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**Outpatient Physical Therapy Management of a Total Knee
Arthroplasty with Severe Contralateral Knee Osteoarthritis: A Case
Report**

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The patient signed an informed consent form allowing the use of medical information, video recording, photography, and voice recording for this report and received information regarding the institution’s policies of the Health Insurance Portability and Accountability Act.

The author acknowledges Mike Fillyaw, PT, MS, for assistance with case report conceptualization, the clinical instructor Warren Hucks, PT, DPT, OCS, for supervision on the case, as well as the patient for their willingness to participate in the case report process.

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24 **ABSTRACT**

25 Background and Purpose: Osteoarthritis (OA) of the knee is a common cause of severe pain,
26 disability within the community, and dependence on others. If conservative treatments fail,
27 orthopedic surgeons often perform a total knee arthroplasty (TKA), in which damaged articular
28 parts of the knee are resurfaced with prosthetics. To maximize physical function, the underlying
29 cause of gait speed limitation must be determined and treated. The purpose of this case report
30 was to examine the impairments following a TKA with concurrent severe OA of the contralateral
31 knee, develop an effective plan of care, describe physical therapy (PT) interventions, and report
32 the outcomes.

33 Case Description: The patient was a 64-year-old male status-post three weeks right TKA with
34 severe contralateral knee OA. He received outpatient PT once a week for seven weeks to
35 improve range of motion (ROM), strength, muscular endurance, balance, and functional
36 mobility.

37 Outcomes: At discharge, the patient demonstrated improved mobility, knee ROM, and strength.
38 The 2 Minute Walk Test score improved from 178 feet to 251 feet, Lower Extremity Functional
39 Scale improved from 23/80 to 29/80, and Numeric Pain Rating Scale improved from 7/10 to
40 6/10. At discharge, the patient improved right knee flexion to 117 degrees and extension to 0
41 degrees, and increased quadriceps and hip abductor strength.

42 Discussion: This report suggests that a combination of manual therapy and therapeutic exercise
43 directed towards hip and knee strengthening along with balance is beneficial for function and
44 quality of life for patients following a TKA. Future research should be performed to further
45 investigate ideal PT interventions to improve function for patients with a unilateral TKA and
46 concurrent contralateral knee OA.

47 **Manuscript Word Count:** 3389

48 **BACKGROUND and PURPOSE**

49 Osteoarthritis (OA) also known as degenerative joint disease, is a chronic degeneration
50 disorder of the articular cartilage and underlying bone within a joint, along with eventual bony
51 overgrowth at the margins of the joints.¹ OA of the knee is a common cause of severe pain,
52 disability, and dependence on others.¹ Between 2008 and 2011, 30.8 million people in the United
53 States had knee OA.² If conservative treatments fail, orthopedic surgeons often perform a total
54 knee arthroplasty (TKA), which is a surgical procedure where damaged articular parts of the
55 knee are resurfaced with prosthetics.³ In the United States, a TKA is one of most commonly
56 performed orthopedic procedures with over 600,000 TKAs performed annually and 95% of them
57 are attributed to OA.³

58 Following a TKA, pain and walking ability are the most important factors that need to be
59 addressed.⁴ Some of the most common issues following a TKA were impairments of: gait speed,
60 bilateral quadriceps strength, and ipsilateral knee flexion range of motion (ROM).⁵ In order to
61 maximize physical function following a TKA, the underlying cause of the gait speed limitation
62 must be determined and treated.⁵ While in outpatient physical therapy (PT), the patient is
63 educated on symptom management and importance of knee ROM.⁶ Once those goals have been
64 met, the objective shifts toward gait training, and higher level strengthening and balance
65 activities.⁶

66 While there are many research articles in the literature regarding PT rehabilitation of a
67 TKA, currently there are not any published articles describing PT management of a TKA, with
68 severe OA of the contralateral knee. Therefore, the purpose of this case report was to examine
69 the impairments following a TKA with concurrent severe OA of the contralateral knee, develop
70 an effective plan of care, describe the interventions used during seven weeks of outpatient PT,
71 and report the outcomes.

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72 **Patient History**

73 The patient was a 64-year-old male status-post (s/p) three weeks right TKA with
74 precautions as weight bearing as tolerated. X-rays demonstrated severe OA of his left knee with
75 complete loss of medial joint spaces and bone on bone appearance. He planned on having a left
76 knee replacement once he completed rehab of his right knee. Prior to his right TKA, the patient
77 was ambulating with a cane or walker for the past seven years due to pain in bilateral knees.

78 Before attending outpatient PT, he attended inpatient rehabilitation five times per week
79 for two weeks. While in inpatient rehab, a week prior to the outpatient initial examination, the
80 patient had a Baker's cyst rupture of the right lower extremity. After being discharged from
81 inpatient rehab he received outpatient PT once a week. Comorbidities included: orthostatic
82 hypotension, essential hypertension, obstructive sleep apnea, osteoporosis, hyperlipidemia, BMI
83 30+ obesity, and diabetes mellitus type II. Chief complaints were pain and limited range of the
84 right knee, which made ambulation difficult. The patient's goals for PT were to improve his right
85 lower extremity (LE) pain level and function so that he could have his left knee replaced.

86 **Systems Review**

87 During the initial examination a comprehensive systems review was performed (Table 1).
88 The patient's right LE strength, ROM, symmetry, posture, skin integrity, transfers, and
89 functional mobility were all impaired. The patient also demonstrated strength and ROM
90 impairments of his left LE.

91 **Clinical Impression 1**

92 The patient was s/p three weeks right TKA with severe left knee OA confirmed via X-
93 rays. The problem list included: deconditioning, increased pain, weakness, loss of motion, and
94 poor endurance of bilateral LEs. Also, the patient had increased pain, weakness, and decreased
95 ROM of the left LE. Based on the systems review, the following tests and measures were

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96 completed to obtain objective information: goniometry, girth measurement, manual muscle test
97 (MMT), joint play, palpation, and assistive and supportive devices. The Numeric Pain Rating
98 Scale (NPRS), 2 Minute Walk Test (2MWT), and Lower Extremity Functional Scale (LEFS)
99 were assessed to acquire a functional baseline and for goal setting. The patient was a good
100 candidate for a case report because there were not any studies in the literature about
101 rehabilitation protocols following a TKA with concurrent severe contralateral knee OA.

102 **Examination – Tests and Measures**

103 Once history and systems review were completed, identified impairments were revisited with
104 subsequent tests and measures to gain additional information (Table 2).

105 Goniometry

106 Active range of motion (AROM) and passive range of motion (PROM) of the knee was
107 obtained through goniometry measurements as described by Norkin and White.⁷ The interrater
108 reliability was acceptable (ICC= 0.83 for flexion, ICC= 0.82 for extension) for physiotherapists
109 measuring knee ROM with a goniometer.⁸

110 Joint Play

111 Joint play of tibiofemoral and patellofemoral joints was performed only on the right side
112 since the left knee was too painful to test. The procedure for these tests were described by
113 Kaltenborn et al.⁹ When measuring the passive physiological movements of the lower extremity
114 joints the interrater reliability is generally low.¹⁰ While interrater reliability was low, this is a
115 standardized test used in clinical practice and provides important information needed.

116 Manual Muscle Test

117 This was performed within available range of motion of only the right LE as the left knee
118 was painful. Quadriceps, hamstrings, hip flexors, and hip abductors were tested as muscle
119 groups. The hamstrings, quadriceps, and hip flexors were tested in the seated position and hip

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120 abductors in the side-lying position. MMT is the most commonly used method to assess
121 strength.¹¹ Its test-retest coefficient was moderate at 0.63 with poor interrater reliability with an
122 ICC of 0.11 to 0.42.¹¹ While hand-hand dynamometers are more accurate for measuring muscle
123 strength,¹¹ this equipment was not available in the clinic.

124 Girth Measurement

125 The patient was lying supine with knees extended in a relaxed position. A tape measure
126 was used to take the circumferential measurement at the tibiofemoral joint line. Multiple
127 measurements were taken on their respective side and the average of the two were noted. Lower
128 extremity girth measurements can be highly repeatable amongst experienced clinicians when
129 utilizing simple standardized procedures.¹²

130 Palpation and Scar Integrity

131 Various structures local to the knee were assessed with varying pressure for tenderness,
132 temperature alteration, swelling, or muscle spasms. While there were not any reliability or
133 validity values for palpation or scar integrity, given the right TKA procedure, it is critical to
134 check for signs of infection and poor healing to prevent wound complications.¹³

135 **Outcome Measures**

136 Once tests and measures were completed, outcome measures were used to obtain additional
137 information about function (Table 3).

138 2 Minute Walk Test (2MWT)

139 The patient is asked to walk as far as they safely can for two minutes to assess the
140 patient's endurance and functional mobility. The patient performed this test indoors on a flat
141 smooth surface and used a rolling walker. The distance was tracked while following the patient
142 using a digital measuring wheel (Harbor Freight Tools Co., Camarillo, CA).

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143 In older adults the 2MWT had excellent correlation to the 6MWT ($r= 0.93$) and to the
144 TUG ($r= -0.87$).¹⁴ In patients with a TKA the 2MWT had excellent test-retest reliability with an
145 intra-class correlation coefficient (ICC) of 0.97.⁴ The minimal detectable change (MDC) for the
146 2MWT was 49.08 feet and the standard error of measurement (SEM) was 17.72 feet.⁴ The
147 2MWT is quick, reliable, easy to use, and was recommended to use for functional outcome
148 measures in patients who had a TKA.⁴ Walking is related to an independent and active lifestyle,
149 therefore objective walking assessments need to be performed in patients following a TKA as
150 they provide vital information about prognosis and the healing process.⁶

151 Lower Extremity Functional Scale (LEFS)

152 The LEFS is a self-reported questionnaire with 20 questions regarding their ability to
153 perform various daily tasks. For patients with a TKA due to OA, the LEFS had an excellent test-
154 retest reliability ($r= 0.86$) and in more chronic conditions ($r=0.94$, while the interrater reliability
155 was excellent ($r=0.84$).¹⁵ The minimal clinically important difference (MCID) of the LEFS is
156 nine, while the SEM is 3.7. ¹⁵

157 Numeric Pain Rating Scale (NPRS)

158 Pain level was obtained from the patient through verbal response where zero was
159 considered “no pain” and a ten was considered “the worst pain imaginable”. In healthy
160 populations the NPRS had excellent interrater reliability and in regard to its concurrent validity it
161 had excellent correlation between the Visual Analog Scale (VAS) and 21- Point Numeric Rating
162 Scale with $r= 0.86$ and $r=0.88$ respectively.¹⁶

163 **Clinical Impression 2**

164 The examination data confirmed the patient was deconditioned with bilateral LE
165 weakness, decreased knee ROM, reduced endurance, and increased pain. The patient continued

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166 to be appropriate for the case because, while knee ROM progressed well, functional tasks such as
167 squatting, stairs, and ambulation were limited by pain of the left osteoarthritic knee. It created an
168 interesting dilemma of balancing single leg activities and functional activities to promote the
169 most effective physical rehab program.

170 Diagnosis

171 The patient's medical diagnoses using the International Classification of Disease (ICD)
172 10 code was (Z47.1) aftercare following surgery for joint replacement and (Z96.651) status
173 (post), organ replacement, by artificial or mechanical device or prosthesis of, joint, knee-see
174 presence of knee joint implant.¹⁷

175 Prognosis

176 Prognosis for this patient to improve with PT was fair. He was highly motivated and had
177 great social support from his wife. Primary TKA is an effective procedure as health-related
178 quality of life (HRQoL) improved by 63% at 12 months post-operation.¹⁸ This patient was
179 morbidly obese, but patients who underwent a TKA were capable of comparable or greater
180 improvement than non-obese patients.¹⁹ While it appears the patient had lived a sedentary
181 lifestyle based upon interview, it is difficult to determine the reason behind his lack of activity.
182 The primary concern limiting his rehab potential was severe OA of his left knee, which would
183 hinder performance of bilateral activities and potentially affect accomplishing anticipated goals.
184 Patients two years s/p unilateral TKA with severe bilateral knee OA had achieved good
185 outcomes in HRQoL.²⁰ While his prior medical history was significant, evidence and clinical
186 judgment led to the prediction the patient would regain functional mobility of his right LE and
187 allow him to have a left TKA in the future.

188 **Plan of Care**

189 Based on the patient's presentation during the PT examination, there was no need for

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190 referral or consultation. The patient was scheduled to attend outpatient PT once a week for six to
191 eight weeks. The treatment plan included: manual mobilization of the tibiofemoral and
192 patellofemoral joints, along with therapeutic exercises to improve LE strength, ROM, balance,
193 flexibility, and muscular endurance. The patient would adhere to the home exercise program
194 (HEP) discussed during the initial examination. The procedural interventions were developed to
195 achieve the short and long- term goals (Table 4).

196 **Interventions**

197 Coordination, Communication, Documentation:

198 After the initial examination, we contacted a representative from Full Range Rehab to
199 have the EZ Stretch device (Full Range Rehab, Cincinnati, Ohio) delivered to the patient's home.
200 Initially the patient rented the device for 30 days, with an extension for 60 more days, after the
201 PT decided the patient would continue to benefit from it. Upon each visit, the PT confirmed with
202 the patient about adherence to the HEP along with any modifications needed to help reach the
203 desired goals. All documentation and orders were entered into a Computerized Patient Record
204 System (CPRS).

205 Patient/Client Related Instruction:

206 The patient was educated on the importance of being compliant with PT appointments
207 and the HEP. The patient was informed that using the EZ Stretch (Full Range Rehab Cincinnati,
208 Ohio) at home should not be painful, but some discomfort was allowed. The HEP was printed for
209 him to take home and each exercise contained a picture and written description (Appendix 1).
210 Constant communication occurred between the PT and patient regarding status of symptoms,
211 exercise performance, and plan of care.

212 Procedural Interventions:

213 The patient attended outpatient PT for five treatment sessions over a 30-day period and

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214 missed one session due to a viral infection that sent him to the ER. The duration of each
215 treatment session varied from 30-45 minutes (Table 5). The Brigham and Women's Hospital
216 TKA protocol²¹ was referenced for prognostic indicators and general advancement of
217 therapeutic exercises and manual therapy, however, patient needs, clinical judgment, and
218 evidence based research were the ultimate deciding factors for progression.

219 Typically, the patient began each session warming up on the NuStep machine (NuStep
220 Inc., Ann Arbor, MI) for 10 minutes with mild resistance (level 4 or 5). This device is a
221 recumbent, low impact, lower and upper-body trainer designed to simulate the motion of
222 walking. An active warm-up significantly improves the metabolic and circulatory responses to
223 exercise compared to a passive warm-up such as ultrasound or short-wave diathermy.²²

224 The EZ Stretch (Full Range Rehab Cincinnati, Ohio) device was used by the patient to
225 stretch his knee and improve knee range through mechanical overpressure on the ankles in a
226 seated position. Variable loads in both knee flexion and extension is controlled by the patient
227 using a handheld remote. The patient was diligent in using this device at home for 10 minutes,
228 six times per day. There was not any available research that utilized the EZ Stretch (Full Range
229 Rehab, Cincinnati, Ohio) device following a TKA and the difference from the continuous
230 passive machine is too great to make comparisons about its efficacy.

231 To facilitate pain reduction and improve ROM, joint mobilizations were used on the
232 tibiofemoral and patellofemoral joint as described by Kaltenborn et al.⁹ In a randomized clinical
233 trial the Kaltenborn mobilization method significantly improved knee ROM and physical
234 function, as well as reducing pain and stiffness compared to routine PT alone.²³ During the fourth
235 session, the tibiofemoral and patellofemoral joint play were normal, so there was no longer a
236 need to perform Grade III mobilizations.⁹ Grade I/II mobilizations were still indicated as needed
237 to ameliorate pain.⁹

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238 In patients with knee OA, strengthening, stretching and functional exercises are effective
239 interventions to improve physical function and manage knee pain.²⁴ Inclined squats were
240 performed on the Total Gym 26000 (EFI Sports Medicine, San Diego, CA) to improve LE
241 strength (Figure 1). This device allowed the patient to perform squats at half of his body weight
242 and was tolerable for his left LE. Strengthening of the quadriceps after a unilateral TKA
243 correlates with patient-reported measures of physical function, performance based measures, and
244 patient reported physical function.²⁵ Partial lunges were implemented to further strengthen the
245 quadriceps muscle. While the patient performed partial lunges, he demonstrated difficulty
246 controlling his knee from collapsing medially, so side-lying hip abduction exercise was added. In
247 an EMG analysis of various exercises, the side-lying hip abduction exercise provided the
248 strongest contraction of the gluteus medius muscle.²⁶ In patients after a unilateral TKA, hip
249 abductor strength improved performance based measures of physical function.²⁵ In patients
250 following a TKA, hip abductor strength of the involved limb influenced physical function more
251 than quadriceps strength, anthropometric measures, or demographic measures.²⁷

252 Incorporation of a balance program with a functional training program following a TKA
253 demonstrated clinically important improvements in single-leg stance time, gait speed, and knee
254 stiffness.²⁸ A balance program should challenge knee stability to teach patients how to react to
255 loads encountered in daily activity.²⁸ The patient performed a single-leg stance exercise on a
256 level surface within the parallel bars and this appeared to provide a sufficient level of difficulty.

257 **OUTCOME**

258 At initial examination, the patient was s/p three weeks right TKA and had severe OA of
259 his left knee, which limited his participation in functional activities. Upon discharge, his walking
260 distance, function, knee motion, and strength were improved. 2MWT scores improved from 178
261 feet to 251 feet, which was a long-term goal that was effectively met (Table 4). His LEFS scores

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262 from initial exam, session four, and discharge were as follows: 23/80, 39/80, and 29/80. Despite
263 the inconsistencies displayed in the scores, it demonstrated functional improvement and
264 decreased disability. NPRS scores improved minimally from 7/10 to 6/10 and was a long-term
265 goal that was not met (Table 3).

266 He increased strength of right hip flexion as well as knee flexion and extension from 4/5
267 to 5/5. The patient met both ROM goals as he increased right knee flexion from 76° to 117° and
268 extension from -12° to 0°. Also, the patient's right knee joint play improved to within normal
269 limits and his girth measurements decreased from 48.5 cm. to 45.0 cm. The patient ambulated
270 using a less restrictive device transitioning from a rolling walker to a rollator. He could walk
271 without use of an assistive device, however, he was limited by pain of his left LE (Table 2).

272 **DISCUSSION**

273 Following a TKA with concurrent severe OA of the contralateral knee, the patient
274 progressed well in seven weeks of PT based on functional outcome measures and clinical
275 judgment. In this case report, the impairments following a TKA were identified and a plan of
276 care was developed. The purpose of this case report was achieved, and many of the patient's
277 goals were met.

278 Of the goals developed by the PT, decreased pain level and increased LEFS scores were
279 not met. Speculation for why pain level of less than 2/10 on the NPRS was not attained may have
280 been due to unrealistic goal setting by the PT. After the patient met with his orthopedic surgeon,
281 he learned he would likely feel pain in his knee for at least 4-6 months post-op. Another factor
282 that may have played a role in his consistent knee pain was his tendency to over use his right
283 knee, as his left knee was painful and weak.

284 At initial examination, session four, and discharge, the patient's LEFS scores were:
285 23/80, 39/80, and 29/80. The LEFS score at discharge was only two weeks after session four and

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286 there were not any notable set-backs identified by the PT that would have accounted for the 10-
287 point difference. However, the first two LEFS questionnaires were given at the beginning of the
288 session prior to exercise, while the last one was given afterwards. The PT did not consider the
289 psychological effects of when the LEFS was filled out. In hind sight, it would have been more
290 effective to control as many variables as possible to attain a more accurate score.

291 The goals for right knee flexion and extension were both met and it is possibly attributed
292 to both the patient's diligence using the EZ stretch (Full Range Rehab, Cincinnati, Ohio) device
293 and the manual therapy provided by the therapist. The improvements in knee range may have
294 contributed toward his ability to ambulate faster and longer distances, as well as participate in
295 more therapeutic exercises. Also, utilization of the EZ stretch (Full Range Rehab, Cincinnati,
296 Ohio) device decreased the amount of manual stretching the PT needed to perform.

297 While researchers' debate whether quadriceps or hip abductor strength is more critical in
298 functional improvements following a TKA, this patient appeared to have benefitted from
299 strengthening both. The patient's weakness in both of these areas were highlighted while
300 performing partial lunges and single leg stance exercises. In both exercises the patient had
301 difficulty controlling his knee in the frontal plane which would likely indicate hip abductor
302 weakness. Also, the patient demonstrated difficulty with eccentric lowering into a partial lunge
303 and prolonged isometric contractions during a single leg stance, which may have been attributed
304 to quadriceps weakness.

305 This patient had many positive prognostic indicators including being highly motivated,
306 having strong family support, and compliance with the HEP. However, the patient also had
307 several comorbidities such as: hypertension, diabetes mellitus, osteoporosis, and morbid obesity.
308 His greatest challenge was severe OA of the contralateral knee as it made bilateral exercises less
309 tolerable and it affected his capacity for ambulation.

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310 While the Brigham and Women’s Hospital TKA protocol ²¹ was used to determine when
311 to advance exercises and manual therapy following a TKA, future research is needed to develop
312 a plan of care for patients following a TKA with concurrent severe contralateral OA. Clinical
313 judgment was used based on the patient’s response to various treatments, but it would be useful
314 to have a protocol in place to serve as a guide for management of this condition.

315 In conclusion, this case report suggests that a combination of manual therapy and
316 therapeutic exercise directed towards hip and knee strengthening along with balance, is
317 beneficial for functional mobility and quality of life for patients following a TKA with severe
318 contralateral knee OA. While various factors play a role in PT management of these patients,
319 ultimately, it is critical to rely on clinical judgment, evidence based practice, and the patient’s
320 needs.

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433 **Table 1. Outpatient Initial Examination Systems Review**

Cardiovascular/Pulmonary	Respiration Rate: 18 breaths/minute Blood Pressure: 135/70 mmHg ^a Oxygen Saturation: 99% Pulse: 67 beats/minute Edema: impaired
Musculoskeletal	Gross ROM: impaired Gross strength: impaired Gross symmetry: impaired Posture: impaired
Neuromuscular	Balance: unimpaired Coordination: unimpaired Transitions: unimpaired Transfers: impaired Gait/locomotion: impaired
Integumentary	Skin color/ discoloration: unimpaired Integrity: impaired Pliability/texture: not tested Scar formation: impaired
Communication	Unimpaired
Affect, Cognition, Language, Learning Style	Affect: unimpaired Cognition: unimpaired Language: unimpaired Learning style: pictures and demonstrations

434 ^ammHg= millimeters of mercury

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442 **Table 2. Tests & Measures with Initial Examination and Discharge Data**

Tests & Measures	Initial Examination		Discharge	
<u>Active Range of Motion</u>	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Flexion	108°*	76°*	Not tested	117°
Extension	-10°*	-12°*	Not tested	0°
<u>Passive Range of Motion</u>				
Flexion	114°*	85°*	Not tested	123°
Extension	-8°*	-9°*	Not tested	0°
<u>Tibiofemoral Joint Play</u>			All tibiofemoral and patellofemoral glides were 3/6 without any dysfunctional end feel or increased pain.	
Posterior glide	2/6, firm end feel			
Anterior glide	2/6*, empty end feel			
<u>Patellofemoral Joint Play</u>				
Inferior glide	2/6, firm end feel			
Superior glide	2/6, firm end feel			
Lateral glide	1/6*, empty end feel			
Medial glide	1/6*, empty end feel			
<u>Manual Muscle Test</u>	<u>Right</u>		<u>Right</u>	
Quadriceps	4/5*		5/5	
Hamstrings	4/5*		5/5	
Hip Flexors	4/5		5/5	
Hip Abductors	3+/5		4/5	
<u>Knee Girth Measurement</u>	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
	46.0 cm.	48.5 cm.	47.0 cm.	45.0 cm.
<u>Palpation</u>	There was swelling at the right popliteal fossa and general knee area. Moderate tenderness to the right distal hamstrings and popliteal fossa with mild pressure.		There was not any tenderness to palpation or other notable deformities.	

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Skin Integrity	The scar was intact and healing well upon visual inspection.	The scar was intact and healing well upon visual inspection.
Assistive Devices	Rolling walker	Rollator
Supportive Devices	Bilateral below knee thrombo embolic deterrent (TED) compression stockings.	Bilateral below knee TED compression stockings.

443 * Pain increased during the test.

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462 **Table 3. Outcome Measure Scores at Initial Examination, Re-Assessment, and Discharge**

Outcome Measures	Initial Examination:	Re-Assessment (Session #4):	Discharge (Session #6):
2MWT^a	178 feet	221 feet	251 feet
LEFS^b	23/80	39/80	29/80
NPRS^c	7/10	6/10	6/10

463 ^a2MWT= 2 Minute Walk Test

464 ^bLEFS= Lower Extremity Functional Scale

465 ^cNPRS= Numeric Pain Rating Scale

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497 **Table 4. Short-Term and Long-Term Goals for Outpatient PT**

Short-Term Goals	Long-Term Goals
Decrease R knee circumference from 48.5 cm to <46.5 cm in order to improve pain and ROM within 3 weeks from start of care.	Increase R knee flexion AROM ^a from 76° to >110° in order to safely negotiate 9” rise steps in 8 weeks from start of care.
Improve R knee patellofemoral joint play medially and laterally from 1/6 to at least 2/6 in order to facilitate normal patellar kinematics within 3 weeks from start of care.	Improve report of pain level based on NPRS ^b from 7/10 to <2/10 of R knee at rest in 9 weeks from start of care.
Increase R knee extension AROM ^a from -12° to >-2° in order to improve normalized gait in 4 weeks from start of care.	Increase 2MWT ^c from 178 ft. to >250 ft. using a rolling walker in order demonstrate improved community ambulation ability in 9 weeks from start of care.
Patient will improve R knee tibiofemoral joint play from 2/6 to 3/6 in order to aide in improvement of ROM within 4 weeks from start of care.	Patient will increase LEFS ^d score from 23/80 to >32/80 in order to show functional improvement in 9 weeks from start of care.

498 ^a AROM= active range of motion
 499 ^b NPRS= Numeric Pain Rating Scale
 500 ^c 2MWT= 2 Minute Walk Test
 501 ^d LEFS= Lower Extremity Functional Scale

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523 **Table 5. Timeline of Interventions Performed**

Intervention	Session 2	Session 3	Session 4*	Session 5	Session 6
NuStep	10 mins, level 4	10 mins, level 4	10 mins, level 5	10 mins, level 5	5 mins, level 6
EZ Stretch	5 mins (flexion and extension)	5 mins (flexion and extension)	5 mins (flexion and extension)	5 mins (flexion and extension)	5 mins (flexion and extension)
Patellofemoral (superior/inferior) glides	5 mins; grades I, II, III	5 mins; grades I, II, III	Did not perform	Did not perform	Did not perform
Tibiofemoral (anterior/posterior) glides	5 mins; grades I, II, III	5 mins; grades I, II, III	2 mins; grades I, II	2 mins; grades I, II	Did not perform
Total Gym Squats		2 sets of 15 repetitions at 48% body weight	2 sets of 20 repetitions at 58% body weight	2 sets of 20 repetitions at 58% body weight	2 sets of 20 repetitions at 58% body weight
Single Leg Stance			10 sets, 5 second hold	10 sets, 5 second hold	4 sets, 15 second hold
Side-lying hip abduction				2 sets of 10 repetitions	3 sets of 10 repetitions
Partial Lunges				2 sets of 10 repetitions	2 sets of 15 repetitions

*This session was a re-assessment

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Figure 1. Patient performed inclined squats on the Total Gym 26000 (EFI Sports Medicine, San Diego, CA) to improve lower extremity strength, while minimizing force on the left severely osteoarthritic knee.

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549 **Appendix 1. Home Exercise Program**

Exercise	Parameters	Diagram
Supine Straight Leg Raise	3 sets, 10 repetitions, once per day	 <p>www.hep2go.com</p>
Side-lying Straight Leg Raise	3 sets, 10 repetitions, once per day	 <p>www.hep2go.com</p>
Bridging	3 sets, 10 repetitions, once per day	 <p>www.hep2go.com</p>
EZ Stretch	5-minute sessions each of flexion and extension, 4-6 times per day.	 <p>www.fullrangerehab.com</p>