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# A Barefoot Running Program For A College Lacrosse Player With Chronic Exertional Compartment Syndrome: A Case Report

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**University of New England**  
**Department of Physical Therapy**  
**PTH 608/708: 2018 Case Report Template**

Name: Erica Mazzarelli                      Abbreviated (Running) Title: A Barefoot Running Program for a College  
Lacrosse Player with Chronic Exertional Compartment Syndrome: A Case Report

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Please use this template, as clearly outlined both in blackboard and the syllabus, by entering the necessary information into each section under the appropriate headers as assigned and submitting to blackboard for the assigned due dates. The format consists of a full traditional case report using the CARE guidelines.

Once a section is complete and has been graded, you may delete the instructions provided in grey. Feel free to work ahead as your case allows, but only assigned sections will be graded by the due dates. Please start by adding your name above and in the header, and once you develop your title, a “running” or abbreviated title. Name the file to include your last name for submission to BB. This same template will be used for PTH708, and will be completed throughout the fall.

All sections should be in **black text, size 12-font, Times New Roman, and double-spaced with proper grammar and punctuation. Track changes must be switched OFF.** Any assignments submitted in unacceptable condition as determined by the faculty will be returned to the student for resubmission in three days for a maximum score of 80%.

All case reports are written in **past tense**, so ensure that your submissions are past tense. No patient initials are necessary; please refer to your case subject as “patient” throughout the manuscript.

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*You may use any resources at your disposal to complete the assignment. You may not communicate with other UNE students to obtain answers to assignments or share sources to submit. Proper citations must be used for referencing others’ published work. If you have questions, please contact a PTH608 course instructor. Any violation of these conditions will be considered academic dishonesty.*

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72 **ABSTRACT**

73 **Background and Purpose**

74 Although barefoot running has been investigated for anterior and lateral exertional  
75 compartment syndrome, a specific barefoot running program aimed at altering running  
76 mechanics has not been determined for posterior exertional compartment syndrome for a college  
77 lacrosse player. The purpose of this case report was to examine the effects of adopting a forefoot  
78 running pattern through a barefoot running program in a 20-year-old college lacrosse player with  
79 posterior chronic exertional compartment syndrome (CECS) in conjunction with a  
80 comprehensive physical therapy program.

81 **Case description**

82 The patient was a 20-year-old female college lacrosse player who presented to physical  
83 therapy with a 9-month history of bilateral, posterior lower leg pain, which was brought on by  
84 running on pavement, up hills, and longer than 5-10 minutes. The patient reported extreme  
85 tightness and throbbing in the posterior lower leg and numbness and tingling into the feet while  
86 running on pavement and long distance runs greater than 1 mile. The patient was seen 1-2x/week  
87 for twelve weeks.

88 **Outcomes**

89 DF ROM improved from lacking 16° to lacking 8° on the right and lacking 12° to lacking  
90 4° on the left. All hip and ankle strength improved from 4-4+/5 to 5/5 throughout. The LEFS  
91 improved from 9% disability to 5% disability. The patient's running tolerance improved from 1  
92 min shod to 12 min barefoot before experiencing tightness in her legs.

93 **Discussion**

94 Barefoot running, in conjunction with manual therapy, lower extremity (LE) stretching,  
95 strengthening, and stabilization exercises was found to be effective at improving running

96 tolerance for a female college lacrosse player. Future research should investigate the efficacy of  
97 barefoot running programs and appropriate timelines for progression in patients with posterior  
98 CECS.

99 **Abstract Word Count: 275**

100 **Word Count: 3336**

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-----PART ONE BEGINS HERE-----

105 **INTRODUCTION/BACKGROUND and PURPOSE**

106         The cause of chronic exertional compartment syndrome (CECS) is somewhat of a  
107 mystery. In a literature review by Schubert, multiple factors were cited. It could be due to  
108 “muscle hypertrophy, fascial thickness or stiffness, stimulation of fascial sensory stretch  
109 receptors, decreased venous return, microtraumatic muscular injuries, and clinical myopathies”.<sup>1</sup>  
110 It could also be due to limitation in strength, range of motion (ROM), flexibility, endurance,  
111 flawed motor control, a rapid increase in training volume, frequency, and intensity.<sup>1</sup> CECS is  
112 diagnosed via intercompartmental pressure testing. Compartment syndrome is considered if the  
113 compartment pressure is 15 mmHg before exercise and 30 mmHg post exercise.<sup>2</sup> The anterior  
114 compartment of the lower leg is most commonly affected by CECS (42.5%), followed by the  
115 lateral compartment (35.5%), and the deep posterior (18.9%) and superficial posterior (3%)  
116 compartments.<sup>2</sup> Females and athletes playing at competitive levels are more likely to develop  
117 CECS.<sup>2</sup> Lacrosse was found to be one of the top three sports with the most cases of CECS.<sup>2</sup>

118         Although a fascia release is recommended, it was proposed CECS can be managed  
119 conservatively first for 6-8 weeks before a fasciotomy may be necessary.<sup>3</sup> It was recommended  
120 CECS can be managed with activity modification, pressure, rest, ice, compression, and elevation  
121 (PRICE), ROM, and soft tissue mobility, stretching, joint mobilizations, neurodynamic

122 mobilizations, strengthening, taping, orthotics, NSAIDs, and biomechanical analysis.<sup>1</sup>

123         Barefoot running has been researched extensively as running shoes have evolved and  
124 running injuries have become more widely examined over the last few decades. Running  
125 barefoot has been found to alter foot strike from a rearfoot pattern to a midfoot or forefoot  
126 pattern.<sup>4</sup> Barefoot running has been shown to decrease ground reaction force (GRF),<sup>4,5</sup> increase  
127 stride frequency, decrease stride length, and decrease peak pressure under the heel, midfoot, and  
128 hallux compared to standard running shoes.<sup>5</sup> Lower impact loads may reduce impact-related  
129 running injuries and decrease stress on the surrounding musculature.

130         A case series, done by Diebal et al, applied a 6-week forefoot running program to two  
131 patients with CECS of the anterior and lateral compartments.<sup>6</sup> After the 6-week intervention, the  
132 subjects were able to increase running tolerance to 5 km (3 miles) and decrease  
133 intercompartmental pressure at rest and after running 0.8 km (0.5 miles).<sup>6</sup> The protocol included  
134 initial training drills and eventual inclusion of forefoot interval running of 0.25 km followed by a  
135 two-minute walking interval, with the running intervals gradually progressed.<sup>6</sup> Another study of  
136 ten patients with anterior CECS also benefited from a forefoot running intervention, which  
137 decreased intracompartmental pressures and pain, increased running tolerance, and successfully  
138 avoided surgery.<sup>7</sup>

139         While there has been some limited research investigating a barefoot running protocol on  
140 patients with anterior and lateral compartment syndrome, there has not been any studies  
141 investigating their protocol in posterior CECS. Therefore, the purpose of this case report was to  
142 examine the effects of adopting a forefoot running pattern through barefoot running training in a  
143 20-year-old college lacrosse player with posterior compartment CECS in conjunction with a  
144 comprehensive physical therapy program.

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146 **CASE DESCRIPTION**

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148 **Patient History and Systems Review**

149       The patient was given a verbal explanation of the study protocol and expected outcomes and  
150 provided with written informed consent before testing and video recording. The patient was a 20-  
151 year-old female college lacrosse player who presented to physical therapy with a 9-month history  
152 of bilateral lower leg pain, which was brought on by running on pavement, up hills, and with  
153 long-distances. The patient reported extreme tightness and throbbing in the posterior lower leg  
154 and numbness and tingling into the feet while running on pavement and with long distance runs  
155 greater than 1 mile. The patient reported the tightness and 8/10 pain on the Numeric Pain Rating  
156 Scale (NPRS) after 5-10 minutes of running on pavement in running shoes and after 15-20  
157 minutes of running on turf in cleats. She reported having to sit down to relieve the pain, which  
158 would subside within 5-10 minutes, the pain would not subside with static standing.

159       Upon returning home from college, she saw an orthopedic doctor who diagnosed her with  
160 exertional compartment syndrome and referred her to physical therapy. The patient's main  
161 concern was her ability to continue playing lacrosse at a collegiate level without pain or  
162 discomfort in her lower legs. She reported her lacrosse coach strongly suggested bilateral  
163 fasciotomies, however, she and her mother agreed on an initial conservative approach for  
164 symptom management. The patient reported taking two 400 mg ibuprofen as needed after  
165 lacrosse practice or games. She reported she had not needed to take any medication within the  
166 past month as she had not been running.

167       The patient rated her overall health as very good. Significant medical history reported by the  
168 patient included a history of right ankle sprains and left sided atrophy, weakness, and decreased  
169 stability caused by Lyme disease which had since been treated six years ago. It is worthy to note  
170 she had been seen by a physical therapist for her diagnosis of Lyme disease for left sided lower

171 extremity (LE) atrophy, weakness, and balance disturbances. At that time treatment sessions  
172 included strength training, neuromuscular re-education, which included stability and balance  
173 training, and LE and cardiovascular endurance training. After pharmacological treatment for  
174 Lyme disease and physical therapy, she had returned to gymnastics and sport with normalized  
175 strength 10 weeks later after the Lyme diagnosis. All other history, comorbidities, or genetic  
176 information was unremarkable.

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### 179 **Examination – Tests and Measures**

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181       During the initial examination, lower extremity ROM and manual muscle testing (MMT)  
182 were performed (Table 2). Goniometry was used to measure joint ROM as it has good intrarater  
183 reliability.<sup>8</sup> MMT was chosen as a reliable and valid measure for the assessment of the  
184 musculoskeletal system.<sup>9</sup>

185       Navicular drop (ND) was tested as it is a reliable and valid measure of subtalar joint  
186 position and an objective measure of pronation.<sup>10,11</sup> For the ND test, the patient was in standing  
187 and the navicular tuberosity was marked. The patient was guided to move her foot into subtalar  
188 neutral by the therapist who was palpating the navicular. Then the patient was instructed to relax  
189 her feet and the excursion of the two points was measured. A measurement of less than 10 mm is  
190 considered normal and greater than 15 mm excessive pronation and is considered abnormal.<sup>12,13</sup>  
191 A ND of greater than 10 mm has been reported in competitive runners experiencing exercise-  
192 related leg pain (ERLP) and runners with a ND of >10 mm have 4 times greater odds of  
193 experiencing ERLP.<sup>13</sup> The Lower Extremity Functional Scale (LEFS) was used to assess lower  
194 extremity (LE) dysfunction at initial evaluation due to its reliability and responsiveness to  
195 change.<sup>14</sup> The Numeric Pain Rating Scale (NPRS) was used to quantify pain experienced after or



196 during running. A score of zero represents no pain experienced by the patient and a score of ten  
197 being the worst pain.<sup>15</sup>

198 Three physical therapy sessions after the initial examination, a functional walking and  
199 running gait analysis was conducted on a commercial grade treadmill (Startrac, Core Health &  
200 Fitness, Vancouver, Washington) using video recording. Although observational gait analysis  
201 has been found to be only slightly to moderately reliable, it is a convenient and inexpensive way  
202 to evaluate gait.<sup>16,17</sup> Walking and running gait analysis were performed before starting the  
203 barefoot running program. The patient began walking at a self-selected pace of 3 miles per hour  
204 (mph) for three minutes. She then ran at a self-selected pace of 5.5 mph for 1 minute then a 3-  
205 minute cool down walk at 3 mph.

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**Clinical Impression: Evaluation, Diagnosis, Prognosis**

211 At the initial evaluation, the patient's impairments were consistent with exertional  
212 compartment syndrome. The patient had limitations in ROM, MMT, and had pain, numbness,  
213 and tingling into the feet with running more than 10 minutes which resolved with rest. Prior to  
214 physical therapy, she was assessed by an orthopedic surgeon. The gold standard for CECS  
215 diagnosis is intracompartmental pressure measurement before exercise and 1-5 minutes after  
216 exercise.<sup>18</sup> However, the patient did not undergo this testing until after she was discharged,  
217 which revealed elevated intracompartmental pressures in the posterior compartments bilaterally.  
218 Differential diagnoses included: medial tibial stress syndrome, stress fracture, peroneal nerve  
219 entrapment, popliteal nerve entrapment syndrome, and claudication.<sup>18</sup>

220 The patient was a good candidate for the case report as she was motivated to continue  
221 playing lacrosse at a collegiate level and wanted to manage her symptoms conservatively. Her  
222 ICD-10 medical diagnosis was M79.A21, nontraumatic compartment syndrome of right lower

223 extremity and M79.A22, nontraumatic compartment syndrome of left lower extremity. Her ICD-  
224 10 PT diagnosis was M79.661, pain in right lower leg and M79.662, pain in left lower leg.

225 Non-operative management of CECS has mixed reviews in the existing literature and  
226 patients may continue to experience persistent symptoms with exercise after conservative  
227 management lasting 6 weeks to years.<sup>3,19</sup> However, in case reports studying the effects of  
228 forefoot running on CECS, reduction of symptoms and improved running tolerance were  
229 reported by 6 weeks.<sup>6,7</sup> The patient had many positive prognostic factors including her high level  
230 of motivation to return to sport, avoid surgery, her familiarity with exercise, compliance with her  
231 home exercise program (HEP), age, and ability to rest for the summer before returning to college  
232 to play lacrosse.

233 No additional referrals or consultations were considered or needed for the patient. If  
234 progress was not being made with physical therapy and the intervention, a referral back to her  
235 orthopedic physician for MRI or a specialist for intracompartmental pressure testing may have  
236 been warranted.

237 The decision was made to proceed with the chosen plan of care incorporating barefoot  
238 running training to influence a forefoot running pattern to decrease GRF, stride length, and  
239 contact with the ground time.<sup>5</sup> Joint mobilizations were performed to improve talocrural  
240 mobility. Soft-tissue massage and stretching of the gastrocnemius and soleus were implemented  
241 to improve ROM and decrease pain. Lower extremity strengthening and neuromuscular re-  
242 education such as balance training were also introduced. ROM, MMT, running testing, and  
243 observational gait analysis were re-tested at the end of 4 weeks to assess progress in mobility,  
244 strength, and running tolerance. Short- and long-term goals for physical therapy are listed in  
245 Table 3.

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-----PART TWO-----

251 **Intervention**

252 **Coordination, communication, documentation, patient related instruction**

253       Following the initial evaluation (IE), a plan of care (POC) was established. Coordination and  
254 communication with her orthopedic doctor were established to share the patient’s progress. The  
255 IE was documented using an electronic medical record system (EMR). In addition to the EMR,  
256 the patient’s POC, including exercises, was documented on hand-written flow sheets to track  
257 progress and measurements.

258       During the IE, the patient was educated on the evaluation findings, her condition, possible  
259 prognosis, the importance of regaining ankle ROM and LE strength, and her HEP. The HEP was  
260 demonstrated by the therapist and patient to ensure proper form. The patient was given pictures  
261 and written instructions of the exercises, which included sets, repetitions, frequency, and  
262 duration of rest periods. The patient was also given a green theraband (The Hygenic Corporation,  
263 Akron, OH) tied in a circle for clamshells. An outline of the HEP is demonstrated in Table 4.

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265 **Procedural interventions**

266       The patient was seen 1-2x/week for twelve weeks for 1 hour. The patient missed 1 session  
267 due to family obligations. The interventions included barefoot running training on a treadmill,  
268 manual soft tissue and joint mobilizations, stretching, strengthening, and stabilization exercises.  
269 Ice was also used at the end of each session for both legs. The patient was compliant with her  
270 HEP.

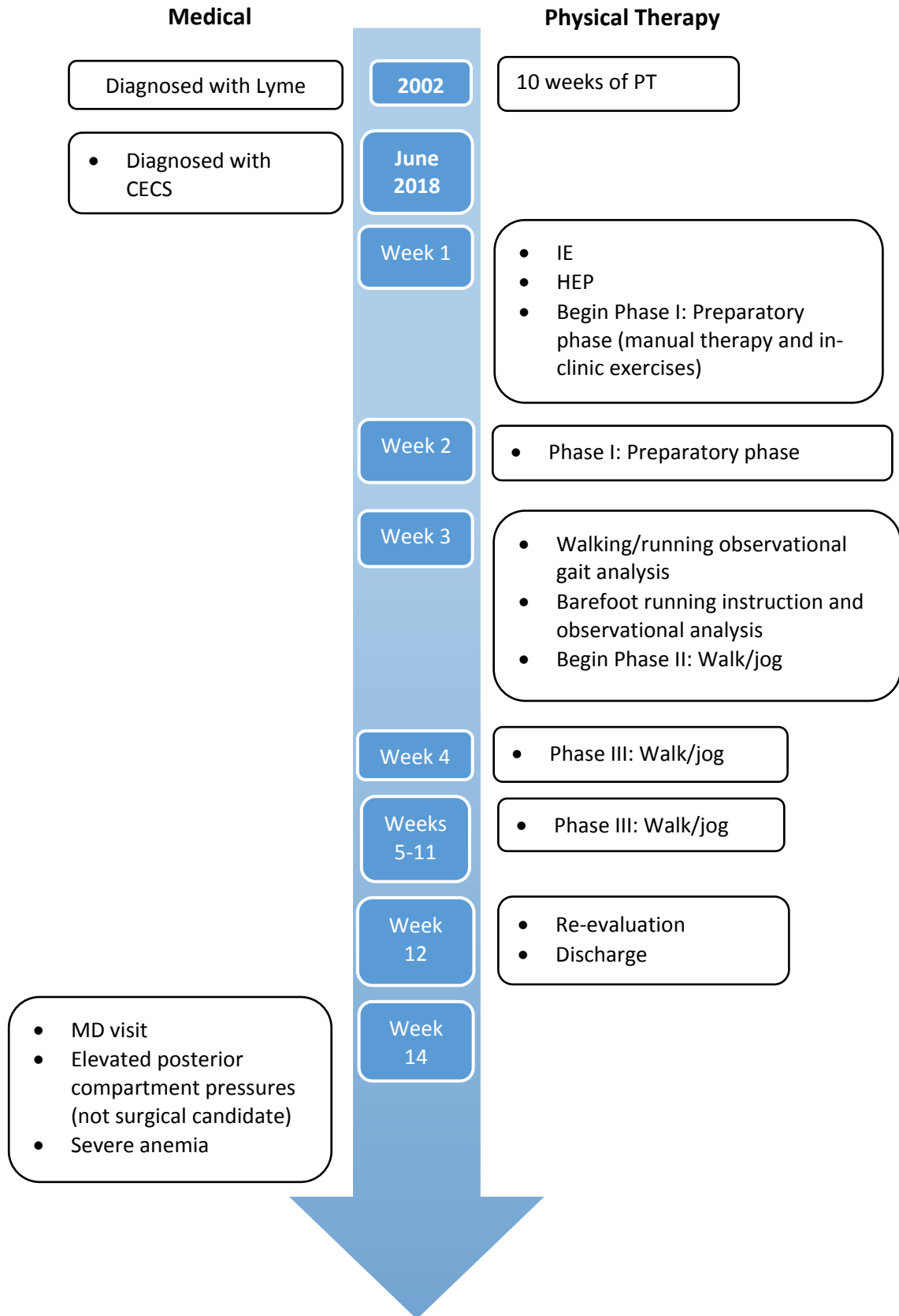
271       The barefoot running training was used to promote a forefoot strike to decrease GRF, stride  
272 length, and contact time with the ground to decrease compartment pressures and, therefore,

273 reduce pain with running.<sup>5</sup> Before initiating the barefoot running program, the patient completed  
274 a 2-week preparatory stretching and strengthening phase to address any ROM limitations,  
275 muscular imbalances or strength deficits. During week 3, the patient was introduced to barefoot  
276 running and was instructed verbally and visually to land “quietly” on the ball or front of the foot,  
277 increase step frequency, and decrease stride length.<sup>6</sup> She was provided visual feedback using a  
278 video recording cellphone (iPhone 5s, Apple). The next session she demonstrated barefoot  
279 running on a treadmill and her barefoot running technique was analyzed. The patient was given a  
280 barefoot running schedule (Table 5) to perform outside of the clinic, which was adapted from a  
281 presentation by Rothschild given at the FPTA annual conference.<sup>20</sup> Instructions for the program  
282 included: perform the running on a treadmill or track, transition back to shoes if pain is  
283 experienced and finish the running as prescribed, do not proceed to the next workout without  
284 pain, and cross-train or run in shoes on rest days. The patient would begin the PT session with  
285 either the prescribed running according to the program or with a 10-minute bike warmup if the  
286 running was already performed for that day. After the warmup, soft tissue and joint mobilizations  
287 were performed followed by stretching, strengthening, and stabilization exercise. Each session  
288 was ended with ice for 10 minutes on her gastrocnemius bilaterally. This chronology of the  
289 interventions was chosen so the patient’s symptoms could be managed if she experienced  
290 increased pressure or tightness with the barefoot running intervention. Please see Appendix 1 for  
291 a timeline of the patient’s medical and physical therapy timeline of care.

292 Soft tissue mobilizations were used to reduce myofascial restrictions posteriorly in the  
293 gastrocnemius and soleus, anteriorly in the tibialis anterior, and laterally in the peroneals.  
294 Anterior-posterior joint mobilizations of the talocrural joint were performed to improve  
295 dorsiflexion ROM.<sup>21</sup> Manual stretching of the gastrocnemius and soleus were performed in 30  
296 second intervals, which has been found to elicit the greatest change in ROM.<sup>22</sup> Stretching of the

297 gastrocnemius and soleus were performed using a slant board. After stretching, strengthening  
298 and stabilization exercises were performed focusing on strengthening hip abductors, gluteals,  
299 quadriceps, hamstrings, and gastroc/soleus complex. In the clinic, banded exercises such as  
300 clamshells, 3-way hip kicks, and side steps were performed with a miniband (Perform Better,  
301 West Warwick, RI). Stabilization exercises, such as single leg stance, were performed on an  
302 airex pad (Airex, New York, NY) and a rockerboard (Fitterfirst, Calgary, AB, Canada) was  
303 utilized for double leg balance both anterior/posterior and laterally. An outline of all exercises  
304 can be found in Table 6.

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307 **TIMELINE**  
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**OUTCOMES**

313       After 10 weeks of barefoot running, LE strengthening, stretching, and manual therapy, the  
314 patient improved running tolerance, palpable tenderness, ROM, MMT, and LEFS. The patient's  
315 running tolerance improved from 1 minute shod with 5/10 pain to 12 minutes barefoot before  
316 experiencing tightness and pain in her calves which she rated 6-7/10 on the NPRS. At the IE, the  
317 patient experienced tightness or tenderness with palpation in her soleus, gastrocnemius, tibialis  
318 anterior, tibialis posterior, and peroneals. These restrictions were eliminated at discharge. The  
319 patient improved her DF ROM from 16° to 8° on the right, and 12° to 4° on the left. At the IE,  
320 MMT testing indicated slight weakness in her hips bilaterally, which was more pronounced with  
321 left hip flexion and abduction. Initial MMT testing also revealed weakness in all directions of the  
322 right ankle. At discharge, MMT of the hips and ankles improved to 5/5 bilaterally. The patient's  
323 excursion with the ND test was measured to be 6 mm and 8 mm on the right and left  
324 respectively, which was a normal amount of excursion and did not change after the intervention.  
325 The LEFS improved from 9% disability to 5% disability, which was associated with a 3-point  
326 improvement. This was not statistically significant as the minimally clinically important  
327 difference (MCID) is 9 points. The results of all tests and measures at IE and discharge can be  
328 found in Table 2.

329       During and after running observational gait analysis, she reported tightness and discomfort in  
330 both lower extremities and 5/10 pain on the NPRS. While walking she demonstrated a longer  
331 stride length with the right leg than the left. During running, she presented with a heel strike  
332 running pattern and an audible foot slap bilaterally. She also demonstrated increased transverse  
333 plane motion and internal rotation of the hips and knees at contact, which continued throughout  
334 the stance phase. This was thought to be due to the patient's high-arched, rigid foot which

335 prevented pronation early in stance and caused LE IR in the second half of stance as  
336 compensation, possibly due to weakness of the external rotators of the hips.

337 All short-term goals were met, and two long-term goals were not met. At the conclusion  
338 of this report, the patient was not able to run for 15 minutes without tightness or pain. Her LEFS  
339 still showed minor disability and she still experienced 6-7/10 pain with running. Patient short-  
340 and long-term goals can be found in Table 3.

341 Following the conclusion of this case report, the patient was seen by her orthopedic  
342 surgeon for compartmental pressure testing. The results revealed her posterior compartment  
343 pressure levels were elevated bilaterally, but not enough for surgical intervention. Further blood  
344 testing revealed severe anemia and the patient received subsequent treatment for the deficiency.

345

#### 346 **DISCUSSION**

347 This case report investigated the use of a barefoot running program for a female college  
348 lacrosse player with posterior CECS in conjunction with a conventional physical therapy  
349 program. The purpose of the barefoot running program was to modify running mechanics to alter  
350 stride length and rate and decrease ground reaction forces.<sup>4,5</sup> While studies have examined  
351 barefoot running for individuals with anterior and lateral CECS,<sup>6</sup> none have examined this  
352 intervention in posterior CECS.

353 The 10-week barefoot running intervention did improve running tolerance, however, it  
354 did not improve tightness and pain with running. The patient did not finish the entire protocol  
355 due to tightness and pain in her lower legs and was only able to run up to 12 minutes. In the case  
356 report by Diebal et al, one subject with bilateral anterior and lateral CECS, who was assigned a  
357 barefoot running program along with “focused training drills”, was successful in improving  
358 running tolerance from 0.5 miles to 3 miles without any tightness or pain.<sup>6</sup> However, the study



359 had a different running protocol than the one performed in this case report and the subject  
360 presented with anterior and lateral CECS.

361         There may be many reasons as to why the patient did not see improvements in tightness  
362 and pain with barefoot running. One limitation is the lengthy adaptation time of modifying  
363 running mechanics. Although the patient was seen 2x/week for 12 weeks and was very compliant  
364 with her running program, possible adaptations and positive effects of altering running  
365 mechanics may take longer than anticipated. In addition, the barefoot running protocol that was  
366 used in this report has not been validated or supported by research. Furthermore, the patient's  
367 underlying anemia may have been a contributing factor to her running intolerance. Barefoot  
368 running, or running with a forefoot strike pattern, may have also put excessive stress on the  
369 posterior compartments, which could have aggravated the musculature and surrounding tissue. A  
370 walking and running observational gait analysis should have been completed at discharge to  
371 evaluate any changes in walking or running form; however, it also may have been too early in  
372 the program to see significant changes. A strength of this case report was the improvement seen  
373 in most other measures, such as palpable tenderness, ROM, and MMT. This may be due to the  
374 comprehensive nature of the physical therapy program.

375         A barefoot running program may be an effective way of altering faulty or inefficient  
376 running mechanics in individuals with lower extremity running injuries but may take an  
377 extensive period of time to see significant changes. Future research should investigate  
378 appropriate timelines and progression for barefoot running interventions. Studies should also  
379 explore barefoot running interventions for individuals with posterior CECS.

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442 **TABLES and FIGURES**

443  
 444 **Table 1: Systems Review**  
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	<b>Initial Evaluation</b>	<b>Discharge</b>
<b>Cardiovascular/Pulmonary</b>	Not impaired	Not impaired
<b>Musculoskeletal</b>	Impaired: Passive hip external rotation 90% limited bilaterally. All other hip and knee passive and active ROM within functional limits.  ROM impairments of bilateral ankles  Gross symmetry: bilateral forefoot varus, high arched feet, Haglund's deformity left calcaneus.	Impaired: Bilateral ankle active ROM impaired  Gross symmetry: bilateral forefoot varus, high arched feet, Haglund's deformity left calcaneus.
<b>Neuromuscular</b>	Not impaired	Not impaired
<b>Integumentary</b>	Not impaired	Not impaired
<b>Communication</b>	Not impaired	Not impaired
<b>Affect, Cognition, Language, Learning Style</b>	Not impaired	Not impaired

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**Table 2: Tests & Measures**

<b>Tests &amp; Measures</b>	<b>Initial Evaluation Results</b>	<b>Discharge Results</b>
Right ankle ROM	DF: lacking 16° PF: 80° Soleus DF: 12°	DF: lacking 8° PF: 80° Soleus DF: 5°

	INV: 20° EV: 15°	INV: 20° EV: 15°
Left ankle ROM	DF: lacking 12° PF: 80° Soleus DF: 10° INV: 23° EV: 15°	DF: lacking 4° PF: 80° Soleus DF: 0° INV: 23° EV: 15°
Right hip strength	Flexion: 4+/5 Extension: 4+/5 Internal rotation: 4+/5 External rotation: 4+/5 Abduction: 4+/5	Flexion: 5/5 Extension: 5/5 Internal rotation: 5/5 External rotation: 5/5 Abduction: 5/5
Left hip strength	Flexion: 4/5 Extension: 4+/5 Internal rotation: 4+/5 External rotation: 4+/5 Abduction: 4/5	Flexion: 5/5 Extension: 5/5 Internal rotation: 5/5 External rotation: 5/5 Abduction: 5/5
Right knee strength	Flexion: 5/5 Extension: 5/5	Flexion: 5/5 Extension: 5/5
Left knee strength	Flexion: 5/5 Extension: 5/5	Flexion: 5/5 Extension: 5/5
Right ankle strength	DF: 4/5 PF: 5/5 INV: 4/5 EV: 4/5	DF: 5/5 PF: 5/5 INV: 5/5 EV: 5/5
Left ankle strength	DF: 4+/5 PF: 5/5 INV: 4+/5 EV: 4+/5	DF: 5/5 PF: 5/5 INV: 5/5 EV: 5/5
Navicular drop	Right: 6 mm Left: 8 mm	Right: 6 mm Left: 8 mm
Palpation	Tightness and tenderness to palpation in soleus, gastrocnemius, tibialis anterior, tibialis posterior, and peroneals	No palpable tenderness  No restrictions palpated
Lower Extremity Functional Scale (LEFS)	73/80, 9% deficit	76/80, 5% deficit
Running tolerance	1 min with shoes (8/10 pain)	12 min barefoot (6-7/10 pain)

Dorsiflexion (DF), plantarflexion (PF), inversion (INV), eversion (EV)

**Table 3: Patient Goals**



<b>Time Frame</b>	<b>Goal</b>
<b>Short term: 8 weeks</b>	Patient will improve ankle DF by 8-10 degrees to improve joint mobility and LE




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	<p>biomechanics.</p> <p>Patient will have minimal to no palpable tightness in the gastrocnemius/soleus complex to improve soft tissue mobility and LE biomechanics.</p> <p>Patient will be able to tolerate 5 minutes of running with no complaints of tightness or pain in lower leg.</p>
<b>Long term: 12 weeks</b>	<p>Patient will improve hip and ankle strength to 5/5 throughout to allow appropriate hip, knee, and ankle position while running and sport activities.</p>
	<p>Patient will be able to tolerate 15 minutes of running with no complaints of tightness or pain in lower leg.</p>
	<p>Patient will improve LEFS score to 80/80 and a NPRS to 0/10 with running to return to play lacrosse.</p>

456 Dorsiflexion (DF), lower extremity (LE), lower extremity functional scale (LEFS), numeric pain rating  
 457 scale (NPRS)  
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459 **Table 4: Home Exercise Program**

<b>Exercise</b>	<b>Parameters</b>	<b>Diagram</b>
Gastrocnemius Stretch with Towel (long-sitting)	<p>R and L LE: 30 sec hold</p> <p>Repetitions: 3</p> <p>Sets: 1</p> <p>Frequency: twice per day</p>	 <p>www.hep2go.com</p>
Gastrocnemius stretch (standing)	<p>R and L LE: 30 sec hold</p> <p>Repetitions: 3</p> <p>Sets: 1</p> <p>Frequency: twice per day</p>	 <p>www.hep2go.com</p>

<p>Soleus stretch (standing)</p>	<p>R and L LE: 30 second hold</p> <p>Repetitions: 3 Sets: 1 Frequency: twice per day</p>	 <p>www.hep2go.com</p>
<p>Gluteus bridges</p>	<p>R and L LE: 3 second hold Rest 30 sec between each set</p> <p>Repetitions: 10 Sets: 2 Frequency: once every other day</p>	 <p>www.hep2go.com</p>
<p>Clamshells</p>	<p>R and L LE: with green theraband</p> <p>Repetitions: 10 Sets: 2 Frequency: once every other day</p>	 <p>www.hep2go.com</p>

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461 **Table 5: Barefoot Running Intervention Timeline**


Day	Activity	
<b>Phase I: Preparatory Phase</b>		
<b>Weeks 1-2</b>		
<b>Phase II: Weeks 3-4</b>		
1	Walk 30 min	
2	Walk 9 min/jog 1 min (x3)	
3	Rest	
4	Walk 8 min/jog 2 min (x 3)	
5	Walk 7 min/jog 3 min (x3)	
6	Rest	
7	Walk 6 min/jog 4 min (x3)	

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8	Walk 5 min/jog 5 min (x3)	
9	Rest	
10	Walk 4 min/jog 6 min (x3)	
11	Walk 3 min/jog 7 min (x3)	
<b>Phase III: Weeks 5-7 - 3 days/week</b>		
12	Jog 12 min	Re-evaluation
13	Rest	
14	Jog 15 min	
15	Rest	
16	Jog 17 min	
17	Rest	
18	Jog 20 min	
19	Rest	
20	Jog 20 min	
21	Rest	
<b>Phase IV: Week 7-8 – 4 days/week</b>		
22	Jog 25 min	
23	Rest	
24	Jog 25 min	
25	Rest	
26	Jog 30 min	
27	Rest	
28	Jog 30 min	
29	Jog 30 min	
30	Rest	



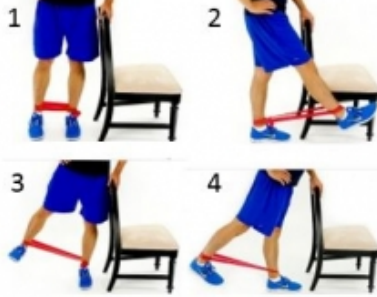

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463 **Table 6: In-clinic Exercises**





Exercise	Parameters	When added	Diagram
Slantboard calf stretch (straight leg)	R and L LE at same time: 3 minutes	2 <sup>nd</sup> visit	 <p>www.hep2go.com</p>




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Squats	Repetitions: 10 Sets: 2	2 <sup>nd</sup> visit	 <p>www.hep2go.com</p>
Single leg stance (SLS) on airex	R and L LE: 30 second balance Repetitions: 3	2 <sup>nd</sup> visit	 <p>www.hep2go.com</p>
3-way hip kicks with green miniband	R and L LE Repetitions: 10 Sets: 2	2 <sup>nd</sup> visit	 <p>www.hep2go.com</p>
Step up 8-inch step with leg drive	R and L LE Repetitions: 10 Sets: 2	3 <sup>rd</sup> visit	 <p>www.hep2go.com</p>

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<p>Side step with miniband</p>	<p>R and L LE 10 feet one way Repetitions: 2 laps</p>	<p>3<sup>rd</sup> visit</p>	 <p>www.hep2go.com</p>
<p>Goblet squat with 8-pound weight</p>	<p>Repetitions: 20 Sets: 2</p>	<p>4<sup>th</sup> visit</p>	 <p>www.hep2go.com</p>
<p>Step down 8-inch step</p>	<p>R and L LE Repetitions: 10 Sets: 2</p>	<p>4<sup>th</sup> visit</p>	 <p>www.hep2go.com</p>
<p>Rockerboard (front and side)</p>	<p>30 second balance Repetitions: 3</p>	<p>6<sup>th</sup> visit</p>	 <p>www.hep2go.com</p>

Agility drills (light jog)	Side shuffle 20 feet each side Cross over front 20 feet each side Cross over back 20 feet each side Grapevines 20 feet each side	7 <sup>th</sup> visit	 <p>www.womensrunning.com</p>
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465 **CARE Checklist**

466 *Final Parts One & Two, PTH708:* Completed for the final submission to document the locations of key case report components.

<b>CARE Content Area</b>	<b>Page</b>
1. <b>Title</b> – The area of focus and “case report” should appear in the title	2
2. <b>Key Words</b> – Two to five key words that identify topics in this case report	2
3. <b>Abstract</b> – (structure or unstructured) <ul style="list-style-type: none"> <li>a. Introduction – What is unique and why is it important?</li> <li>b. The patient’s main concerns and important clinical findings.</li> <li>c. The main diagnoses, interventions, and outcomes.</li> <li>d. Conclusion—What are one or more “take-away” lessons?</li> </ul>	3-4
4. <b>Introduction</b> – Briefly summarize why this case is unique with medical literature references.	4
5. <b>Patient Information</b> <ul style="list-style-type: none"> <li>a. De-identified demographic and other patient information.</li> <li>b. Main concerns and symptoms of the patient.</li> <li>c. Medical, family, and psychosocial history including genetic information.</li> <li>d. Relevant past interventions and their outcomes.</li> </ul>	6-7
6. <b>Clinical Findings</b> – Relevant physical examination (PE) and other clinical findings	7-9
7. <b>Timeline</b> – Relevant data from this episode of care organized as a timeline (figure or table).	13
8. <b>Diagnostic Assessment</b> <ul style="list-style-type: none"> <li>a. Diagnostic methods (PE, laboratory testing, imaging, surveys).</li> <li>b. Diagnostic challenges.</li> <li>c. Diagnostic reasoning including differential diagnosis.</li> <li>d. Prognostic characteristics when applicable.</li> </ul>	8-9
9. <b>Therapeutic Intervention</b> <ul style="list-style-type: none"> <li>a. Types of intervention (pharmacologic, surgical, preventive).</li> <li>b. Administration of intervention (dosage, strength, duration).</li> <li>c. Changes in the interventions with explanations.</li> </ul>	10-12
10. <b>Follow-up and Outcomes</b> <ul style="list-style-type: none"> <li>a. Clinician and patient-assessed outcomes when appropriate.</li> <li>b. Important follow-up diagnostic and other test results.</li> <li>c. Intervention adherence and tolerability (how was this assessed)?</li> <li>d. Adverse and unanticipated events.</li> </ul>	14-15

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<b>11. Discussion</b> a. Strengths and limitations in your approach to this case. b. Discussion of the relevant medical literature. c. The rationale for your conclusions. d. The primary “take-away” lessons from this case report.	15-16
<b>12. Patient Perspective</b> – The patient can share their perspective on their case.	
<b>13. Informed Consent</b> – The patient should give informed consent.	2

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