# Manual Therapy, Therapeutic Exercise, and HipTrac™ for Patients with Hip Osteoarthritis: A Case Series

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## ABSTRACT

**StudyDesign:** Case series. **Background**: Manual, long-axis hip traction has been used for centuries to treat pain and dysfunction associated with hip osteoarthritis (OA). The purpose of this case series is to describe a rehabilitation program that was used to treat two patients with hip OA using the HipTrac traction device in addition to manual therapy and therapeutic exercise. **Case Description**: Two patients were treated with manual therapy, therapeutic exercise, and administered the HipTrac device. The manual therapy and therapeutic exercise programs targeted impairments each patient presented with at each treatment session. The HipTrac, applied in the clinic and in each patient's home, was used for mobilizing the joint capsule and to provide pain relief. **Outcomes**: The primary outcome measures were the CareConnections Functional Index (CCFI), the Visual Analog Pain Scale (VAS), range of motion (ROM), manual muscle tests, performance of functional single leg squats and single leg dead lifts. Improvements in all outcome measures were observed for both patients. **Discussion:** Clinically meaningful improvements in self-reported function and pain were described by both patients two years posttreatment. Both patients reported that they had greatly benefited from combining the techniques and procedures used. The use of the HipTrac along with traditional physical therapy procedures may relieve pain and improve function in patients with hip disorders.

**Key Words:** mechanical traction, stiffness, gluteal muscle weakness

## INTRODUCTION

For decades, the first and most widely used manual therapy technique for hip joint pain has been long-axis hip traction. Brackett stated in 1890, "the value of traction in the treatment of the acute condition of hip disease has abundant evidence, both in its relief of the symptoms and in its influence on the course of the disease." Brackett credited Bradford and Conant for describing the position of traction, that is, when the hip is flexed and abducted. Brackett concluded that in "ordinary cases" when continual traction is used, distraction occurs and "this may happen even after disease has existed for some time." Brackett also noted that continual traction is beneficial for alleviating pain and for preventing the mechanical sequelae associated with excessive muscular irritability.[1]

Many manual therapy techniques, including joint mobilization and manipulation, are important in the treatment of hip joint pathology. There is strong evidence in the current literature that shows the benefit of joint mobilization, including long-axis traction, in improving range of motion (ROM) and functional index scores while decreasing pain. There has been much discussion about how joint mobilization might affect hip joint pathology including (1) restoring positional faults and accessory movements,[2] (2) stretching the joint capsule thus restoring normal arthrokinematics, (3) inducing pain inhibition and improving motor control,[3] (4) changing the descending pain inhibitory system and/or central pain processing mechanisms,[4,5] (5) stimulating joint mechanoreceptors thus inhibiting nociceptive stimuli,[6] (6) altering inflammatory mediators,[7] or (7) reducing fear avoidance with movement and exercise.[8]

Long-axis traction is one of the techniques that can provide immediate pain relief while also working to improve general mobility in the treatment of hip joint pathology. Based on recent clinical findings obtained with manual therapy and the potential need for prolonged and continual traction as stated by Brackett, can we improve patient care in the treatment of hip joint pathology by combining these two concepts in the short and long term?

The purpose of this case series is to describe a rehabilitation program that included using long-axis hip traction using the HipTrac (MedRock Inc., Portland, OR) for two patients with hip osteoarthritis (OA). In addition to using the HipTrac, the patients participated in an individually-dosed and impairment-specific manual therapy and therapeutic exercise program. The HipTrac is a home medical device that the patient can use independently to perform long-axis hip traction that replicates the manual technique performed in the clinic. It can be applied in supine in any degree of rotation and abduction as well as 4 levels of flexion (0°, 10°, 20°, and 30°). The HipTrac can also be used in sidelying for traction in any degree of extension. The hip joint requires approximately 400 N to achieve distraction[5] and the HipTrac is able to produce forces well over 1000 N. In this case series, the HipTrac was used only for supine long axis-traction in varying positions between close-packed and loose-packed hip positions. This is the first paper evaluating a multi-modal treatment approach to hip OA that allows the patient to receive long periods of hip traction at home as well as in the clinic.

## REVIEW OF THE LITERATURE

Within the last decade several authors have investigated the effects of manual therapy, including long-axis hip traction, as a component of the rehabilitation program for patients with hip OA. In a single-blind, randomized clinical trial of 109 patients with OA of the hip, Hoeksma et al[9] reported statistically significant improvements in hip function (Harris Hip Score[10]) and pain (Visual Analog Scale [VAS]) in a group that received manual therapy (which included manual traction of the hip) versus a group that received exercise alone.

MacDonald et al[11] described the outcomes from a series of 7 patients with hip OA who were treated with manual therapy (including long-axis hip traction) and exercise. All patients exhibited reductions in pain (numeric pain rating scale), increases in passive hip ROM, and improvements in function (Harris Hip Score[10]).

Vaarbakken and Ljunggren[12] compared the effectiveness of manual hip traction that was progressed to 800 N in 10 patients (experimental group) to a group (n=9) who received exercises, soft tissue techniques, and self-stretch procedures. Six out of the 10 subjects in the experimental group showed superior clinical posttreatment effects on the

Hip Disability and Osteoarthritis Score[13] whereas none of the 9 subjects in the control group showed as comparable improvement on the same outcome measure. The results suggest that higher known forces with manual hip traction are more effective in reducing self-rated hip disability after 12 weeks of treatment than the application of unknown manual traction forces provided by the clinician.

Wright et al[14] retrospectively analyzed the data from 70 subjects who had participated in a randomized controlled trial. Forty-seven subjects were assigned to an exercise and manual therapy group (which included manual hip traction) and 23 subjects were assigned to a control group who received routine care offered by their general practitioner. Significant differences in the regression coefficients for the Global Rating of Change Scale[15] and the pain scale from the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)[16] were found for the exercise/manual therapy group versus the control group.

Using the WOMAC as the primary outcome measure, Abbott et al[17] allocated 206 adults with hip (n=93) or knee (n=113) OA to the following groups: usual care only (n=51), usual care plus manual therapy (n=54), usual care plus exercise therapy (n=51), and usual care plus combined exercise therapy and manual therapy (n=50). For the patients with no joint replacement surgery during the trial (n=162), the authors reported statistically significant improvement in WOMAC scores for all 3 interventions; that is, manual physical therapy versus usual care, exercise therapy versus usual care, and the combined therapies versus usual care. The manual therapy group showed the greatest reductions in WOMAC scores of all groups overall and these reductions were still present one year later.

Using a randomized participant and assessor-blinded protocol trial with a 12-week intervention period, Bennell et al[18] compared manual therapy, home exercises, education, and advice in 49 patients to a group of patients (n= 53) who received a sham treatment intervention. All participants met the hip OA classification criteria of pain and radiographic changes set by the American College of Rheumatology.[19] The inclusion, criteria were as follows: 50 years of age or older, pain in the hip or groin for more than 3 months, a VAS score of 40 or higher on a 100 mm scale and at least moderate difficulty with activities of daily living. Major exclusion criteria included participation in physical therapy/chiropractic treatment in the past 6 months, prescribed exercises for the hip or lumbar spine in the past 6 months, current participation in a daily walking program for 30 minutes, or current participation in a regular structured exercise routine more than once weekly. The primary outcome measures were the VAS and the WOMAC. After 10 treatment sessions over 12 weeks, the investigators reported no significant difference between the treatment group and the sham treatment intervention. Based on the results of their study, the investigators concluded that "there is limited evidence supporting use of physical therapy for hip osteoarthritis."

## CASE DESCRIPTION AND OUTCOMES

Each patient was informed that his physical therapy chart notes could be used in a publication or presentation. Each patient was informed that his identity would not be disclosed in a publication or presentation and fictitious names would be used.

### Patient One

Jill is a 50-year-old female with a diagnosis of moderate right hip OA by her orthopaedic surgeon and supported by radiographic evidence. Her symptoms began 6.5 months ago and she describes her pain as sharp, dull, aching, throbbing, and constant in the groin and buttock regions. Her pain is aggravated by sitting, rising from sitting, walking, ascending/descending stairs, and crossing her legs. It is relieved by stretching, rest, and medication. She has been given the recommendation for total hip replacement at any time when she can no longer subjectively tolerate her pain and dysfunction. Jill's CareConnections Functional Index (CCFI) score prior to receiving physical therapy was 52%. A change greater than 11 points has been reported as representing the minimal clinically important difference (MCID) for the lower extremity.[20] Jill takes over-the-counter nonsteroidal anti-inflammatory medications as needed. Jill rates her pain as 3 out of 10 on the Visual Analog Pain Scale. An MCID of 1.37 cm has been determined for the 10 cm VAS.[21] Jill's ROM on intake and discharge appears in Table 1.

Jill had the following positive signs on the right: Trendelenburg gait, flexion abduction external rotation (FABER) test, and a capsular pattern of restriction (defined here as loss of closed-pack position, FABERs, and flexion/internal rotation quadrant). She has increased hip pain with compression and decreased pain with traction. Jill's manual muscle test for sidelying hip abduction was 4-/5 on the right and 4+/5 on the left. Jill could not perform a functional single leg squat with gluteal emphasis or a single leg dead lift without loss of balance, pelvic drop, or pain. The following goals and expected outcomes by time of discharge for her were as follows: independence and compliance with her home exercise program, pain rated as 1 out of 10 or less on the VAS, an increase in hip ROM (flexion to at least 110°, extension to at least 15°, internal rotation to at least 10°, and external rotation to at least 50°), to walk safely and independently all distances, and to perform all normal work tasks without limitations.

Jill received 17 physical therapy sessions over a span of 6 months with therapy provided 2 times per week for 4 weeks, then once per week for 6 weeks, then one time per month for 2 months, and finally 1 discharge visit 2 months later. Manual therapy in the clinic was focused on improving hip joint mobility and decreasing pain. Techniques are described in Appendix A. Home and clinic therapeutic exercise programs focused on increasing lower extremity and lumbopelvic mobility, neuromuscular control, biomechanics, strength, flexibility and stabilization (Appendix B). The HipTrac was used at home, after the eighth clinic visit, and to be used between visits and after discharge for pain-control and to augment the hip mobility gains that she achieved with her clinical treatments (Appendix C – protocol).

Jill's CCIF increased from 52% (intake score) to 86% (discharge score); this met the MCID of 11 points. Jill's VAS decreased from 3 (intake score) to 0.4 (discharge score); this met the MCID criteria of 1.37 cm. Jill also reported that her global rate of change was 5/7 at discharge. Between intake and discharge from physical therapy, Jill's ROM retest scores for her right hip increased by 30° for flexion, 11° for extension, 7° for abduction, 18° for internal rotation, and 27° for external rotation (Table 1).

When Jill was discharged, she reported that she rarely needed to take over-the-counter medications and was much more active now, participating in yoga twice per week in addition to her weekly home exercise program developed during treatment. Jill's hip abduction manual muscle test at discharge was 4+/5 on the right as compared to 4-/5 at intake. In addition, Jill was able to perform functional single leg squats with gluteal emphasis and single leg dead lifts without loss of balance, pelvic drop, or pain great than 1/10 (2 sets of 10 of each) at discharge. Jill reported that she felt that she had greatly

**Table 1. Jill's Hip Range of Motion Over 17 Visits in a 6-month Period**

| | Intake | | Discharge | |
|---|---|---|---|---|
| Hip ROM (deg) | Right | Left | Right | Left |
| Flexion (supine knee flexed) | 90 | 115 | 120 | 124 |
| Extension (prone, knee extended) | 9 | 15 | 20 | 25 |
| Abduction (supine) | 28 | 40 | 35 | 45 |
| Internal rotation (90° flexion) | 0 | 19 | 18 | 30 |
| External Rotation (90° flexion) | 35 | 65 | 62 | 73 |

benefitted from home manual therapy using the HipTrac as well as her home exercise program. She verbalized understanding that her OA will progress and that consistent home manual therapy and exercise may continue to help her have less pain, increased mobility, and increased functionality. She reports her new goal is to more comfortably delay her surgery as long as possible. As of completion of this case series two years later, she has yet to have surgery and reports that she continues to maintain her higher level of function, reduced pain, and a more active lifestyle.

### Patient Two

Travis is a very active 40-year-old male with a diagnosis of moderate left hip OA and left femoral acetabular impingement (FAI) by his orthopaedic surgeon and supported by radiographic evidence. He reports his symptoms began two years before with a gradual onset, which he noticed while running. His chief complaint is a dull and constant ache in the left groin, thigh, and buttocks. Walking, stairs, and recreational sports such as running, skiing, cycling, hiking, and surfing aggravate Travis' symptoms; he reports that nothing relieves his symptoms. He has been given the recommendation for total hip replacement. Travis' CCIF score on intake was 80%. A change of greater than or equal to 11 points has been reported as representing the MCID for the lower extremity.[20] Travis takes over-the-counter nonsteroidal anti-inflammatory medications as needed. Travis rates his pain as 3.7 on the VAS. An MCID of 1.37 cm or greater has been determined for the 10 cm VAS.[21] Travis' ROM on intake and discharge appears in Table 2.

At intake Travis had a positive left Trendelenburg gait, positive FABER test, and significant capsular restrictions. He had increased pain with compression and decreased pain with traction. His hip abduction muscle strength was 4/5 on the left and 4+/5 on the right. Travis could not perform a functional single leg squat with gluteal emphasis or a single leg dead lift without loss of balance, pelvic drop, or pain.

Expected goals and outcomes for Travis were as follows: home exercise program independence, pain rated as 1/10 or less on the VAS, improved hip ROM (flexion to at least 110° and internal rotation at 90° of hip flexion to at least 10°), and participation in most of his recreational/sports activities with decreased symptoms less than 1/10.

Travis received 15 physical therapy visits over a 5.5 month period with therapy provided 2x per week for 4 weeks, then 1x per week for 4 weeks, followed by 3 visits over the next 4 months. Manual therapy in the clinic focused on improving hip joint mobility and decreasing pain through a variety of techniques (Appendix A). Home and clinic therapeutic exercise programs focused on increasing lower extremity and lumbopelvic mobility, neuromuscular control, biomechanics, strength, flexibility, and stabilization (Appendix B). HipTrac was initiated at home, after the fourth visit, to be used between visits and after discharge for pain control and to supplement, reinforce, and further improve the hip mobility gains that he achieved with his clinical treatment (Appendix C – protocol).

Travis' CCFI score increased from 80% (intake) to 94% (discharge); this met the MCID of 11 points. Travis' VAS decreased from 3.7 (intake score) to 1 (discharge score); this met the MCID criteria of 1.37 cm. His perceived global rate of change was 5/7 at discharge. Between intake and discharge from physical therapy, Travis' ROM retest scores for his left hip increased by 27° for flexion and 14° for internal rotation (Table 2). Travis' left hip abduction manual muscle test score at discharge was 4+/5 as compared to 4/5 at intake. In addition, Travis was able to perform 3 sets of 10 functional single leg squats and single leg dead lifts with proper technique and no pain over a 1/10 at discharge.

Near the end of Travis' physical therapy program, he reported that he had participated in a painfree 62-mile bike ride. He also stated he was very happy to not only delay his total hip replacement but participate in more activities with less pain. He was able to return to surfing with some symptoms and could ride his bike daily for commuting without aggravating his hip. Against the advice of his medical team, he also returned to running 4 to 5 miles on trails 3 times per week with pain below a 2/10. Because of his interest in regular participation in the high-level activities of surfing, running, and performance cycling, Travis reports that he has good days and days with some soreness. However, he now has improved mobility and strength in addition to pain management strategies to cope with any flare-ups. He reports that he can use the HipTrac and home exercise program to quickly decrease pain from increased activity and maintain hip mobility. He reported that he would not have been able to return to any of these activities or delay hip surgery for the past two years if he had not used the HipTrac regularly at home.

## DISCUSSION

Providing individually dosed and impairment-specific manual therapy, therapeutic exercise, a home exercise program, and use of traction using the HipTrac independently at home between visits and after discharge increased the quality of life for these two patients. Hip traction has long been established as an effective therapy for patients with hip OA.[1] The most effective form of long-axis traction is when the distraction force is progressed.[12] The HipTrac allows the patient to receive prolonged and progressed distraction forces in the clinic and at home.

We have described a multi-modal rehabilitation program that produced subjective and objective results for these two patients. Our results are consistent with other authors[9,11,12,14,17] who have reported benefits from manual therapy, exercise therapy, and a reinforcing home program. However, our findings are not supported by the work of Bennell et al.[18] Differences between our case series and the Bennell et al[18] study may be related to the following: (1) the dosage of manual therapy and therapeutic exercise provided; (2) the impairment-specific manual therapy techniques and therapeutic exercises provided to each individual patient or

**Table 2. Travis' Hip Range of Motion over 15 Visits in a 5.5-month Period**

| | Intake | | Discharge | |
|---|---|---|---|---|
| Hip ROM (deg) | Right | Left | Right | Left |
| Flexion (supine knee flexed) | 115 | 85 | 120 | 112 |
| Extension (prone, knee extended) | 22 | 20 | 23 | 20 |
| Abduction (supine) | 35 | 40 | 40 | 45 |
| Internal rotation (90° flexion) | 28 | 0 | 27 | 14 |
| External Rotation (90° flexion) | 40 | 50 | 45 | 51 |

lack thereof and, (3) the activity level of the patients.

Regarding dosage, the authors of this paper spent more time with the patients than did Bennell et al.[18] The authors believe that when treating such a complicated and varying pathology, a meaningful dose of manual therapy and therapeutic exercise cannot be properly applied in only 30 minutes and only one time per week. Some individuals may only need 30 minutes while others may require up to 60 minutes per session, with sessions being 1 to 2 times per week for 4 to 6 weeks initially.

Regarding the manual therapy and exercise approach, the authors's program was individualized for each patient whereas that of Bennell et al[18] used a semi-standardized approach to treatment. Random allocation of subjects into treatment and control groups is a very important component of a well-done study, as was the case with the Bennell et al[18] work. However, treatment for hip OA may need to be very specific to the individual's impairments, and providers may need to take special care to non-randomly categorize patients into the proper treatment protocol in order to show success. For example, clinical reasoning would discourage placing a patient with very good ROM into a manual therapy-emphasized category to increase ROM, just as we would not expect to place a patient with severe capsular restrictions into an exercise-only category. Treatment emphasis and categorization should depend on that individual's impairments.

In addition, all of the Bennell et al[18] subjects received only 2 to 3 different joint mobilization techniques: long-axis distraction in clinic and lateral distraction and/or inferior glide in hip flexion. Only 22% of the subjects in their active group also received joint mobilization in anterior glides for hip extension and external rotation, and 16% received posterior glides for internal rotation. It is well established that hip extension, internal rotation, and external rotation can be greatly limited with hip OA and are critical to specifically target in treatment when these limitations exist. In our case series, our two subjects received 8 different joint mobilization techniques, as needed, rather than only 2 to 5 techniques to specifically target each individual's impairments.

Also, Bennell et al[18] excluded patients under 50 years old as well as patients who could walk continuously for more than 30 minutes daily and those who participated in regular structured exercise more than once weekly. By excluding these individuals, Bennell et al[18] may only be studying individuals who are unmotivated to exercise/improve, who are in too much pain or dysfunction to exercise, or who are fear-based individuals avoiding exercise. There is also a growing number of individuals younger than 50 years old that may benefit from treatment for hip OA earlier in the disease cycle. We believe that all individuals of all ages along the continuum of mild, moderate, and severe OA who are active and inactive more accurately represent those who need and may seek treatment for hip OA prior to becoming surgical candidates.

Evidence-informed practice takes into account what has been published in the literature, the experience of the clinician, and the goals of the patient. Consequently, success may need to be individually defined. There is no cure for hip OA and therefore providers cannot rid these patients of OA. The goals for most patients are to more comfortably avoid or delay surgery, improve mobility, decrease risk for co-morbidities due to inactivity related to their disease, decrease pain, and increase overall quality of life to engage in all of their social, occupational, and leisure activities. For some patients, making a change from a 7/10 pain level and no participation in a regular exercise regimen to a 3/10 pain level with consistent participation in an exercise regimen could equate to 100% success. For others, success could be to delay their hip replacement by 6 months for personal scheduling reasons while not having increased risk for hypertension or loss of blood glucose control due to inactivity. However, for all patients, we should not underestimate the significance of assisting them to become more active for at least 30 minutes per day to decrease the risk for heart disease, stroke, cancer, diabetes, depression, and other co-morbidities related to inactivity. Total hip replacement is the gold standard of care once conservative measures have been exhausted and it is well documented that these individuals do very well after surgery in terms of functionality and quality of life. However, surgery is expensive, carries its own risks associated with being under general anesthesia, and will usually need to be repeated 15 to 20 years later on the same hip. From the point of view of the patient as well as that of the federal and private health care system, it is in the best interest to more comfortably delay this surgery as long as possible to decrease the overall health care utilization related to chronic pain and inactivity while improving the quality of the life for each individual.

We would like to emphasize the importance of evidence-based treatments including clinic and home manual therapy, therapeutic exercise, and patient education that can help each individual meet his or her specific goals. In this process we hope to discover which manual therapy techniques and therapeutic exercises, as well as which dosages of each, can help improve outcomes for individuals along the entire progressive continuum of hip OA and other hip joint pathologies.

Our two patients had joint mobility restrictions, muscle length deficits, muscle strength limitations, and insufficient muscle endurance/coordination at intake. The two patients were gradually progressed to higher levels of clinical manual therapy, traction at home via HipTrac, therapeutic exercise, and soft-tissue stretch-and-release techniques such that the rehabilitation remained challenging. Our case study added home manual therapy, in the form of long-axis traction with HipTrac, as an additional benefit for the patients between visits and after discharge.

One potential challenge with using HipTrac is that it may be cost-prohibitive for some patients. According to their website, cost to rent is $125 per month and the cost to purchase is $895. Additionally, since this is a new device, there is no literature on standard-

ized protocols for use and progression. These two patients were not required to follow any strict protocol. They were simply educated in loose-packed and close-packed positions and were encouraged to progress towards close-packed as quickly as was comfortable. In addition, they were encouraged to discover a particular position, intensity, and dosage that produced personal results for them in the form of decreased pain, increased mobility, and improved functionality during activities of daily living.

A limitation of any case series is that causality cannot be inferred from the data, especially with only two subjects and no control group. However, the findings can be used to inform clinical practice. Future studies will need a more robust experimental design and the addition of a control group. These authors would like to see further studies on the effectiveness of this device. Studies could specifically address reductions in medication usage, increases in activity level, decreases in pain scores, increases in ROM, and increases in functional indices among patients with hip OA. The unique role of this device in independent home programs including therapeutic exercise and home manual therapy needs further study.

## CONCLUSION

We have shown that providing manual therapy, exercise therapy, a home program, and home long-axis hip traction with the HipTrac provided clinically important improvements in pain and function for our two patients with OA of the hip. While not definitive, we also documented objective and subjective feedback indicating that the use of continuous and progressive hip traction can play a valuable role in improving mobility and function while relieving pain in patients who have hip OA.

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## Appendix A. Manual Therapy Techniques

**Clinic Joint and Soft Tissue Mobilization**

Long-axis distraction was performed at grade IV and High velocity low-amplitude thrust (HVLAT), while all other techniques were grades III-IV. Time spent on mobilizations varied with each individual. During the first 4 to 6 weeks, at least 30 to 40 minutes of each session was spent solely on joint and soft tissue mobilization while 15 to 20 minutes was spent on exercise instruction/education. After the 6th week, mobilization continued as needed with an emphasis placed on spending more time instructing the patients in advancing independent home exercise work. Proper technique was always evaluated at each session. Patients were encouraged to spend their time at home performing their stretches and exercises while taking full advantage of their clinical time obtaining manual therapy.

**Long-Axis Hip Traction (Grades IV and HVLAT)**

**Sidelying Long-Axis Traction in Abduction with Inferior/Medial Glide (two people)**

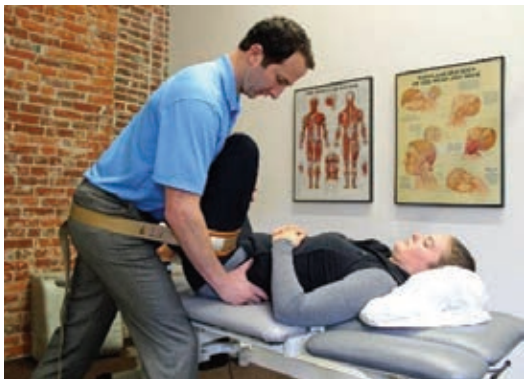
**Lateral Distraction in Neutral (45° and 90° of hip flexion)**

**Lateral Distraction in External Rotation**

**Lateral Distraction in Internal Rotation**

**Prone Anterior Glide in Extension**

*(Continued on page 18)*



**Inferior Glide**

**Prone Anterior Glide in FABER (flexion, abduction, external rotation position)**

**Posterior Glide**

**Home Joint and Soft Tissue Mobilization**
See Appendix C for HipTrac protocol

**HipTrac – Long-Axis Hip Traction Unit used for home use.**

Soft-tissue release using a foam roller or ball was performed 4 to 7 days per week for 90 seconds minimum, but no more than 5 minutes per body part

**Psoas Release Using Different Balls**

**Gluteal/Deep Hip Rotators Release Level I with Foam Roller**

**Gluteal/Deep Hip Rotators Release Level II with Roller**

**Gluteal/Deep Hip Rotator Release Level II with Ball**

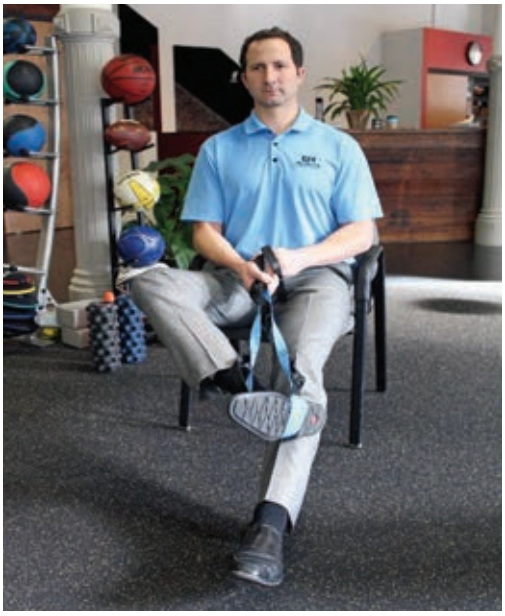
## Appendix B. Therapeutic Exercises

**Hip Capsular and Soft-Tissue Stretching/Positioning**

Below are examples of therapeutic exercises and movements/positions that the two patients did in the clinic and at home. Because the patients had capsular restrictions, they did not initially report that they felt stretch in the muscles. During this phase, we still asked them to move into the positions but to keep pain levels below a 2-3/10 on their scale. As manual therapy accumulated to improve capsular mobility, the goal was for the patients' sensation to evolve from joint/capsular pain/restriction to more of a muscular stretch. The goal was not to stretch aggressively to lengthen muscles (especially in the presence of certain labral tears and the absence of osteoarthritis) but rather to achieve quadrants and positions that were important for activities of daily living and normal human mechanics. The patients were encouraged to "snack/graze" on these movements 3 to 6 times per day for 15 to 30 seconds each, 6 to 7 days per week. The patients were encouraged to perform any other traditional stretches that they liked to perform including quads, hamstrings, gastrocnemius/soleus, iliotibial band, etc.

**Hip Opening/Adductor Stretch**

**Extension Movement/Hip Flexor Stretch**



**Assisted Seated External Rotation Cross-Over Phase I**

**Assisted Seated External Rotation Cross-Over – Phase II**

**Hip Internal Rotation Movement/Stretch of Left Hip**

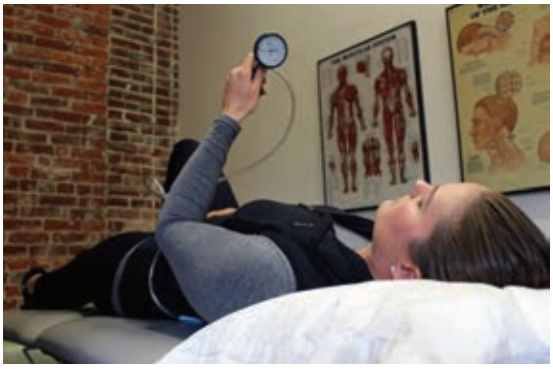
*(Continued on page 20)*

## Appendix B. Therapeutic Exercises *(Continued from page 19)*

**Strengthening and Biomechanical Re-education Exercises**

These exercises were divided into 3 main categories and were performed by the patients during rehabilitation and after discharge from physical therapy: (1) sequencing/coordination; (2) lumbopelvic/hip floor core, and (3) weight-bearing functional strengthening. The goal was not simply to be strong, but to be "smart and strong." The emphasis was more on neuromuscular control and coordination, building towards this "smart-and-strong" foundation for more mobility without compensation. Some of these exercises can be in different categories depending on instruction and the goal of their performance. There are hundreds of other exercises that can be used in each category limited only by the provider's creativity and clinical reasoning. We chose this group of exercises to help transition from nonweight bearing to functional weight bearing while also working on muscle groups at the hip and around the hip. Pain levels again were encouraged to stay below 2-3/10 on their pain scale.

**Phase I: Sequencing and Coordination (2-3 sets of 5-10 reps 4-5 days per week for weeks 1-3)**



**Pressure Biofeedback in Lumbopelvic Coordination and Control of Lower Extremities**

**Clam Shell with Lumbopelvic Coordination and Co-recruitment of Transversus Diaphragm Abdominis, Breathing, Multifidi, and Pelvic Floor**

**Supine Lumbopelvic Control with Opposite Arm and Leg Lifts**

**Phase II: Lumbopelvic/Hip floor Core (2-3 sets of 10 every other day for 1 week). Continue with phase I but reduce to a 5-minute warm-up prior to initiating phase II exercises in weeks 2-8.**

**Resisted Clam Shell with Reverse Clam Shell**

**Double and Single Leg Bridge**

*(Continued on page 21)*

**Side Plank I: With Emphasis on Posterior Pelvic Tilt and Push of Lower Knee into Ground for Enhanced Gluteal Contraction**

**Side Plank II: Same as Version I Adding Repeated Abductions of Top Leg Fully Locked into Extension at Knee, Ankle Dorsiflexed, and Hip in Neutral Rotation**

**Forward Plank I, II – I: Static Holds and II. Abduction Toe Taps with Neutral Lumbopelvic Region**

**Quadruped Opposite Arm and Leg (bird dogs) Neutral Lumbopelvic Region**

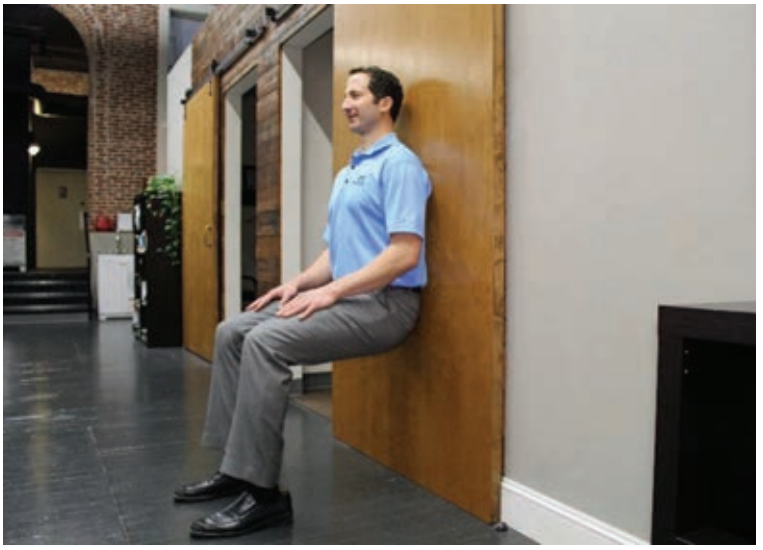
**Phase III: Functional Weight-bearing Strengthening (2-3 sets of 10 reps every other day). Continue with phase II every other day 2-3 sets of 10. Discontinue phase I. Phase III is initiated in weeks 6+ ongoing in a progressive manner over time.**

**Assisted Single Leg Dead Lift (well-controlled neutral pelvis, neutral hip; avoid any femoral adduction/internal rotation of WB LE)**

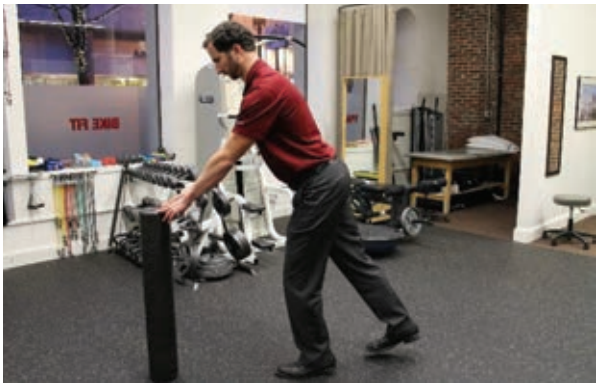
**Single Leg Dead Lift with Kettle Bell (same biomechanical rules as per assisted)**

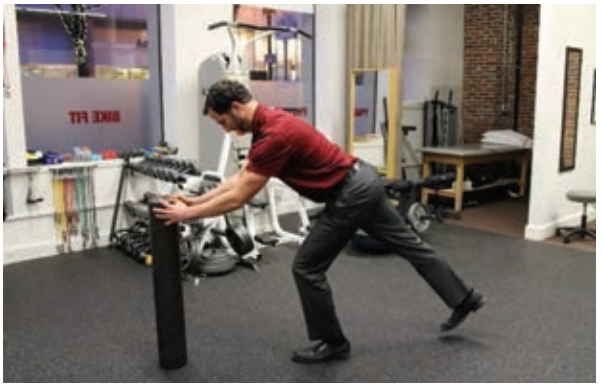
*(Continued on page 22)*

**Monster Walking (no femoral internal rotation during lateral movements)**



**Quad Emphasis Partial Wall Squat (without femoral internal rotation)**





**Assisted Single Leg Functional Squat with Gluteal Emphasis – Start and End Positions**
NWB LE stays extended long while WB LE moves into traditional squat; patella is behind the toes and over 2nd/3rd ray with weight equal through metatarsal heads and calcaneus. First metatarsal head stays on the ground and LEs each stay in their sagittal position without any movement into frontal or transverse planes.

**Miscellaneous:**
Cardiovascular exercise - The patients were also encouraged to perform any cardiovascular exercise, such as a stationary bike, that did not increase their pain levels past 2-3/10. They were encouraged to participate 4-6 days per week starting at 10 minutes and working up to 30-45 minutes per session.

These two patients started with their individualized physical therapy treatment. As they improved and were able to keep pain levels low and/or manage their pain with HipTrac, they were encouraged to add other activities such as yoga, hiking, and other personal hobbies/exercises of their choosing to their daily routine.

## Appendix C. HipTrac Protocol

These two patients' HipTrac protocol was based on subjective reports, clinical reasoning, and individual clinical presentation. The HipTrac can perform traction in flexion from 0-30°, any degree of abduction available and any degree of rotation available. Our initial goal was pain relief. Consequently, the patients were instructed to perform in as close to the loose-packed position as possible (30° of flexion, 30° of abduction while relaxing their LE into as much naturally available external rotation as possible). As the patients improved with overall treatment, pain was reduced and tolerance was increased, they were encouraged to move towards less flexion/relative extension while maintaining abduction and naturally available ER. In the end, we encouraged the patients to "discover" in which angles/positions they obtained the greatest relief. Theoretically, if we wanted more capsular mobilization, we would encourage positions closer to close-packed and if we wanted more pain relief, we might move to more loose-packed positions. Patients with hip OA often do not follow one set of strict guidelines so we encouraged them to discover their most pain-relieving and capsular-mobilizing positions for the purpose of this case series.

Day 1-7: 1-minute holds under traction at 20-30 PSI, 5-10 second release halfway. Repeat 6-8 times.

Day 8-14: Begin to increase to 1 to 3 minute holds at 30-50 PSI, 5 to 10 second release halfway, Repeat for a total of 12-15 minutes of traction time; patients chose the duty cycle based on comfort for that session.

Day 14+: 1 to 5 minute holds. Patients progressed gradually over time to as high of PSI (40+) as they deemed comfortable for a total of 15-20 minutes of traction time, with 5- to 10- second release halfway. Patients chose the duty cycle based on comfort for that session.

Jill and Travis were initially instructed to use the HipTrac more frequently to assist with pain relief, 1-3 times per day. As time went on, they were encouraged to use it regularly in the presence or absence of pain to maintain consistent capsular mobilization and also at their discretion when any flare-ups occurred from harder physical days at work or home as needed. They both admitted that they felt they did not need to use it as often as time went on as there was an accumulation effect that occurred overall. When they first used it, pain relief only lasted minutes or while on it. As they progressed, relief began to last longer and up to days after use so they were able to reduce their use to 2-4 times per week, rather than 10-20 times per week. We encouraged Jill and Travis to find their optimum position, amount of time, and traction force when using the HipTrac.