Outpatient PT Management of Patient with Bilateral Knee Pain S/P Stem Cell Cartilage Replacement Therapy of Both Knees

Justin Hett
University of North Dakota

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OUTPATIENT PT MANAGEMENT OF PATIENT WITH BILATERAL KNEE PAIN
S/P STEM CELL CARTILAGE REPLACEMENT THERAPY OF BOTH KNEES

A Scholarly Project Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
by
Justin Hett

In Partial Fulfillment of the Requirements for the Degree of
Doctor of Physical Therapy
Grand Forks, North Dakota
May, 2019
This Scholarly Project, submitted by Justin Hett in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

[Signature]
Graduate School Advisor

[Signature]
Chairperson, Physical Therapy
PERMISSION

Title OUTPATIENT PT MANAGEMENT OF PATIENT WITH BILATERAL KNEE PAIN S/P STEM CELL CARTILAGE REPLACEMENT THERAPY OF BOTH KNEES

Department Physical Therapy

Degree Doctor of Physical Therapy

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Date 5-13-19
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Outpatient PT Management of Patient with Bilateral Knee Pain s/p Stem Cell Cartilage Replacement Therapy of Both Knees

Justin Hett
David Dahl

Abstract:
Background and Purpose: This article describes the 6-week outpatient physical therapy management of a 65-year-old male who c/o bilateral knee pain s/p stem cell cartilage replacement therapy. The patient presented with decreased ROM in both knees R>L, difficulty ambulating moderate distances, knee pain, and decreased LE strength bilaterally. The purpose of this article is to describe the treatments used for this patient and the results from these treatments.

Description: The treatment of this patient involved range of motion, strengthening, patient education, and stretching.

Outcomes: Following PT intervention, the patient had increased ROM in both knees L>R, normal strength, some decrease in pain in both knees L>R, improved functional ambulation endurance, and no need for a single point cane.

Discussion: Rationale for treatment was based on evidence based treatment for knee osteoarthritis and the protocol given to us by the patient’s surgeons. Treatment was altered or progressed based on patient’s response to interventions and the protocol.

Key Words: Knee pain, stem cell replacement therapy, osteoarthritis, cartilage

Introduction/Review of Literature:
Arthritis is the most common cause of adult disability in the United States impacting around 50 million people and is expected to rise to 67 million by 2030. Nearly 21 million of those affected attribute arthritis to activity limitations. Specifically, knee osteoarthritis contributed to 9.3 million cases in 2005. In older adults aged 85 and up the risk of developing symptomatic knee osteoarthritis is one in two and rises to two in three if obesity is involved. Also, men with knee osteoarthritis have a 20% greater likelihood of dying than men of the same age without knee osteoarthritis. And that statistic rises to 50% in women. In 2003 the costs attributable to arthritis and other rheumatic conditions were $128 billion ($81 billion in medical expenditures and $47 billion in earnings losses), which represented nearly 1% of that year’s U.S. gross domestic product. Currently patients with knee osteoarthritis have few options in their care process. Many approaches are palliative and focus on relieving the symptoms. Decreasing the inflammation with medicines like non-steroidal anti-inflammatory drugs is a popular option but does not address the source of pain. While pain may decrease for the short term, most of these patients still end up getting knee replacements in the near future. Literature reviewed for this case study indicates stem cell therapy for osteoarthritic knees is beneficial for pain reduction,
cartilage rebuilding, and functional improvement. Patients that underwent an injection of stem cells into the knee joint had significant improvements compared to the control groups. A systematic review found that all 5 trials that were studied reported superior efficacy in the experimental groups. However, all trials were at high risk of bias which resulted in a low score of level-3 evidence. This study recommends not undergoing stem cell therapy for knee osteoarthritis due to level of evidence. Literature was also reviewed concerning the conservative care and minimally invasive surgical care of knee osteoarthritis. Conservative care includes managing osteoarthritis with physical therapy and focuses on manual therapy, weight loss, education, and strengthening with a focus on functional improvement. Conservative physical therapy management has been shown to decrease pain and increase function compared to placebo groups. While arthroscopic surgery provides minimal increase function and decrease in pain in the short term and minimal to none in the long term compared to conservative management, risks associated with the surgery negate its benefits. Minimally invasive surgical management includes knee arthroscopy to lavage (flush the joint with fluid to remove any debris around the joint), debride (shave off bone spurs and damaged cartilage), and/or perform a partial meniscectomy (removal of a section of loose or damaged meniscus). Arthroscopy shows minimal relief of pain and increase in function in the short term (3 months) and very low to no relief of pain and increase in function in the long term (2 years). Arthroscopy has been shown to be inferior to conservative physical therapy management due to the potential side effects of surgery.

First, literature pertaining to stem cells will be presented. In these studies, adipose derived stem cells are being utilized as progenitors to cartilage. The adipose derived stem cells are known as mesenchymal stem cells which are precursors for tendons/ligaments, stromal cells, osteocytes, fibroblasts, astrocytes, adipocytes, muscle tissue, and cartilage. Stem cell lineage linked to cartilage is shown in Figure 1. To start the stem cell collection, around 140cc of adipose tissue is harvested from the buttocks or abdomen via liposuction. The tissue is then suspended in phosphate-buffered saline and centrifuged to separate mature adipocytes and connective tissues from the stromal vascular fraction. Stromal vascular fraction is a “combination of adipose derived stem cells, endothelial precursor cells, endothelial cells, macrophages, smooth muscle cells, lymphocytes, pericytes, and pre-adipocytes among others.” Once the stromal vascular fraction is confirmed to contain adipose derived stem cells, the solution is cultured and placed in a “specific inductive media to determine the adipogenic, osteogenic, and chondrogenic differentiation potential.” This media ensures that the stem cells are differentiated to replicate into cartilage cells. Around 6 million stromal vascular fraction cells are then prepared with 3.0ml of platelet-rich plasma. Platelet rich plasma is utilized as a source of differentiating factors and growth factors for adipose derived stem cells. The platelet-rich plasma is collected from the patient by a venous blood sample. The blood is centrifuged to “at 1,800 rpm for 15 min to separate the erythrocytes, and then at 3,500 rpm for 10 min to concentrate the platelets.” Platelets are at a concentration 500% times greater than that of whole blood. Calcium chloride is also added to the solution to activate the platelets. The solution of stem cells and platelet-rich
plasma is then injected into the joint space with arthroscopic or ultrasound guidance to the sites of degeneration.

Figure 1: Stem-cell lineage chart
While injection of stem cells into the joint space is constant in all these trials, a few variables have been utilized. In the study done by The Center for Stem Cell and Arthritis Research in South Korea arthroscopic lavage was performed, which is a flush of the joint space using fluid to get rid of any debris present. Before the patients received the stem cell injections, they underwent arthroscopic lavage with at least 1 liter of saline. The patients did NOT receive “synovectomy; excision of degenerative tears of the menisci or osteophytes that prevented full extension, and abrasion or micro-fracture of chondral defects.” Basically, they washed out the joint space and checked for the amount of degenerative changes in the knee joint. Immediately after the lavage, the patients received the stem-cell injections along with platelet rich plasma, first into the most damaged part of the cartilage and then to the rest of the joint. This study utilized the International Cartilage Repair Society (ICRS) Cartilage Injury Evaluation Package to rate the amount degeneration shown in Figure 2. The post injection protocol for this study included immobilizing the knee for 24 hours and did not permit the use of anti-inflammatory medications, immunosuppressive drugs, or analgesics for three months. These were the only post injection instructions detailed in the study. For clinical assessment, they utilized the Lysholm Score, Knee Injury and Osteoarthritis Outcome Score, and Visual Analog Pain Score (0-10). Participants were assessed pre-injection as well as post-injection at 3 months, 12 months, and 2-year follow-up. Each patient was given a questionnaire at the 2 year follow up to determine their overall satisfaction with the study. 16 of the patients in the study also underwent a second look arthroscopy 24 months post injection. 12 were asymptomatic (did not have any knee pain) and 4 were symptomatic (still had knee pain). The researchers looked inside the joint using a camera to determine the healing status of the degenerative cartilage. Four classifications were used to label the healing status; “very positive,” “positive,” “neutral,” or “negative.” “‘Very positive’ was considered when a remarkable change was noted throughout the degenerative cartilage with good integration to adjacent normal articular surface and normal gross appearance. ‘Positive’ was considered when newly forming cartilage tissue was found to partially cover the degenerative cartilage compared to that noted preoperatively. ‘Neutral’ was considered when an uncertain change was noted over 2 years compared to the preoperative status. ‘Negative’ was considered when progression of degenerative cartilage was noted compared to preoperative status. Of the 16 that underwent the second look arthroscopy three patients (all asymptomatic) were “very positive,” seven (6 asymptomatic and 1 symptomatic) were “positive,” four (2 asymptomatic and 2 symptomatic) were “neutral,” and two (1 asymptomatic and 1 symptomatic) were “negative.” Overall, the authors determined that this treatment for knee OA may be a good option for elderly to reduce pain, improve function, and heal cartilage.
A randomized control trial done by Pak, et al. utilized consecutive injections of platelet rich plasma into the joint. For three weeks following initial injection, patients were asked to come back for a platelet rich plasma injection once a week for three weeks. “These growth factors have shown to stimulate growth of stem cells as well as differentiation of stem cells to chondrocytes.” This study also added hyaluronic acid to the initial injection which aids in stem cell adhesion to lesions in the cartilage. The authors attribute symptom improvement to the hyaluronic acid injection. This study utilized Visual Analog Scale, functional rating index, ROM, and MRI before treatment and 3 months post-injection. They also used the Apley and McMurray tests on initial physical examinations to determine ligament laxity. This study does not include information on whether physical therapy treatment was included in the care plan.

Next, literature pertaining to conservative care and minimally invasive surgical care of knee osteoarthritis will be presented. A systematic review done by Brignardello-Petersen, et al. compares the effects and complications of arthroscopic surgery with conservative management strategies (conservative management in this study means exercise therapy, sham surgery, close needle lavage, hyaluronic acid injection, or steroid injection). This study included 13 randomized control trials and 12 observational studies which all compared arthroscopic surgery with a conservative management strategy in patients with knee osteoarthritis. It was found that patients receiving arthroscopic surgery had an increase in pain score on average of 5.4 points (on a 0-100 scale; 100=no pain, 0=worst pain ever) more in the short term and an average of 3.1 points more in the long term compared to conservative management (overall, conservative management increased their pain score on average by 15 points in the short term and 19 points in the long term, compared to 20 points for arthroscopic surgery in the short term and 22 points.
in the long term). The functional scores used (AIMS Physical Function, KOOS ADL, WOMAC Function, SF-36 Physical Function, Knee Society Score, Lysholm Knee Score, and Ordinal Score) were all converted into a 100-point scale (0=0% function, 100=100% function). It was found that patients receiving arthroscopic surgery had an increase in function score on average of 4.9 points more in the short term and an average of 3.2 points more in the long term compared to conservative treatment (overall, conservative management increased their functional score on average by 9 points in the short term and 10 points in the long term, compared to 14 points for arthroscopic surgery in the short term and 13 points in the long term). It is also important to note the risks with arthroscopic surgery study identified. Those who received arthroscopic surgery had a 1.89 times higher chance of getting a knee replacement within one year, the risk of developing a deep vein thrombosis at 1/200, and risk of infection at 1/500. To conclude, the study identified low quality evidence that arthroscopic knee surgery is a safe procedure with low complication risk and moderate to high quality evidence that the procedure provides small to no benefits in pain relief and function compared to conservative management especially in the long term. In the end, the article doesn’t advocate for either style of treatment saying, “Patients and their healthcare providers must trade-off the marginal short-term benefits against the burden of the surgical procedure (pain, swelling, limited mobility, restriction of activities, over a period of 2–6 weeks).”

A study done by Deyle, et al. evaluated the effectiveness of manual therapy and therapeutic exercise in patients with knee osteoarthritis. 83 patients were randomly assigned to either the treatment group or placebo group. Both groups received a formal physical therapy evaluation, 4 weeks of bi-weekly treatment, subjective and objective re-evaluation before and after each session, and a post-treatment re-evaluation at 4-weeks, 8-weeks, and 1-year. The placebo treatment consisted of sub therapeutic ultrasound for 10 minutes at an intensity of 0.1W/cm² at 10% pulsed mode (this ultrasound setting would not provide any medical benefit) to the area of knee symptoms. The treatment group “received manual physical therapy as indicated by the results of the examination. The manual therapy treatment techniques, consisting of passive physiologic and accessory joint movements, muscle stretching, and soft-tissue mobilization, were applied primarily to the knee. The same treatments were also administered to the lumbar spine, hip, or ankle if these areas showed limitation in active or passive movement, were symptomatic, or were contributing to overall lower limb dysfunction.” The treatment group also completed a standardized exercise program including, “active range-of-motion exercises for the knee, muscle strengthening exercises for the hip and knee, muscle stretching for the lower limbs, and riding a stationary bike.” Intensity and duration of the exercises varied from patient to patient depending on patient response and tolerance. All exercise and manual therapy were performed painless or in a minimally painful manner. The two dependent variables used to assess progress were the 6 Minute Walk Test and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score. The 6 Minute Walk Test assesses how far a patient can walk (endurance), using a comfortable pace, in 6 minutes. The WOMAC is a questionnaire used to assess pain, stiffness, and function in patients with hip or knee osteoarthritis. It was found that the placebo group
scored an average of 1093.5 on the WOMAC (higher scores indicate worse pain, stiffness, and functional limitation) at baseline, 921.2 at week 4, and 934.3 at week 8. The treatment group scored an average of 1046.7 at baseline, 505.2 at week 4, and 462.4 at week 8. The placebo group walked an average distance of 402.9 meters (m) in the 6 Minute Walk Test at baseline, 402.1m at week 4, and 409.7m at week 8. The treatment group walked an average of 431.0m at baseline, 484.0m at week 4, and 487.4m at week 8. There were no meaningful changes in either groups at the 1 year follow up; the placebo group still had no improvements and the treatment group maintained their improvements. 20% of patients in the placebo group and 5% of patients in the treatment group decided to get a total knee replacement and 15% of the placebo group and 5% of the treatment group decided to get steroid injections into the knee. The authors concluded that a combination of manual therapy and therapeutic exercise is beneficial in patients with knee osteoarthritis to decrease pain, stiffness, and increase function compared to no treatment. This treatment may also defer or decrease the need for surgical intervention.13 While this study bolsters the effectiveness of physical therapy as an effective short-term and 1-year long term treatment for knee osteoarthritis, a systematic review done by Pisters, et al. finds that long-term effectiveness of exercise therapy may not be there. The authors found exercise therapy to be beneficial for pain relief in the short-term but the benefits disappear in the long-term (6-15 months post intervention). However, studies that included extra (booster) sessions before the long-term follow up showed some long-term benefits in pain relief. The same trends were found for self-reported and observed physical function parameters. The authors concluded that the positive post treatment effects of exercise therapy are not sustained in the long-term.14 This review, however, did not include studies that provided manual therapy as a part of the intervention program. Another systematic review by Newberry, et al. looked at the effectiveness of several types of treatment for knee osteoarthritis. They looked at “cell-based therapies; glucosamine, chondroitin, or glucosamine plus chondroitin; strength training, agility, or aerobic exercise (land or water based); balneotherapy, mud bath therapy; electrical stimulation techniques (including transcutaneous electrical stimulation, neuromuscular electrical stimulation, and pulsed electromagnetic field therapy); whole body vibration; heat, infrared, or ultrasound; orthoses (knee braces, shoe inserts, or specially designed shoes); weight loss diets; and home-based therapy or self-management.” The only long-term benefits they found came from studies that included “agility training and general exercise programs for pain and function, and manual therapy and weight loss for pain.” The authors concluded that only a combination of these techniques show a positive long-term effect.15

Case Description:
Patient is a retired and active 65-year-old male who has had progressive knee osteoarthritis since August 2014. Patient enjoys hiking, biking, and being outdoors. He notes the pain has slowly gotten worse since onset of pain R>L and has had some trouble sleeping or sitting still for more than 30 minutes. Patient did not seek medical treatment for a couple years due to the minimal severity of the pain. As the pain started to limit his active lifestyle he sought treatment and
attended physical therapy from May 2016-September 2016. Minimal pain relief was noted with conservative treatment so patient began researching alternatives. He consulted with orthopedic surgeons and they recommended knee replacements due to the deterioration of the knee cartilage. The patient felt he was too young and active to pursue that option yet. The orthopedic surgeon gave him some information on experimental stem cell regenerative therapies. He decided to go forward with this option and had the procedure done August 2017. An injection of around 6,000,000 of his own stem cells, derived from adipose tissue, and platelet rich plasma was injected into the joint space of both knees. Patient was instructed to remain non-weight bearing for 3 days, ambulate only necessary distances for a 2-weeks with a single point cane, and then to attend physical therapy for 6-weeks. Patient was given a home exercise program to be progressed per protocol by a therapist of his choosing for 6 weeks. One year after the procedure, the patient will return to the treatment center and review his progress.

Examination and Evaluation
Before the initial evaluation, the patient filled out the Lower Extremity Functional Scale (LEFS). LEFS results are listed in Table 1. Upon observation, the patient ambulated into the department with a single point cane in his R hand. Patient had slow, antalgic gait favoring the R LE and was unable to fully extend either leg in stance phase. Special tests were deferred due to the known origin of pain.

Active range of motion of the knee was measured in supine with a goniometer. Range of motion results are listed in Table 2. Strength of the knee was measured using a handheld dynamometer in sitting. Strength results are listed in Table 3. All other motions of hip and ankle were within normal limits for range of motion and strength. Patient states that the pain in his knees feels like its grinding. Pain levels at evaluation and throughout treatment are listed in Table 4. Dermatomal testing came out negative and the patient had a good dorsalis pedis pulse in both feet. The knees, legs, and feet did not have any apparent swelling. The legs appeared normal color and the patient did not report any pain/warmth in the calf or signs of fever ruling out presence of deep vein thrombosis. Patient was independent in all transfers. Circumferential measurements, passive range of motion, stair ambulation, endurance, and palpation of the lower extremities were not tested.

Not much decision making was needed to come to an accurate physical therapy diagnosis due to his history. Knee osteoarthritis was the obvious diagnosis with his symptoms and patient’s self-reported x-ray history showing joint space narrowing as actual x-rays were not available.

Care/Intervention
The first week of treatment involved Nu Step warm up x 5 minutes on 2 resistance, PROM of both knees within available range (3x20 bilaterally), open chain knee extension and knee flexion with red Thera band (3x10 bilaterally), 2 inch box step-ups (3x10 bilaterally), and prone leg curls with
knees off the end of the bed (3x10 bilaterally). Patient notes that he has been able to sleep better the last couple of nights.

The second week of treatment remained fairly conservative due to protocol limitations and included Nu Step warm up x 5 minutes on a ‘3’ level of resistance, PROM of both knees within available range (3x25 bilaterally), open chain knee extension and knee flexion with green Thera band (3x10 bilaterally), 2-inch box step-ups (3x10 bilaterally), prone leg curls with knees off the end of the bed (3x10 bilaterally), and heel toe raises in the parallel bars (3x10). Patient noted that he has been able to ambulate a quarter mile before he needed to sit and rest. Patient also noted that his knees feel less stiff than before the procedure.

The third week of treatment we were able to increase the intensity of the exercises. The patient also ambulated into the facility without the single point cane but still exhibited the antalgic gait, though his body sway was markedly lessened. This included recumbent bike warm up x 5 minutes with no resistance (patient had to alternate going forward and backward for 2 minutes because the R knee was unable to complete a full cycle due to limited range; once loosened up he could pedal continuously with moderate hip hiking noted on the R), flexion stretch of both knees in sitting just beyond end range (8x 30 second holds bilaterally), mini squats (3x10 bilaterally), 4 inch box step-ups (3x10 bilaterally), leg curls on leg curl machine with 10 lbs. (3x10 bilaterally), supine extension stretch with heels propped up on bolster(x 3 minutes bilaterally), and heel toe raises without assist of parallel bars (3x10). Patient noted he has felt minimal changes in the pain during exercise but feels like his legs are getting much stronger.

The fourth week of treatment included recumbent bike warm up x 5 minutes with no resistance (patient had to alternate going forward and backward for 1 minutes because the R knee was unable to complete a full cycle due to limited range; once loosened up he could pedal continuously with moderate hip hiking noted on the R), flexion stretch of both knees in sitting just beyond end range (8x 30 second holds bilaterally), mini squats (3x10 bilaterally), 6 inch box step-ups (3x10 bilaterally), leg curls on leg curl machine with 12.5 lbs. (3x10 bilaterally), supine extension stretch with heels propped up on bolster and 5 pound ankle weights on knees (x 3 minutes bilaterally), and heel toe raises without assist of parallel bars (3x10). Patient notes he’s been doing his exercises religiously as prescribed and feels stiff with no change in pain during ambulation or exercising. He also states that his legs feel much stronger.

The fifth week of treatment included recumbent bike warm up x 5 minutes with no resistance (patient did not need to warm up back and forth anymore and could complete cycles with minimal hip hiking on the R), flexion stretch of both knees in sitting to patient tolerance (8x 30 second holds bilaterally), squats (3x10 bilaterally, patient cued to move deeper into the squat), 8 inch box step-ups (3x10 bilaterally), leg curls on leg curl machine with 12.5 lbs. (3x10 bilaterally), supine extension stretch with heels propped up on bolster and 7 pound ankle weights on knees (x 3 minutes bilaterally), and heel toe raises without assist of parallel bars (3x10). Patient
demonstrated a normal gait pattern with no body sway. Patient also ambulated up and down two flights of stairs without difficulty or increased pain. Patient is independent with his exercise program and demonstrates understanding how to progress his exercise as he can tolerate. Patient notes a decrease in his pain levels over the last week.

Outcomes

Table 1: Lower Extremity Functional Scale at evaluation and discharge.

<table>
<thead>
<tr>
<th></th>
<th>Initial Evaluation</th>
<th>At Discharge</th>
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<tbody>
<tr>
<td>Lower Extremity Functional Scale</td>
<td>56/80</td>
<td>76/80</td>
</tr>
</tbody>
</table>

0/80=0% lower extremity function. 80/80=100% lower extremity function.

Table 2: Knee Range of Motion throughout treatment (in degrees)

<table>
<thead>
<tr>
<th>Active Range of Motion</th>
<th>Initial Evaluation</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
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<tbody>
<tr>
<td>Left Knee Flexion</td>
<td>88</td>
<td>90</td>
<td>98</td>
<td>109</td>
<td>108</td>
<td>110</td>
</tr>
<tr>
<td>Right Knee Flexion</td>
<td>72</td>
<td>73</td>
<td>81</td>
<td>102</td>
<td>103</td>
<td>104</td>
</tr>
<tr>
<td>Left Knee Extension</td>
<td>-8</td>
<td>-9</td>
<td>-8</td>
<td>-6</td>
<td>-4</td>
<td>-4</td>
</tr>
<tr>
<td>Right Knee Extension</td>
<td>-15</td>
<td>-15</td>
<td>-12</td>
<td>-7</td>
<td>-5</td>
<td>-5</td>
</tr>
</tbody>
</table>

(-) indicates degrees from full extension.

Table 3: Knee strength throughout treatment (in pounds via handheld dynamometer)

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<thead>
<tr>
<th>Strength</th>
<th>Initial Evaluation</th>
<th>At Discharge</th>
</tr>
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<tbody>
<tr>
<td>Left Flexion</td>
<td>29.3 (51.0=normal)</td>
<td>48.3 (51.0=normal)</td>
</tr>
<tr>
<td>Right Flexion</td>
<td>28.0 (51.0=normal)</td>
<td>45.6 (51.0=normal)</td>
</tr>
<tr>
<td>Left Extension</td>
<td>49.7 (83.0=normal)</td>
<td>75.9 (83.0=normal)</td>
</tr>
<tr>
<td>Right Extension</td>
<td>46.2 (83.0=normal)</td>
<td>73.5 (83.0=normal)</td>
</tr>
</tbody>
</table>

Strength norms based off of “Normative Values for Isometric Muscle Force Measurements Obtained with Hand-held Dynamometer.”

Table 4: Patient’s pain using the Visual Analog Scale. (0/10= no pain; 10/10= worst pain ever.)

<table>
<thead>
<tr>
<th>Pain</th>
<th>Initial Evaluation</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left knee at rest</td>
<td>2/10</td>
<td>1-2/10</td>
<td>1-2/10</td>
<td>1/10</td>
<td>1/10</td>
<td>0-1/10</td>
</tr>
<tr>
<td>Right knee at rest</td>
<td>2/10</td>
<td>1-2/10</td>
<td>1-2/10</td>
<td>1/10</td>
<td>1/10</td>
<td>0-1/10</td>
</tr>
<tr>
<td>Left knee with exercise</td>
<td>5/10</td>
<td>5/10</td>
<td>4/10</td>
<td>4/10</td>
<td>3-4/10</td>
<td>3-4/10</td>
</tr>
<tr>
<td>Right knee with exercise</td>
<td>7/10</td>
<td>6-7/10</td>
<td>5/10</td>
<td>5/10</td>
<td>5/10</td>
<td>5/10</td>
</tr>
</tbody>
</table>
**Discussion and Reflection**

This patient progressed well with therapy including significant increases in strength, moderate increases in ROM, and moderate decreases in pain. The patient was independent with the home program and will continue exercising to progress towards patient goals (previous level of active function to be able to hike, bike, and explore). Initially the patient’s strength, pain, and ROM improved quickly, though towards the end of the 6 weeks, progress slowed, yet was still showing improvements. During the evaluation circumferential measurements, passive range of motion, stair ambulation, endurance, and palpation of the lower extremities were not tested. These measures would have been helpful to track progress and guide intervention more efficiently. Circumferential measurements and palpation around the knees would have been useful to track the progress of swelling; is it increasing or decreasing? Is decreased swelling correlating to range of motion gains? If we did see increased swelling, we could have kept a closer eye on the potential of infection or deep vein thrombosis. While we didn’t see obvious signs of infection or deep vein thrombosis, we still should have informed the patient of the signs and symptoms so he could identify them himself. Palpation would also have been useful to identify tender points around the knees. Passive range of motion would have been useful to see if it was identical to active range of motion. If this is so, we can equate the range of motion loss to joint stiffness rather than muscle weakness. Even though the patient was able to ambulate up and down two flights of stairs independently at discharge, we should have tested it right away. Endurance also should have been tested with a Six Minute Walk Test. With knowledge of his stair climbing/descending and endurance limitations we could have incorporated more function specific interventions into his plan of care. Normally treatment would have continued for this patient because he was making progress, however, he was approved for only 6 weeks of therapy through the treatment center. Stem cell therapy is still a very new and experimental treatment for osteoarthritis. This patient is the ideal candidate to prove that it could work; he’s motivated to get better and follows directions to a T. Patient noted that he isn’t as nearly as nimble as he was before the OA set in, but feels better than he was a year ago.
References


