Chiropractic management of low back pain in a patient with a transfemoral amputation

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Abstract

Objective: The purpose of this case report is to describe the chiropractic management of a patient with a unilateral transfemoral amputation and low back pain (LBP).

Clinical Features: A 20-year-old woman with right transfemoral amputation and a right upper extremity amputation due to amniotic band syndrome had approximately 40 different prosthetic lower extremities in the prior 20 years. She presented for chiropractic care for LBP (5/10 numeric pain scale) that she experienced after receiving a new right prosthetic leg. The pain increased with walking, attempts to exercise, and lying supine. Physical evaluation revealed asymmetrical leg length (long right limb); restricted left ankle dorsiflexion; restricted lumbopelvic motion; and hypertonicity of the left triceps surae muscle complex as well as the gluteus maximus, quadratus lumborum, and erector spinae bilaterally. Gait examination revealed a right Trendelenberg gait as well as a pattern of left vaulting. The working diagnosis was sacroiliac joint dysfunction, with lumbar facet syndrome secondary to a leg length inequality causing alteration in gait.

Intervention and Outcome: Chiropractic management included manipulative therapy to the lumbar spine and pelvis, trigger point therapy of hypertonic musculature, and strengthening of pelvic musculature. In addition, the patient's prosthetist shortened her new prosthetic device. After 18 treatments, LBP severity was resolved (0/10); and there was an overall improvement with gait biomechanics.

Conclusion: This case illustrates the importance of considering leg length inequality in patients with amputations as a possible cause of lower back pain, and that proper management may include adjusting the length of the prosthetic device and strengthening of the hip flexors and abductors, in addition to trigger point therapy and chiropractic manipulation.

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Introduction

Low back pain (LBP) affects 80% of adults during their lifetime and is the chief medical condition in which health care dollars are spent as well as causing disability.¹ Several researchers have suggested that a disparity of length between the legs, leg length inequality (LLI), is a contributing cause to LBP.²⁻⁵

It is estimated that 52% to 71% of amputees experience LBP, which is an important cause of secondary disability in transfemoral amputees (TFAs). Almost one-third of amputees with LBP rate their pain as severe and report that it limits their ability to perform regular activities of daily living.⁶⁻⁸ In this population, the correction of LLI through adjusting the prosthetic leg or providing a heel lift is a common clinical approach to the treatment.^{1-3,5-8}

To date, there has been only one study evaluating the relationship of LLI and LBP with regard to the amputee population.⁹ Friberg¹⁰ found a significant correlation between LLI and LBP. However, only 29 of the 113 amputees in this study were transfemoral; and the prevalence of pain was not reported by amputation level. Despite the limited evidence for a relationship between the 2 variables in this population, practitioners commonly assess for an LLI in TFA with LBP of any type.

The mechanism by which LLI causes LBP is not clear. It is hypothesized that LLI causes asymmetry in the lower extremity joints, spine, and pelvis, causing altered stress to the soft tissues of the lumbar spine, further leading to abnormal biomechanical function.¹¹⁻¹⁵

The minimal LLI necessary to cause LBP has been a matter of debate. Most researchers agree that an LLI of more than 20 to 30 mm can cause LBP.^{16,17} However, a study by Defrin et al¹ suggested that an LLI as small as 2 mm can be clinically significant. As chiropractic management tends to focus on musculoskeletal function and biomechanics, it is possible that patients with LBP, LLI, and TFA may benefit from chiropractic care.

The purpose of this case report is to describe and discuss the clinical diagnosis of LLIs' relationship to low back pathology in a young woman with a transfemoral prosthetic device that responded to a multimodal management approach provided by a chiropractic physician.

Case report

A 20-year-old woman presented to the chiropractic clinic with a chief concern of bilateral LBP, achy in

quality, and rated her pain as a 5 of 10 on a numeric pain scale. The patient reported that her LBP began after receiving a right knee revision of her prosthesis in 2006. She denied any previous history of LBP. The patient is a right TFA and a right upper extremity amputee due to amniotic band syndrome. She stated that she has had approximately 40 different prosthetic lower extremities in the past 20 years. The patient reported that lying flat on her back as well as excessive walking and exercise intensified her symptoms. She denied bowel or bladder dysfunction, as well as increased symptoms with coughing, sneezing, or straining.

Active extension of the lumbar spine was limited and locally painful bilaterally. Active right and left rotation was within normal range of motion; however, it reproduced her LBP. All other ranges of motion were within normal limits and nonprovocative. A visual gait analysis revealed a right-sided Trendelenburg gait in the stance phase (Fig 1), severe right hip hiking during left stance as well as limited left dorsiflexion of her ankle, and quick translation onto her forefoot on the left in a manner that visually made the patient vault forward. Orthopedic testing was provocative for her LBP only with hyperextension maneuvers. Soft tissue hypertonicity was noted in the gluteal, quadratus lumborum, and erector spinae musculature bilaterally, as well as the left triceps surae complex. A standing iliac crest LLI test revealed that her right iliac crest was approximately 1" higher. A gait analysis scan using the GaitRite system (CIR Systems, Inc, Havertown, PA) was taken on 4 separate occasions with the patient wearing the same shoe on each occasion over a 26-ft gait mat. She was asked to walk at a moderate pace for all attempts. The following measurements were taken over the course of 18 treatments; a baseline measurement prior to any reduction in prosthetic height, then 4 weeks after, a 1/4" reduction in prosthetic height, and then both 3 and 16 weeks after, an additional 1/8" reduction in prosthetic height. The patient's prosthetist corrected for these heights. The GaitRite system demonstrated an initial asymmetry with both swing time and single limb support time (Fig 2).

The working diagnosis was sacroiliac joint dysfunction, with lumbar facet syndrome secondary to an LLI causing alteration in gait. Management started at a frequency of 1 time per week for 2 weeks and then increased to 2 times per week for 4 weeks, which tapered to 1 time per week for 2 weeks. As her subjective complaints improved and fewer objective findings were seen (Table 1), her care continued for 1 visit every month for 4 months. Total passive chiropractic care was over a period of 6 months;

Fig 1. Posterior inspection of the patient's right Trendelenburg gait. Lines have been drawn to demonstrate the high iliac crest on the right and the low gluteal fold on the left, which is a common presentation of a Trendelenburg sign on the right.

however, the first 2 months of treatment consisted of approximately 80% of her care. Passive management consisted of side posture chiropractic diversified adjustments to the lumbar spine, sacroiliac joints, and left ankle mortise joint. In addition, hip flexor strengthening and myofascial release to the left triceps surae complex were performed during each treatment session. The high-velocity, low-amplitude adjustments were performed on the patient in the side posture position. Depending on the situation of the patient, in terms of her personal time constraints, she would occasionally take off the prosthetic device to make it easier for the intern adjusting her to create good tissue pull. If the patient was to have an adjustment with the prosthetic leg side up, then the upside's leg knee would

be in slight flexion; and the upside's hip would be under 90° . The hip could not be taken past 90° because of the constraints of the prosthetic device. Extremity adjusting to the left ankle mortise was performed with the patient supine (hip at 45° and ankle at 90°) with the use of a speeder board. The clinical basis behind the adjustments came from the intern's motion palpation skills for restricted spinal motion units. Passive muscle isometric contraction was performed on the patient's prosthetic side while in the supine position. The patient's right hip would be flexed to approximately 90° , and then moderate resistance was added to the knee in the position while the patient attempted to hold the position for 5 to 10 seconds. The intern would vary the angulation of the hip after this first attempt was made. If the patient was able to resist the starting position, the hip would then be placed at 70° , 50° , and 30° . Each of these positions will also be held for 5 to 10 seconds based upon patient comfort and hip flexor endurance. Myofascial release was performed to the bilateral erector spinae and quadratus lumborum while the patient was side-lying into a flexed fetal position. The left posterior calf complex myofascial release was performed with the patient prone and the ankle dorsiflexed passively by the intern.

Active management was provided to the patient in terms of patient education and through gentle exercises. Avoidance of walking without proper running shoes, avoidance of lumbar extension movements, and home posterior pelvic tilting exercises were prescribed.

During the span of treatment, the patient went on a 2-week vacation traveling in Europe in which she walked for more than 5 hours daily, and admitted to not doing any exercises or stretching while away. When she returned, her LBP had subjectively increased; and her gait was objectively altered. In addition, there was a period of 4 weeks near the end of treatment in which the patient was being fit for a new prosthetic socket; and she had a moderate allergic reaction to the glue being used. Because of the irritation and pain on her dermis, an alternation in gait was noted as well as an exacerbation of her LBP.

Outcome measures included the numeric pain scale; motion palpation of lumbar spine, sacroiliac joints, and left dorsiflexion; and a visual and computerized gait analysis assessment. Subjective pain complaint was recorded as either verbiage (ie, some, extreme pain) and listed as a grade out of 10 (ie, 10 being the worst pain imaginable). During the course of care, the patient provided a subjective report of an increase in her activity level without an associated increase in back pain severity. Within 3 weeks of active and passive

Fig 2. GaitRite analysis measurements. The chart represents time (in seconds) over a walkway of 26 ft.

treatment, the patient stated that she had no back pain. This subjective outcome continued for 2 additional months, until she went on a holiday to Europe and her LBP increased minimally. After 18 treatments (end of passive care), her LBP severity was reduced to 0 of 10;

and there was an overall improvement with her gait biomechanics with symmetry in swing time and single limb support time as seen through the GaitRite system. As the patient continued to show improvement, management did not deviate from this methodology.

Table 1 Progression of symptoms and outcome measurements over the course of treatment

Visit #: week #	Treatment	Symptoms
1:1	Initial GaitRite scan taken, MRT, CMT-D, MAMJ	Pain 5/10, night pain (lying supine only), pain affecting ADL (exercise/walking), palpable tenderness in left gastrocnemius/soleus
2:2	Same as 1:1 with additional 1/4" reduction of prosthetic leg, pelvic tilting exercises, and home care education given	Subjective decreased in pain, minimal night discomfort, pain affecting ADLs (exercise/walking), palpable tenderness in left gastrocnemius/soleus
3:3	Same as 1:1	Decreased subjective "pressure" in low back, pelvic tilts easier to perform, pain with ADL (exercise).
4, 5:4	Same as 1:1	No pain with ADLs (exercise), right hip hiking seen in the swing phase of gait
6, 7:5	Same as 1:1 and review home exercise	100% resolution of symptoms; bilateral sacroiliac restriction
8, 9:6	2nd GaitRite scan taken, MRT, CMT-D, MAMJ	Slight exacerbation of pain at work
10, 11:7	Same as 1:1	Moderate exacerbation of symptoms (vacation with no care), left calf pain
12:8	Same as 1:1	No pain since last visit, exercise bike irritated skin proximal to prosthetic device
13:9	Same as 1:1	No LBP at night, no leg pain, left ankle feels "free"
14:10	3rd GaitRite scan taken same as 1:1	Patient had a skin reaction to a new glue used on prosthetic device (this altered her gait), and a moderate exacerbation of pain in her low back was noted
15:11	1/8" reduction of prosthetic leg, MRT, CMT-D, MAMJ	Same symptoms as 14:10
16:12	Same as 1:1	Same symptoms as 14:10, foam with glue has not been replaced yet, patient unable to complete home exercises
17:13	4th GaitRite scan taken, same as 1:1	No more skin allergy, no pain, discontinue care

All office visits for the week are listed together, represented by weekly treatments.

ADL, activities of daily living; *CMT-D*, chiropractic manipulative technique—diversified; *MAMJ*, manipulate left ankle mortise joint; *MRT*, myofascial release technique.

With decreased severity of symptoms and improvement in the patient's objective gait, the patient was discharged from care.

Discussion

Low back pain is a prevalent and often disabling condition in those with a transfemoral prosthetic device.⁶⁻⁸ However, there is currently a poor understanding of the underlying mechanisms. Moreover, there are few studies comparing lower back pain and LLI in those with TFA.

A patient with a lower extremity amputation has his/her own unique gait pattern. Research on the differences of gait between amputees and nonamputees suggests that the amputee can never walk in the way that nonamputees can.¹⁸ An amputee must compensate with movement to overcome the different locomotive abilities between the sound leg and the prosthetic leg.¹⁸

This proclamation is exemplified by this case. It was hypothesized by the authors that this patient's gait pattern and examinations findings were directly compensatory to the anomalous increased prosthetic height as well as the biomechanical characteristics of the manufactured right limb. With the approximate 1-in length increase of this limb, complications of ground clearance during the swing phase of that limb would be probable. To overcome this issue, it would be anticipated that, during the stance phase of the left limb, the patient would attempt to broaden the area of passage in which the right limb could travel during swing. During the left stance phase of gait, 2 possible mechanisms in achieving this goal would be to elongate the standing left limb or vertically raise the right pelvis.

Visual analysis of this patient's gait supported the appropriateness of our hypothesis by revealing both right hip hiking as well as a vault-like toe-walking pattern of the left extremity during stance. On physical examination, the finding of a hypertonic left triceps surae complex further supported this patient's attempt to lengthen the left limb during the stance phase of gait.

In addition to the objective length discrepancy of the artificial limb, concerns of the limb's biomechanical requirements for motion were of concern. Gait mechanics were complicated by the fact that the patient did not have normal ankle motion with the prosthetic device. Active plantarflexion was not possible given the passive nature of the ankle-foot complex of the observed prosthetic limbs.¹⁹ This synthetic ankle was required to be set to a predetermined fixed angular degree. The patient would set the ankle dorsiflexion

daily depending on the height of the heel she would be wearing for that day.

Further complications were due to the lack of muscular control at the artificial knee. The prosthetic hinged knee required the laws of momentum and inertia for motion. Creation of knee flexion required the thigh to accelerate at a speed that caused the distal prosthesis (foot) to lag behind. As knee flexion is an additional mechanism to promote ground clearance of the extremity during swing, the possibility of increasing knee flexion by strengthening the force of hip flexion was introduced. This was the rationale for initiating iliopsoas muscle strengthening exercises. In addition, gluteal muscle strengthening was performed under the premise that isolated pelvic musculature weakness leads to increases in anterior pelvic tilt during the stance phase of walking.²⁰ It is hypothesized that this is the reason behind her lumbar spine facet syndrome.

To determine the nature and extent of a gait abnormality, it is essential to undertake an assessment. The assessment tool used in this case report is the GaitRite walkway, which is 26 ft in length and has 2 rows of 256 pressure-activated switches embedded in a mat scanned by a dedicated microprocessor. Data are processed by a second IBM-compatible computer by using GaitRite software.

McDonough et al²¹ published a study that analyzed the GaitRite system, and they found that it was a reliable tool for measuring selected gait components. However, because of the typical high expense of different gait systems, most practitioners provide a subjective written description; but it relies heavily on the skill and experience of the assessor and is prone to error and misinterpretation. The person giving treatment to the patient is an intern with very little experience with visual gait analysis. It is suggested that if distance and timing parameters of gait could be determined objectively, then this would provide extremely useful information to the clinician and would augment, rather than replace, the observational assessment. According to the GaitRite system measurements, the amount of time she spends on both legs independently (ie, stance phase) and the time she spends in the swing phase became nearly symmetrical at the time of her discharge (Fig 2). It is hypothesized that a reduction in pain through treatments and proper symmetrical leg lengths aided in this finding. Moreover, the authors hypothesize that reducing pain and lowering the height of her prosthetic side would allow her to feel more comfortable weight-bearing on that side, thereby allowing her to spend more time in the stance cycle.

This case report appears to be the second report in the literature showing benefit for people with TFA using chiropractic care. This case was especially unique in that the patient's prosthetic limb was longer than the nonprosthetic limb. It is typical for the prosthesis to be intentionally shortened with hopes of improving toe clearance during gait.²² In a study by Livdans-Forret,²³ she demonstrated the use of chiropractic manipulation for a patient with a prosthetic device and LBP; however, this case did not report LLI. To date, our case is the only one to report on the relationship of LLI in a TFA with LBP. It is possible that mild LLI is rarely treated because clinicians are not aware of the potential benefits following correction. We hope that the results of this study will encourage clinicians to measure leg length in patients with LBP and TFA and, if LLI is identified, to correct for it with a shoe insert or alteration of prosthetic length.

Limitations

The limitations are consistent with case report design in that the findings are anecdotal in nature and cannot be generalized beyond this individual case. Although there were outcome measures used to reflect objective changes at each visit, the potential for error in obtaining or influencing outcomes cannot be excluded because the primary author did not directly provide the treatments or conduct the evaluations.

Specifically for this case, there were several limitations. There were no disability questionnaires implemented throughout the treatments. With regards to the method of LLI, in this particular case, it lacked precise measurement. Currently, there is a lack of literature to support the clinical relevance of leg length tests.²⁴ In this case, a standing iliac crest test was implemented. According to Blake and Ferguson,⁴ this indirect method of limb length measurement is commonly used over the highly inaccurate direct method; however, there should be a measurement made of the iliac crests and posterior and anterior iliac spines. These 3 measurements should be taken to look for pelvic obliquely and/or rotation. It could be reasonable to assume because all of these measurements were not taken that, in fact, there was no LLI but a pelvic rotatory issue. Holt et al²⁴ demonstrated consistent findings with other researchers who examined the positive interexaminer reliability of leg length assessments between an experienced chiropractor and inexperienced chiropractic student (that had minimal training).²⁵⁻²⁷

Conclusions

Chiropractic care with correction of LLI appeared to be beneficial for a patient with TFA with a concurrent LLI and LBP. Additional studies are needed to further address the many issues involved in the management of patients with amputations and prosthetic devices.

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