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Distal Femoral Osteotomy with Reflex Sympathetic Dystrophy: A Multifaceted Therapeutic Approach

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Distal Femoral Osteotomy with Reflex Sympathetic Dystrophy: A Multifaceted Therapeutic Approach

by

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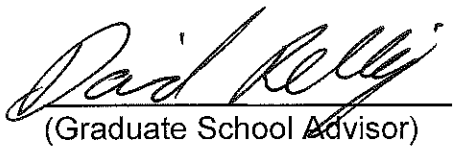

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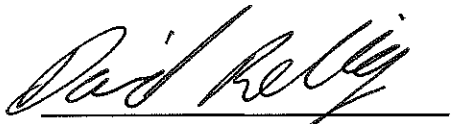

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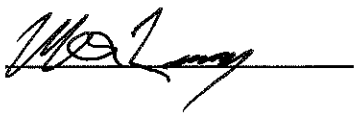
Signature 

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ABSTRACT

Background and Purpose: The surgical procedure known as a distal femoral osteotomy has been shown to be effective in treating valgus deformities of the knee with osteoarthritis in younger, active patients. But with any procedure, unsuspected complications such as Complex Regional Pain Syndrome (CRPS) can make rehabilitation for the patients and their therapists challenging. This study focuses on taking a multifaceted approach to treating all of the underlying impairments of a patient with recurring knee pathologies and an underlying secondary diagnosis of CRPS.

Case Description: The patient is a 38-year-old female who has had multiple surgeries on her left knee, the most recent of which being a left distal femoral osteotomy. She has also experienced symptoms of CRPS after each of her surgeries, causing her to have muscle weakness and extreme sensitivity to touch in her left leg.

Discussion: The patient's CRPS made it difficult to perform any interventions that involved touching her skin. Thus, it was crucial to get her sensitivity under control in order to make significant progress in dealing with her other impairments. This case study demonstrates the importance of taking all of a patient's comorbidities into account when making a treatment plan.

CHAPTER I

BACKGROUND AND PURPOSE

A distal femoral osteotomy is a procedure used to treat patients who have an angular deformity at the knee, known as either varus or valgus deformities. With varus deformities, the tibia is angled medially on the femur creating a bowlegged appearance. This places extra pressure on the medial aspect of the tibiofemoral joint and can damage the cartilage in this area. When the tibia is angled laterally on the femur, creating a knock-kneed appearance, it is known as knee valgus.[1] With knee valgus, there is excessive pressure in the lateral compartment of the tibiofemoral joint when weight bearing. The osteotomy is performed to correct the angular deformity, thereby decreasing the excessive load on the lateral compartment and distributing the weight more evenly across the joint.[2]

Another method of surgical correction for angular deformity and pain at the knee is the total knee arthroplasty (TKA), which is a widely used procedure. In 2010 the Centers for Disease Control and Prevention along with the National Center for Health Statistics performed a National Hospital Discharge Survey. According to their statistics, there was a 21% increase in the number of TKA's performed in those ages 65 and up compared to those ages 45-64, whereas there was a 28% decrease in the number of partial excisions of bone in these

age groups.[3] Because of the wide popularity and improved outcomes for TKA's, osteotomies became less common. At the same time, osteotomies remain a reasonable treatment for those with deformities resulting in malalignment of the hip or knee. Angular deformities of the distal femur can be acquired or develop naturally, and they are common in patients with osteoarthritis. The osteotomies can be performed using either internal or external fixation techniques, with the decision being made based largely on the surgeon's discretion.[4] In those with osteoarthritis, the cartilage that is meant to protect their joints breaks down and can cause significant pain and swelling. This may also lead to the alteration of the alignment of their joints. Osteotomies are a form of surgery that cut and reshape the misaligned bone, allowing for load bearing on the part of the joint that is not diseased.

Evidence shows that osteotomies to correct angular deformities of the knee in patients with osteoarthritis have consistently good results. These results are dependent on proper patient selection, the stage and severity of their arthritis, and achievement and maintenance of adequate operative correction. The osteotomy cannot stop the degenerative process and most of the patients will eventually get a total knee arthroplasty. However, the osteotomy seems to delay the progress of deterioration.[5] These surgeries are also well recognized for their effectiveness in unloading the affected compartment and correcting the underlying deformity for those with osteoarthritis, especially in younger, active patients. In a study of 33 patients for a minimum of 10 years after surgery, patients who had a distal femoral osteotomy demonstrated significantly improved

Knee Society Knee scores from an average of 36.8 before surgery to 77.5 one year after (max score is 100). Of the 33 patients in the study, 15 were converted to total knee arthroplasties at an average of 15.6 years post-surgery. Of the remaining 17 patients, 10 had excellent or good results, 2 had fair results, and 5 had poor results. The study concluded distal femoral osteotomy to be a viable treatment for lateral compartment osteoarthritis.[6]

Sometimes there can be secondary complications that can arise from surgical procedures such as a distal femoral osteotomy. One such unsuspected phenomenon is known as Complex Regional Pain Syndrome (CRPS). The phenomenon of CRPS is a neurological disorder that is often chronic and can be characterized by severe pain, swelling, and motor impairment, among other complications. There is no known cause of CRPS, but it is often seen after minor trauma or surgery, and there is no specific diagnostic test for the disorder.[7]

In 1994, a group of pain medical experts was gathered by the International Association for the Study of Pain (IASP) to distinguish between two similar pain syndromes that differed in the event that caused them, not in their clinical presentations.[8] There are now two main types of CRPS that are recognized: CRPS type I and type II. Previously known as Reflex Sympathetic Dystrophy (RSD), CRPS type I is the more common of the two presentations. It results after minor trauma, such as bone fractures or sprains, bruises, skin lesions, or surgery, with no obvious nerve injury or simply a small nerve lesion. An important feature of CRPS type I is that the severity of symptoms experienced by the patients must be disproportionate to the severity of the initial trauma. The

less common CRPS type II was previously known as causalgia. It is caused by a large nerve lesion and is by definition a neuropathic pain syndrome.[9] For the purposes of this paper, CRPS type I will simply be referred to as CRPS.

CRPS is thought to be the result of changes to the body's somatosensory systems that are responsible for detecting noxious, thermal, or tactile information; to the sympathetic systems that innervate skin; and to the somatomotor systems. Peripheral symptoms can include edema, inflammation, sympathetically maintained pain, or trophic changes that are not explained by the central symptoms.[9]

CRPS can present itself in a variety of manners and is frequently associated with psychosocial components that are additional crucial diagnostic features of the disorder. In addition, they can be targeted for intervention strategies. Given the complexity of the disorder, any unimodal interventional approach usually fails, and multiple modalities or disciplines are required to optimize pain management, functional rehabilitation, and quality of life. The psychosocial aspects can often be overlooked by therapists who choose to target only the physical components of the diagnosis. However, CRPS is not strictly a psychological disorder, so psychotherapy alone will not be a significantly effective treatment plan.[10]

Mixed evidence exists regarding the most effective treatment for CRPS. Apart from physical or psychological therapy, the use of medication demonstrates some positive results. Clonidine is effective in preventing CRPS in patients who had a history of the disorder, and Vitamin C therapy alleviates

neuropathic pain purportedly by neutralizing free radicals. Alternative topical anesthetics such as lidocaine intended to decrease pain demonstrate minimal effects on the pain associated with CRPS.[11]

CRPS can be challenging for patients and for therapists as there are a number of different treatment options. Publications have shown that "physiotherapy" can be beneficial in the treatment of CRPS as recovery of function is required for full recovery. It is for this reason that therapy should be started at an early stage or immediately after the diagnosis is made.[12] Physical therapists work with these patients to normalize sensation and power, promote normal range of motion and flexibility, decrease muscle guarding, minimize edema, and increase functional use of the extremity in order to increase independence at work, leisure, and activities of daily living. However, inappropriately aggressive therapy can trigger extreme pain, edema, distress, and fatigue, and may in turn exacerbate inflammation and sympathetic symptoms of CRPS. Thus, this should be avoided and the patient should be monitored for adverse responses to therapy.[12]

The purpose of this case study is to demonstrate the implementation of a multifaceted intervention plan to address all of the impairments of a patient with chronic recurring knee pathologies and a complicated secondary diagnosis.

CHAPTER II

CASE DESCRIPTION

The patient was a very pleasant 38-year-old female who presented to therapy with a longstanding history of left knee problems that began several years ago after she fell while playing "wallyball." She underwent an arthroscopy which revealed a microfracture in the lateral tibial plateau in March of 2011, and had continued pain afterwards. A later MRI showed that she had osteochondritis dessicans in her lateral tibia, so she underwent an arthroscopy with an osteoarticular transfer system (OATS) procedure performed in 1/13. She started out non-weight bearing, but began having more discomfort with the progression to bearing weight. She began to experience a "catching" sensation with movement, noticing it more towards the end of the day after being on her feet, and noting a feeling of her knee wanting to give out. In August that year, an MRI revealed osteochondral changes in her distal femur, and her exam showed a valgus alignment. Given these findings and her history of osteoarthritis, she had a distal femoral osteotomy on in October. It was for this procedure that we began to see this patient.

She had physical therapy after her past procedures, and reported that her knee became "slightly better" from PT. Her treatment during these therapy sessions included stretching, strengthening, and ultrasound.

Prior to her knee issues she reported that she was very physically active. She ran marathons and exercised 5-6 times per week. She worked as an occupational therapist assistant and as the manager at a restaurant before she was injured. One of her goals was to get back to being active again, along with increasing mobility, range of motion, and decreasing pain.

She had a family history of both CRPS and osteoarthritis. Her father experienced extreme pain down his leg after a back surgery and had osteoarthritis in his hip, and her brother had hip osteoarthritis as well.

Current Condition

She entered therapy on bilateral axillary crutches and a knee brace locked in full extension. She was initially told by her doctor that she would only have to be non-weight bearing for 4 weeks after having this procedure. She said that she was allowed to take the brace off at night and used a continuous passive motion (CPM) machine from 0-36° for 4-6 hours per day in 30-45 minute increments.

She was not working at the time of her evaluation, and had not worked since her injury, but she had children that she took care of at home while her husband was at work. She lived in a house with her husband and children but had no stairs that she had to use. She rated her pain 5/10 at rest and 10/10 with activity, describing it as burning, constant, sharp, and tingling. Aggravating factors included "everything," but more specifically being up and moving her leg. Rest was a relieving factor.

As with her previous knee surgeries, she was experiencing symptoms of CRPS, such as numbness and tingling in her leg and foot, extreme pain and sensitivity to touch, and slight foot drop, which are common hallmarks of the disorder.[12] She reported having difficulty falling asleep due to her pain, and that it was uncomfortable when putting on pants. She even mentioned that her leg would remain cold while soaking it in a hot shower.

Examination, Evaluation and Diagnosis

Examination

She was in a pleasant mood upon arrival, but was clearly in pain with any movement of her knee. She was walking with a step-through gait pattern with her axillary crutches and was proficient with this. Her lower leg was tender with light touch, especially to the lateral knee along the surgical scar. There was edema present when comparing it to her other knee, but it was not pitting. And although the edema was present, it was not deemed significant enough for the therapist to feel the need to make circumferential measurements of either of her knees.

Her left knee passive flexion was 32°. Left ankle dorsiflexion strength was 3+/5 and plantarflexion was 4/5. Due to the patient still being in a great deal of pain, knee strength was not assessed upon initial evaluation. In addition, her uninvolved extremity strength was not evaluated due to therapist discretion that she would have no weakness in this extremity.

Evaluation

After reviewing the patient's chart, taking her history, and making clinical observations, she was determined to have decreased range of motion, decreased strength, edema, impaired gait, and pain. She was limited in the following functional activities: activities of daily living, bending, driving a car, lying, riding in a car, sitting, sleeping, stair negotiation, standing, transitions, turning, and walking.

Diagnosis

A distal femoral osteotomy falls under practice pattern 4I of the *Guide to PT Practice*: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Bony or Soft Tissue Surgery. Its ICD-9 code is 77.3.

Prognosis and Plan of Care

Prognosis

Patients within this practice pattern can expect to demonstrate optimal motor function; muscle performance; range of motion; and gait, locomotion, and balance; and the highest level of functioning in home, work, community, and leisure environments. Expected range of number of visits per episode of care ranges from 15 to 45 visits according to the *Guide*.

Goals

After examining and evaluating the patient's history and tests and measures, short term goals were established. To be achieved in 2 weeks, the patient would: exhibit pain 5/10 or less so that she would be able to dress without discomfort; be independent with her home exercise program so that could improve her strength and progress towards weight bearing; and achieve passive range of motion to 60° so that she would be safer when ambulating with her axillary crutches.

Long term goals, to be achieved in 12 weeks, included that the patient would: exhibit pain 0/10 so that she could sleep pain free; exhibit strength within normal limits so that she could safely ambulate without her crutches; be independent with her home exercise program so that she could continue to improve her level of activity and fitness; demonstrate active range of motion improved by 100% so she could be independent with her self-care activities of daily living and return to previous level of function.

Precautions

According to the Orthopaedic Research Clinic of Alaska's Lateral Distal Femoral Osteotomy Rehab Protocol, the immediate postoperative phase (0-4 weeks) included: no NSAIDS, knee brace locked at 0° worn 23 hours a day, seven days a week (although her doctor said she could take it off at night), and non-weight bearing for 4 weeks. The brace was to be unlocked to 0-30° once quad control was established and the CPM machine was to be used for 6 weeks,

starting at 0-45° and progressing 5° per day. End range flexion was to be avoided, and full extension was targeted. The graft was not to be overloaded, and activities could be progressed within the phase if able to perform prior activities pain free.

Plan of Care

After the above goals had been set, a treatment plan was established to address the patient's impairments. The interventions would include electrical stimulation, gait training, home exercise program, manual therapy, therapeutic exercises, and vasopneumatic treatment. The interventions would be chosen and progressed according to the protocol and patient tolerance. She was to be seen for 2 visits per week for 12 weeks. The patient agreed to this plan.

Intervention

On the day of evaluation, the patient was in a significant amount of pain and her knee had some visible swelling, so treatment focused on addressing these issues. Soft tissue mobilization was performed to address the swelling and for desensitization, and this was followed by vasopneumatic treatment for 15 minutes at low pressure. Therapeutic exercises were attempted the following session, including ankle pumps, straight leg raises into hip flexion, extension, and abduction, 2 sets of 10 reps each, and passive range of motion for knee flexion. It was noted that there was an extensor lag when she performed a straight leg raise into hip flexion.

On the third session she was noticing more of the symptoms of her CRPS. There is evidence that ultrasound may be useful in relieving the pain of patients with CRPS, but these patients often do not tolerate hot or cold extremes, so their response to the ultrasound must be monitored.[13] It has even been reported that the positive effects of ultrasound can be seen in patients with CRPS at very low intensities.[14]

Therefore, ultrasound at a frequency of 1 Hz and an intensity of 1.2 W/cm^2 for 6 minutes was used to loosen up her tissues and allow for more motion. This was followed by quad and ham sets, 2 sets of 10 reps each. Her passive knee flexion improved to 42°.

The patient was encouraged to work on regaining quad control by performing quad sets and straight leg raises and increasing her knee flexion by sitting in a chair and sliding her leg under her at home. The following session

Russian current was introduced to try to achieve a better quad contraction. Two electrodes were placed on her leg with one on her left vastus medialis oblique (VMO) and one on her left proximal anterior thigh. The parameters were set at level 14 milliamps, 30 seconds on and 30 seconds off, for 10 minutes. She was instructed to perform an active quad contraction with each on cycle and rest on the off cycles. Her passive knee flexion improved to 59°. She stated that her foot drop was getting better and that she was increasing her activity.

To address her CRPS symptoms, it was recommended to have a family member lightly stroke her leg with a cotton ball or a facial tissue to desensitize it. She was also applying firm pressure with a wash cloth after taking showers, and making herself do things such as drag her foot on the carpet or pet the cat with her foot. The evidence for these procedures in treating the sensitivity of patients with CRPS is lacking, but they were recommended by the therapist due to past experience in treating the disorder.

The plan of care remained the same for several sessions, and she was noticing that her sensitivity was getting better and her range of motion was improving with each session. In addition, by the 7th visit, a visible quad contraction was observed with the Russian current. However, more swelling was being noticed, so a stockinette was provided to address this. As with her initial evaluation, circumferential measurements were not deemed to be necessary at this time.

In subsequent sessions she stated that she felt that the sensitivity continued to get better, although she was still sensitive to light touch, and that the

swelling had decreased. She even reported 0/10 pain at rest and 4/10 with activity, and she was able to perform a SLR with no extensor lag.

It must be noted the physical therapy student working with this patient reached the end of his clinical rotation after the patient's 11th visit and was not able to observe her discharge from therapy.

Outcomes

This patient came to therapy with decreased strength and range of motion, and edema in her leg, as well as impaired gait due to the recurring need for surgical intervention. We used therapeutic exercise, a home exercise program, manual therapy, electrical stimulation, ultrasound, and vasopneumatic compression to address these issues. After her 11th and final visit to date on the 5th week of her treatment, she has achieved all of her short term goals. According to her protocol, she would be appropriate to move on from the immediate post-operative phase to the late post-operative phase with the improvements that she had made.

Initially she was not able to perform a straight leg raise without extensor lag, but on her last visit she was able to do so with no difficulty. She improved her passive knee flexion from 32° at evaluation to 116°, an increase of 84°. She rated her pain 0/10 with rest. Her edema was not objectively measured, but upon subjective report she felt that the compression stocking and exercise was effective in reducing the edema. It should be noted that during this treatment

time we were not able to address her problem of impaired gait as she was not able to bear weight during this course of treatment.

The patient was pleased with the progress she had made thus far, stating she was especially happy that her sensitivity to touch had decreased. During each session she showed visible signs of being in pain, but was still able to tolerate all interventions, saying that she knew it would benefit her in the end. Although she was in discomfort, she was always pleasant and compliant with therapy.

CHAPTER III

DISCUSSION

This case study was intended to observe the treatment of an individual with a history of chronic knee pathologies and a secondary diagnosis that complicated therapy. An approach that addressed each of her individual impairments was utilized so that she would see improvements on a holistic level as opposed to simply treating those that were a direct result of her procedures. At the time that this patient was last seen, she had achieved all of her short-term goals and was progressing toward addressing her long-term goals.

This was a particularly challenging patient to treat in that she had multiple impairments as well as an underlying issue that made her treatment sessions more painful than they might have been for another person having had the same procedure. As a team we tried to take each of the patient's problems and treat them individually so that she could experience an improvement at the level of the whole person.

To address her decreased strength, Russian current was included in her intervention plan. Strength gains have been reported when using electrical stimulation such as Russian current, just as they are with voluntary exercise. Evidence also shows that the two interventions performed separately can produce greater strength gains than either alone.[15]

The patient's CRPS made it difficult to perform any interventions that involved touching her skin, such as ultrasound, passive range of motion, and manual therapy, without causing her pain and discomfort. Desensitizing her leg using light touch sensation decreased this phenomenon and made it easier to perform interventions that would help her improve upon her other complications.

There is evidence that physical therapy is useful for patients with CRPS, primarily in that it can be useful in reducing pain and preventing functional limitations. Other intervention strategies include a multitude of oral medications for pain reduction and have even been shown to prevent the occurrence of CRPS after wrist fractures. Invasive treatments such as nerve blocks and incisions are also available options, but the evidence for the effectiveness of these procedures is inconsistent. Finally amputation is an option for patients with CRPS who have severe complications, but insufficient evidence exists for the effectiveness of this extreme measure.[12]

Another option for treating CRPS that is showing promising results is mirror therapy.[12] This treatment has been successful in patients who have phantom limb pain or have strokes. The patients perform exercises with both extremities at the same time while watching the unaffected limb and its reflection, keeping the affected limb hidden.[11]

Given the results of this case study, it is clear that all of a patient's comorbidities need to be taken into account when making treatment decisions. Had her CRPS not been considered, we may not have seen the desensitization that we did and might not have been able to proceed with our other interventions.

Thus, the improvements in strength, range of motion, edema, and pain reduction may have not been observed, and the patient would not have progressed as much and as quickly as she did.

It would have been ideal to have been with this patient throughout her entire treatment, as well as to have been able to follow up with her to see how she had progressed after discharge. In addition, there were several aspects of her examination and evaluation that would have been beneficial to have performed, such as range of motion of her uninvolved lower extremity and girth measurements of her involved knee to have had an objective measure from which to gauge her progress.

Further research would be helpful if it addressed which aspect of the management of her CRPS was most beneficial in reducing her sensitivity to touch. It is not certain whether her sensitivity decreased due to her desensitization activities at home, the use of Russian current to regain more quad control, or whether it naturally decreased as more time passed since her procedure. Also, it is plausible that it was a combination of two or more of these examples that reduced her sensitivity.

It is the duty of the therapist to constantly reevaluate the patient and make clinical decisions based on what is observed. Consistently working on and improving upon this procedure will lead to better patient outcomes and satisfaction.

Reflective Practice

Reflecting upon this case, it is clear that there were aspects of the patient's evaluation that were left out due to her condition as well as the therapist's discretion. The strength of her involved extremity was not evaluated due to the amount of pain that the patient was in, and that of the uninvolved extremity was not evaluated as she was deemed to be in good enough physical condition to have no weakness in this extremity. Edema was noted in her involved extremity, but her leg girth was not measured as it did not appear to be significant enough to warrant taking circumferential measurements. Furthermore, one of the patient's long term goals was to improve her strength to "within normal limits," which is a level of improvement that is difficult to quantify. It would have been more appropriate to performed manual muscle testing upon the patient's evaluation, then to have had a grade to which we wanted her to improve to achieve her goal.

In addition, the interventions that were recommended for the patient's CRPS were based on past experiences of the therapist. Although limited evidence exists for these interventions, the patient reported improvements in her sensitivity as therapy progressed.

Although no functional assessments were performed with this patient, scales such as the Lower Extremity Functional Scale (LEFS) could have been useful during her evaluation. The LEFS is a simple 20 point questionnaire that is used to evaluate a patient's ability to perform everyday tasks, such as bed

mobility, walking, or working. It has been shown to have an excellent level of test-retest reliability, measured at 94%.[16] This functional assessment could have been useful for evaluating her initial functional level, monitoring her progress, and evaluating the effectiveness of the interventions used in her therapy sessions.

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