unchanging presentation of symptoms despite the use of pain medications. Pain unrelieved by rest or change in position (or relief of pain by change in position is only temporary). Failure to recover/symptoms persist beyond the expected time for recovery.* Symptoms out of proportion to injury. No change in patient's clinical status despite prior physical therapy treatment. Pain was constant and intense.
Physical Examination Findings	Severe post-traumatic spasm.* Severe post-traumatic painful weakness.* Loss of function (unable to weight bear and ambulate).* "Empty end feel" during passive range of motion testing.* Pain with all resisted movements.* Proximal muscle weakness accompanied by change in one/more deep tendon reflexes.

** Indicates signs and symptoms of possible fracture; other findings mentioned can suggest presence of systemic disease.[17]*

strength and flexibility deficits in the left lower extremity. Lumbar spine involvement was questionable. Although the initial radiographs revealed no fracture, there were many signs and symptoms that indicated the presence of a possible fracture. These included the following: the noise heard (or sensed) during trauma, the sudden onset of post-traumatic pain, the failure to recover despite a period of conservative treatment, the decreased function of the involved extremity in weight bearing and ambulation, the severe post-traumatic spasm[13] along with the severe post-traumatic painful weakness and the 'empty end-feel' (where the examiner is unable to passively move the limb into the end of range to determine true end-feel due to the patient's complaint of pain).[14,15] There were also a number of items in the patient's reported history, systems review, and subjective findings that indicated the presence of significant pathology or fracture (see Table 2).

A letter to the patient's orthopedist was written indicating the above mentioned 'significant hip joint pathology' and the need for further follow-up. The patient was advised to use a standard walker while ambulating, but he refused to use it because it would slow him down.

Diagnostic Imaging

Subsequent follow-up diagnostic imaging studies ordered by the patient's orthopedist, radiologist, and urologist (MRI, CT Scan, Bone Scan) revealed that the patient had a supra-acetabular fracture with degenerative changes affecting the acetabulum but with no obvious abnormality of the femoral head. Degenerative changes were also noted in the lumbar spine particularly at the L2 level. Given these findings, the orthopedist recommended that a total hip arthroplasty be performed.

OUTCOMES

The patient underwent a cemented left total hip arthroplasty (THA) 1 year postinjury. The patient underwent physical therapy treatment both at acute care and at an in-patient rehabilitation center and was discharged home. A mild limp while ambulating was still evident even at 6 months. He appeared to have made a good recovery and did not return to jogging after the THA on the advice of his surgeon. He remained in good health 2 years later.

Missed Information

An old friend of the patient informed the first author months after the initial examination had taken place that the patient was sometimes forgetful. In 2005 while reviewing the medical records of the patient, the first author discovered several other startling facts.

The patient apparently had a prior history of prostate cancer 2 years before the initial hip injury. He had radiotherapy treatment and was placed on leuprolide, which is used as a palliative treatment of advanced prostate cancer. He had made a good recovery and had normal blood test (prostate specific antigen) results at the time. The patient also had a history of coronary artery disease and had a coronary artery stent placed one year prior to the date of the initial examination by the first author. The patient had denied any of these previous illnesses when interviewed during the initial examination. The diagnostic imaging studies done later in 2001 did not show an enlarged prostate or other signs of metatastic disease.

DISCUSSION

There are many aspects to this case study which are interesting. The lack of cooperation from the patient who did not share all the pertinent past medical history or who might have cognitive impairments as well as the presence of a rare acetabular fracture poses a 'no-fault error' in diagnosis. The patient's history of prostate cancer and radiation therapy would have raised a red flag for possible pathologic fracture or metastases and significantly increased the urgency of the situation.

The 'system errors' are obvious in the very long periods of time between his physician appointments (between his primary care physician, orthopedists, urologist, etc.), diagnostic imaging studies, and the final corrective total hip arthroplasty surgery one year postinjury. The 'cognitive errors' present involve falling prey to biased heuristics of representativeness, anchoring and adjustment, as well as inadequate knowledge of acetabular/hip fractures in men. Gender bias might also have played a part in the clinical decision making process as most hip fractures occur in women.[18] This is partly due to demography and the longer life expectancy of women.[18] Recent research based on a predominantly white population, however, indicates that the incidence rate of hip fractures in men approach that of women as the men get older. (The female:male ratio 4.5:1 in the 60-69 age group verses 1.9:1 in the 80 + age group.)[19]

Acetabular fractures are commonly associated with significant high-energy trauma (such as cave-ins, motor vehicle accidents, fall from great heights).[13] Occult acetabular fractures have been known to occur due to both high-energy and low-energy trauma among elderly individuals with osteoporosis.[20,21] The decreased bone density that accompanies osteoporosis may not permit radiographic display of the fracture.[22]

While there is limited potential in reducing the no-fault errors that occur, there is more potential in reducing the system errors with improved efficiency, coordination of care, communication, and timeliness of diagnostic evaluation, etc.[8,12] Reducing the cognitive errors will require clinicians to be aware of the pitfalls of heuristics and of known cognitive biases; engage in active open-mindedness to consider multiple competing hypotheses in order to obtain a correct differential diagnosis.[12] Clinicians need to routinely ask what else could explain the patient's signs and symptoms? Is there any disconfirming evidence that would have indicated that the initial diagnosis of 'hip tendonitis' was wrong? Knowing the probability of acetabular/hip fractures among the elderly might have been helpful in the clinical decision making process in this case study. Clinicians would also need to become aware of their own thinking process (or metacognition)[12] so as to be the model reflective practitioner who can gauge their own clinical reasoning, minimize errors, and enhance patient outcomes.

CLINICAL IMPLICATIONS

This case study involving an elderly runner with hip pain shows the challenges of arriving at a diagnosis in the presence of a rare fracture complicated by the cognitive impairment of the patient, and by the diagnostic errors (ie, no-fault errors, system errors, and cognitive errors) that influenced this case. When making decisions in situations of uncertainty, clinicians often used heuristics that contain certain inherent psychological biases. Clinicians have to be aware of biases that affect their clinical decision making and employ debiasing techniques such as considering multiple competing hypotheses, seeking disconfirming evidence, and being continually critical of their own thinking processes.

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The Role of the Physical Therapist in the Assessment and Management of the Elderly Patient with Postoperative Delirium Following Hip Fracture Surgery: An Evidence-based Case Report

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ABSTRACT

Background and Purpose: Postoperative delirium is a common problem following hip fracture surgery in the elderly population. Despite a growing body of evidence suggesting worsened outcomes in patients with postoperative delirium, recognition and management of this disease state remains inadequate. The purpose of this case report is to describe the role of the physical therapist in the assessment and treatment of a patient with postoperative delirium. **Case Description**: The patient is an 87-year-old female with postoperative delirium who sustained a right femoral neck fracture after a fall with a subsequent hip hemiarthroplasty. On initial examination, the patient required maximal assistance for all functional mobility tasks. Impairments in right lower extremity musculature strength as well as significant pain level at 7/10 on verbal analog scale contributed to overall functional limitations. Interventions included functional mobility training, modalities, therapeutic exercises, and patient education. Daily assessments of mental status were performed using the alert and oriented portion of the Mini Mental State Examination. **Outcomes**: Following 13 visits in a 2-week period, the patient was discharged to a skilled nursing facility. The patient exhibited improvements in strength, range of motion, and function from baseline, however, she did not achieve established goals requiring contact guard assist/supervision for all functional mobility tasks. **Discussion**: Physical therapists' ability to assess and monitor delirium in high-risk patients can potentially improve the rehabilitation process. Daily assessment and development of standard delirium interventions may lead to improved functional recovery and higher quality of life in patients suffering with delirium.

Key Words: delirium, rehabilitation, femoral neck fracture, physical therapy

INTRODUCTION

Hip fracture is a major health concern in the elderly population today.[1] One third of the elderly population sustain at least one fall per year resulting in a hip fracture and long-term functional decline can be seen in 20% to 30% of those patients.[2-5] In addition, delirium is a prevalent postoperative complication that is associated with poor functional recovery in 20% to 50% of patients following surgical hip repair.[6,7] Postoperative delirium is a commonly misdiagnosed or nondocumented problem that can lead to prolonged hospital length of stay, increased health care costs, long-term neurocognitive and functional deficits, and increased mortality rates.[6-9] Despite a growing body of evidence suggesting worsened outcomes in patients with postoperative delirium, recognition and management of this disease state remains inadequate.[6] As health care practitioners, physical therapists are in a key role to assess for postoperative delirium, which will highly impact the rehabilitative process. By alerting the medical team of possible signs of delirium, proper intervention can be established in order to attempt reversal of this disease state.

The diagnosis of postoperative delirium remains quite difficult for the medical profession posing great risk for delaying the early medical treatment of the patient.[6,10] Postoperative delirium is misdiagnosed in 32% to 67% of cases due to the fluctuating nature of the symptoms.[6] The differential diagnosis of delirium is made in comparison to dementia and depression.[6] The clinical presentation of these 3 diagnoses is presented in Table 1.[6] Delirium as defined in DSM-IV is a neuropsychiatry syndrome characterized by reduced ability to focus, sustain or shift attention, the occurrence of cognitive changes such as memory loss, disorientation, language disturbance, or the development of a perceptual disturbance.[6,11] An acute confusional state (ACS) is also a widely acceptable term for delirium with the onset of development being hours to days following surgery.[12,13] Table 2 highlights the major diagnostic criteria for delirium according to the DSM-IV.[7] Other validated methods of diagnosing delirium in the patient with postoperative hip fracture include the Confusion Assessment Method (CAM),[1,6,10,13] the Delirium Rating Scale (DRS),[14] and Mini Mental State Examination.[5,6,10,13]

Physiological and psychological factors may contribute to the development of postoperative delirium following hip fracture surgery.[10] Common risk factors known to be associated with delirium include prior cerebral vascular accident (CVA), baseline cognitive impairment, older age, hypoxia, depression, auditory or visual impairments, postoperative pain, length of time to ambulate following surgery, time to surgery, infection, sleep disturbance, institutionalization, environmental change, and anticholinergic medication usage.[4,6,9,10,12,13,15] Among those patients who develop postoperative delirium, studies have shown a poor functional prognosis negatively associated with recovery of premorbid ambulation status.[4,16-18] The advent of delirium leads to a higher risk of postsurgical complications including decubitus ulcers, infection, hypoxemia, malnutrition, and self-destructive behaviors.[8,18] Numerous studies have revealed that patients are less likely to return to their prior level of function, with mortality rates between 14% to 36% within one year following the fracture.[16] In addition, patients suffering with delirium are more likely to be

Table 1. Differential Diagnosis of Delirium, Dementia, and Depression[6]

Differential Diagnosis of Delirium, Dementia, and Depression			
Feature	Delirium	Dementia	Psychotic depression
Onset	Acute	Insidious	Acute
Course	Fluctuating, lucid periods in a day	Relatively stable	Relatively stable
Duration	Days to weeks	Months to years	Weeks to months
Consciousness	Reduced	Clear	Clear
Attention	Impaired	Normal, except for severe cases	May be disordered
Hallucinations	Usually visual or visual and auditory	Often absent	Predominantly auditory
Delusions	Fleeting, poorly systematized	Often absent	Sustained, systematized
Orientation	Usually impaired, at least for a time	Often impaired	May be impaired
Memory	Immediate and recent memory impaired, remote memory intact	Immediate memory intact, recent memory impaired, more than remote memory	May be selectively impaired
Psychomotor	Increased, reduced, or shifting unpredictably	Often normal	Varies from retardation to hyperactivity (in agitated depression)
Speech	Often incoherent, slow or rapid	May have difficulty finding words, perseveration	Normal, slow or rapid
Thinking	Disorganized or incoherent	Impoverished and vague	Impoverished, retarded
Physical Illness or drug toxicity	One or both are present	Often absent, especially in Alzheimer's disease	Usually absent, but debatable

Table 2. DSM-IV Diagnostic Criteria for Delirium[6]

A. Disturbance of consciousness with reduced ability to focus, sustain, or shift attention.
B. A change in cognition or the development of a perceptual disturbance that is not better accounted for by a pre-existing, established, or evolving dementia.
C. The disturbance develops over a short period of time and tends to fluctuate during course of the day.
D. There is evidence from the history, physical examination, or laboratory findings that the disturbance is caused by the direct physiological consequences of a general medical condition.

discharged to a skilled nursing facility and sustain long-term cognitive impairment.[10,19]

The treatment of postoperative delirium involves both pharmacological and nonpharmacological measures. Pharmacological management of postoperative delirium involves the administration of haloperidol and atypical antipsychotics.[6,10] According to the American Psychiatric Association guidelines, haloperidol (haldol) is the drug of choice in the medical management of delirium.[10] Haloperidol also has potential applications for pharmacological prophylaxis in postoperative orthopaedic patients.[20] As a dopamine antagonist, haloperidol binds to central nervous system dopamine receptors and inhibits transmission of the endogenous neurotransmitter.[21] Indications for haloperidol include hyperactivity, agitation, and aggressive behaviors commonly seen in acute and chronic psychosis.[22] Contribution of haloperidol administration can potentially assist in the patient's participation during physical therapy treatments. Physical therapists should be aware of the extrapyramidal side effects highly associated with the administration of haloperidol due to the nonselectivity of dopamine inhibition in the basal ganglia.[22] Physical therapists may be the first clinician to recognize early signs of extrapyramidal side effects with a disturbance in balance, posture, and functional mobility.[22] The medical team should be immediately contacted in the event of these side effects, which may cause long-term motor impairments. Other side effects may involve sedation, anticholinergic effects, and orthostatic hypotension.[22]

Nonpharmacological treatment for postoperative delirium has been shown to reduce the severity and duration of postoperative delirium with shorter hospital length of stay and improved functional recovery at discharge.[6,9,19,23] Pain management and early intensive rehabilitation programs have addressed early mobilization with scheduled pain medication administration to promote greater functional tolerance throughout the day.[6,9,19,23] Other supportive care measures include frequent reorientation with clocks and calendars, family visitation, use of eyeglasses and hearing aids, a well-lit environment, absence of physical restraints, hydration, promotion of normal sleeping patterns, and ambulation with range of motion (ROM) exercises.[6,9,19,23,24]

Postoperative delirium is a highly preva-

lent occurrence among the elderly population being treated with surgical hip repair following a fracture.[5,6] As a direct patient care provider, physical therapists are at the forefront of observing the signs and symptoms of delirium and should be aware of the impact it can play on the rehabilitation process. Physical therapists can actively communicate with the medical team to aide in early recognition and intervention of delirium as well as establish an effective intervention program. Potential barriers to treatment in patients with delirium may include inability to retain new information, difficulty in responding to verbal stimuli, reduced safety awareness, and inability to comply with written instruction and verbal commands. Development of intervention strategies for patients suffering from delirium such as removal of environmental stimuli, pain management techniques, early mobilization, frequent reorientation to person/place/time, and encouragement of social supports in the treatment sessions may assist in improving the patient's participation and effort to achieve optimal functional recovery.[6,9,19] Table 3 exemplifies treatment strategies utilized in the following patient case. The purpose of this case report is to describe the role of the physical therapist in the assessment and treatment of a patient with postoperative delirium following hip hemiarthroplasty due to a femoral neck fracture.

CASE DESCRIPTION

The patient is an 87-year-old female who sustained a right femoral neck fracture secondary to a fall at home while attempting to negotiate over a carpet with her rolling walker. The patient was immediately brought to the emergency room and went to the operating room the following day for surgical repair with a hip hemiarthroplasty. The patient was provided with postoperative medical treatment in acute care and recommended for continued physical therapy in an acute rehabilitation setting. The patient received the care of an interdisciplinary team within a 2-week period. The social history included the patient living alone independently and driving prior to admission. The patient's prior level of function consisted of using a straight cane and rolling walker for ambulation and independence with all other functional mobility tasks and activities of daily living. Her past medical history was significant for controlled sinus ventricular tachycardia, hypothyroidism, urinary tract infections, lower back pain, and degenerative joint disease. A medication list is provided in Table 4 illustrating the dosages and frequency of intake.

Table 3. Physical Therapy Treatment Strategies for the Patient with Postoperative Delirium[6,38]

Provide support and orientation

Provide clear and simple instruction of treatment tasks.

Give gentle reminders of the day, time, year, location, and reason for physical therapy treatment.

Encourage family members and caregivers to provide orientation and participate in physical therapy sessions.

Provide an unambiguous environment

Provide treatment in a clear and quiet location as able to avoid unnecessary external sensory stimulation.

Provide the patient with simple instructions and commands to follow for functional tasks.

Use simple language and avoid using medical jargon to explain reason for physical therapy treatments.

Maintaining competency

Identify and correct sensory impairments; ensure patient wears their glasses and hearing aids.

Use an interpreter for patients with language barriers.

Encourage active participation during physical therapy treatments.

Arrange treatments to allow maximum periods of uninterrupted sleep.

Maintain activity levels: ambulatory patients should walk three times daily; nonambulatory patients should undergo full range of movement exercise for 15 minutes three times daily.

Upon admission to the rehabilitation unit, the physician noted episodes of sundowning and made a differential diagnosis of resolving delirium versus dementia. Sundowning is characteristic of confusion or agitation that occurs late in the afternoon.[25] Dementia is a decline in cognitive functioning that usually progresses slowly in which memory, thinking, judgment, and the ability to pay attention and learn are impaired and personality may deteriorate.[26] The patient had a neuropsychology consult and a neurological screening was performed resulting in a diagnosis of postoperative delirium. In general, the patient was oriented to person and time with assistance of a calendar for the specific day; however, she could not recall the place or the events leading up to her hospital admission. She felt hopeless with her present situation and admitted feeling sadness about the future.

TESTS AND MEASURES

The patient was examined within the limitations of anterior-lateral total hip replacement precautions and a weight bearing as tolerated (WBAT) status. Range of motion (ROM) of the left uninvolved hip was within normal limits (WNL) measured by goniometry and the right hip was indicated as painful with all motions within the restrictions of the hip precautions. Goniometry is a standardized measurement tool for joint motion.[27] Manual muscle testing, which is a reliable and valid method of strength assessment revealed grossly 4/5 left lower extremity strength within all musculature while the right lower extremity consisted of the following: 2+/5 iliopsoas, 3/5 quadriceps, 3+/5 hamstrings, and 4/5 anterior tibialis musculature strength.[28] Light touch sensory testing was performed using the index finger with the patient's eyes closed. In addition, a proprioception test was completed to assess joint sense through the use of the great toe of bilateral feet. Both of these measures were deemed WNL bilaterally. The Timed Up and Go test, a reliable and valid functional test, was only used at discharge because the patient was unable to ambulate the full distance necessary for completion of the test initially.[29] Balance testing in a seated posture revealed good static supported balance, fair plus static unsupported balance, and fair dynamic supported balance. Dynamic un-

Table 4. Patient's Medication List

Medications	Dosage	Frequency
Coumadin	4 MGM	Daily
Tylenol	650 MGM	Prn Pain
Actonel	35 MGM	Every Week
Synthyroid	0.075 MGM	Daily
Amiodarone	200 MGM	Daily
Xanax	0.25 MGM	Q HS Prn
Atenolol	25 MGM	Daily
Ciprofloxacin	250 MGM	BID
Lexapro	10 MGM	Daily
Vericare	5 MGM	Daily
Multivitamin with iron	1 TAB	Daily

supported balance was not tested secondary to a pain level of 7/10 using the verbal analog scale (VAS). Standing balance was poor-poor plus for both static and dynamic postures. The subjective balance grading scale does lack reliability measures placing more emphasis on comparison of the Timed Up and Go test in this patient case.[30]

Functional mobility testing included bed transfer, toilet transfer, and gait assessment. The patient required maximal assistance for the bed transfer including the sit<->stand transfer with use of the rolling walker and the supine <-> sit on and off of the bed. The gait assessment revealed the patient was able to ambulate 10 feet with the rolling walker and maximal assistance. Gait mechanics included an uneven stride length with an antalgic gait pattern requiring verbal cues for proper sequencing and safety awareness. Stair assessment was deferred due to safety concerns and the patient's inability to ambulate on level surfaces without maximal assistance.

The Functional Independence Measure (FIM) is a rehabilitation outcome tool that is used by the acute rehabilitation facility at the initial admission within 48 hours of evaluation and at discharge. The validity and reliability of this outcome measure has been widely studied and documented in the literature.[31-33] Aiken et al assessed the sensitivity of the FIM tool with the Short Form-36 Health Related Quality of Life (SF-36 HRQOL) in patients with orthopaedic diagnoses. The results of this study showed that the FIM scores were highly correlated with predicted outcomes especially within the motor domain whereas the SF-36 HRQOL measure did not show significant sensitivity.[34] Functional Independence Measure scores were applied to all of the areas of functional mobility upon admission including bed transfer (2), toilet transfer (2), gait (1), and stairs (0). Predicted discharge functional outcomes were established including FIM scores of bed transfer (6), toilet transfer (6), gait (5), and stairs (2). These FIM scores reflect an anticipated level of modified independence to be achieved with bed mobility, transfers, and ambulation 50 feet with the rolling walker and minimal assistance to negotiate 4 steps with use of a rail and cane. The discharge plan was established at the initial FIM meeting in which the patient would go to an assisted living facility after an estimated length of stay of 2 weeks. Both the patient and family were in agreement with the plan of care.

DIAGNOSIS AND PROGNOSIS

According to the *Guide to Physical Therapist Practice*, the physical therapist diagnosis of this patient is within Pattern I including impaired joint mobility, motor function, muscle performance, and range of motion associated with joint arthroplasty.[35] The prognosis of this patient was for her to achieve her prior level of function within an assisted living facility following 2 weeks of inpatient rehabilitation. This decision was based upon the fact that the patient received an early diagnosis of delirium and was being properly managed. The team felt that the patient would not be able to return to her own home due to mild residual cognitive deficits but would be safe in an assisted living facility to receive assistance with activities of daily living as necessary. Documented literature poses a poor functional prognosis for patients with postoperative delirium; however, due to early recognition and medical management, the team felt that the patient would at least return to a modified independent level of function.[4,16-18]

INTERVENTION

Physical therapy treatment was provided twice a day with 1-hour sessions over the course of 2 weeks. Daily assessments of mental status were performed using the alert and oriented portion of the Mini Mental State Examination by asking the patient 3 questions related to person, place, and time. The practical nature of this short examination allowed for the ongoing assessment of the patient's present cognitive status whereas the Confusion Assessment Method and Delirium Rating Scale are mainly used for diagnostic purposes.[36] The patient was frequently reoriented to her present condition and the reason for rehabilitation intervention. A simple memory assessment consisted of the patient's ability to perform the exercises and functional mobility with proper sequencing as practiced during the previous treatment session.

The sessions included gait training with the rolling walker, transfer training from different surfaces with the rolling walker, and bed mobility training on a mat in the gym. The patient was educated in the anterior-lateral hip precautions to avoid dislocation and her weight bearing as tolerated status prior to all interventions. Due to poor memory retention, the patient demonstrated difficulty in remembering her hip precautions as well as education on safety awareness and home exercise program. A written home exercise program allowed the patient to follow the exercises; however, multiple verbal cues were necessary to perform the exercises properly. The lower extremity exercises included quad sets, glut sets, short arc quads, long arc quads, hip abduction, heel slides, and ankle pumps. The patient performed 2 sets of 10 repetitions of each exercise. Due to mild perseveration with alternating sequences and poor procedural memory as indicated by the

neuropsychologist during the initial FIM meeting, the ability to instruct the sequencing of all functional mobility tasks required multiple verbal cueing to ensure safety and proper joint positioning.

By the second week, the patient was able to ambulate the length of the gym, which is 40 feet with the rolling walker, minimal assistance, and occasional verbal cueing for sequencing during constant practice sessions. Transfers and bed mobility tasks also required minimal assistance of the therapist due to decreased strength and increased pain level. Pain management strategies were provided with ice application to the right hip and coordination with nursing for pain medication administration prior to treatment sessions. The postoperative delirium was slowly resolving at this point and with daily assessment of mental status using the alert and oriented (A & O) test, the patient was considered A & O x 3. This test involves 3 questions involving knowledge of person, place, and time.

OUTCOMES

The final FIM scores for this patient were bed transfer (5), toilet transfer (5), gait (2), and stairs (2). Strength measurements obtained at discharge showed improvement with iliopsoas 4-/5, quadriceps 4/5, hamstrings 4/5, and anterior tibialis 5/5. Range of motion of the right hip was WNL. Sitting balance was Good and standing balance in static postures Fair-Fair minus and dynamic postures Poor plus. The Timed Up and Go test score was 44 seconds with use of the rolling walker. The literature states that a score of greater than 16 seconds in a community dwelling elder correlates with increased fall risk.[29] The patient achieved a supervision/contact guard assist level of function and was deemed unsafe alone due to fair-poor safety awareness with tasks. The discharge plan was revised and the patient was transferred to a skilled nursing facility for continued rehabilitation. Despite improvements in cognitive status, the patient demonstrated residual memory impairments that would not allow her to safely function independently alone.

DISCUSSION

Postoperative delirium is a serious medical condition that afflicts many elderly patients following orthopaedic surgery. The early recognition and diagnosis of this condition can prevent grave consequences such as long-term functional decline.[4,15] In this particular case report, the physiatrist was alerted to a cognitive impairment during his initial examination of the patient and consulted the neuropsychologist on the first day of admission. During the initial FIM meeting, the physical therapist as well as other team members was able to report on the patient's presentation during treatment sessions, which involved slight difficulty in following commands and poor memory retention of the overall sequencing of functional activities. The interdisciplinary approach to this patient provided early medical and therapeutic treatment aimed at reorientation and early mobilization. Time to ambulate has been shown as an important factor in the onset of postoperative delirium following surgery demonstrating a positive correlation in occurrence of delirium with delayed mobilization.[4]

The patient's functional goals were not met at discharge despite efforts to attain a modified level of independence. However, the patient did achieve overall strength gains as well as improvement in functional mobility from a maximum assistance level of care to a contact guard assistance/supervision functional level. Her cognitive status had dramatically improved over the course of 2 weeks with nonpharmacological measures used; however, she continued to have a slight memory impairment that deemed her supervision level of care. It was the hopes of the interdisciplinary team that she would continue rehabilitation in a skilled nursing facility and then be discharged to an assisted living facility.

Physical therapists can play a key role in the early detection of postoperative delirium symptoms in patients following orthopaedic hip surgery. Delirious symptoms may not be apparent until needing to cognitively process multistep commands to perform functional activities challenges the patient. The development of an effective plan of care focused on the reorientation and early mobilization of the patient will also lead to better functional outcomes. In this case, the patient lived alone and was unable to return home due to lack of supervision. The patient did achieve positive functional improvements over the course of treatment despite requiring further rehabilitation.

CONCLUSION

This case report demonstrated the importance of early recognition of postoperative delirium following hip fracture surgery. The physical therapist may be the first clinician to detect delirium and alert the medical physician of its clinical presentation. Interdisciplinary management resulted in the patient achieving functional gains of a light assistance level of care over a 2-week period despite the need for continued rehabilitation. Published trials have indicated that postoperative delirium is associated with long-term functional decline and this case was able to demonstrate the benefits of an effective physical therapy treatment program in a patient with delirium.[4-9,16-18,37] Further research is warranted to develop a standardized treatment protocol for patients with postoperative delirium in order to optimize functional recovery and enhance quality of life.

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Patients Journey through Knee Osteoarthritis: From Total Knee Arthroplasty through the Rehabilitative Process

Kimberly D. Galbreath, PT, DPT

ABSTRACT

This case series describes the progression and subsequent functional declines of 3 patients with knee osteoarthritis. Evidence based theory and practice is used in describing declines in muscle function and imbalances causing increased joint abnormalities and functional deterioration. These imbalances and declines are addressed as the patients undergo total joint arthroplasty and are rehabilitated in the subacute phase at an outpatient physical therapy setting.

Key Words: rehabilitation, osteoarthritis

INTRODUCTION

The incidence of knee arthritis is high. A survey conducted by the National Health Institute in 1999 had the incidence of knee pain, swelling, and stiffness at 5 million.[1] Risk factors for disease onset and progression are difficult to modify, such as sex (females more likely), prior joint injury, joint deformity, obesity, and genetic factors.[2] There are many problems associated with knee osteoarthritis and as these conditions worsen, patients contemplate the decision to have a total knee replacement (TKR). In 2002, the National Inpatient Survey reported 365,000 surgeries at an average cost of $25,000.[1] As our population ages, the incidence of knee osteoarthritis will increase and the numbers of TKR surgeries will increase also as the disease progresses. The physical limitations associated with knee osteoarthritis will be reported and interventions following TKR surgery will be described.

As knee osteoarthritis progresses, patients tend to exhibit decreased quad strength.[3-5] Quadriceps strength is important as it is associated with many functional tasks such as rising from a chair, going up and down steps, and gait.[6,7] Patients have increased hamstring activation with functional tasks which may be a contributor in disease progression by changing the normal load distribution on the knee.[8] Other muscle imbalances include increased use and strength of adductor muscles with varus deformity at the knee.[9] A decrease in adductor usage and toe out gait was associated with valgus deformity.[10] Muscle imbalances affect joint deterioration and alter functional activities, such as gait and balance needed to ambulate.[11]

Integrity of the sensorimotor system is essential to the production of a smooth gait, in which harmful transient forces at heel strike are decreased by accurate timing and placement of the lower limb on the ground.[11-13] Eccentric quadriceps contraction is essential to allow a smooth gait. Balance can be affected with knee osteoarthritis and makes patients more susceptible to falling since proprioceptive activity is also impaired in patients with knee osteoarthritis.[3-5,12] Treatment goals should address improvements in proprioception, muscle imbalances, and other components of the lower quadrant chain.

Neighboring joints can be treated and have an effect at the knee and aid in the sensorimotor abilities. Messier et al has shown that strengthening the ankle will decrease knee pain and improve balance.[14] The ankle has been correlated with increasing balance in the elderly.[15] Manual therapy of the hip has been shown to aid in knee pain associated with arthritis.[16-18]

In a randomized controlled trial by Hurley and Scott, exercise was shown to increase quad strength and proprioception in 60 patients with knee osteoarthritis.[4] These patients were seen twice a week for 12 weeks by a physical therapist. The program included riding an exercise bike with increased resistance, isometric quadriceps sets, and 3 functional exercises consisting of sit to stand, step ups and down, and single leg stance exercises with and without balance boards. Functional activity training has been shown to result in specific gains related to the specific function being trained.[19] Velocity of the exercise did not make a difference in the functional training task.[19] A simple aerobic exercise program has been shown to increase ADL function to a greater extent when compared to a resistance program.[20] Supplementing a home exercise program with a class-based program has been shown to be more effective than a home program alone.[21] When treatment strategies such as those previously described are not able to control symptoms, a total knee replacement is considered.

Patients are considered for replacement of the knee when arthritis is prevalent on a weight-bearing anterior posterior radiograph. The most common grading scale was developed by Kellgren and Lawrence in 1957. It uses grading on a scale of 0 to 3 in all compartments measuring joint space narrowing and osteophytes.[24] A newer procedure was tested using measurements of the cartilage loss over 2 years in MRI imaging. This procedure was shown to be a direct indicator of a TKR with the odds increasing 20 fold for each 1% loss of cartilage over 8%.[25] However, MRI is an expensive procedure and most likely will not be used to correlate the odds that a patient will need a TKR. Radiological evidence as well as moderate to severe pain not adequately controlled with medications are frequently used as indicators for joint replacement surgery.[24] Furthermore, the patient should also have clinically significant functional limitations resulting in decreased quality of life.[25] When function is decreased and the pain associated with the disease is unable to be controlled, the TKR procedure is used if the patient does not have significant contraindications for surgery. The benefits must outweigh the risks.

Improvements by the TKR surgeries are in direct correlation with the amount of prior disability. Patients with higher degrees of disability and pain prior to surgery tend to be more satisfied with the surgical outcome.[26] Patients with more co-morbidities and a poorer health-related quality of life will experience a greater improvement after surgery.[27] Nevertheless, patents with lower function preoperatively failed to reach a level

of function postoperatively that was similar to that achieved in patients with better preoperative function.[28] It has been said that the lower limit range of motion for adequate function is 90° of flexion at the knee.[29] The most important factors which influenced the range of movement after arthroplasty were the preoperative range of flexion and the body weight of the patient.[30]

Twelve to 22 months post-TKR patients still display less force production of the quadriceps in the involved knee compared to the nonsurgical knee.[31] Cadence of stair climbing was 57% slower 2 months post-op[32] and was still 51% slower in ascending and descending 10 steps after one year.[33] These are functional activities that are important. Although TKR improves quality of life and function, some important activities are still not possible. Sixty percent said they had moderate to extreme difficulty with steps and 64% had the same amount of difficulty participating in heavy domestic duties.[34] Of 176 respondents to a questionnaire one year post-TKR, 40% stated it was important to be able to squat, and 76% of the respondents were unable to complete the task comfortably.[35] Function is important to the patients who undergo a TKR surgery and knee range of motion and strength are directly correlated to function.

Quadriceps strength, muscle imbalances, and gait deviances affect the knee joint prior to TKR surgery. These problems still exist after surgery and need to be corrected. Many studies address techniques and modalities to help osteoarthritic knee patients. There are limited research reports available addressing interventions in the subacute phase after the surgery. Some results from research on patients with knee osteoarthritis and/or a TKR cannot be generalized to patients in the outpatient setting. Many studies on TKR were protocols to be used in the acute care setting and were focused on transfers and length of stay issues. Those studies will not be addressed in this paper.

Gait is significantly altered both before and 2 months post-TKR. When patients who had a TKR were compared to a nonsurgical control group, cadence was slower by 31 and 46%.[32] There was an increase in double limb support with a corresponding decrease in single leg stance time and increased activity of the vastus lateralis.[32] Ouellette and Moffat also discovered a significant overall decreased muscle activation pattern with the exception of the vastus lateralis and the medial hamstring when compared to the nonsurgical control group.[32] As with the gait pattern, the stair ascent also showed an increase in hip and ankle plantar flexion and a decrease in knee flexion.

INTERVENTION AND OUTCOME STUDIES

A search for evidence based literature to interventions with TKR patients revealed very little information. There were 2 different investigations using a neuromuscular electrical stimulator (NMES) to strengthen the quadriceps, and to increase walking speed. Kyriadow et al used the stimulator at 40 Hz, 300 micro seconds at post-op day 2. Patients used the stimulator over the vastus medialis which was ramped at 8 seconds with an 8 second rest between stimulations. Subjects used the stimulator for 2 hour sessions, twice a day for 6 weeks. A statistically significant increase in walking speed was attained at 6 and 12 weeks.[36] A case series was reviewed in which NMES was applied 3 weeks post-op in bilateral knee replacement patients.[37] The weaker leg in 5 patients was stimulated for 10 seconds and repeated 10 times with an 80 second rest between contractions. A 2500 Hz was used with a 50 burst per second speed and 2-3 second ramp. The control group of 3 subjects completed an exercise program along with the NMES subjects 3 times a week for 6 weeks. Subjects receiving the NMES had the most strength increase when measured after the first 3 weeks of treatment. Subjects in the control group also gained strength, but not at the same rate. No statistics were used in this series as there were only 8 subjects.

A study by Moffet et al was used during treatment with the case series reported.[38] Experimental subjects performed a physical therapist supervised intensive functional rehabilitation program, while the control group received the standard of care. The subjects were enrolled 2 months after a TKR and received the intervention 2 times a week for 6 weeks. Adaptations were taken as the patient progressed through the 60 to 90 minutes sessions. Specific exercises were utilized but the same principles of progression were used. As the tasks became easier, the load or the repetition was increased. Each session had 5 components: warm-up, specific strengthening exercises, functional task-oriented exercises, endurance exercises, and cool-down. During the first 2 weeks, the warm up session, specific exercises, and cool down exercises were stressed, so less demand was placed on the joint. During the next phase until the 6-week ending point, more task oriented exercises were stressed. Significant differences were seen in the intensive exercise group after the intervention and 6 months after treatment when comparing the 6 minute walk test (6 MWT) and total Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores between groups. Twelve months after intervention there was no significant difference between the groups.

Outcome measures used in the current case series were the 6 minute walk test, the aggregated locomotor function (ALF) score, and a Tinetti balance score. The six minute walk test has been shown to be highly responsive with a standardized response mean (SRM) of 1.5 to changes over the 2 to 4 month rehabilitation period post-TKR when compared to the WOMAC difficulty score.[39] Another outcome measure used was the aggregated locomotor function (ALF) score. The ALF has been shown to be moderately responsive to change (.49 SRM) in an arthritic knee population.[40] The ALF is a series of functional tests which are easily done in the clinic, mirroring the activities that have been described as difficult after surgery and important to the TKR population.[34-35] Time taken to ascend and descend a series of 7 steps is repeated 3 times and averaged, as was an 8-meter walk and a transfer from a chair to standing. The averages of the 3 trials were recorded and an aggregate score tallied. The ALF score is reliable (0.99) and shows good validity when compared to the WOMAC function and the SF-36 outcome measures (0.59, -0.53). A Tinetti balance score was also taken before and after intervention. The Tinetti score was deemed the most responsive when compared to the timed up and go, the one leg stand test, and the functional reach test.[41] Reliability of both the gait and balance scores in the Tinnetti were .83 respectively.[42] These 3 outcome studies are able to give a valid, objective number to the functional tasks which are important to our patients.

All subjects used in this case series had interventions performed at Therapy Plus, an outpatient facility owned and operated by Shawnee Mission Medical Center in Merriam, KS. Patients were referred for treatment

by 3 different orthopaedic surgeons familiar with our level of care. All patients signed an informed consent and agreed to take part in this convenience sample series.

SUBJECT INFORMATION

The first subject included was a woman who had her left knee replaced in 1999. She had been in considerable pain prior to surgery and reported pain of 3/10 on an 11 point visual analog scale (VAS) [43] with weight bearing activities after surgery. Pain medications taken after surgery were hydrocodone, 1 pill every 4 hours. Prior to surgery, she volunteered at the hospital and wanted to return to her job as soon as possible as she had never missed a week previously. Another goal was to return to walking her 50 pound dog 1 mile daily. She had lived on a farm for most of her life and was used to hard work and was very motivated to get back to life without her walker or cane.

The second subject was experiencing his first knee replacement. He reported no pain with activities, but was having difficulty sleeping through the night after the TKR procedure. He was taking no pain medications. His job as a warehouse supervisor required him to be able to get out of a golf cart up to 25 times daily as well as walk long distances. Ambulation at initial evaluation required him to use a cane and he was self-conscious using the assistive device. Another goal was to return to working out and to be able to ride his bike 150 miles in the MS 150 in 6 months as he had done previously. Patient 2 was also highly motivated as he wanted to return to work in 2 weeks so one of the other supervisors could go on vacation.

Subject number 3 had undergone his first knee surgery and worked as an accountant. His goal was to be able to get up and down the 12 steps to his workshop and be able to hunt and fish again. This gentleman was taking no pain medication, reporting no pain, but was having difficulty sleeping. Previous to surgery, he had difficulty getting out of a low chair and managing the steps. He was experiencing the same difficulties managing steps and low chairs and was ambulating with a cane on initial evaluation.

An initial evaluation was performed on the 3 subjects. Objective information included wound assessment and edema measurements, ROM and strength testing, balance testing using the Tinneti[42] balance test and functional testing with the 6 minute walk test[37] and the aggregated locomotor score (ALF).[40]

INTERVENTION

At the start of the rehabilitation visit, patients warmed up on the stationary bicycle. As revolution through the bicycle became easier, the seat was lowered to increase the knee range of motion requirement to complete a revolution. Patients were also progressed in the length of time to increase their cardiovascular endurance. Stretching was then performed, followed by specific exercises (Table 3), warm down, manual therapy techniques, and ice to decrease edema. Stretching was performed by the patient using a 30-second static hold as advocated in a study by Bandy, Irion, and Briggler.[43]

Patients responded well to the intervention regimen proposed by Moffet et al and reported previously.[36] Exercises also used were from the study by Stevens et al which were shown to increase strength.[35] Gait training was done with emphasis on heel strike, push-off at toe-off, and normal knee excursions. Added to this program were balance activities with use of an Airex® balance mat (Alcon Airex AG, Kins, Switzerland), Theraband stability trainer® (Hygenic Corp, Akron, OH), one legged stand and the Bosu® (DW Fitness, Canton, OH). The Bosu® was used with a forward and backward mini lunges alternating legs to improve medial and lateral stability and proprioception. It has been shown that there is increased EMG activity of the quadriceps and hamstrings with anterior and posterior mini lunges.[43] One legged stand exercises have been shown to improve balance and gait activities in the elderly.[7]

Hip and ankle mobilization were used when patients demonstrated ROM deficits. These techniques have been shown to increase function as demonstrated by the 6 MWT and the WOMAC in the osteoarthrit-

Table 1. Specific Information on the Subjects

Patient	1	2	3
Sex	F	M	M
Age	79	55	73
TKR	R	R	L
Days post	6	28	21
Home health	None	8 visits	6 visits

Table 2. Subjects Objective Information

Patient	1		2		3	
Range of Motion						
	Pre	Post	Pre	Post	Pre	Post
ROM Knee ext (deg.)	Lack 5	Hyper 2	Hyper 5	Hyper 5	Lack 5	Hyper 3
Flexion (flx)	96	120	105	120	106	125
Hip flexion	98	105	95	103	90	100
Ankle dorsiflexion	2	5	5	7	4	5
Hamstring length	50	60	60	70	40	65
Strength						
	Pre	Post	Pre	Post	Pre	Post
Strength Knee ext	4	4 +	4	4+	4	4+
Knee flx	4	4+	4+	4+	4	4+
Hip ext	4	4+	4+	4+	4	4+
Hip flx	4	4+	4+	5	4+	5
Ankle dorsiflexion	4+	5	5	5	4+	5
Edema						
	Pre	Post	Pre	Post	Pre	Post
cm *	25.0	15.0	18.0	12.5	5.0	4.0

*Edema measured at the joint line and 5 cm above and below, with the summed total compared to nonoperative extremity.

ic knee patient population.[17] Caudal glides were used to increase hip ROM as shown with significance in a study by Cliborne et al with knee OA patients.[16] Other manual techniques included patella and incision mobilization until normal movement was attained. Soft tissue stretching and manual work was performed on the hamstrings, gastrocnemius, and iliotibial band as needed.

A Cyrocuff® (Aircast Inc, Summit, NJ), was used after interventions to decrease inflammation and edema using compression and decreasing temperature. The cuff was applied with the extremity elevated for 15 minutes. Placement of cold packs for 15 minutes has been shown to decrease edema when utilized for 10 treatments.[45,46]

OUTCOMES

The outcome measures provided objective information to the functional activities that the subjects wanted to achieve. All patients demonstrated improvements in sectors of the postintervention outcome measures. A clinically important benefit was also seen by increasing quadriceps strength, ROM, and time to walk 50 feet. Patient 1 was able to return to the volunteer work at the hospital, where she escorts people to areas of the hospital. She also again enjoys walking her large dog. Patient 2 was able to comfortably get in and out of the cart and walk to return to work allowing a co-worker to have a vacation. Patient 3 was able to go up and down the steps without use of the rails. He was also able to ambulate on uneven surfaces with enough confidence to return to fishing and hunting. All functional and objective goals were met by the patients in this case series.

DISCUSSION

Many patients such as the three described are seen in the outpatient physical therapy setting. There are limitations in this case series. No statistical analysis was able to be calculated due to the limited number of subjects. Subjects were chosen at convenience with no blinding or randomization. Much of the past research in this topic area has involved subjects that have knee osteoarthritis, but who have not had joint replacement surgery. This research was generalized to the patients used in this case series and it is not known if the results would differ if past research had used subjects who had joint replacement surgery.

The review and subsequent case series outline the need for continued research on interventions post-TKR. This common procedure will be increasing as the population ages and physical therapists need to be using evidence-based practices. Intervention evidence needs to be applied, so our patients are able to get back to their previous activities quickly and with less expense. Outcome studies were found which put an objective number to functional activities, which is necessary to be able to qualify our services.

Table 3. Exercises Performed by Subjects

Patient	1	2	3
# visits: sessions			
Specific stretching exercises			
Warm-up and stretching	1-6	1-8	1-8
Exercise bike	1-6	1-8	1-8
Hamstring stretch	1-6	1-8	1-8
Gastroc/soleus stretch	1-6	1-8	1-8
Specific strengthening exercises			
Isometric knee extension supine	1-4	1-4	1-4
Isometric knee flexion supine	1-4	1-4	1-4
Hip abduction sidelying (S/L)	1-4	1-4	1-4
Hamstring curls standing	1-4 Red T-band	1-4 Green T-Band	1-4 Green T-Band
Terminal knee extension	3-6 Green T-Band	2-8 Green T-Band	3-8 Green T-Band
Functional Task oriented exercises			
Mini Squats	2-6	2-8	2-8
Mini Lunges	2-6	2-8	2-8
Step over mini hurdles	4-6	4-8	5-8
Step ups and downs	3-6	3-8	4-8
Gait training	2-6	2-8	2-8
Resisted gait training	5-6	5-8	5-8
Balance activities	2-6	2-8	2-8
Cool down	2-6	2-8	2-8

T-Band= Theraband manufactured by Hygenic Corp. Akron, OH.

Table 4. Subjects Outcome Measurement Information

	Patient 1		Patient 2		Patient 3	
Outcome Measures	Pre	Post	Pre	Post	Pre	Post
Tinneti Score	12	27	11	28	10	24
Walk time	6.0	6.1	5.9	5.7	6.2	6.1
Stair time	9.2	9.0	8.9	8.6	9.4	9.0
Transfer time	5.1	4.9	5.3	5.0	5.7	5.5
ALF score	20.0	4.9	20.1	19.3	21.3	20.6
6 MWT	240	285	262	315	253	305
PT OP		6 V		8 V		8 V

PT= physical therapy OP=outpatient V=visits, 6 MWT=6 minute walk test

Currently and in the future, medical cost will rise and the importance of functional outcomes measures after intervention will be important to our practice.

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The Use of Multiple Impulse Technology in Treatment of a Patient with Low Back Pain

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ABSTRACT

Background and Purpose: Determining the source of low back pain can be difficult, resource intensive, and frustrating. This case report describes the use of a method of instrument-assisted palpation to evaluate and treat a patient with low back pain. **Case Description:** The patient had a 2-week history of low-back pain incident to exercise. The patient displayed pain and limited range of motion of approximately 25% in extension indicated pain levels of 6/10 on the Borg scale. The patient reported 75% improvement of pain levels after one treatment session using Multiple Impulse Therapy (MIT) applied to the cervical region only. Range of motion was immediately increased to normal in extension. **Discussion:** The results of the case suggest the appropriateness of a full spine evaluation in treating low back pain and the use of impulse technology in identifying spinal dysfunction leading to symptomology.

Key Words: low back pain, joint mobilization, manual therapy, multiple impulse therapy

INTRODUCTION

Low back pain represents over 50% of patient complaints in my private practice. This case study describes the assessment and treatment of a patient presenting with low back pain. The patient had no unique signs or symptoms that made the case special. On the contrary, the patient's symptoms, history, and examination provide little to distinguish this case from many other patients I have treated with low back pain. However, what makes this case of interest is the site of treatment relative to the site of patient complaint and the information gathered from the patient that led to the decision to treat.

Physical therapy education, as practiced when I received my degree in physical therapy (1973), was focused on the treatment of neurologic patients and rehabilitation. Upon assuming a position as a PT in the hospital setting, my caseload consisted of treatment of patients with low-back pain, a task for which I had not been prepared.

Treatments then and frequently now consist of the application of ultrasound, heat, massage, transcutaneous electrical stimulation, back exercises, and life-style counseling. A successful outcome generally took 6 to 8 weeks or more of therapy. Studies found little if any clinically significant differences in outcomes such as pain relief when comparing different therapeutic approaches.[1,2] Shortly after my entry into the profession, mobilization as a means of manual therapy was introduced and later the publication of guidelines for low back pain by the U.S. Agency for Health Care Policy and Research[3] stimulated interest in the profession in the use of manipulation for the treatment of low back pain as well.[4] Currently there is not enough emphasis on manual manipulation in a typical physical therapy curriculum to produce a graduate that is proficient in manual manipulation. Proprietary manual techniques are offered in the form of post-graduate education for those who wish to pursue the attainment of proficiency in passive manual methods of treatment. Having pursued that avenue myself, I found assessment methods such as palpation, motion palpation, and end-feel difficult to master and, when subjected to objective evaluation, unreliable.[5-20] Of the commonly used techniques for manual assessment, the provocation or simply the accurate identification of pain appears to have the highest reliability although its validity has been questioned due to the concept of referred pain.[21]

Recently, a new method of instrumentation has emerged that purports high reliability of measurement as well as efficiency in treatment.[22-24] The instrument allows the application of a low energy mechanical impulse to the patient for assessment and treatment. During assessment, a single mechanical impulse is applied to each vertebral level of the spine and the resistance of the body is measured during the impulse. The integral of the resistance force over the time of the impulse can be shown to be equal to the change in momentum imparted to the body by the instrument[25] and, when compared to other sites, reflects the relative resistance to the impulse along the spine. The use of the device may assist in providing an objective method to assessing of the spinal and tissue stiffness. Treatment is performed by applying a train of impulses at the point or points selected by the clinician and the same instrument is used to monitor the changes in momentum transfer as the resistance of the patient's musculoskeletal system changes in response to the treatment. This case report describes the use of instrumented palpation as an adjunct to the clinical decision making process, treatment, and outcomes for a patient with a 2-week history of low-back pain. The unique aspect of this case is the fact that treatment was not applied at the site or location of pain yet the effects of successful treatment were immediately apparent to the patient. I believe the instrument was integral in allowing for the successful evaluation and treatment of the patient's symptoms.

CASE DESCRIPTION

Patient History and Demographics

The patient was a 48-year-old woman (145 cm tall, 59 Kg) self-employed as an office worker with an unremarkable past medical history. She was married and the mother of 2 children with a moderately active lifestyle. The patient reported that she had a prior history of headache and neck pain. The patient was not on any medications. The patient presented with pain in the lumbar region, specifically L4, L5, but no signs of radiculopathy. This condition had lasted for over 2 weeks. The onset of pain was the result of the use of an aerobic workout bicycle type machine that incorporated a rowing motion in addition to pedaling. The patient presented via direct access and had

not previously visited a medical practitioner for this complaint. Lumbar range of motion presented as follows; flexion was normal (although painful at end range of motion), extension was 75%, sidebending and rotation were normal. The chief complaint was pain during flexion, extension, and side bending with increased pain at the end ranges of movement. The patient's complaint of pain was manifested primarily while in upright standing and sitting positions.

No neurological evaluation was completed due to a denial of radiculopathy. No lateral shifting was evident and the patient's posture was otherwise unremarkable. The patient also attributed an exacerbation of her pain to extended periods of computer work in a sitting position. During the evaluation ergonomic factors were not observed or taken into account for this case report. The patient had previously sought chiropractic care in the past for migraine headaches but not for this specific complaint.

Instrumentation

The Pulstar (Sense Technology, Murrysville, Pa)[11] was used to provide multiple impulse therapy to the patient. This instrumentation was reviewed by the Food and Drug Administration of the United States Government and approved for marketing as a medical device in 1994 (510 K940085) and in its present form in 1998 (510 K973914). Indications for use of the Pulstar include musculoskeletal pain due to restricted joint mobility, myofascial spasm, and ligamentous strain.

The Pulstar consists of 3 integrated components which function to provide the clinician a measurement of musculoskeletal resistance at each vertebral level and a multiple impulse treatment (Figure 1). For measurement, the first component, a hand-held impulse head, is pressed against the patient and provides a single low energy impulse to the vertebral level of interest. A force sensor in the impulse head measures the resistance of the patient to the impulse. The integral of the resistive force over the time of the application can be shown to be the change in momentum resulting from the collision between the impulse head and the patient.[25]

The second component, the impulse head control unit, monitors the impulse head and provides the electrical impulses to the head to create the impulse, interpret the output of the head, and communicate the results of the measurement to the third component, a computer. The computer displays the results of the measurement, which may be thought of as a computer-assisted palpation of the spine, in a series of bar graphs. The measurement has been found to possess 'good to excellent' inter- and intra-examiner repeatability.[22]

During the treatment phase, the device supplies multiple impulses to the areas selected by the clinician while simultaneously measuring the musculoskeletal resistance for each impulse. The changes in musculoskeletal resistance that occur during treatment are displayed for the clinician and used to monitor the treatment. A complete description of the theory and operation of the Pulstar is beyond the scope of this report but may be found in US Patents 4,841,955 (Chiropractor Adjustor), 4,984,127 (Control System for Precision Spinal Adjustment) and 5,662,122 (Method and Apparatus for Objectively Assessing and Correcting the Relative Compliance of Vertebral Segments), the Pulstar User's Manual (26) as well as Evans (27) and at www.WeArePt.com.

Instrument Protocol

The treatment of musculoskeletal symptoms with multiple impulse percussive therapy can be separated into 6 related steps. These are:

1. Collection and evaluation of preliminary general information, ie, completion of patient history, evaluation of patient symptoms, review of X-rays, and ancillary tests;
2. A preanalysis to determine the relative resistance of the area of the musculoskeletal system of interest;
3. Analysis of resistance readings in combination with other tests and observations resulting from patient history to determine site or sites of intervention;
4. Application of multiple impulse therapy to those sites chosen for intervention;
5. Postanalysis of the relative resistance of the same area of the musculoskeletal system;
6. Review of the results of the intervention by the clinician (often in concert with the patient) to confirm that the desired results have been achieved.

Each step in this process is conducted according to a basic protocol as recommended by the manufacturer.

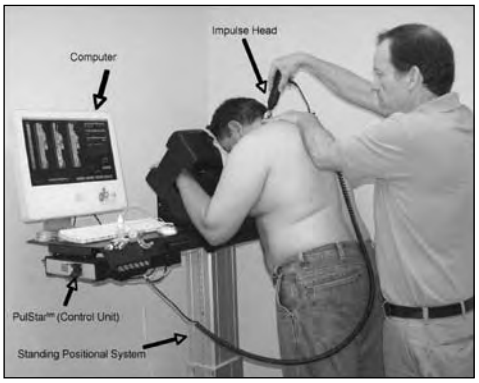

Figure 1. An example of patient evaluation using the Pulstar System.

Instrumented Palpation

Figure 2 shows pre- and postresistance measurements at each vertebral level of the spinal system. The reading labeled "Occ" (Occiput) is taken just below the occipital ridge and not on the occiput itself. All readings were taken with a dual prong (30mm spacing) attachment for the impulse head. The dual points of contact were placed on either side of the spinous process, follows the rule of 3's in the thoracic spine.

The solid line running from the top of the bar graph to the bottom represents the 'expected value' for a patient in the standing position. The figure shows the large de-

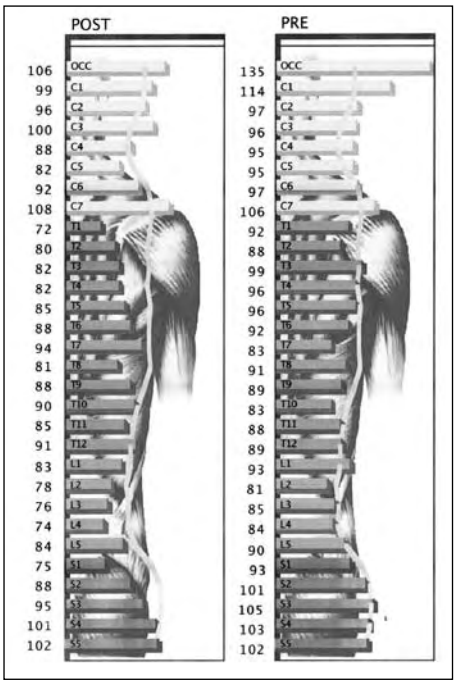

Figure 2. Pre- and postanalysis output provided by the Pulstar System.

viation from adjacent vertebra as well as the expected value with respect to occiput and C1 as well as C7 and T1. In addition, it is important to note that the lumbar and sacral regions appear to be consistent with expected deviations.

Physical Therapy Diagnosis
Low back pain incident to exercise
Rationale for treatment

Clinicians routinely palpate spinal structure to determine differences in joint mobility, stiffness, tenderness, swelling, temperature, pain, etc. The findings of palpation are integrated with the clinician's other knowledge of the patient to decide if, when, and where physical intervention may be warranted. Incorporating instrumentation into the palpation process in an effort to increase the repeatability of the observations is a natural extension of the process. Various groups have undertaken investigations of what might be classified as instrumented palpation.[28-41] These investigations range in complexity from simple manual algometry to complex combinations of force transducers, displacement sensors, and accelerometers. The approach as implemented in the PulStar attempts to strike a balance between cost, complexity, and clinical usefulness by using a simple, hand-held impulse head. The impulse head is used to expose each joint segment to a precisely controlled impulse when the impulse head is pressed against the segment. The impulse is generated only when sufficient force is developed between the head and the subject. The contact force that must be achieved between the impulse head and the segment to be analyzed prior to the initiation of the impulse is referred to as the 'preload.' The impulse head incorporates a preload sensor and a force transducer. The preload sensor is used to establish a repeatable initial preload condition against the point to be analyzed. The preload sensor is continuously monitored by the control circuitry of the instrument and when the required preload condition has been met, a precisely controlled energy impulse is applied to the actuation mechanism of the impulse head. This causes the impulse head to impart a small mechanical impulse to the body that imparts energy to the joint and surrounding tissue. The force transducer is used to monitor the resistance of the body to the energy of the impulse. For this patient the evaluation revealed increased stiffness the expected value at occiput, C1 and C7.

INTERVENTION

To apply a treatment the therapist identifies the points of interest or dysfunction and then has the option of setting the impulse mode (frequency and force level). Multiple impulse therapy was applied at points of discontinuity in pattern of vertebral resistance. For this patient I chose to first mobilize the occiput at a force level of 20 lbs for a total of 450 impulses. I mobilized C7 for a total of 174 impulses of a force level of 20 lbs and C6 255 times at a force level of 15 lbs The PulStar system assists in determining the number of impulses required to effect a mobilization of the joint. During the treatment process I monitored the resistance at each point of therapy to ensure that the resistance to mobilization decreased before moving on to the next vertebral level. The device also terminates treatment when no further reduction in stiffness is sensed by the impulse head.

OUTCOMES

Examination of the postresistance graph revealed that the resistance in the area of Occiput and C1, had either been reduced or approached the expected value line. Back pain decreased by 75% after the first visit. The patient self evaluated on the Borg scale as a 6 to 7 out of 10 on initial visit and ±2 out of 10 posttreatment. Patient reevaluated as a 0 out of 10 on follow-up 2 days later. No further treatment was given.

DISCUSSION

Fruth[42] recently published a case report illustrating the procedure for differential diagnosis and treatment of a patient with thoracic pain. Fruth recommended an extensive series of tests and examinations, some of which are not available in private practice. A similar procedure is often recommended for the evaluation of low back pain. The tests and examinations included would be similar to those recommended by Fruth and might include:

- History
- Observation
- X-Ray
- CT Scan
- MRI
- Orthopedic Tests
- Neurological Tests
- Range of Motion
- Palpation

A full and exhaustive spinal evaluation using these methods and procedures may require the investment of significant resources as well as time and, in my experience, a finding of a specific cause is the exception rather than the rule. Many studies report the result of therapeutic procedures performed on patients with 'mechanical' or 'nonspecific' low-back pain. These terms are used to classify patients for whom there is no known underlying cause. Such classifications may be misleading as they imply that all possible causes were in fact evaluated. This is seldom the case. It would appear that the resources expended in time and personnel using an exhaustive method of differential diagnosis methodology versus the information gained that might be useful in the treatment of the patient appears to be too high to be justified in the current economic environment of patient care. The work of Waddell[2,43,44] recognizes this and has led to the use by the medical profession of the '10 Minute Consultation.'[45] This approach might be characterized as 'grin and bear it' in that the primary advice given to the patient is (in the absence of 'red flag signs') is to remain active and not to expect passive care to be helpful during the course of the episode of pain which may take 6 to 8 weeks to resolve.

In my practice I have adopted a middle ground approach that is somewhere in between and so far seems to be more effective than either of the 2 extremes described above. I have now incorporated in my practice an instrument that allows me to perform an objective measurement of the resistance of the patient to a low-energy impulse of constant magnitude at each vertebral level. Rather than perform a complete and exhaustive differential diagnosis upon first contact with the patient, I use instrument palpation as my initial evaluation tool after performing the initial patient workup, which includes demographics, history, orthopedic tests, etc. After reviewing the patient's condition for contraindications, I performed an instrumented palpation of each vertebral level of the patient's spine prior to the application of therapy. The measurement itself is objective in that the number presented to the clinician is not a result of a subjective decision making process. The palpation process is very

efficient. I gown my patients so the identification and location of spinal landmarks is facilitated.

At the end of the palpation process, the instruments selects up to 5 locations of the spine that may be candidates for therapy. This selection is also objective taking into account the 'expected' pattern of results for each palpation position (prone, seated, and standing) as well as the differences between adjacent readings. I often accept the results of the selection algorithm but when they are at odds with the other findings, I may choose to disregard them and make my own selections.

Therapy is provided by choosing an appropriate force level for the location (between 5 and 35 pound force) and pressing the impulse head against the patient at the desired location. When a preset preload is achieved between the impulse head and the patient this action triggers a train of low-energy impulses to be delivered to the patient. I start with a low setting and only increase if I don't see the expected response. There are 3 treatment modes; constant force-constant frequency where the clinician sets the force level as well as the frequency (from 2 to 20 Hertz), constant force-variable frequency where the clinician sets the force level, and the frequency changes in response to the measurement of the resistance of the patient and 'sweep' mode where the force must be set to between 5 and 15 pounds and the frequency is swept between 2 and 60 Hertz.

To prevent over-treatment, the impulse train in the first 2 treatment modes will be terminated if the change in measured resistance during treatment approaches 0 or if the number of impulses reaches a predetermined value set by me. During each of these treatment modes I am able to monitor changes in the measurement of tissue resistance as they occur at each impulse. I interpret a favorable treatment result as one where the frequency and the measured tissue resistance decrease during therapy indicating a relaxation response at the site of treatment.

Additional conformation of achievement of an expected response is obtained by repeating the initial instrumented palpation of the patient after therapy has been performed. I show these results to the patient to reinforce the effectiveness of the treatment by providing a visual as well as verbal assurance that the treatment actually achieved our mutual goals.

Both the pre- and posttreatment palpation readings are recorded at each patient visit as well as the location, force level used, and number of impulses applied for each separate treatment during the visit. This information may be reviewed and printed immediately or at a later time.

Therapy was applied to this patient only in the cervical area even though the primary complaint was low back pain. This decision was influenced primarily by the readings obtained during the instrument assisted palpation of the patient's spinal system but also by a series of other patients where similar patterns were observed. Evans[46] makes a case for the evaluation of the full spine rather than limiting to investigation to specific regions because of the complex, highly coupled nature of the spinal system. In my own practice, I have observed multiple instances that indicate back pain and headaches are a common thread among back complaints.

I believe that this process of full spine evaluation and treatment provides more information that is actually useful to me in the assessment and treatment of low-back and neck complaints than any other methodology that I have tried in 30 years of practice. The results obtained with this protocol on this specific patient while they cannot be construed to be caused by the treatment, fall within the range of results documented in 2 recent studies using this methodology.[23,24] In addition, they reflect numerous other patients that I have recently treated using these protocols. I believe that this approach enhances my normal treatment of low back pain and I intend to continue to pursue its efficacy in treatment of spinal dysfunction. Further research on this device also appears warranted.

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Case Report: Rehabilitation and Outcomes for a Patient Following Implant of a Reverse Delta III Shoulder Prosthesis

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ABSTRACT

Glenohumeral arthritis with an associated irreparable rotator cuff tear, termed rotator cuff arthropathy, leads to a painful and pseudoparalytic shoulder and remains a challenge for orthopaedic and rehabilitation clinicians. This case study scribes the results of a 'reverse' total shoulder prosthesis, in which the convex-concave relationship of the joint partners was reversed, thus relying on an intact deltoid muscle rather than a rotator cuff for shoulder function. The subject was a candidate for this shoulder based on a previous cuff tear and subsequent repair, followed by a re-rupture of the same rotator cuff. After 15 weeks of rehabilitation, the subject reported only minimal pain, and his passive range of motion was 175° flexion, 90° external rotation, and 60° internal rotation. Strength gains allowed for a return to function for all activities for daily living. At an 8 month follow-up, the patient reported that he was extremely pleased with his results. Few rehabilitation guidelines are available following this unique surgery. The greater knowledge a physical therapist has regarding a surgical procedure the greater the likelihood that an appropriate rehabilitation program can be developed. Long-term outcome studies with a greater number of patients following a reverse shoulder procedure are needed.

Key Words: reverse shoulder arthroplasty, rotator cuff tear, Delta III prosthesis

INTRODUCTION

Glenohumeral arthritis with an associated irreparable rotator cuff tear leads to painful and pseudoparalytic shoulders, and remains a challenge for orthopaedic surgeons and physical therapists alike. Advanced osteoarthritic disease with concomitant pain and loss of function and independence was described by Adams in 1873,[1] and later termed rotator cuff arthropathy by Neer et al in 1983.[2,3] Rotator cuff arthropathy is a degenerative condition more prevalent in females and typically occurs in the dominant extremity in individuals over 65 with associated erosion of the acromioclavicular joint.[2,4-8] Shoulder arthropathy can lead to loss of dynamic glenohumeral stabilization, causing anterosuperior migration of the glenohumeral center of rotation, leading to a nonphysiological articulation and insufficiency of the deltoid muscle.[5,8-10] Attempts have been made to treat the condition conservatively, and with arthroscopic debridement, or even arthrodesis. Each intervention can lead to inconsistent pain relief and unsatisfactory functional outcomes.[11-14]

SHOULDER ARTHROPLASTY PROCEDURES

Lo et al[15] report that more than 10,000 shoulder arthroplasties are performed in the United States annually. Shoulder arthroplasty has been shown to be as cost-effective as total hip or knee arthroplasties for improving one's quality of life.[16] However, total shoulder arthroplasty has been less than optimal for treating shoulder arthropathy due to the loss of force coupling of the supraspinatus-deltoid complex.[17-20] Active contraction of the rotator cuff is necessary in order to produce a perpendicular force vector within the glenoid concavity to prevent a "rocking horse phenomenon" whereby the humeral head subluxes proximally onto the glenoid rim and can lead to loosening of the glenoid component.[12,14,17,19-24]

Hemiarthroplasty is currently the most widely used surgical intervention for shoulder arthritis with associated irreparable rotator cuff tear, but it also has resulted in poor functional outcomes and inconsistent pain relief.[2,7,19,23,25-28] The poor outcome has been because of the inability to attain sufficient caudal and medial relocation of the center of rotation of the humeral head, causing subsequent upward displacement and glenoid loosening. Active elevation rarely exceeds 120° following this procedure.[9,14,17,23,26,27,29]

In response to the traditional anatomic joint reconstruction, Boileau[30] notes that several authors in the 1970s and 1980s designed reverse total shoulder prostheses in which the convex-concave relationship of the joint partners was reversed. However, for each of these 'semi-constrained' prostheses, the center of rotation of the humeral component was lateral to the glenoid, leading to high torque moments exerted on an already frail glenoid, and subsequent glenoid loosening with high complication rates.[19,31-33]

REVERSE TOTAL SHOULDER PROSTHESIS

During the evolution of the reverse prosthesis, which was designed in 1985 by Grammont,[34] two more current versions of the prosthesis have been developed and used in France since 1991[30]: the Delta III™ (DePuy, Warsaw IN) and the Tornier Aequalis Reversed Shoulder Prosthesis™ (Tornier SA, Montbonnet, FR).[8,19] These prostheses have been made available in the US following FDA approval in 2003 and 2004, respectively, and have been followed by 2005 FDA approval of the Encoure Reverse Shoulder Prostheses (Encore Medical Corp, Austin, TX; Harman) and the Zimmer Trabecular Metal Reverse Shoulder Prosthesis (Zimmer, Warsaw IN).

The reverse total shoulder prosthesis relies almost entirely on an intact deltoid muscle rather than a rotator cuff.[5,11,14,34,35] The reversal of glenoid and head components provides stability and creates an increased moment arm for the deltoid to elevate the shoulder and prevent superior migration of

the humeral head (Figure 1). Compared to previous prostheses, Grammont's concept is unique in that: (1) the glenoid component is larger (36-42mm);[19] (2) the center of rotation is medialized;[19] (3) the humeral neck angle is nonanatomic and more horizontal (~155°);[14] (4) the wrapping angle is decreased;[36,37]and (5) the deltoid insertion is lowered.[11,20,34,38] Seebauer et al[9] and Grammont & Baulout[34] report that a 10 mm displacement of the glenohumeral center of rotation caudally and proximally resulted in a respective 20% and 30% increase in the moment of rotation of the deltoid. Research suggests the reverse total shoulder arthroplasty is indicated in 5 patient scenarios: (1) primary osteoarthritis or rheumatoid arthritis of the shoulder with massive and irreparable rotator cuff tear;[9,19] (2) fracture sequelae of the comminuted proximal humerus with tuberosity malposition and nonunion;[19] (3) revision of previously failed arthroplasty secondary to cuff tear arthropathy;[19] (4) failed rotator cuff surgery with subsequent anterior-superior shoulder instability and coracoacromial arch violation;[5,39] (5) following oncologic eradication of proximal humeral tumors with associated rotator cuff resection.[36] The surgical approach is typically deltopectoral with or without detachment of the anterior deltoid in patients with osteoarthritis, though a anterosuperior approach, superolateral, or a transacromial approach may be indicated or preferred by the surgeon.[4,9,11,14,20,28,40,41] A review of the literature shows that most reported cases for the reverse shoulder surgery have provided patients with a very good to excellent outcome (Table 1). These studies all used the Constant-Murley Scale as their method of assessing patient outcomes.

REHABILITATION CONSIDERATIONS FOLLOWING REVERSE SHOULDER ARTHROPLASTY

Other than one rehab protocol designed by Grammont and Baulot,[34] minimal research has been published concerning the rehabilitation following the reverse total shoulder arthroplasty. Most authors currently recommend the use of an abduction pillow and shoulder immobilization for 4 weeks post-op, with the initiation of PROM within standard limits (90° elevation, 0° external rotation) in the acute phase.[19,34,38] After 4 to 6 weeks, patients are typically managed with a sling as they initiate AAROM, with AROM to begin during week 9, and resisted therapeutic exercise to begin during week 12.[19,34,38] Physical therapy intervention in research published by Werner et al[11] is notably different than the protocol described by Grammont and Baulot,[34] however. Therapy was initiated on post-op day one, with passive and active mobilization in a pool as soon as suction drains were removed. Between PT sessions, a sling was used, but never an abduction brace. After 2 weeks, unrestricted AROM was encouraged as tolerated. The lack of published rehabilitation guidelines and general research on this surgical procedure was the motivation for writing this case report. The purpose of this case report was to highlight the rehabilitation progression and outcomes of a patient who received a Reverse Delta III Shoulder Prosthesis.

CLINICAL CASE REPORT

Patient History

A 72-year-old white male was initially evaluated 19 days postoperatively following an implantation of a Reverse Delta III Shoulder Prosthesis in the right shoulder on August 3, 2005. The patient was a candidate for this shoulder based on a previous cuff tear and subsequent repair in 1996 and then a re-rupture of the same cuff muscle following a recent fall in February 2005. He also had significant pain and disability in conjunction with osteoarthritis of the glenohumeral joint. Faced with continued disability and nonfunctional use of the right upper extremity the patient agreed to have the procedure in order to restore upper extremity function and relieve pain.

The rehabilitation goals and exercise progression for this patient are summarized in

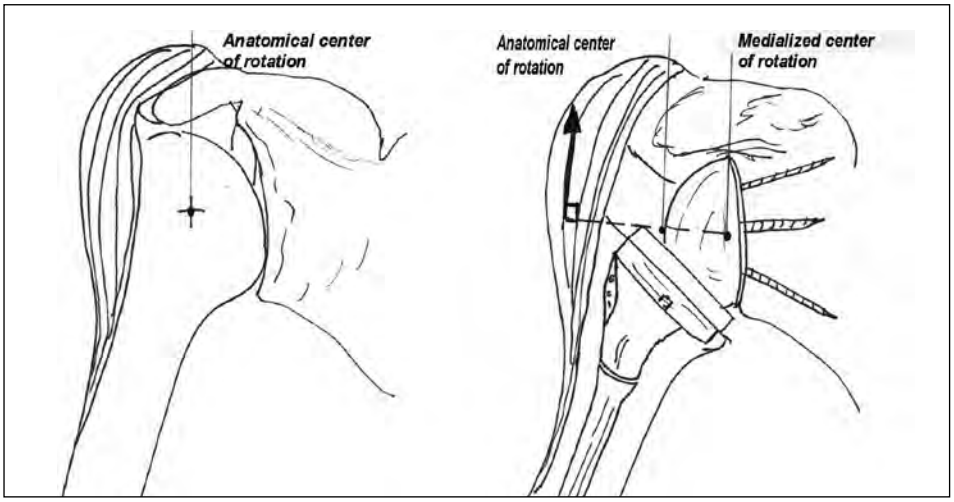

Figure 1. Incresed mechanical advantage created by Reverse Delta III Shoulder Prosthesis.

Table 1. Outcomes Table for Past Studies on Reverse Total Shoulder Arthroplasty

Author	N	Mean Age	Prosthesis	Avg. P/O Months	Total Constant Murley Scale (100)	Constant-Scale: Pain (15)	Constant Scale: Activity (20)	Constant Scale: Active Mobility (40)	Constant Scale: strength (25)	ABD ROM (Deg)	Flexion ROM (Deg)	ER ROM (Deg)	Personal Satisfaction
Frankle et al[3]	60	71	RSP‡	33						41.4-101.8 *	55-105.1*	12-41.1*	95%
Sirveaux et al[4]	80	73	Delta III™	44	23-66**	-42					73-138**	11.2	93%
Seebauer et al[9]	57	70	Delta III™	18.2	to 67	to 13**	to 14.8**	to 28.1**	to 10.5**	to 140**	to 145**		98%
Werner et al[11]	58	68	Delta III™	38		5.2-10.5 *				43 - 90*	42-100*	17-12	
Vanhove & Beuginies[12]	32	71	Delta III™	31	to 60	to 12**	to 14**	to 27**	to 7**				92%
Boulahia et al[14]	16	72	Delta III™	35	22-59*	2.8-12.8 *	4.2 -14.8 *	12.5-25.9*	1.5→5.4*		70-138 *	6-3	
Rittmeister & Kerschbaumer[20]	8	58	Delta III™	54	17-63**	1.6-14.1**	5.8-13.5**	5.3-28 **	4.5 -7.3 **				100%
Boileau et al[30]	45			40	17-59*						55-121*	7-11	78%
De Wilde et al[36]	4	42	Delta III™	38	to 85	to 13.75	to 19.3	to 34	to 17.5	to 175	-169	to 6.75	
Valenti et al[41]	39	70	Delta III™	84	21-63	3-13	6-14	9-28	3-8		60-120	10 to"behind head"	
Jacobs et al[44]	7	72	Delta III™	26	18-57*	1.4-12 **	4.3-12.3**	11-24.6 **	<4→7.7 **	<90->90	<90->90		

Reverse Shoulder Prosthesis

*Significant at P<0.05 level
**Significance not reported

Figure 2. Early rehabilitation efforts focused on facilitation of healing, pain control, patient education, and protection of the deltoid. Progression was then made based on patient tolerance and postsurgical healing. Passive range of motion on initial evaluation was 160° flexion, 30° external rotation, and 60° internal rotation. The patient was in an abduction pillow for 4 weeks and standard precautions were explained to the patient to not actively lift the arm and to use the sling at all times.

For the first 5 weeks of rehab, the patient's therapy consisted of shoulder isometrics in all directions, passive external and internal rotation to tolerance on an Isokinetic machine (Biodex) in the modified neutral shoulder position, standing scapular retraction exercise using light resistance tubing, seated upper body exercycle, proprioceptive closed kinetic chain mobility by performing scapular depression using a paddle on a physioball in standing with a slightly abducted shoulder position (15°) , light external rotation oscillations with a body blade to neutral, manual therapy for general shoulder stretching and mobilization, electrical stimulation to the deltoid and posterior cuff musculature, as well as cryotherapy. The home exercise program for this patient was begun the first week and consisted of light isometric strengthening, active assisted elbow flexion exercise, and towel gripping for increasing hand strength. The patient was also given forward flexion towel slides while seated at a table. As the patient tolerated the exercise intensity was increased by having the patient perform more repetitions, greater resistances, and increased time for isometric contractions.

After post-op week 9, we felt it was safe to directly strengthen the cuff and scapular stabilizers. Since one of the complications following this surgery can be shoulder instability we proceeded with caution. The following exercises were progressively added to his program at weeks 13 to 15 to restore force couple mechanics and enhance dynamic stabilization: tubing external rotation to neutral using red and green thera-band tubing, prone trap strengthening using 2 to 3 pound weights, sidelying ER using 2 pounds, free weight elevation with a 1 pound weight in the scapular plane (scaption), chest passes using a weighted (red) ball against a plyoback, and active-assisted and isokinetic internal and external rotation on the isokinetic machine in the modified neutral position.

RESULTS

We saw this individual a total of 29 visits over 15 weeks. On discharge the patient had achieved a good outcome. His passive range of motion was 175° flexion, 90° external rotation, and 60° internal rotation. Actively he still presented with a shrug with shoulder elevation to 140°, and was only able to pass trunk midline in reaching behind the back. He also achieved a manual muscle test grade of 3+/5 for external rotation with the arm in neutral position with the elbow flexed 90°. However his pain was minimal. At the time of discharge he was still not able to complete more vigorous ADLs that involved lifting more than 10 pounds overhead, but he was very pleased with his progress and his significant reduction in pain.

Follow-up

A follow-up exam was performed on the patient 8 months post-op. The simple shoulder test (SST) was administered and the patient was interviewed with regard to his most recent functional success with his desired activities. The patient successfully answered yes to 11 out of 12 items on the SST. The exception being item 7 (Can you lift eight pounds (a full gallon container) to the level of your shoulder without bending your elbow?). However, the patient did not complain of pain during performance of any of the movements required during the simple shoulder test. Prior to shoulder surgery the patient was unable to successfully perform any of the items described on the SST due to pain and weakness and loss of range. The patient was extremely pleased with his results and reported no limitations in his activities for daily living. His most

Weeks 3-8 postoperatively: facilitate healing, protect deltoid, preserve and restore passive range of motion

- Submaximal isometrics for scapular stabilizers and light stimulation of cuff musculature
- Passive motion exercise for internal external rotation in modified neutral position on Isokinetic machine (Biodex)
- Modalities for pain control and muscle stimulation included cryotherapy and muscle re-education
- manual therapy for general shoulder stretching and mobilization
- Home exercise program compliance
- Patient education with regard to healing and use of abduction pillow

Weeks 9-12: Begin light strengthening, proprioception, and scapular stabilization exercises

- Initiate select active assistive exercises ie, upper body ergometry, proprioceptive closed kinetic chain mobility using paddle on physioball, light vibratory motions using body blade with arm moving from neutral position into slight external rotation
- Light strengthening progression: scapular retractions using theraband tubing
- Continue stretching program
- Modalities as needed to control for inflammation and pain

Weeks 13-15: progressive strengthening added to restore force couple mechanics and enhance dynamic stabilization

- tubing external rotation to neutral
- prone trap strengthening with isotonic load
- sidelying ER with isotonic load
- scaption with isotonic load
- chest passes into a plyoback active-assisted effort for internal and external rotation in neutral plane using isokinetic machine (Biodex)

Figure 2. Goals in rehabilitation for Reverse Delta III Shoulder Arthroplasty.

Figures 3-6 Patient active range of motion in right shoulder at 8 months postoperatively.

Figure 3. Active elevation.

Figure 4. Active abduction.

Figure 5. Ability to clasp hands behind head.

Figure 6. Active reach behind the back.

rigorous activity was pulling logs along with other yard work which he said he was able to do without pain. Physical exam results during the follow-up visit revealed symmetrical active shoulder flexion compared to left upper extremity with minimal shoulder shrugging, good reach behind the head with hands clasped, and functional range of motion to waist level when reaching behind the back. Figures 3 through 6 demonstrate this patient's active mobility 8 months after having shoulder surgery. Goniometric measurements passively while the patient was supine were: 175° shoulder flexion, 90° external rotation with the shoulder placed in 90° abduction and also 60° of internal rotation. Manual muscle testing indicated the presence of subtle weakness with shoulder abduction 4-/5 and shoulder external rotation 4+/5 with the upper extremity placed at the side (neutral) and elbow flexed to 90°.

DISCUSSION

We chose to use the Simple Shoulder Test to assess this individual's outcome because it is a patient-derived questionnaire and has been noted to provide a high level of agreement with surgeon assessments of outcome function following shoulder surgery.[42] The simple shoulder test consists of 12 functional items, and does not directly assess pain, ROM, or strength. It has been shown to have predictive value for predicting improved motion, strength, and patient satisfaction.[43] Comparing scores on the dichotomous SST to the 100 point Constant – Murley Scale are difficult as both outcomes scales have limitations. One scale may not be adequate to capture a patient's perceived progress with regard to mobility and pain relief.

Comparing our patient's range of motion values to those reported in the literature (Table 1) revealed a greater than expected outcome in regaining external range of motion and shoulder flexion. The gain in external range of motion is significant because external rotation motion is unable to be independently controlled by the deltoid without an intact rotator cuff. This deltoid rotator cuff force coupling is also necessary in elevation and abduction. Only the presence of an intact teres minor can prevent a Hornblowers sign (weakness of external rotation with 90° abduction).[4,11,14] Interestingly the in-vivo kinematic study by Mahfouz et al[8] comparing a normal shoulder, a rotator-cuff deficient shoulder, a shoulder following total arthroplasty, and a reverse total shoulder, the reverse total shoulder group demonstrated kinematic and kinetic patterns most similar to those of the normal shoulder. In these subjects, scapular rotation provided the greatest contribution to overall arm elevation.

Like any other surgical procedure it is important to note that reverse shoulder arthroplasty is not without complications. In studies by Werner et al[11] and Hatzidakis et al,[19] 33% and 22% of subjects respectively required further surgery in order to treat complications. Glenoid notching has been radiologically confirmed in ≥50% of subjects in several studies.[11,12,19,30,41,45] Using fluoroscopic examination, Boileau et al[30] postulates that the notching is secondary to impingement of the medial aspect of the polyethylene cup in the adducted extremity. Despite a high percentage of scapular notching, Hatzidakis et al[19] report that none of the patients under study were symptomatic. As with any joint arthroplasty the probability of component loosening, instability and ultimate prosthetic durability (glenoid or humeral components) can be influenced by proper rehabilitation, patient activity level, and prudent use of the extremity.

CONCLUSION

We have presented a case of successful rehabilitation of a patient who required a unique shoulder replacement procedure. This patient was selected to describe our rehabilitation approach for this rather unique surgical procedure. The greater knowledge a physical therapist has regarding a surgical procedure the greater the likelihood that an appropriate rehabilitation program can be developed. Long-term results of greater numbers of patients following a reverse shoulder procedure still need to be published.

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Pigmented Villonodular Synovitis of the Knee in a 7-Year-Old

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Dr. P.C. Wali; Dr. Shonali S; Dr. Shilpa P

ABSTRACT

We report a case of pigmented villonodular synovitis of the left knee in 7-year old girl. She presented with only swelling of knee joint. The diagnosis of pigmented villonodular synovitis was confirmed by its classical microscopic findings. Our case report emphasizes the importance of considering pigmented villonodular synovitis in the differential diagnosis of children presenting only with swelling over knee joint for short duration.

Key Words: pigmented villonodular synovitis, swelling, children, knee joint

INTRODUCTION

Pigmented villonodular synovitis is a rare disorder with typical monoarticular involvement affecting most commonly the knee joint.[1] Its yearly incidence is of 1.8 cases per million population.[2-5] The etiology of pigmented villonodular synovitis remains controversial. The most widely held theory is that the disease is an inflammatory reaction of the synovium. However, some evidence exists that it is a benign neoplastic process. Pigmented villonodular synovitis (PVNS) has 2 forms—diffuse and nodular.[4-6] Nodular forms occurring most commonly in the hands and diffuse once affecting knee joint. Pigmented villonodular synovitis generally occurs in patients between the ages of 20 and 45 years, but it has been found in patients as young as 11 years and as old as 70 years and it affects males and females equally.[7] Pigmented villonodular synovitis remains a diagnostic challenge. The difficulty stems from the insidious onset and nonspecific presentation of the disease, as well as its subtle radiographic findings. It usually presents as painless or mildly painful joint with swelling. MRI and biopsy are the gold standard for its diagnosis.[8-10] We report this rare condition with atypical presentation.

CASE REPORT

A 7-year-old female child presented with complaint of solitary swelling over popliteal fossa of left knee joint for last the last 3 months (Figure 1). Swelling was progressively increasing without any associated symptoms such as pain or restriction of joint motion. On examination this solitary swelling was soft to firm in consistency, movable, and located over the lateral aspect of the popliteal fossa. She had full range of motion. Radiographic evaluation and routine blood investigations did not reveal any pathology. She was then treated with surgical excision of this pedunculated mass. This pedunculated mass was sent for histopathological reporting. Microscopic findings suggested features of pigmented villonodular synovitis (Figures 2, 3, 4). Postoperatively this patient was mobilized on postoperative day 5 with full weight bearing. To start with passive knee exercises were advised followed by active movements. By postoperative day 10, she was able to walk without any support and discomfort.

DISCUSSION AND CONCLUSION

Pigmented villonodular synovitis is a rare condition. It commonly affects the knee joint. Other joints involved are hip, ankle, and shoulder. It has 2 forms—localized pedunculated and diffuse.[5,6] A diffuse form affecting knee joint was first reported in 1909. The term PVNS was adopted by Jaffe et al in 1941.[11] These patients usually present with mechanical symptoms of joint.[11-13] Grossly this growth has brown to yellowish color. Its microscopic findings include synovial cell hyperplasia both on the surface and below the synovium. Also present are hemosiderin-laden multinucleated giant cells, lipid-laden macrophages, and fibroblasts. The ubiquitous presence of hemosiderin lends the tissue the characteristic pigmented appearance. The pathologic differential includes hemosiderotic synovitis, rheumatoid arthritis, and synovial chondromatosis. Treatment of PVNS is surgical excision.[8-10] In diffuse forms, along with surgical excision, involved bone has to be currated if required reconstructive procedures have to be done. Diffuse forms are known to have high recurrence rate. Some authors advise postoperative radiotherapy (35 Gy in 15 fractions) in cases of high risk of recurrence.[14-16] The family physician plays a crucial role in the early diagnosis and treatment of pigmented villonodular synovitis. Because patients often present initially with vague complaints, early diagnosis requires knowledge of the common symptoms and radiographic features of the disease. Our reported case is localized pedunculated form of pigmented villonodular synovitis affecting knee joint but with atypical features. These include age of presentation, commonly seen in 3rd and 4th decade, but our patient was a 7-year-old child. As for our literature search

Figure 1.

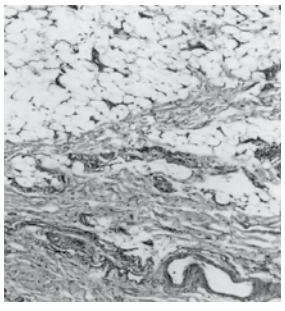

Figure 2.

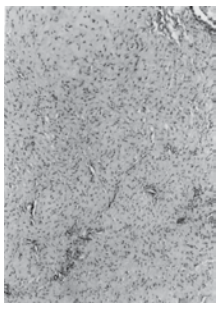

Figure 3.

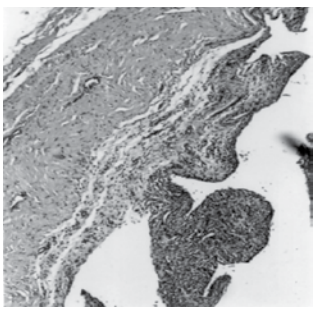

Figure 4.

Figure 5. Postoperative photograph (3rd Day).

Microscopy showing synovial cell hyperplasia both on the surface and below the synovium. Also present are scattered giant cells, hemosiderin, and foam cells (Hemotoxylin and Eosin).

it is one of the youngest reported cases. They usually present with chronic history of mechanical symptoms of affected joint. But our case had only painless solitary swelling for short duration of 3 months. These nodular forms of villonodular synovitis are commonly seen in the hand but in our case it was affecting the knee joint. In our case radiographic imaging did not show any musculoskeletal abnormality. Thus we emphasize the importance of considering pigmented villonodular synovitis in the differential diagnosis of children presenting only with swelling over popliteal aspect of knee joint for short duration.

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HELLO OHSIG MEMBERS

We hope you received the OHSIG email newsletter that was sent a couple weeks ago, updating you on OHSIG activities. If you did not receive the email blast, please contact Jen Steiner, Membership Chair; she can be reached at Jennifer.steiner@healthsouth.com. This is our way of keeping you informed.

Task Force Update:

(1) OSHA Alliance – Kathy Rockefeller and Drew Bossen, the Task Force Co-Chairs, along with Barb McKelvy and Margot Miller are in the final phase of selecting 3 members from the OHSIG membership to participate in this initiative. This has been a difficult decision as we had 12 excellent candidates interested in participating. Final notices should be sent by mid-April to all candidates.

(2) Occupational Health Specialization Certification – The Task Force finalized the survey for OHSIG members and members of the Orthopaedic Section. We hope you received your email survey and responded. We need 300 signatures from therapists who indicate they will sit for the exam within 5 years of an exam being offered. This will be part of the information we provide ABPTS, in support of the certification process for Occupational Health Specialization. If you have not responded to the survey, please do so. Our next step is to get 100 letters of support for therapist specialization from employers, physicians, insurers, etc.

If you have questions, comments, or if the Board can serve you better, please contact any one of us. You can find the OHSIG officer listing at www.orthopt.org. Remember, we work on your behalf!

Sincerely,
Margot Miller PT
OHSIG President

CASE STUDY: REDUCING WORKERS COMPENSATION COSTS BY UTILIZING A FORMAL TRANSITIONAL WORK PROGRAM AND ONSITE THERAPY

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The Ohio Bureau of Workers' Compensation (BWC) continues to implement programs to decrease workplace injuries, control claims management, and improve workplace safety. One of the major initiatives of Ohio BWC is the Transitional WorkGrants Program. This was introduced in January 2001 to educate and help Ohio employers pay for the development of transitional work programs. As of December 2004 a total of 4576 Ohio employers had implemented formal transitional work programs. Many other employers are using onsite therapy and transitional work for their injured employees without the formal program, but with written policies and procedures. This case study highlights one Northeast Ohio manufacturing company that has benefited greatly from the formal transitional work program and onsite therapy.

This company has both heavy and repetitive lifting requirements. They do, however, stress safety and encourage the workforce to request help when needed. I first met with them and their Managed Care Organization (MCO) representative in November 2002 to discuss implementing an Ohio BWC Transitional WorkGrant Program (TWP) to help them reduce their workers' compensation costs. They were penalty rated based on their 4-year claims history for 1999 through 2002. The majority of these injuries occurred in the production departments such as material handling, manufacturing, warehouse, shipping, and packaging/labeling. Most of their claims were sprain/strains, burns, and lacerations. They had 92% medical only claims and 8% lost time claims. They had over 100 lost work days and over 800 restricted duty days. Ohio defines a claim as being medical only if the injured worker returns to work within 7 days. The claim is defined as a lost time claim if they do not return to work within that time frame. All lost time claims become significantly more expensive due to the reserve dollars and other indirect costs that become additional costs of the claim. The Ohio BWC statistics show that the average medical only low back sprain/strain costs $750. And this cost increases to $36,000 for a similar diagnosis lost time claim.

The TWP for this company was implemented in January 2003 and has been very successful. The first stage of development of the TWP was the corporate analysis. Corporate analysis is the first step for all Transitional Work Programs. Next as a Transitional Work Developer (TWD), I completed the functional job task analyses. Once these were completed we met with the company's TWP Committee. The TWP committee included members of management and labor. In conjunction with the TWP Committee, we developed policies and procedures and set up a preferred provider list. We then presented an education program to an audience that included the providers and all employees, in a required meeting for the entire company.

The company had a written policy and procedure for reporting accidents/incidents immediately; however, they did not have any documented return-to-work policies. They relied solely on physician's orders and restrictions, which was identified during the corporate analysis portion of the program. The company also identified numerous barriers to returning their injured workers to work in a timely basis. The 3 major barriers identified were:

- physician and other providers' lack of knowledge regarding the worker's job;
- poor communication between the providers and the company; and
- extensive injured worker's restrictions with vague and confusing interpretation of the restrictions.

Since implementing the program, the human resources department has worked hard to ensure utilization of the company's new TWP policies and procedures to manage their work-related injuries. In doing so, they have become very proactive. The accident reports and first report of injuries are being completed immediately and the workers are being seen by an occupational medicine physician the same day of the injury. Physicians are aware of the company's TWP program and their desire to initiate onsite therapy within 48 hours of injury, if needed. The onsite therapy has reduced their average number of required therapy visits from over 30 in the clinic to 5.88 visits onsite, with a range of 2 to 12 visits for the injured workers who have required therapy. All of these workers have returned to full duty within a few weeks.

Since implementation of the transitional work program in January, 2003 through mid-2005, the company has reported the same rate of medical only claims but NO LOST TIME CLAIMS. Their average lost work days per year have improved by 61% and the average restricted duty days per year have improved by 87%. They are no longer penalty rated, and they anticipate that they will progress to being group rated again next year.

The Transitional Work Program, with its sports medicine approach to occupational injuries has proven to be beneficial for both the injured worker and the company with impressive outcomes. The employee benefits include:

- Ability to retain full wages and benefits rather than the BWC reduced rates.
- Continued interaction with co-workers.
- Minimization of de-conditioning.
- Maintenance of positive relationships in the workplace.
- Emphasis on the role of the employee as a part of the team.
- Building of trust with resolution of uncertainty regarding return to work issues.
- Reduction or elimination of return to work fears through the progression of job tasks.
- A focus on prevention of reinjury.
- Ability to work with a physical therapist who has actually observed their job and knows their required functional duties.

The employer benefits include:

- Elimination of 'light duty forever' programs.
- Reduction in workers' compensation and absentee costs.
- Promotion of a team effort for return to work.
- Maximization of the employee's productivity while following the physician's restrictions.
- Demonstration of concern for the employee.
- Enhanced utilization and retention of skilled workers.
- Utilization of work-focused 'real life' interventions.
- Written and individualized plans for each worker.
- A time and task progressive process.
- Provision of a 'team' that gets to the root cause of the problem, including work site evaluation for ergonomic intervention, if needed.
- Assistance in case resolution by the physical therapist who can function as a mediator, arbitrator, advocate, and /or objective observer.

The company is very pleased with the program. They hope that together with the occupational physician and the physical therapist, they can continue to even better control their workers' compensation claims and costs. Two major factors have been identified for the program's success. The first is the improved communication among the providers, the injured workers, and the company. The second is that the onsite therapy is more specific to the injured worker's functional needs, ergonomic issues are better addressed, and compliance is improved because the therapy is provided during work hours while the injured worker is still on the clock. This company has demonstrated how an employer can grow from being penalty rated to a positive model for proactive and successful management of workers' compensation costs.

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IN-SHOE PRESSURE ANALYSIS IN THE TREATMENT OF A RUNNER WITH A HISTORY OF 'SHIN SPLINTS'

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INTRODUCTION

'Shin splints' are one of the most common nontraumatic overuse injuries experienced by the running athlete.[1] Originally defined as anterior lower leg pain resulting from repetitive overuse during walking and running, the term 'shin splints' is not a specific diagnosis but rather a label commonly used to describe a cluster of lower leg impairments.[2]

Upon closer inspection most runners complaining of 'shin splints' are diagnosed with posterior tibialis tendonitis or tibial stress fractures (TS), which collectively account for as much as 15.8% of all running injuries.[3]

Medial tibial stress syndrome (MTSS) is a term more recently introduced to characterize pain and tenderness along the inner distal 2/3 of the tibial shaft that is commonly associated with periostitis but does not include TS.[2,4] The MTSS and TS may occur independent of one another, however, if not identified and treated early, MTSS can lead to stress fracture formation.[4,5]

The vertical ground reaction force of running has been measured to reach as high as 2 – 3 times body weight.[6] This means that if an individual weighing 150 lbs ran 1 mile taking an average of 800 foot strikes, each foot would be subjected to 120 tons of force.[6,7] Or, based on the same projection, if the same individual ran a 26-mile marathon each foot would be subjected to 3000 tons of force.[6,7]

Although such high forces are believed to be the primary cause for both MTSS and TS, to date a clear pathomechanical model for either condition has not been identified.[4,8] In addition to the repetitive exposure to high forces, significant associations have been found to exist between over-pronation, structural mal-alignment, improper footwear ,and MTSS and/or TS.[2,4,8-15]

As an interface between the foot and the ground, running shoes have the potential to affect the ability of the LE to attenuate the load of impact. The role of a running shoe is to support and guide the lower extremity during the gait cycle while protecting the foot and LE from the deleterious affects of excessive impact without imparting negative influences on the runner.[9] When effective, the cushion provided by a running shoe absorbs the impact force of foot strike, stores it during the stance phase and returns it to the runner at the time of push off while optimizing the biomechanical shock absorbing system of the LE. The properties of shock absorption and support provided by running shoes are known to affect the degree and rate of pronation, the magnitude of the vertical ground reaction force (VGRF), the magnitude and rate of tibial strain, and coordination strategies employed by the LE to attenuate force during impact.[14,16-20]

The purpose of this case study is to describe the **effect** of running footwear design characteristics on measures of in-shoe forces and patient symptoms in an elite runner with a history of MTSS and TS.

CASE REPORT

A 22-year-old competitive male distance runner referred himself to be evaluated for 'shin splints.' This young man's chief complaints included bilateral shin and left lateral ankle pain which limited his ability to train and compete. This patient wanted to continue to run competitively and compete at a professional level. Prior to attending this evaluation the patient had previously worked with a variety of health care providers including podiatry, orthopaedics, and physical therapy all of which resulted in unsuccessful outcomes.

This patient is a distance runner, typically competing in 5K races. When training, his average weekly mileage was 75 miles/week, however, on occasion he ran as many as 90 miles/week. In general this patient felt best running out-doors or on an outdoor track and found that a flat indoor track caused the worst pain in his shins and left lateral ankle.

The shin pain and left lateral ankle symptoms started 5 years earlier when he was competing in his freshman collegiate year. Previous to this time, the patient had been successfully running in the Asics DS Trainers without any problems. However, in his freshman year the patient reports that Asics changed the design of the DS Trainer, increasing its medial post after which point he was no longer able to run in that shoe without issue. Based upon a recommendation he then tried running in the Saucony Grid Hurricane, however, that seemed to precipitate his left lateral ankle pain which was later diagnosed as subtalar joint inflammation by an orthopedist. The patient was then fit with custom molded orthotics which helped reduce the subtalar joint symptoms; however his shin pain worsened, resulting in TS. Through out his college running career, this patient continued to experiment with different orthotics and running shoes finding some relief but not enough to compete at the level he desired and not enough to prevent chronic problems, such as MTSS and TS. Based upon the patient's report it was difficult for anyone to find a solution to his problems, since techniques that reduced the shin pain worsened the ankle pain and vice versa.

At the time of this evaluation the patient had been running in the Nike Air Pegasus, which he felt was the best he could find, but was still not as comfortable as the original Asics DS Trainers he ran with in high school.

The author examined the patient for structural alignment and soft tissue extensibility and strength as described in the literature.[21,22] The significant findings of this evaluation are listed in Table 1.

The patient demonstrated excessive pronation through out all phases of stance bilaterally, and mild left in toeing compared to the right side during both walking and running, barefoot, and with the Nike Air Pegasus running shoes. In fact, his gait deviations appeared to be worse in the Nike Air Pegasus running shoes than when he was barefoot.

The Nike Air Pegasus running shoes were less than 1 month old; however, there was a clear wear pattern consistent with over-pronation. In addition, this running shoe did not properly fit the patient's foot shape causing his foot to roll over the lateral out-sole of the forefoot.

Clinical Decision Making

This patient presented with a complicated clinical history. He was a competitive runner with good training and nutrition habits, physical strength, and flexibility. The manifestation of MTSS, TS, and lateral ankle/STJ pain appeared to be related, however, prior intervention that helped control over-pronation worsened his lateral ankle pain and visa versa. He demonstrated an abnormal over-pronatory gait pattern that would typically be treated with corrective foot orthotics and motion control running shoes; however, such previous intervention had not been successful for this patient.

The author paid particular attention to the fact that this patient identified an interaction between running shoe characteristics and his symptoms, suggestive of pathologic influences at the foot-ground interface.

Plan

Based upon the author's biomechanical knowledge and resources as well as clinical experience it was suggested that advanced biomechanical analysis of running shoe effects be studied in this patient. The author's clinic is equipped with an in-shoe pressure analysis system that allows for reliable and valid analysis

Table 1.

Past Medical History: bilateral 'shin splints', left proximal tibial stress fracture diagnosed 10 months prior, left lateral ankle pain diagnosed as subtalar joint inflammation and occasional left low back pain of unknown origin			
Age	Height	Weight	Shoe Size
22	5' 11"	145.5 lbs	10.5 medium
Standing Posture: Elevated right iliac crest, right genu varum, right knee slightly flexed, bilateral tibial varum measured as 8° and 6° on the left and right respectively, bilateral rearfoot valgus with relatively abducted, dorsiflexed and everted forefoot alignment - consistent with the 'too many toes sign.' Additional testing demonstrated slight right rib hump with forward bending and limited passive dorsiflexion of bilateral 1st MTPs in relaxed stance – consistent with an impaired windless mechanism			
Non-weightbearing Findings:			
	Left	**Right**	
Leg Length: (ASIS – Medial Malleoli)	91.5 cm	91.5 cm	
Shank Length:	37.5 cm	38.5 cm	
Hip PROM	With in functional limits	With in functional limits	
Muscle Length	Moderately decrease hamstring length but still within functional limits	Moderately decrease hamstring length but still within functional limits	
Q- angle	2° varum	2° varum	
Tibial Torsion	Significant internal tibial torsion bilaterally L >> R		
STJ Axis orientation	Bilateral increased angle of inclination in the sagittal plane and a medially rotated orientation in the transverse plane		
Rearfoot frontal plane position in STJN	2° varus	2° varus	
Forefoot frontal plane position relative to rearfoot in STJN	4° varus	3° varus	
1st Ray position relative the lessor tarsus in the sagittal plane	Slight dorsiflexion	Within normal limits	
1st Ray passive motion in the sagittal plane	Semi-rigid	Semi-rigid	
1st MTP non- weightbearing passive dorsiflexion	30°	35°	

of force related measures during both walking and running.[23]

At the time of the initial visit in-shoe plantar pressure data was collected of this patient running on a treadmill in the Nike Air Pegasus running shoes. Secondary to time restrictions the data was not analyzed at that time.

Intervention

Based upon the author's knowledge of athletic shoe design and clinical experience, it was recommended that the patient switch to the Brooks Dyad running shoe. The Brooks Dyad was thought to be a better shoe for this patient in both fit to foot shape and construction of midsole; however, both the Nike Air Pegasus and the Brooks Dyad are classified as cushioned running shoes.

Follow up

The patient returned with the Brooks Dyads one week later, at which time in-shoe plantar pressure data collection was repeated. The new running shoes felt good to the patient and based upon visual observation, his gait deviations were less than when he was in the Nike Air Pegasus. The patient was instructed to break the shoes in as tolerated using them for both running and walking and asked to follow up 2 weeks later for reassessment. The data for both running conditions was analyzed after the patient left. The results of the data were not disclosed to the patient at this time to avoid influences of bias.

At the 2 week follow up appointment the patient reported a significant reduction in both shin and lateral ankle pain. He stated that this was the first time in a few years that he was able to run with out his orthotics. In-shoe pressure analysis was repeated using the 2 week old Brooks Dyads. Again the data was analyzed and compared to the prior conditions after the patient left. Following the third data collection session the patient returned to the clinic to view the results of the running trials.

Methods

The F-Scan® Mobile System is an untethered pressure analysis system manufactured by Tekscan, Inc. that records bipedal plantar pressure. For this analysis, thin in-shoe pressure sensors were used to quantify pressure, force, and relative timing during the contact phase of both treadmill running and walking. The pressure sensing insoles are composed of a thin flexible polymer in which 960 ink-based force-measuring cells reside. Each cell measures force that is then used to calculate plantar pressure. All measures related to in-shoe vertical ground reaction force and timing can be calculated using this system.

New foot sensors were used for this patient. Each sensor was trimmed to fit the patient's foot and shoe size, and conditioned per Tekscan to ensure reliability of sensor readings. The patient was fit with ankle cuffs that connect to the sensor tabs. The ankle cuffs collect and process sensor data and deliver it by cable to the F-Scan® Mobile receiver unit attached to a waist belt worn by the patient. After conditioning the sensors, each sensor output was calibrated to the patient per Tekscan. Once the calibration process was completed and data collection parameters set, the F-Scan® Mobile receiver was triggered to collect data and disconnected from the laptop computer. Data was collected at 100 Hz for 10 seconds. Each data collection period was externally triggered. Once the trials for each condition were completed, the F-Scan® Mobile receiver unit was reconnected to the pc and the data was downloaded and saved using the F-Scan® Mobile software. The sensors were re-calibrated for each testing condition within and between days. The data from each test condition was analyzed using the research software and Timing Analysis Module (TAM) provided by Tekscan, Inc.

Data Processing

Single stance phase and averaged stance phase data for each testing condition was analyzed using Tekscan's TAM and research software. The single stance phase that best represented the averaged data of all stance phases collected for each condition was analyzed to measure specific variables of the loading and propulsive phases of running gait. The averaged data was used to analyze the contact and propulsive phases of gait as whole units. The center of force (COF) and center of force trajectory (COFT) of a stance phase for each testing condition was qualitatively analyzed.

Definitions

Contact phase is defined as the entire stance phase of gait, beginning with initial contact and ending with foot off. This phase encompasses both the loading and propulsive subphases of gait.

Loading phase is a subphase of the contact phase and is defined as the interval starting with initial contact and ending with foot flat. This phase corresponds to phase in which the LE functions to attenuate the impact forces of running.

Peak load is defined as the magnitude of peak force that occurred during the loading phase.

Propulsive phase is a subphase of the contact phase and is defined as the interval beginning just after **foot flat period** and ending with the push off.

Peak propulsion is the magnitude of peak force that occurs during the propulsive phase.

Center of force is the resolution of all vertical forces applied to the contact area, to one point. This measure is synonymous with the center of pressure.

Center of force trajectory is the trajectory of movement of the instantaneous COF along the contact area during stance.

Peak pressure is the highest pressure, expressed as PSI that occurred during a specified phase of stance.

Contact area is the surface area, expressed as in^2 that was loaded at a specific instant or during a specified phase of stance.

Force is the total vertical ground reaction force (VGRF), expressed as pounds that occurred at a specific instant or during a specific phase of stance.

Contact pressure is the pressure, expressed as PSI that occurred on the loaded contact area.

Hallux contact time is the percentage of time during the stance phase that the hallux is bearing load.

RESULTS

Many substantial differences were found between in-shoe measures of the Nike Air Pegasus and those of the Brooks Dyad. Qualitative analysis of the graphical pressure display and force vs. time curves demonstrates significantly improved symmetry

in both spatial and temporal characteristics of the loading and propulsive phases of running, (Figures 1 – 4). Although the impact forces at initial contact increased bilaterally in the Brooks Dyad condition, the rate of load, peak force, peak pressure, and their respective absolute asymmetries significantly decreased compared to the Nike Air Pegasus condition (Figures 1 and 2).

The center of force location and trajectory became relatively symmetric in spatial orientation, rate and line of progression (Figures 1 and 2). Measures of absolute asymmetry for contact area, contact pressure, and peak pressure at peak load all reduced, demonstrating a clear trend suggestive of an improved ability of the lower extremity to attenuate the load of impact.

In addition, peak pressure at peak propulsion shifted medially to the Hallux on the left side and laterally to the 2nd metatarsal head on the right side, which indicates decreased over-supination of the left side and decreased over-pronation of the right side (Figures 3 and 4). Hallux contact time increase bilaterally, demonstrating more normally distributed regions of plantar load (Figures 3 and 4).

DISCUSSION

Using in-shoe plantar pressure analysis, the author was able to quantify spatial, temporal, and force measures associated with the stance phase of running and determine the interaction affects of specific athletic footwear on the lower extremity mechanics of an elite runner. It is clear from this study that the interface between the foot and the ground can be successfully manipulated to improve performance, facilitate healing, and reduce risk for injury.

In this case, manipulation of the foot ground interface resulted in positive biomechanical changes which allowed the patient to more adequately attenuate the impact forces of foot strike and effectively propel forward off the stance leg, while reducing symptom and improving functional capabilities. For this patient these changes were not enough to allow him full return to pain free running. Further analysis was done to analyze the affects of foot orthotic use and to successfully implement additional foot orthotic therapy. With the aid of the F-Scan Mobile System a clinically-based biomechanical analysis of this patient facilitated his ability to return to competitive running, where he has performed better than before.

Future research needs to be conducted to quantify the biomechanical influence of athletic design and fit characteristics on function of the lower extremity.

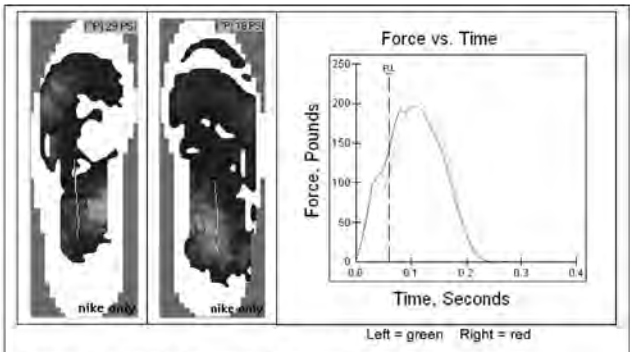

Figure 1. Nike Air Pegasus: Peak Load

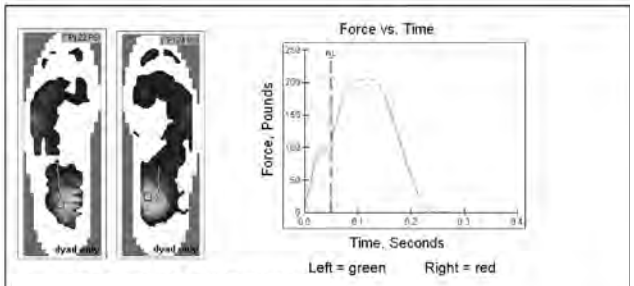

Figure 2. Brooks Dyad: Peak Load

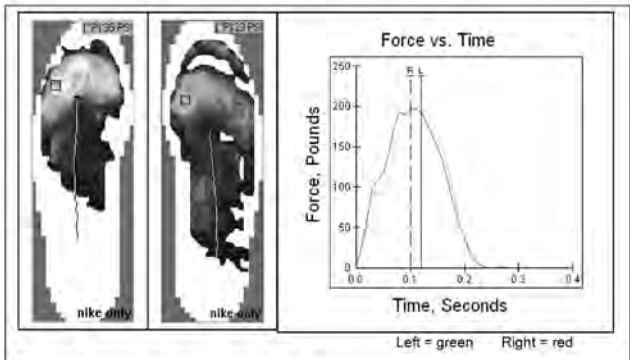

Figure 3. Nike Air Pegasus: Peak Propulsion

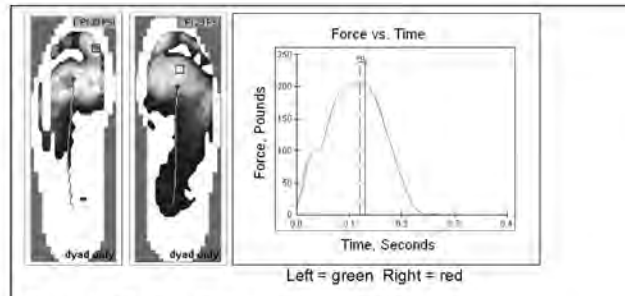

Figure 4. Brooks Dyad: Peak Propulsion

Figures 1-4. Loading patterns for each type of shoe using Tekscan plantar pressure measurement system.

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painmanagement

SPECIAL INTEREST GROUP

PRESIDENT'S MESSAGE

Joseph A. Kleinkort, PT, MA, PhD, CIE, CEAS, DAAPM

"It is one of the most beautiful compensations of this life that no man can sincerely try to help another without helping himself…Serve and thou shall be served." Ralph Waldo Emerson

Dealing with patients in chronic pain can become a huge challenge for the therapist. Many seek to avoid these patients like the plague. Others seek to assist them with their extensive knowledge and data concerning the physical ramifications of what the patient presents. Others feel compassion and care for those who have a chronic illness, especially pain. Still others feel in their spirit that they have had a destiny since birth to touch the lives of hurting people. These approaches are all encompassing, affecting the mind, body, emotions, spirit, and even cultural responses to pain. Each patient is a new experience and never exactly the same. It is with this complex mix that the therapist enters the arena to assist, at times ill prepared, and at times, without other medical specialties to call upon. Sometimes, the therapist can give so much of themselves that they feel drained, and over time, even burned out. This can happen especially if the patient is taking the energy the therapist is giving and the therapist is not aware how to protect against being drained. The therapist is most likely the person in the health care field that will spend the most one on one time with the patient and often will listen more to all the peripheral issues surrounding the person in pain. It is the therapist that will often be the only one to touch the patient with the knowledge of hope, of future life without frustration, of return to function in a new way, a way of coping, feeling care and empathy, and so many more attributes that seem to flow naturally from the therapist involved in pain management. The paramount of these is the genuine love and care for the patient, as well as faith that they can overcome, in many different ways, the obstacles facing them.

As their coach, we must somehow guide the patient through the web of snares that often challenges them, to bring them to a level of higher function, so that the body can begin its self correction, which it does so masterfully with the right support and guidance. It is so important to assist the patient in converting their negativity and their frequent thinking of catastrophic thoughts into positive thoughts. A Stanford University study once showed that people spend 98% of their time thinking about the past or future and only 2% concentrating on the now. Frequently, their minds take over where the pre-existing physical insult left off. Although it is important to have psychological assistance in this process, often the therapist acts as a tremendous positive catalyst to motivate, guide, direct, share, and empathize with the patient as they walk through the journey of life.

Through this complicated and often fragile tapestry of life, we walk in that very broad specialization of pain management. It is those many gifted therapists that I have come to know, respect, and most of all love, for whom I have the highest gratitude, for all that you have shared to help me grow and become. I feel honored and privileged to know each of you. My patients have taught me so much as I have learned to listen with attentive anticipation and they have given me such joy. As we glean from each patient that we touch, we receive the ultimate gift of life and the highest vibrational energy of the heart. It is only then that we can receive the true fullness that our profession has blessed us with and we can return the gift back to the patient who came to receive.

"Someday, after man has mastered the winds, the waves, the tides, and gravity…we shall harness all the energies of LOVE, and then for the second time in the history of the world, man will have discovered FIRE! Theilhard de Chardin

TWO EXTRAORDINARY (ALMOST MIRACULOUS) TREATMENT OUTCOMES FROM THE ERCHONIA COLD LASER

Anne Ingard, PT

Case 1: Knee Osteoarthritis Pending TKR

Father M. is a 79-year-old retired Air Force Chaplain who was scheduled to have a left TKR 2 months from the first physical therapy appointment Nov 9, 2004. This patient also had Parkinson's disease for 10 years. Pt. had a history of DVT of unknown etiology. He had shortness of breath which was felt to be related to the Parkinson's disease.

Orthopedic History: - unsuccessful arthroscopy left knee, one year prior to this appointment.

Medications: Sinemet, Carbadopa, Levadopa, Mirapex, Coumadin, and a Lidocaine patch for knee pain.

Father M asked me on this visit if I would call his orthopedist and have his surgery moved up. He was in so much knee pain with such a poor quality of life, he felt he could not wait 2 months for his surgery. I did not know his orthopedist and was unable to convince the orthopedist's secretary to change the surgery.

Knee range of motion: Active knee extension –10˚ felt by me to be limited by hamstring tightness rather than an articular block. Active assisted flexion 95˚.

Ankle dorsiflexion range of motion: -5˚, calf very tight.

Muscle testing of the quad and hamstrings elicited pain, making strength grading of the muscles inappropriate. I was able to break this patient's isometric knee extension ability with minimal force. The medial joint space was very tender. He was unable to perform unilateral stance secondary to knee pain and balance deficits from Parkinsons. No other testing done on the first visit so that my time could be spent on pain reduction. Treatment done in the chair as truncal rigidity and patients' size made it very difficult to get on and off the treatment table.

Laser Treatment

Frequencies for pain, arthritis, inflammation according to the Erchonia frequency charts were programmed into the laser and the knee was bathed in laser for 180 seconds on each set of frequencies. Then the neurological frequency head of the laser which is unchangeable, preprogrammed by Erchonia was placed over the nerve roots of L2, 3, 4 for one minute. Since the laser will go through the body, it is possible to stimulate these nerves anteriorly for treatment ease. L2 is located 1 inch above the umbilicus, L3 at the level of the umbilicus, L4 is one inch below L3, and so on. While the nerve root stimulation was being done, the other laser head was programmed with the frequencies 9, 16, 42, 53 was moved in a sweeping motion over the entire quad for one minute. The patient was asked to extend his knee as much as possible without pain. No resistance was applied on the first visit. It appeared to both of us that full active extension was being hampered by the tightness of the hamstrings, and possibly the popliteus and gastrocnemius muscles. The patient was then positioned standing with hand support on the treatment table. His left foot was placed on a stool to put the hamstring on a slight stretch and to enable me to move the wide beam along the entire length of the hamstrings and the calf muscle. The beam was slowly moved to cover both muscle groups and the patient was asked to gently bend and straighten the knee. The beam was focused on the popliteal fossa as the patient felt most of the tightness there. As the patient felt the tightness release, I asked the patient to dorsiflex and plantarflex the foot and focused the beam on the calf. When the patient felt some release in the calf, he sat down again and he performed active knee extension. The knee extension improved to -5° with no pulling felt behind the knee and the patient was able to tolerate light quad resistance, at end range only. 5 reps. Pain with resisted extension significantly reduced to a tolerable level. This patient noted a 70% reduction in knee pain when standing and walking after the first visit. The relief lasted 2 to 3 days. On subsequent visits, the same treatment regime was used but neuromuscular reeducation of other muscle groups were added. For example, on the second visit, the neurological head of the laser was placed over the nerve roots at the level of L4, L5, S1 while gentle isometric resistance was given to resisted abduction and adduction of the hip and knee flexion, in the chair. This patient came once weekly. Many of the strength exercises with the laser stimulation were progressed to standing. On the 7th visit, Father M told me that he had postponed his TKR surgery until August. His pain had been reduced to a very tolerable level and he was able to start the NuStep Machine at the gym where he lives. He cancelled the surgery altogether a few months later. It is my opinion based on 30 years of clinical experience, that I could not have achieved this outcome without the laser quickly reducing the inflammation, giving pain relief and allowing me to 'turn back on' the inhibited knee muscles. This case should give us some pause for thought. Is the pain of arthritis and the apparent need for joint replacement from loss of articular cartilage or from the resulting shutting down of the supporting musculature? I feel that if used correctly and combined with good therapeutic exercise programs and education the laser can eliminate the need for many orthopaedic surgeries and will save our health care system billions.

Case #2: Neck Stiffness and Dizziness

A 62-year-old female administrative assistant presents with neck stiffness and dizziness of one year duration. Dizziness worse in morning when awakening from sleeping, but has frequent dizzy spells during the day. This patient admits to many bad postural habits that abuse neck muscles such as holding the phone with the neck muscles, neck in a side bent position for long periods of time, reading in bed with 3 pillows under head and using poor posture at the computer at work. This patient was provided with education to stop these habits. At the time of the first visit, this patient was very stressed because she felt that despite the extensive workup being negative, she had a brain tumor and it was being missed by the many physicians she had consulted.

Previous orthopaedic history:
Discectomy 30 year's prior-excellent result.
Medical history: Osteopenia
Meds: Fosomax, Advil as needed

Cervical Evaluation: Fibrotic changes noted in the lateral neck muscles bilat.
Rotation right and left 50° with strong pulling at end range
Sidebending to right 15°- left sidebend 25°
Dizziness brought on by sidebending.
Flexion full but with strong pull posterior neck.
Extension normal.
Neck muscles tested 3+/5 with pain and muscle shaking noted on resisted sidebend and rotation. Pt had poor control of the deep neck flexors.

Shoulder elbow wrist hand range of motion normal. Neural tension signs normal but feels strong pulling in upper extremities when arms placed in a T position (shoulder abduction to 90° with straight elbows) and wrists in extension.

The cranial base was very tight, this patient could not perform active axial extension secondary to suboccipital tightness. Thoracic rotation and sidebending stiff but without significant restriction of movement.

Laser Treatment

The neurological head of the laser beam was placed over the entire cervical spine from C1-T1. The programmable head was

set at 9, 16, 42, 53 and was stacked on top of the neurological laserhead with the beam in a horizontal configuration to cover the nerve roots on both sides of the neck. The beam was applied to cover from C1 to T1 for one minute. Then gentle isometric contractions were applied to the neck extensors for 5 reps while I manually applied gentle traction to facilitate the cervical spine achieving a position of axial extension (OA flexion and lower cervical ext.) Then gentle isometric resistance was applied to the cervical rotators, sidebenders, and to the neck flexors. The patient and I noted an immediate increase in the neck muscles ability to generate force in the sidebending and rotation movements with no pain. Next, I used the cold laser for myofacial release for all the major muscle groups in the neck by moving the beam over various neck muscles while they were being lightly stretched and performing very gentle contract relax to the cervical sidebenders, rotators, and extensors with the laser beam on the muscle being stretched. The patient was taught postural awareness and standard cervical ROM exercises. Her range post Rx increased to 75° of rotation bilaterally, sidebending 35° to right, and 35° to left with very minimal pulling sensations in the neck. She was able to control axial extension without my assistance. At the next visit 4 days later, this patient reported that the dizziness problem had completely resolved and the stiffness improved but was not gone. She was treated once more with the same regime and felt that she could be discharged to do exercises for her neck independently. One year later, the dizziness remains resolved.

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Washington, DC . . . . . .Patla . . . . . .Aug 4 - 6
Wilkes-Barre, PA . . . . .Varela . . . . . .Aug 25 - 27
Chicago, IL . . . . . .Varela . . . . . .Oct 6 - 8
Houston, TX . . . . . .Varela . . . . . .Oct 20 - 22
St. Augustine, FL . . . . .Patla . . . . . .Oct 27 - 29
Boston, MA . . . . . .Patla . . . . . .Nov 3 - 5

Medical Diagnostics
20 Hours, 2.0 CEUs (No Prerequisite)
Also available to OTs **$575**

Reykjavik, Iceland . .Boissonnault/Koopmeiners . . . . . Oct 27 - 29

S3 - Advanced Evaluation & Manipulation of the Cranio Facial, Cervical & Upper Thoracic Spine
27 Hours, 2.7 CEUs (Prerequisite S1) **$750**

Baltimore, MD . . . . . .Smith . . . . . .Jul 13 - 16
Baton Rouge, LA . . . .Rot . . . . . .Jul 27 - 30
Boston, MA . . . . . .Smith . . . . . .Sep 14 - 17
St. Augustine, FL . . . .Rot/Paris . . .Sep 28 - Oct 1
Chicago, IL . . . . . .Rot . . . . . .Oct 12 - 15
Atlanta, GA . . . . . .Smtih . . . . . .Oct 26 - 29
LaJolla, CA . . . . . .Rot . . . . . .Nov 2 - 5
New York, NY . . . . . .Rot . . . . . .Nov 30 - Dec 3
Ft. Lauderdale, FL . . .Smith . . . . . .Dec 16 - 19

S4 - Functional Analysis & Management of Lumbo-Pelvic-Hip Complex
15 Hours, 1.5 CEUs (Prerequisite S1) **$495**

New York, NY . . . . . .Nyberg . . . . . .Jun 3 - 4
Denver, CO . . . . . .Varela . . . . . .Jun 10 - 11
St. Augustine, FL . . . .Varela . . . . . .Jun 17 - 18
Washington, DC . . . . .Nyberg . . . . . .Jun 24 - 25
Ft. Lauderdale, FL . . .Nyberg . . . . . .Aug 5 - 6
Los Angeles, CA . . . . .Varela . . . . . .Sep 16 - 17
St. Petersburg, FL . . . .Nyberg . . . . . .Oct 7 - 8
Flint, MI . . . . . .Nyberg . . . . . .Nov 11 - 12
St. Augustine, FL . . . .Varela . . . . . .Nov 11 - 12
Atlanta, GA . . . . . .Nyberg . . . . . .Dec 2 - 3
Chicago, IL . . . . . .Varela . . . . . .Dec 9 - 10

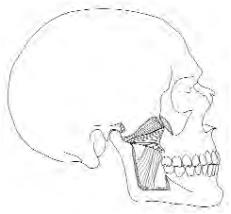
CERTIFICATION WEEK Preparation and Examination
32 Hours, 3.2 CEUs
(Prerequisites for each Certification vary) **$925**

St. Augustine, FL . . . . . .Sep 18 - 23
St. Augustine, FL . . . . . .Oct 9 - 14

Advanced Manipulation Including Thrust of the Spine & Extremities
20 Hours, 2.0 CEUs (Prerequisite Manual Therapy Certification) **$695**

Chicago, IL . . . . . .Irwin/Yack . . . . . .Jun 9 - 11
LaJolla, CA . . . . . .Irwin/Yack . . . . . .Dec 1 - 3

Cranio Facial Seminars



CF 1: Basic Cranio-Facial
20 Hours, 2.0 CEUs (No Prerequisite) **$525**

*Atlanta, GA . . . . . .Rocabado . . . . . .Aug 14 - 16
New York, NY . . . . . .Rocabado . . . . . .Sep 15 - 17

CF 2: Intermediate Cranio-Facial
20 Hours, 2.0 CEUs (Prerequisite CF 1 available as a Seminar or Online) **$525**

Atlanta, GA . . . . . .Rocabado . . . . . .Aug 17 - 19
*New York, NY . . . . . .Rocabado . . . . . .Sep 18 - 20

Cranio Facial Certification Track

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A $50 non-refundable deposit must accompany registration form. A 50% non-refundable, non-transferable deposit is required for Certification. Balance is due 30 days prior to start date of the seminar. Balance can be transferred or refunded with 2 week written notice. Notice received after that time subject to only 50% refund. No refunds or transfers will be issued after the seminar begins.

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Team Discount - Two or more persons from the same facility registering for the same seminar at the same time, receive a 10% discount at the time of registration.
(Advanced notice and full payment required, does not apply after the first day of a seminar.)

Multiple Seminar Discount - Register and pay in full for two or more seminars at the same time and receive a 10% discount.
(May not be combined with any other discounts or previous registrations.) Ortho 6-06

*Specifically designed to respect the Sabbath.

Seminar dates, locations, and tuition are subject to change, please call before making any non-refundable reservations.

performingarts

SPECIAL INTEREST GROUP

MESSAGE FROM THE VICE PRESIDENT

CSM 2007 planning is already underway. The topic will be the Hip Joint. Those members with specific content or speaker suggestions can contact me at Tarajo@udel.edu.

We are also excited to inform our members of the Emergency Response Course for Performing Artists. This course will be geared to those who provide primary care and coverage to performing artists. The participant will become an American Red Cross Certified Emergency Responder for a period of 3 years. The 3-day course will be held at the University of Delaware in Newark, Delaware from September 15th-17th, 2006. We hope to see you there! For more information, please access our homepage where you will be directed to additional details regarding this course.

We wanted to provide you with a sample of our monthly PASIG Citation Blast . This blast is a benefit of PASIG membership. Be sure to join the PASIG to receive these valuable monthly e-mail updates.

Sincerely,
Tara Jo Manal, PT, OCS, SCS
PASIG VP/Education Chair

PASIG MONTHLY CITATION BLAST NO. 9 APRIL 2006

Dear PASIG Members:

This month's Citation BLAST initiates our special topic series. To mix it up, the format is a bibliography of articles on the selected topic from 1996 – 2006. Special topics will be targeted periodically throughout the year. If you'd like to suggest a topic or create one, please let me know.

As a reminder, each month's citations will be added to specific EndNote libraries: (1) Ice Skating, (2)Gymnastics, (3) Music, (4) Dance.

These updated libraries will, in turn, be posted on the PASIG webpage for our members to access and download. (Please note: information about EndNote referencing software can be found at http://www.endnote.com, including a 30-day free trial.) This month's topic on the hallux sesamoids will be added to the Dance library.

I'd like to share with our members an update on the Dance/USA Medical Task Force meetings on preventing injury and illness in professional dancers. In February, Dance/USA company managers and the dancer's union AGMA endorsed a pilot trial of the *Annual Post-Hire Health Screen for Professional Dancers* by a group of representative member companies. The finalized 30-minute assessment and guidelines are near completion. A formal letter inviting companies interested in participating in the pilot has been sent out. It is anticipated that each organization will screen their dancers at the beginning of their new fiscal year, which is usually during the summer. This is an exciting next step in providing a new standard of health care to dancers.

Don't forget, the PASIG sponsors an annual student research scholarship. This award is to recognize students, who have had an abstract accepted to CSM, for their contribution to performing arts medicine and research. We encourage you to mentor your students in PA-related research and have them apply! The award is a $400 scholarship to defray the costs while presenting at CSM 2007. If the PASIG Research Committee can assist students, please contact us. For more information on the research award please check our webpage (www.orthopt.org/sig_pa.php). The deadline for 2007 CSM abstracts submission is July 14th, 2006. They can be submitted via link at the APTA's website or at http://apta-csm2007.abstractcentral.com.

As always, your comments and entry contributions to these Citation BLASTs are always welcome. Please drop me an e-mail anytime.

Shaw Bronner
Chair, PASIG Research Committee

SPECIAL TOPIC: PATHOLOGY OF THE HALLUX SESAMOIDS

Rolling through the foot to attain relevé makes painful sesamoids particularly problematic for the dancer. The following question was asked: What is the optimal treatment of hallux sesamoid non-union or avascular necrosis? Bone stimulation, ultrasound, or surgical excision? Considerations regarding excision include the potential loss of flexor strength of the first toe and postoperative weightbearing discomfort (padding is not an option for the modern dancer when dancing barefoot). This resulted in the following literature search.

1. Anderson, R. B. and A. M. McBryde, Jr. (1997). "Autogenous bone grafting of hallux sesamoid nonunions." Foot Ankle Int 18(5): 293-6.
2. Biedert, R. and B. Hintermann (2003). "Stress fractures of the medial great toe sesamoids inathletes." Foot Ankle Int 24(2): 137-41.
3. Blundell, C. M., P. Nicholson, et al. (2002). "Percutaneous screw fixation for fractures of the sesamoid bones of the hallux." J Bone Joint Surg Br 84(8): 1138-41.
4. Cortes, Z. E. and J. F. Baumhauer (2004). "Traumatic lateral dislocation of the great toe fibular sesamoid: case report." Foot Ankle Int 25(3): 164-7.
5. Fleischli, J. and E. Cheleuitte (1995). "Avascular necrosis

of the hallucial sesamoids." J Foot Ankle Surg **34**(4): 358-65.
6. Julsrud, M. E. (1997). "Osteonecrosis of the tibial and fibular sesamoids in an aerobics instructor." J Foot Ankle Surg **36**(1): 31-5.
7. Kanatli, U., A. M. Ozturk, et al. (2006). "Absence of the medial sesamoid bone associated with metatarsophalangeal pain." Clin. Anat. 19, 2006. (c)2006 Wiley-Liss, Inc.
8. Lee, S., W. C. James, et al. (2005). "Evaluation of hallux alignment and functional outcome after isolated tibial sesamoidectomy." Foot Ankle Int **26**(10): 803-9.
9. Oloff, L. M. and S. D. Schulhofer (1996). "Sesamoid complex disorders." Clin Podiatr Med Surg**13**(3): 497-513.
10. Ozkoc, G., S. Akpinar, et al. (2005). "Hallucal sesamoid osteonecrosis: an overlooked cause of forefoot pain." J Am Podiatr Med Assoc **95**(3): 277-80.
11. Perez Carro, L., J. I. Echevarria Llata, et al. (1999). "Arthroscopic medial bipartite sesamoidectomy of the great toe." Arthroscopy **15**(3): 321-3.
12. Richardson, E. G. (1999). "Hallucal sesamoid pain: causes and surgical treatment." J Am Acad Orthop Surg **7**(4): 270-8.
13. Riley, J. and M. Selner (2001). "Internal fixation of a displaced tibial sesamoid fracture." J Am Podiatr Med Assoc **91**(10): 536-9.
14. Saxena, A. and T. Krisdakumtorn (2003). "Return to activity after sesamoidectomy in athletically active individuals." Foot Ankle Int **24**(5): 415-9.
15. Talbot, K. D. and C. L. Saltzman (1998). "Assessing sesamoid subluxation: how good is the AP radiograph?" Foot Ankle Int **19**(8): 547-54.
16. Toussirot, E., L. Jeunet, et al. (2003). "Avascular necrosis of the hallucal sesamoids update with reference to two case-reports." Joint Bone Spine **70**(4): 307-9.

If you are interested in the full annotated bibliography, please check our website at www.orthopt.org under the Performing Arts Special Interest Group. If you would like to be added to the email list to receive these monthly blasts, please join the Performing Arts Special Interest Group.

animalpt

SPECIAL INTEREST GROUP

INTRODUCTION – LIN MCGONAGLE

Amie has asked each of the officers to introduce ourselves so that you can get better acquainted with your officers. As many of you know, I was a founding member and the first President of the Animal PT SIG. On a state level, I currently represent the SIG as the New York Liaison.

My formal training includes a B.S. in Animal Science from Cornell University, a Master's degree in Physical Therapy from Arcadia University (then Beaver College), and an Associates degree in Veterinary Technology.

My career as a Physical Therapist currently spans 21 years in human medicine focused in acute care, rehabilitation, pediatrics, and home care. I operated a private practice for the past 13 years that included animal rehabilitation. In the fall of 2005, I became the Chief of Rehabilitation Services at Colonial Veterinary Hospital in Ithaca with full-time responsibilities in patient care and administration. We collaborate with Cornell University's Hospital for Animals as well as local veterinarians within the Finger Lakes region. At this time we offer Rehabilitation, Fitness and Conditioning, and Weight Management programs. Our facility includes an open exercise area, Ferno Underwater Treadmill, and a dedicated physical therapy exam and treatment room. We have a team of 10 veterinarians, including 2 Orthopaedic surgeons. My clinical research interest is Canine Functional Outcome Assessment. Amie, Carrie, and I are collaborating to test this tool with cases involving cruciate surgery. We hope to have preliminary results to share in the next 2 years.

Many of you may not realize it but we are coming up on our "unofficial" 10th anniversary! It was at the June 1996 APTA Annual Conference that the idea for the Animal PT SIG gained momentum. There were several trips to Fairfax soon after for meetings at APTA Headquarters. They were followed by travels to Combined Sections in San Diego and Annual Conference in Orlando to make presentations to the Section Board, gain support, and member signatures. Within a relatively short time bylaws were written, officers recruited, and education courses offered. The SIG became an official part of the Orthopaedic Section in 1998, just 2 years from the time David Levine and I started talking about the possibilities in Minneapolis.

Since that time the SIG and its members have been embracing a new paradigm for our profession. I am particularly excited about our Strategic Plan. It is a significant step forward for such a 'young' group. The Plan will guide us into the next 5 years with a clear vision for documenting our scope of practice, developing an Animal Rehabilitation Journal, and creating a professional network within the animal rehabilitation community. This amazing journey could not have happened without the support of many people: all of our past SIG officers, Section Officers and Board members, and APTA Officers and Board members who helped us behind the scenes. I would especially like to acknowledge the contributions of Jan Richardson, Bill Boissonault, Marilyn Moffat, Lola Rosenbaum, Andrew Guccione, Steve Levine, Jodi Gandy, Joe Godges, Rebecca Craik, Carol Oatis, as well as Tara and Terri and the entire Orthopaedic Section staff.

I am grateful to be a part of this dynamic group. We all share a passion for physical therapy as a profession and for animals! In closing, I encourage all of you to take an active role in the SIG. We need your input, leadership, and commitment to make the goals of our Strategic Plan a reality. I look forward to our next 10 years together!

APTSIG NATIONAL LIAISON COORDINATOR REPORT

The Animal Physical Therapy Special Interest Group (APTSIG) is continuing correspondence with liaisons in the following 18 states: Alaska, California, Colorado, Connecticut, Florida, Illinois, Kansas, Louisiana, Maryland, Minnesota, Missouri, Nebraska, Nevada, New Hampshire, New York, North Carolina, Virginia, and Wyoming. In its recent history, the APTSIG had upwards of forty state liaisons, however, given that many of these volunteers are no longer APTA members, they can no longer serve in this capacity. As a result, the APTSIG is actively recruiting liaisons in thirty-two states and Washington, DC. Please contact Charlie Evans, our National Liaison Coordinator, if you are interested in serving as a state liaison.

As an APTA APTSIG state liaison, you are part of an important information network for APTSIG members. We ask that each state liaison be familiar with the physical therapy and veterinary state practice acts, rules, and regulations. It is also important that each liaison understand his or her state's licensure boards' interpretation of these practice acts. The APTSIG will be contacting these liaisons for assistance and expertise in carrying out our strategic plan as well as for reports from each state on an annual basis.

Our National Liaison Coordinator has compiled a summary of all of the physical therapy practice acts and many of the veterinary practice acts. These are available on the Orthopaedic Section website at: *http://www.orthopt.org/animal%20rehab%20resources.php*. As you review your state's practice act, specific attention should be paid to the language used, especially the words person, human being, individual, public, client, and/or patient. Depending on the specific rules and regulations of your state, if a physical therapist or assistant practices physical therapy on animals, calls the practice physical therapy, or displays his or her credentials, the physical therapist's or assistant's license could be in jeopardy. As well, the therapist or assistant might possibly be prosecuted for practicing veterinary medicine without a license.

Keep in mind, also, the statement released by the APTA Board of Directors last spring: "Acknowledging the collaborative relationships between physical therapists and veterinarians, and the evolving specialized practice by some physical therapists in animal rehabilitation, APTA has adopted a Board position that states "the practice of animal rehabilitation by physical therapists is permissible where allowed by law and regulation." The Board cited the House Mission Statement Fulfillment Policy (HOD 06-93-06-07) in its deliberations, noting that the Association is to enable physical therapists to improve their knowledge and skills in the interest of furthering the profession. The Board concluded that its simultaneous responsibility is to further the profession and to promote legal practice. "

In attempts to communicate with our membership, we will include reports from our state liaisons in this and future issues of the APT-SIG newsletter. The first report is from Nevada, which has recently adopted unique regulations concerning the practice of animal rehabilitation by physical therapists.

NEVADA

Physical Therapy Practice Act
(*http://www.leg.state.nv.us/NRS/NRS-640.html*)
"CHAPTER 640 – PHYSICAL THERAPIST
GENERAL PROVISIONS
NRS 640.022 'Physical therapy' defined. 'Physical therapy' means the specialty in the field of health which is concerned with prevention of disability and physical rehabilitation of persons having congenital or acquired disabilities.

NRS 640.024 'Practice of physical therapy' defined. 'Practice of physical therapy':
1. Includes:
   (a) The performing and interpreting of tests and measurements as an aid to evaluation or treatment;
   (b) The planning or initial and subsequent programs of treatment on the basis or the results of tests; and
   (c) The administering of treatment through the use of therapeutic exercise and massage, the mobilization of joints by the use of therapeutic exercise without chiropractic adjustment, mechanical devices, and therapeutic agents which employ the properties of air, water, electricity, sound and radiant energy."

Veterinary Medical Practice Act
(*http://www.leg.state.nv.us/nac/nac-638.html*)
"CHAPTER 638 – VETERINARIANS
GENERAL PROVISIONS
NAC 638.001 Definitions. (NRS 638.070) As used in this chapter, unless the context otherwise requires, the words and terms defined in NAC 638.003 to 638.0185, inclusive, have the meanings ascribed to them in those sections.

NAC 638.006 'Direct supervision' defined. (NRS 638.070) 'Direct supervision' means that a veterinarian is on the premises of an animal hospital or in the same area on a range and is quickly and easily available, and the animal has been examined by the veterinarian within the previous 12 hours or at such time as good veterinary medical practice requires consistent with the particular delegated task o animal health care.

NAC 638.0175 'Veterinarian-client-patient relationship' interpreted. (NRS 638.070) For the purposes of this chapter, a veterinarian shall be deemed to have a 'veterinarian-client-patient relationship' concerning a nonhuman animal if the veterinarian satisfies all of the following conditions:
1. The veterinarian assumes the responsibility for making medical judgments concerning the health of the animal and the need for medical treatment of the animal.
2. The veterinarian has knowledge of the present care and health of the animal sufficient to provide at least a general or preliminary diagnosis of the medical condition of the animal. This knowledge must be acquired by:
   (a) Conducting a physical examination of the animal; or
   (b) Visiting the premises where the animal is kept in a timely manner that is appropriate to the medical condition of the animal.
3. The veterinarian obtains the informed consent of the client for medical treatment of the animal.
4. The veterinarian obtains the agreement of the client to follow the instructions provided by the veterinarian for the care and medical treatment of the animal.

ANIMAL PHYSICAL THERAPY
NAC 638.750 'Animal physical therapy' defined. (NRS638.070) As used in NAC 638.750 to 638.790 , inclusive, 'animal physical therapy' means the rehabilitation of injuries in a nonhuman animal through the use of the following techniques, but does not include animal chiropractic:
1. Stretching;
2. Massage therapy;
3. Rehabilitative exercise;
4. Hydrotherapy;
5. Application of heat and cold; and
6. Stimulation by use of:
   (a) Low-level lasers;
   (b) Electrical sources;
   (c) Magnetic fields; or
   (d) Noninvasive ultrasound.

NAC 638.760 Requirements to practice; application for certificate of registration; fee. (NRS 638.070)
1. A person shall not practice animal physical therapy in this State unless he is:
   (a) A veterinarian;
   (b) A licensed veterinary technician who has received training in animal physical therapy and is working under the directs supervision of a veterinarian licensed in this State; or
   (c) A physical therapist who has obtained a certificate of registration pursuant to this section and complies with the provisions of NAC 638.780.
2. A physical therapist who desires to secure a certificate of registration to practice animal physical therapy in this State must make written application to the Board.
3. The application must be on a form provided by the Board, include any information required by the Board and be accom-

panied by satisfactory proof that the applicant:

(a) Is of good moral character;
(b) Has been an active licensed physical therapist in this State for at least 3 years;
(c) Is in good standing with the State Board of Physical Therapy Examiners;
(d) Has successfully completed at least 100 hours of instruction or course work, or a combination of both, in the area of animal physical therapy, which must include, without limitation, assessment and planning of treatment, behavior, biomechanics, common orthopedic and neurological conditions, comparative anatomy, neurology, and therapeutic modalities and exercises; and
(e) Has completed at least 125 hours of supervised clinical experience in animal physical therapy with a licensed veterinarian.

4. The application must be signed by the applicant, notarized and accompanied by a fee of $50.

5. Except as otherwise provided in NAC 638.790, upon receipt of the application and information required by subsection 3 and payment of the fee, the Board will issue to the physical therapist a certificate of registration.

NAC 638.780 Standards of practice for physical therapist holding certificate; maintenance of records. (NRS 638.070)

1. Each certificate of registration issued pursuant to sect 3 of this regulation or renewed pursuant to this section expires on January 1 of each year.

2. Each application for renewal of a certificate of registration must be:

(a) Submitted in the form established by the Board
(b) Signed by the physical therapist and accompanied by a renewal fee of $25;
(c) Accompanied by proof that the physical therapist completed, during the 12-month period immediately preceding the beginning of the new registration year, at least 5 hours of continuing education in animal physical therapy approved by the Board; and
(d) Accompanied by proof that his license as a physical therapist in this state is active and that he is in good standing with the State Board of Physical Therapy Examiners.

3. A physical therapist who fails to renew his certificate of registration before it expires forfeits his certificate of registration.

1. A physical therapist who has been issued a certificate of registration pursuant to NAC 638.670 may practice animal physical therapy only:

(a) Under the direction of a veterinarian licensed in this State who has established a valid veterinarian-client-patient relationship concerning the animal receiving the animal physical therapy before the animal physical therapy is performed; and
(b) If the physical therapist assumes individual liability for the quality of the animal physical therapy performed.

2. The veterinarian under whose direction the physical therapist performs the animal physical therapy:

(a) Is not required to supervise the physical therapist during the animal physical therapy.
(b) Is not liable for the acts or omissions of the physical therapist who performs the animal physical therapy.

3. Each physical therapist who has been issued a certificate of registration shall:

(a) Maintain in this State for at least 4 years a separate written medical record of each animal receiving animal physical therapy from the physical therapist.
(b) Within 48 hours after the initial visit with the animal, mail or transmit by facsimile machine a progress report to the veterinarian under whose direction the physical therapist performs the animal physical therapy.
(c) Within 48 hours after each subsequent visit with the animal, mail or transmit by facsimile machine a progress report to the veterinarian under whose direction the physical therapist performs the animal physical therapy.

4. The veterinarian shall include the copy of the medical record received pursuant to subsection 3 in the medical record required pursuant to NAC 638.0475. The written medical record must include, without limitation:

(a) The name, address and telephone number of the owner or the animal;
(b) The name or identifying number, or both, of the animal;
(c) The age, sex and breed of the animal;
(d) The dates of care, custody or treatment of the animal;
(e) The results of a basic rehabilitation examination related to physical therapy;
(f) The diagnosis and treatment plan related to physical therapy recommended by the physical therapist for the animal; and
(g) The progress and disposition of the case.

NAC 638.790 Disciplinary action. NRS 638.070

1. A violation of a provision of chapter 638 or 640 of NRS or a regulation adopted by the State Board of Physical Therapy Examiners or the Nevada State Board of Veterinary Medical Examiners is a ground for disciplinary action.

2. If the Nevada State Board of Veterinary Medical Examiners determines that an applicant for a certification of registration pursuant to NAC 638.760 or a physical therapist who has been issued a certificate of registration pursuant to NAC 638.760 has committed any act which is a ground for disciplinary action, the Board may:

(a) Refuse to issue a certificate of registration;
(b) Refuse to renew a certificate of registration;
(c) Revoke a certificate of registration;
(d) Suspend a certificate of registration for a definite period or until further order of the Board;
(e) Impose a fine in an amount not to exceed $10,000 for each act that constitutes a ground for disciplinary action;
(f) Place a physical therapist who has been issued a certificate of registration on probation subject to any rea-

sonable conditions imposed by the Board, including, without limitation, requiring courses in continuing education or a periodic or continuous review of his animal physical therapy practice;

(g) Administer a public reprimand;

(h) Require the physical therapist who has been issued a certificate of registration to take a competency examination or a mental or physical examination; and

(i) Require the physical therapist who has been issued a certificate of registration to pay all costs, including, without limitation, attorney's fees, incurred by the Board in taking disciplinary action against him."

NEVADA APTSIG LIAISON REPORT

"Our two boards (physical therapy and veterinary) worked collaboratively, with the veterinary board being in the leadership position. The terms 'animal physical therapy' and 'physical therapy' are exclusive one of the other. They are different and the designation of "animal physical therapy" or "APT" is used when a physical therapist meets the criteria as set in the veterinary rules and regulations. The term 'physical therapy' remains PROTECTED and is utilized for treatment of humans (person) in accordance with our practice act.

Issues that remain unaddressed are the role of the physical therapist assistant and how this role may impact the licensed veterinary technician with additional education in animal physical therapy. There was a physical therapist assistant from Las Vegas who reportedly petitioned the veterinary board to gain equal status as an animal physical therapist. The board denied her request.

Another issue that remains is that of the setting in which animal physical therapy services are provided. For example, the current regulations allow an animal physical therapist to have a private practice while a licensed veterinary technician with additional training in physical therapy could not have a private practice, as there is a requirement of supervision by a veterinarian, unless the veterinarian opened a dedicated therapy practice with veterinary technicians employed by that veterinarian. I believe that there are currently several models of this structure elsewhere in the USA.

Out here in the Old West, in a very general sense, the veterinarians recognize animal physical therapy and animal physical therapists as having a professional body of knowledge and, in general, they do not equate a veterinary technician as having the same body of knowledge, yet clearly recognize that the licensed veterinary technician is a critical person on the rehabilitation team (as a rehabilitation nurse). This is NOT regulated at this time. However, there is a need to clarify in the near future how the physical therapist assistant fits into this picture, particularly how the physical therapist assistant and the licensed veterinary technician relate to one another, if at all. There are those veterinarians who do NOT want licensed veterinary technicians to be 'lost' to rehabilitation as they are in short supply and to have them absorbed into rehabilitation would be quite a 'loss' to the veterinary practice pool. Their skills are needed in surgery, anesthesia, dentistry, radiology, etc. So far, very few veterinary technicians (in Nevada) have expressed an interest in becoming so specialized that their training as a 'nurse' would go "down the tubes."

Requiring a veterinarian to have additional training in animal physical therapy, at least in Nevada, is not in the cards at this time. On the other hand, this is a very small community and the veterinarians simply have not shown an interest in this area. This doesn't mean that a veterinarian couldn't set up a specialized practice. We (Nevada) just haven't gone in this direction yet. If this did occur, and per the regulations, it could, they could do so without any additional training.

In summary, all that we have done in Nevada is establish quality criteria for a physical therapist practicing animal physical therapy. We at least have a collaborative working model between the boards and have established clearly who practices 'physical therapy' and 'animal physical therapy' and further what qualifications must be met to be an animal physical therapist. The physical therapy board doesn't have a problem using the term "animal physical therapy," only "physical therapy" if it pertains to non-human patients and, as stated above, these are entirely separate credentials and practices.

I can share with you that so far what we have in Nevada is working very well. We have, as a foundation, an environment of mutual respect, professionalism, trust, and collegiality; recognizing that issues and problems will come up. Perhaps what we did here in Nevada was a little bit easier given our state's size. We recognize that we have a long way to go to ensure that the people and animals of Nevada receive quality and optimal animal physical therapy services by credentialed individuals."

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