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Postural correction reduces hip pain in adult with acetabular dysplasia: a case report

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Abstract

Developmental dysplasia of the hip is often diagnosed in infancy, but less severe cases of acetabular dysplasia are being detected in young active adults. The purpose of this case report is to present a non-surgical intervention for a 31-year-old female with mild acetabular dysplasia and an anterior acetabular labral tear. The patient presented with right anterior hip and groin pain, and she stood with the trunk swayed posterior to the pelvis (swayback posture). The hip pain was reproduced with the anterior impingement test. During gait, the patient maintained the swayback posture and reported 6/10 hip pain. Following correction of the patient's posture, the patient's pain rating was reduced to a 2/10 while walking. The patient was instructed to maintain the improved posture. At the 1 year follow-up, she demonstrated significantly improved posture in standing and walking. She had returned to recreational running and was generally pain-free. The patient demonstrated improvement on self-reported questionnaires for pain, function and activity. These findings suggest that alteration of posture can have an immediate and lasting effect on hip pain in persons with structural abnormality and labral pathology.

Keywords

dysplasia; gait; posture; labral tear; movement system

Background

Acetabular dysplasia is an orthopedic disorder characterized by a shallow acetabulum resulting in inadequate coverage of the femoral head. The poor congruency leads to increased stress which may cause fracture of the acetabular rim and separation of rim fragments as well as labral hypertrophy and tears (Dorrell and Catterall, 1986; Klaue et al., 1991; Lane et al., 2000; Hickman and Peters, 2001; McCarthy and Lee, 2002; Horii et al., 2003; Leunig et al., 2004; Mavcic et al., 2008; Chegini et al., 2009). Mild dysplasia may not be diagnosed until insidious hip or groin pain presents in skeletally mature adults (Nunley et al., 2011). Symptoms often increase with walking, running, standing and other impact

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activities (Nunley et al., 2011). Currently, the standard treatment approach in adults is the Bernese periacetabular osteotomy (PAO) (Ganz et al., 1988; Hickman and Peters, 2001; Millis et al., 2009). The surgical goal is to reduce contact stress by improving the coverage of the femoral head, and thereby delay or prevent the onset of hip OA. Overall, the results for Bernese PAO are favorable (Clohisy et al., 2005; Matheney et al., 2009). However, a complication rate of 15% can be expected (Matheney et al., 2009).

Given the invasive nature of surgery, the development of an effective non-surgical treatment option for active adults with mild dysplasia is important, particularly if the clinician suspects that the pain is exacerbated by poor posture or abnormal movement patterns which may further increase the stresses on the dysplastic hip. The purpose of this case study is to present a successful non-operative treatment for a patient with symptomatic mild acetabular dysplasia and an acetabular labral tear.

Case Description

This patient was seen as part of a larger research study on movement patterns in people with hip pain. This study included a brief physical examination and a biomechanical movement evaluation. The patient provided written informed consent as approved by the Institutional Review Board of Boston University.

History

This patient was a 31-year-old female (height: 1.62 m; mass: 68.0 kg), who participated in our research study at the recommendation of her orthopedic surgeon. She reported insidious onset of pain over the past year, and denied any history of acute injury to her right hip. She stated that the pain was in the “anterior groin or hip” region, and indicated the circled region on the body chart (Figure 1). The pain increased with prolonged activity, prolonged sitting, driving and when lying on her left side. She described the pain as a constant ache with an occasional sharp, higher intensity pain component. The average pain rating, on a 0 to 10 scale with 10 being the worst pain (Downie et al., 1978), was 3/10 on non-work days and this would increase to 7/10 while working as an acute care nurse. Pain was reduced by rest and by taking non-steroidal anti-inflammatory medications.

Five months prior to enrollment in this study, she was seen by an orthopedic surgeon. Imaging studies at that time included plane radiographs of the pelvis and a magnetic resonance arthrogram (MRA) of the right hip. These imaging studies indicated acetabular dysplasia as noted by a decreased lateral center edge angle (22° left, 18° right) (Figure 2A) and decreased anterior center edge angle (31° left, 24° right) (F igure 2B). Dysplasia is indicated by a lateral center edge angle less than 25° (Millis et al., 2009) or an anterior center edge angle less than 20° (Millis et al., 2009). An acetabular labral tear was also noted on the MRA (Figure 3). She was then referred to a physician specializing in Sports Medicine for an intra-articular cortisone injection, which she received three months later. This injection reduced her pain, indicating intra-articular pathology, but only temporarily as the pain returned. She had discussed with her orthopedic surgeon options to address the dysplasia and labral tear, including acetabular reorientation, but declined.

At the time of enrollment, she was working as an acute care nurse at a local hospital. She was also taking care of her three children under the age of 5 years. Her primary functional complaint was that the pain was interfering with her ability to return to her recreational fitness activities, primarily running.

The patient completed self-report questionnaires for pain, function, and activity level as part of the larger research study. These questionnaires included the Hip disability and Osteoarthritis Outcome Score (HOOS) (Nilsdotter et al., 2003; Kemp et al., 2013; Hinman et al., 2014), the Modified Harris Hip Score (MHHS) (Kemp et al., 2013), and the University of California, Los Angeles (UCLA) activity score (Terwee et al., 2011) (Table 1). These measures have been demonstrated to be reliable and are commonly used in hip pain populations (Nilsdotter et al., 2003; Terwee et al., 2011; Hinman et al., 2014).

Examination

As this was part of a larger research study, only a limited examination was performed. During visual observation, the patient was noted to stand in slight hip and knee hyperextension and posterior pelvic tilt with the trunk significantly swayed posterior to the pelvis (swayback posture) (Figure 4). Passive hip range of motion was measured using a goniometer in standard positions (Norkin, 2009). Both with the hip flexed and hip extended, the patient had more internal rotation range of motion and less external rotation range of motion of the right hip than of the left hip (Table 2), which is consistent with dysplasia (Nakahara et al., 2014). Hip flexion, extension, abduction, adduction, and internal and external rotation strength were assessed using isometric hand-held dynamometry. No significant strength deficits were noted for these motions.

The right hip pain was reproduced with the anterior impingement test (hip flexion to 90° with adduction and internal rotation). It is considered positive if it reproduces the anterior hip pain. Hip pain with this test is common in dysplastic hips (Langlais et al., 2006; Nunley et al., 2011) despite the test also being positive in patients with femoroacetabular impingement (FAI) (Clohisy et al., 2009). No pain was reported with the posterior impingement test, with FABER (flexion, abduction and external rotation), or with resisted straight leg raise. No symptoms were elicited for any of these tests on the left hip.

For the biomechanical evaluation, reflective markers were placed on the patient’s trunk and lower extremities. Specifically, markers were placed over the first and fifth metatarsal heads, the calcanei, the lateral and medial malleoli, the lateral and medial femoral epicondyles, the greater trochanters, the anterior superior iliac spines, the sacrum between the posterior superior iliac spines, the iliac crests, the xiphoid process, the spinous process of the seventh cervical vertebra, and the acromion processes. Plastic shells with four non-collinear markers each were placed laterally over the thigh and shank (Cappozzo et al., 1997). Marker positions were collected using a 10 camera motion capture system (100Hz, Vicon Motion Systems Ltd., Centennial, CO) and ground reaction forces were measured using an instrumented force treadmill (1000Hz, Bertec Corporation, Columbus, OH). Commercially available software (Visual3D, C-Motion, Inc, Rockville, MD) was used to calculate joint kinematics and internal muscle moments. Verbal pain ratings, on a 0 to 10 scale with 10 being the worst pain, were recorded. At the end of walking for approximately two minutes on the treadmill at the preferred speed (1.52 m/s), the patient reported 6/10 pain in the right anterior hip. The patient maintained her swayback posture during gait.

Intervention

A previous study demonstrated that walking in the swayback posture results in higher hip flexion moments (Lewis and Sahrmann, 2014), and thus may increase stresses on anterior hip structures, including the acetabular labrum. Therefore, the intervention focused on correcting the patient's natural posture in standing using tactile, visual, and verbal cues. The patient was instructed to maintain a slight anterior pelvic tilt, and then to contract her abdominal muscles to reduce posterior trunk sway. These cues brought her into a more upright posture (Figure 4). She was also encouraged to avoid hip and knee hyperextension. While maintaining these corrections, the patient walked again at 1.52m/s on the instrumented treadmill. Her pain rating at the end of two minutes was reduced to 2/10 while walking.

Biomechanical analysis of the postural correction revealed that she maintained the slight anterior pelvic tilt during gait, and that there was a 12% reduction in peak internal hip flexion moment (Figure 5). The internal hip flexion moment reflects the force that anterior hip structures must generate during walking, and could become overstressed especially in the dysplastic hip. An increase in the patient's self-selected stride length from 1.33 +/− 0.03m to 1.40 +/− 0.02m in the corrected posture was noted.

The patient was instructed in the importance of reducing the stress on the painful tissue in the anterior portion of the hip, specifically with postural corrections. These corrections were emphasized especially for work and standing tasks.

Outcomes

Three months following the initial visit, the patient was contacted via email and reported that she continued to be pain-free most of the time. She stated that when she was particularly busy at work, she might have minimal anterior hip pain, but that focusing on her posture and positioning resulted in immediate resolution of the pain.

One year following the initial visit, she returned to the laboratory for a follow-up biomechanical analysis. At that time, she demonstrated significantly improved posture, keeping her trunk vertically aligned over her hips in standing. In walking, she also maintained the improved posture (Figure 5). However, her reduction in the hip flexion moment had not been maintained. Her self-selected stride length during walking was 1.42 +/- 0.02m. She reported returning to recreational running. While she was pain-free during running on a treadmill, she stated that she would have pain immediately following running as she transitioned to walking. During this visit, her running was observed. She demonstrated good alignment and control, and did not have high ground impacts which could produce high tissue loading rates (Milner et al., 2006). However, during the transition period from running to walking she demonstrated increased hip extension and decreased ankle pushoff as the treadmill slowed from the running speed to the walking speed. Her hip pain was reproduced during this transition period. Increased hip extension has been linked to higher anterior hip joint forces (Lewis et al., 2010). Conversely, increased ankle pushoff has been shown to decrease anterior hip joint forces (Lewis and Garibay, 2014). Therefore, she was instructed to reduce her hip extension by taking shorter and quicker steps, and to push more with her feet when transitioning from running to walking. The next day, the patient reported that she was able to run and then walk on the treadmill without pain by focusing on pushing with her feet.

The patient demonstrated improvement on the MHHS and on three of the five subscales of the HOOS. These improvements were at or above the level of minimal important change for the MHHS and the ADL, Sports & Rec, and Quality of Life subscales of the HOOS (Kemp et al., 2013). She also had a significant increase in her UCLA activity score, reflecting her return to recreational running. The one area that had not improved was the Pain subscale of the HOOS. The patient reported that this was primarily due to activity-related anterior hip pain or pain after long walks, things she was unable to do the time of the initial evaluation. Despite this increase in pain rating, she felt that her symptoms had significantly improved.

Discussion

Recent advances in diagnostic imaging have brought increased attention to structural abnormalities of the hip. Despite the emphasis on early diagnosis and treatment of dysplasia, many cases of milder dysplasia are not detected until adolescence or adulthood. These cases present as insidious onset of hip or groin pain (Hickman and Peters, 2001; McCarthy and Lee, 2002; Peters and Erickson, 2006; Nunley et al., 2011).

The reduced bony contact area of the dysplastic hip results in increased stress on the acetabular rim and the acetabular labrum, especially during walking (Chegini et al., 2009). The increased stress may lead to acetabular labral tears (Dorrell and Catterall, 1986; Klaue et al., 1991; Lane et al., 2000; Hickman and Peters, 2001; McCarthy and Lee, 2002), as was noted in this patient. Walking in a swayback posture results in increased hip flexion muscle moment and increased peak hip extension (Lewis and Sahrmann, 2014).

Walking with increased hip extension also increases the anteriorly directed forces from the femur on the acetabulum (Lewis et al., 2010) further stressing the acetabular rim and labrum. Correction of abnormal posture and modification of movement patterns, therefore, can reduce stress on hip structures and can be an effective non-invasive intervention, as evidenced by the patient described in this case report. This patient experienced an improvement in her symptoms and function, and was able to achieve her goal of returning to recreational running. None-the-less, the intervention did not change the patient's hip dysplasia or labral tear. A recent study found that 69% of participants had an asymptomatic acetabular labral tear (Register et al., 2012). This finding indicates that not all labral tears result in hip pain, and that it is possible to be pain-free despite the continued presence of the tear. This is why similar non-surgical interventions have been recommended for patients with a tear of the acetabular labrum (Lewis and Sahrmann, 2006).

The cues to modify posture immediately reduced the patient's pain, as well as the hip flexion moment, during gait. While the change in posture was maintained at one year, the reduction in the hip flexion moment was not. The initial reduction in hip flexion moment was likely due to the significant change in posture. However, there was an increase in the stride length between the preferred and corrected posture and between the corrected posture and the 1 year follow up. Lower extremity joint moments have been shown to increase with increasing stride length during walking (White and Lage, 1993) and running (Schubert et al., 2014). Therefore, the patient may have benefited from also decreasing stride length.

Despite the return to a higher hip flexion moment during gait, the patient's symptoms did not return. It is theorized that the abnormal posture along with the acetabular dysplasia resulted in low-level repetitive stress to the intra-articular structures. Without relief, this stress can result in chronic activation of inflammatory mediators, reduced stress tolerance, and pain. The pain can result in alterations in muscle activity, changing the mechanical behavior of the joint, which can perpetuate an increased stress/pain paradigm (Hodges and Tucker, 2011). Providing an alternative postural strategy that reduced the hip moment may have provided sufficient reduction in stress on the anterior hip capsule and labrum to alleviate pain, promote tissue recovery, and enable the tissues to subsequently tolerate higher stresses during walking and running.

Conclusion

This case suggests that alteration of posture and movement patterns can have an immediate effect on hip pain in a person with acetabular dysplasia and labral pathology. The findings highlight a role for non-surgical intervention in cases of mild structural hip abnormalities, and demonstrate that correction of abnormal posture can be an effective and non-invasive intervention.

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Highlights

- The patient had anterior hip pain, acetabular dysplasia, and a labral tear.
- The patient stood and walking in a swayback trunk posture.
- Correction of the posture reduced her hip pain and allowed her to run without pain.
- Addressing abnormal posture can be an effective non-surgical intervention.

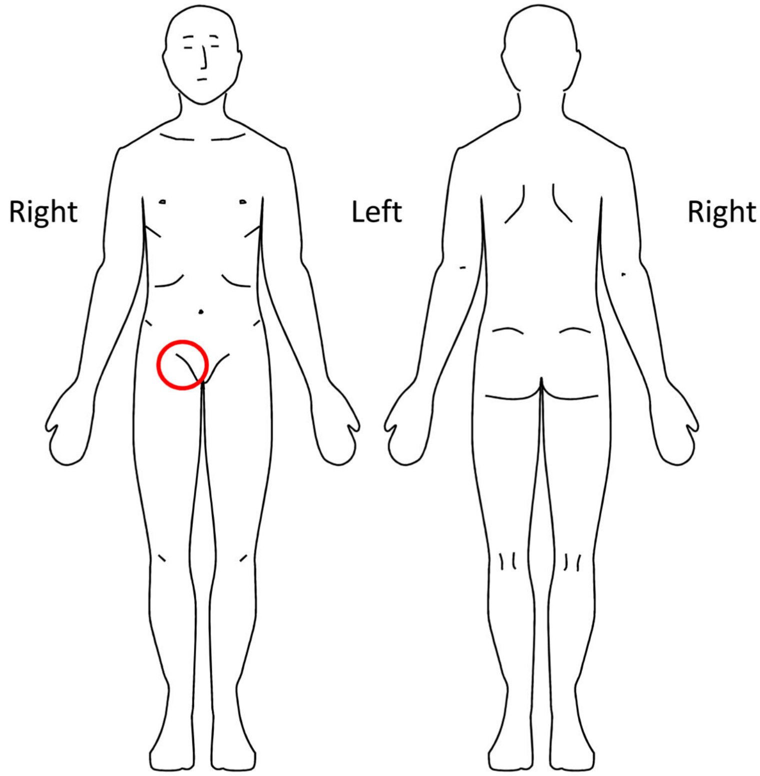

Figure 1.
Body chart illustrating location of pain.

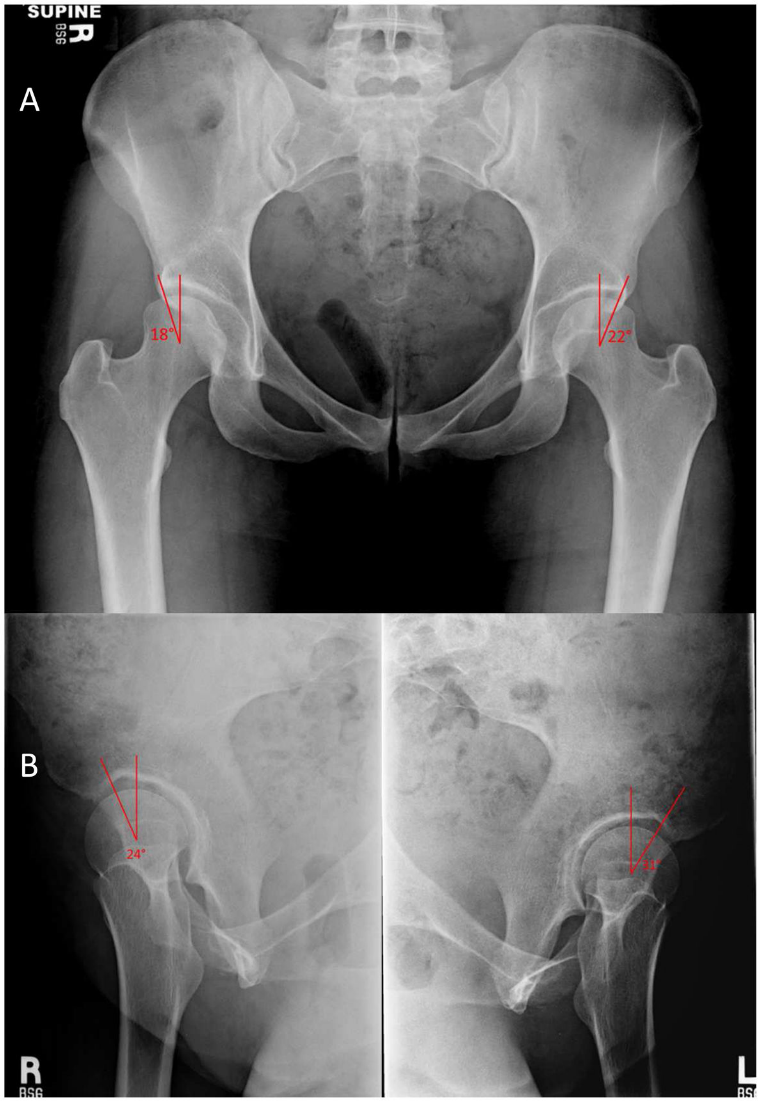

Figure 2.
Mild acetabular dysplasia of the right hip evident on the A/P pelvic radiograph (A) and the false profile (B).

Figure 3.
Small acetabular labral tear noted on T1-weighted magnetic resonance arthrogram.

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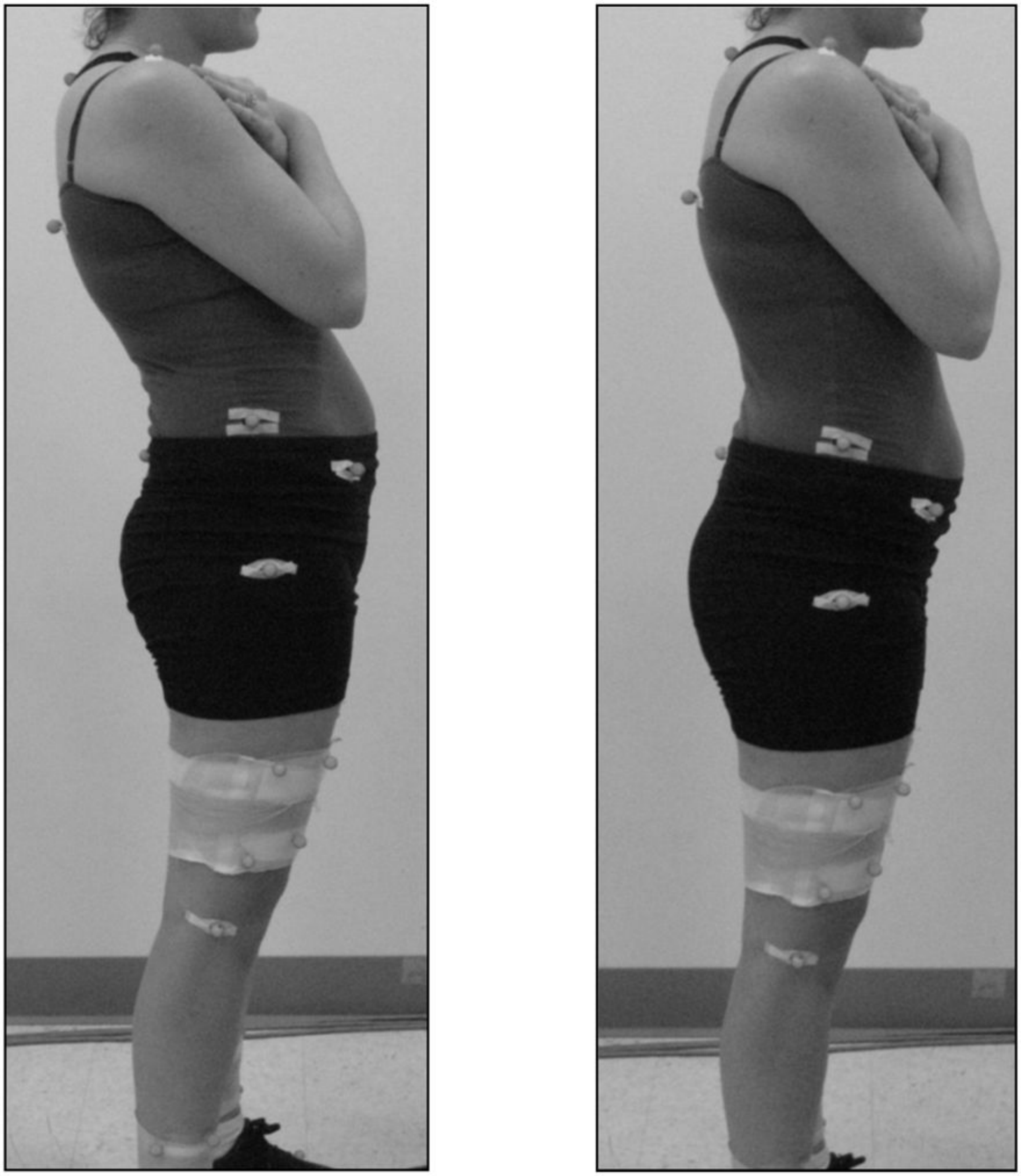

Figure 4.
Initial (left) and corrected (right) standing posture.

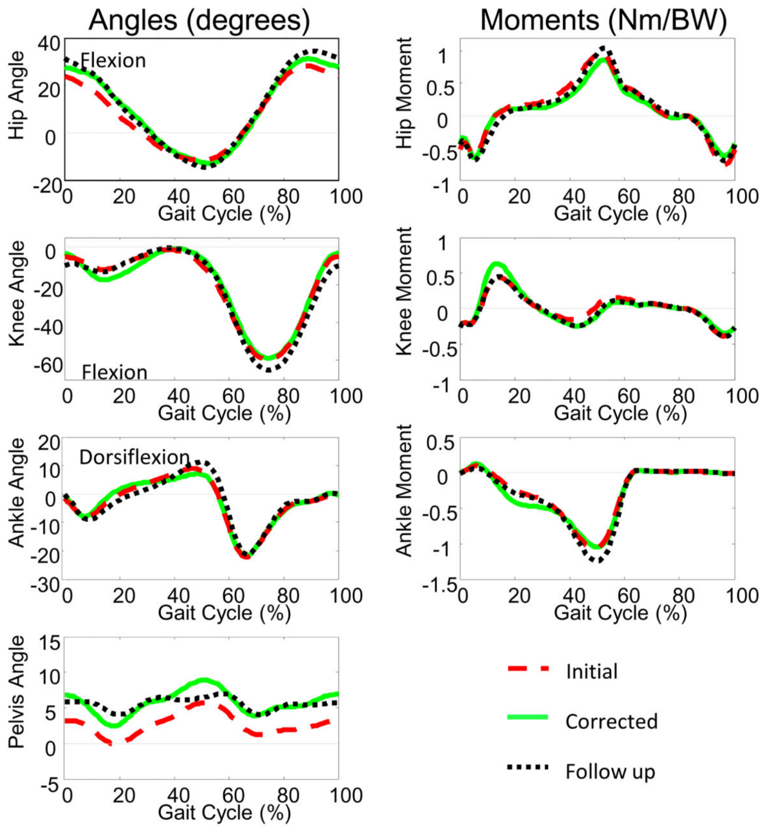

Figure 5.
Kinematic and kinetic data during walking at 1.52 m/s for the initial preferred trial (red dash line), initial corrected trial (green solid line), and follow up visit (black dotted line).

TABLE 1

Self-reported pain, function and activity level questionnaires.

Outcome	Initial	1 year
HOOS		
Symptoms	80	80
Pain	65	55[a]
ADL	87	96[b]
Sports & Rec	69	81[b]
Quality of Life	56	63[b]
MHHS	76	84[b]
UCLA Activity	6	9

[a] Poorer rating primarily due to activity-related pain

[b] Indicates an improvement at or above the level for minimal important change (Kemp et al., 2013).

TABLE 2

Passive range of motion goniometric measurements on initial evaluation (degrees).

	Left	Right
Sitting:		
Hip internal rotation:	0–35	0–45
Hip external rotation:	0–30	0–25
Supine:		
Hip internal rotation:	0–35	0–40
Hip external rotation:	0–30	0–20
Hip flexion:	0–120	0–120
Hip abduction:	0–45	0–40
Hip adduction:	0–20	0–18
Prone:		
Hip extension:	0–20	0–20