L5-S1 Discoligamentous Distraction Injury following Bilateral Total Hip Arthroplasty Using an Anterior Approach: A Case Report

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Keywords
Discoligamentous injury · Spinal injury · Bilateral total hip arthroplasty · Anterior approach · Complication

Abstract
Although acute spinal injury is rarely reported to complicate total hip arthroplasty (THA), its consequences can be devastating. We present a case of L5-S1 discoligamentous dissociation following single-stage bilateral THA performed sequentially through an anterior approach with a traction hemi-table applied on the operated leg. Internal fixation L5-S1 was required, resulting in prolonged recovery, but without relevant long-term sequelae. Pre-operative assessment of the spine is recommended when considering these procedures to evaluate the risk for this potentially severe complication. Particularly, lateral position may be favoured to avoid extension stresses of the spine. An anterior approach may have to be avoided, as it requires hyperextending the hip. A staged procedure may also be preferred to a single-anaesthesia bilateral procedure, limiting duration of potentially harmful positioning.
Introduction

Primary osteoarthritis is the most common disorder associated with severe hip pain and disability in the elderly. Following total hip arthroplasty (THA), approximately 22% of patients with initially bilateral disease require later arthroplasty of the contralateral hip [1]. Single-stage bilateral THA may be preferred over staged surgery to shorten overall rehabilitation time [2–6].

Acute spinal injury following THA is a rarely reported, but well-recognized complication in patients with ankylosing spondylitis (AS) and diffuse idiopathic skeletal hyperostosis (DISH) [7–10]. In the following report, we present a lumbosacral discoligamentous distraction injury following bilateral single-stage THA. The supine position on a traction table as well as the overall operation time of the sequentially performed bilateral procedure likely played a contributing role. To our knowledge, there are no reported cases of spinal injury resulting from a bilateral single-stage THA. Even if such a complication is rare, the potential severity of this complication warrants a careful risk analysis when planning bilateral THA.

Case History

An 88-year-old female patient, who was still living independently despite severely impaired mobility due to bilateral ankylosing osteoarthritis of the hip causing flexion contractures of 40–50° on both sides, as well as bilateral osteoarthritis of the knee with valgus instability and extension deficit. The patient had also recently undergone breast cancer surgery, but long-term survival was expected, with an adjuvant therapy being discussed despite the age. In view of her advanced age, rehabilitation restrictions secondary to bilateral hip and knee flexion contractures, leg-lengthening requirement due to coxa vara (Fig. 1), and timing of her adjuvant chemotherapy, a single-stage bilateral THA was performed via a direct anterior approach. Furthermore, hybrid fixation was chosen due to poor bone quality and the patient’s inability to partially weight-bear. The operation was performed under general anaesthesia and carried out sequentially one side at a time. The patient was positioned supine with the operated leg placed on a mobile traction hemi-table to enable leg rotation and hip hyperextension (Fig. 2). No closed attempt to stretch the hips was performed. Traction was exerted

Fig. 1. Anteroposterior pelvic radiographies pre- (a) and post-operatively after bilateral THA having been performed (b). Clearly visible is a post-operative extension position of the pelvis, with reduced craniocaudal diameter of the obturator foramina, despite release of the anterior soft tissues at the level of the hip joints.
only following osteotomy of the femoral neck. The contralateral leg was cushioned in order to
maintain flexion in the hip and to avoid malpositioning of the pelvis in extension. Surgery
lasted 90 min on the first and 78 min on the second side, with a 28 min delay in between for
re-positioning and re-draping. Post-operatively, the bilateral hip pain resolved rapidly.

However, the patient reported new debilitating lower back pain from post-operative
day two on. CT and MR imaging of the lumbar spine showed an acute L5-S1 discoligamentous

Fig. 2. Illustration of the setup for the operation, with the patient in supine position, with the leg to be oper-
ated on fixated on a mobile traction hemi-table (Mobile Leg Holder, Medacta, Castel San Pietro, Switzerland)
(a, b). The table allows for stable positioning of the leg including traction, rotation, abduction/adduc-
tion, and hyperextension of the hip (c). The system releases traction automatically when hyperextension
is performed, in order to reduce the risk for traction injuries. Illustrations from the instructions for use
from the manufacturer.
distraction injury, with rupture of the intervertebral disc and interspinous ligaments (Fig. 3a-d). The facet joints were not dislocated, but degenerative neuroforaminal stenosis was present bilaterally in contact with the L5 roots (Fig. 3a, b). A dorsal spondylodesis L5-S1 was performed, with only partial reduction being performed intentionally (Fig. 3e, f). Although reduced mobility delayed rehabilitation, the patient’s back pain resolved and the rest of the hospital stay remained uneventful.

At the 8-week follow-up appointment, a secondary displacement of the spondylodesis with implant loosening was noted, whereby the L5 vertebra had spontaneously migrated to an anatomic position in relation to S1 (Fig. 3g, h). The patient, however, remained asymptomatic.
from her lower back, thus no revision was performed despite obvious instability of the affected segment. After approximately 6 months in a nursing home, the patient was able to return home. At the 1-year follow-up, she still required walking aids in the form of crutches or a walking frame but had recovered enough mobility so that nursing support at home was reduced from once a day to three times a week. Despite relatively good function of both hips, a distinct malposition of the spinal column remained (Fig. 3i, j). This is most likely due to the degenerative kyphoscoliosis as well as the persisting flexion contracture of the lower extremities. The initially discussed adjuvant therapy of the breast cancer as well as secondary arthroplasty of the knees had been refused categorically after the complication incurred after THA. However, no recurrence of breast cancer was observed so far.
Discussion

THA is considered to be one of the safest and most effective surgical procedures, with patients reporting high satisfaction and improved activities of daily living [11–13]. Although single-stage bilateral THAs have been associated with a higher risk of cardiopulmonary complications as well as thromboembolic events [14–16], several studies have demonstrated the benefits of this procedure, including shorter hospital length of stay, shortened overall rehabilitation, and improved cost-effectiveness, when compared to sequential, two-stage THA, without increased global complication rates [3–6].

Acute spinal injury following THA is a rare, but well-recognized complication. To date, only a few cases of vertebral fractures following unilateral THA have been reported in patients with AS or suffering from DISH [7–10, 17]. In these cases, spinal injuries developed following use of the posterior, the lateral as well as the anterior approach for THA [8–10, 17]. Interestingly, the majority of these patients were operated on in the supine position, suggesting that perhaps patient positioning, rather than the approach itself, is a risk factor. In one case report, a patient with severe kyphotic lumbar deformity sustained a left trochanteric fracture of the femur and was placed in a supine position using a traction table during the operation and suffered a vertebral fracture L4 [18]. Seven months earlier, the same patient had sustained a subtrochanteric fracture of the contralateral femur, which had been treated successfully with the patient in the lateral, rather than supine, position. It was believed that while in a supine position under general anaesthesia, the contact of the patient’s lower back with the operating table likely created a fulcrum at her lumbosacral spine, bearing the mass of her upper body. There is a consensus among the authors of these reports that patients with an ankylosed spine should be operated on in a lateral position in order to avoid excessive strain which could lead to spinal injury [7, 10, 18]. Caution should still be taken in the lateral position as two cases operated in this position developed high paraplegia consecutive to thoracic vertebral fractures [7].

In addition, limb manipulation during THA may create enough stress to cause fractures in predisposed patients with osteoporosis and hip flexion contractures, as was the case with our patient. Limb hyperextension is required with the direct anterior approach in order to allow safe and adequate exposure during femoral preparation [19]. This hyperextension, especially in the supine position and with a traction table, likely exacerbates the pre-existing forces due to the bilateral hip flexion contractures and may produce tremendous loads on the spine. Suspension of the leg in a boot without thigh or leg support may also place shear or tensile forces on the spine, increasing the fracture risk [20]. This may lead to fractures in case of osteoporosis, or to discoligamentous injuries, as reported here. The traction table used in our case, however, releases traction once in hyperextension, a mechanism designed to reduce the risk of such injuries (Fig. 2). However, single-stage sequential THA required approximately 4 h of anaesthesia time in the supine position, which likely contributed to the development of the spinal injury, despite cushioning of the contralateral leg to compensate for the flexion contracture.

Considering the gravity of such a complication and lack of definitive criteria currently available to fully assess for any potential risks, the authors propose a careful review of patient and technical factors at critical stages of the patient’s surgical journey. This begins with a pre-operative assessment, including a comorbidity index tool for risk stratification, when considering a single-stage bilateral THA for patients. In a recent national study, the Charlson Comorbidity Index was used to identify “at-risk” groups for patients undergoing simultaneous bilateral THA [16]. It was found that patients younger than 60 years or with a score of 0 on the Charlson Comorbidity Index have comparable complication rates with that of two-stage procedures. The greater risk noted in simultaneous procedures, including cardiopulmonary...
complications, becomes apparent with increasing age and comorbidity. This may be counter-intuitive, as the benefit of a shortened, combined rehabilitation might have been expected to be particularly interesting in invalidated elderly patients. In addition, a thorough pre-operative radiological assessment of the hips and spine is highly recommended, especially for patients with AS or DISH, before proceeding to THA. In our case, radiological evaluation of the spine had not been performed, and imaging would have been limited as she was unable to stand due to severe degenerative disease of both hips and both knees.

Intraoperatively, we would recommend that the patient is in a lateral decubitus rather than supine position, or that no traction table is used if the anterior approach is chosen. Maintaining flexion of the upper body may be as important to avoid extension injuries on the lumbar spine. In cases of severe kyphosis, such as with our patient, a two-stage rather than one-stage bilateral THA with a short time interval between the two procedures could have been an alternative option. Post-operatively, any patient with spinal deformity, hip flexion contractures, or osteoporosis who presents with worsening back pain or new neurologic deficits on the lower extremities should receive a full neurological and radiologic evaluation of the spine. Not only should discoligamentous injuries or vertebral body fractures be ruled out but also a deterioration of pre-existing stenosis of the spinal canal should also be considered following THA.

If despite all relevant precautions and screening measures, a spinal injury is still incurred, a spondylodesis of the affected segment may be necessary. A minimal procedure with partial reduction of L5 to S1 had been chosen for this patient to avoid requirements for resection of the facet joints, as nerve root compression was expected in case of reduction without decompression, considering the severe degenerative foraminal stenosis present at the affected segment. Furthermore, resection of the facet joints would have increased instability and requirements for an extension of the fixation one level above as well as to the ilium. The chosen option may be criticized, but the technical aspects of spinal fixation are beyond the scope of this report. Despite secondary dislocation, the spinal injury healed without further complications.

**Summary**

Injury of the spine is a rare but potentially devastating complication of THA, especially in individuals with severe degenerative ankyloses of the spine. Among the potential risk factors described, the total operation time of a single-anaesthesia bilateral procedure using the anterior approach likely played a significant role in this case. Identifying patients at risk using an index tool and adapting surgical techniques to a staged procedure with the patient in the lateral position may offer a safer alternative and minimize this debilitating complication.

**Statement of Ethics**

Written informed consent was obtained from the patient for publication of the details of the medical case and any accompanying images. As a quality control study, no formal approval from an ethics committee is required in accordance with Swiss national law.

**Conflict of Interest Statement**

The authors have no conflicts of interest to declare.
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Author Contributions

Ferda Gronki: investigation, writing – original draft, and visualization; Alex Alfieri: validation, resources, and writing – review and editing; Fabian Kalberer: conceptualization, validation, and writing – review and editing; Christoph Meier: validation, resources, writing – review and editing, and supervision; Peter Wahl: conceptualization, validation, investigation, resources, writing – original draft, visualization, supervision, and project administration.

Data Availability Statement

All data supporting the findings of this study are included in this article. Original data are available upon request.

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