■ HIP

Lumbar fusion involving the sacrum increases dislocation risk in primary total hip arthroplasty

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Aims

Concurrent hip and spine pathologies can alter the biomechanics of spinopelvic mobility in primary total hip arthroplasty (THA). This study examines how differences in pelvic orientation of patients with spine fusions can increase the risk of dislocation risk after THA.

Patients and Methods

We identified 84 patients (97 THAs) between 1998 and 2015 who had undergone spinal fusion prior to primary THA. Patients were stratified into three groups depending on the length of lumbar fusion and whether or not the sacrum was involved. Mean age was 71 years (40 to 87) and 54 patients (56%) were female. The mean body mass index (BMI) was 30 kg/m^2 (19 to 45). Mean follow-up was six years (2 to 17). Patients were 1:2 matched to patients with primary THAs without spine fusion. Hazard ratios (HR) were calculated.

Results

Dislocation in the fusion group was 5.2% at one year *versus* 1.7% in controls but this did not reach statistical significance (HR 1.9; p = 0.33). Compared with controls, there was no significant difference in rate of dislocation in patients without a sacral fusion. When the sacrum was involved, the rate of dislocation was significantly higher than in controls (HR 4.5; p = 0.03), with a trend to more dislocations in longer lumbosacral fusions. Patient demographics and surgical characteristics of THA (i.e. surgical approach and femoral head diameter) did not significantly impact risk of dislocation (p > 0.05). Significant radiological differences were measured in mean anterior pelvic tilt between the one-level lumbar fusion group (22°), the multiple-level fusion group (27°), and the sacral fusion group (32°; p < 0.01). Ten-year survival was 93% in the fusion group and 95% in controls (HR 1.2; p = 0.8).

Conclusion

Lumbosacral spinal fusions prior to THA increase the risk of dislocation within the first six months. Fusions involving the sacrum with multiple levels of lumbar involvement notably increased the risk of postoperative dislocation compared with a control group and other lumbar fusions. Surgeons should take care with component positioning and may consider higher stability implants in this high-risk cohort.

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Patients with concomitant degenerative pathology of the hip and lumbosacral spine represent a challenge to orthopaedic surgeons.[1-4] When the lumbosacral spine is stiff, secondary either to degenerative change or to fusion surgery, this leads to distortion of spinopelvic biomechanics and subsequently an increase in the risk of dislocation following total hip arthroplasty (THA). This is for two principal reasons: first, the abnormal position of the pelvis leads to functional malposition of the acetabular component in THA, even if the component is positioned correctly within the pelvis (Fig. 1); second, the degree of lumbar spine lordosis cannot change to allow the pelvis to tilt so that the range of movement demanded from the replaced hip is greater than that required in a normal THA.[5,6] Several studies have recognized the relationship between lumbar spine deformity and functional pelvic orientation in THA,[7-9] yet limited comparative data exist on the specific impact of sacral fusions and the extent to which increased lumbar level involvement has on the risk of dislocation in primary THAs.

Recommendations for implant positioning in primary THA have long been debated.[10,11] The 'safe zone' first described by Lewinnek et al[10]

Fig. 1

Anteroposterior (AP) radiograph of a 66-year-old female patient with an extensive fusion involving the sacrum and bilateral total hip arthroplasties demonstrating the complex cohort of patients requiring specific surgical attention and consideration for dislocation risk.

established recommended acetabular inclination and anteversion (AV), but has been challenged by several authors, indicating that even within the proposed zone dislocations occur.[12-14] Furthermore, recognizing spinopelvic interactions is important for patient-specific orientation of the acetabular component.

As such, the purpose of this study was to determine the impact of prior vertebral fusion level involvement on the dislocation risk in patients undergoing primary THA, with emphasis on specific risk factors for dislocation, survivorship, functional outcomes, and complications.

Patients and Methods

Between 1998 and 2015, 16 453 primary THAs were performed at our institution. There were 206 patients identified before exclusions. All patients undergoing a primary cementless or hybrid THA for osteoarthritis were eligible for inclusion in the study; patients undergoing hemiarthroplasty, hip resurfacing arthroplasty, dual mobility, or constrained THA were excluded, as were those who had an isolated cervical or thoracic spinal fusion. A total of 97 cases (84 patients) were identified as undergoing THA in patients who had undergone a previous spinal fusion, 56 (58%) of which were instrumented fusions. Following institutional review board approval, all 97 cases underwent a retrospective review of medical notes and radiological investigations.

The mean age of patients at the time of THA was 71 years (40 to 87), and 54 patients (56%) were female. The mean body mass index (BMI) was 30 kg/m^2 (19 to 45). Of the 84 patients, 13 underwent bilateral surgery either simultaneous (five) or staged with a mean time between sides being three years (0 to 9). Spinal fusion was performed at a mean of five years (three months to 19 years) prior to the THA. One patient died before her two-year follow-up visit, and four patients (5%) were lost to follow-up. The remaining 79 patients had a mean follow-up of six years (2 to 17).

We performed 1:2 matching of the 97 prior fusion cases to 194 control patients who underwent primary THA and had no history of spine fusion. Matching criteria were based on mean age (± 5 years), gender, BMI (± 5 kg/m^2), year of THA, surgical approach, and femoral head size (Table I).

Patients in the fusion group were stratified into three groups according to levels of vertebral involvement: patients in the first group had undergone a single level fusion of the lumbar spine (43/97, 44%); those in the second group had two or more fused levels of the lumbar spine (21/97, 22%); and the third group contained patients with any fusion including the sacrum (33/97, 34%; Fig. 2). The third group was further subdivided into patients with only an L5/S1 fusion (12/33, 35%) or those with multiple lumbar levels with a sacral fusion (21/33, 64%). A range of demographic and surgical factors were recorded and analyzed for statistical significance (Table II, Table III). Primary outcome was occurrence of dislocation. Functional outcome was assessed using the Harris Hip score (HHS).[15]

Total hip arthroplasty. Surgical approach was at the discretion of the operating surgeon. Of the 97 primary THAs completed in patients with prior spine fusion, 49 (51%) had an anterolateral approach, 39 (40%) had a posterolateral approach, and nine (9%) had a direct anterior approach. Of 194 control cases (194 hips), the surgical approach was anterolateral for 98 (51%), posterolateral for 78 (40%), and direct anterior for 18 (9%).

Radiological measurements. We analyzed component positioning on postoperative standing anteroposterior (AP) radiographs performed at the three-month follow-up visit. Inclination was defined as the angle formed between the larger diameter of the component and the inter-teardrop line. Anteversion was calculated using the formula $AV = \sin^{-1}(A/B)$, with A being the short diameter and B being the long diameter of the component (Fig. 3a).[12]

We analyzed sacral tilt and pelvic incidence on standing lateral spinopelvic radiographs performed at the most recent follow-up. Sacral tilt was defined as the angle formed between the sacral slope and a horizontal reference line.[6] Pelvic incidence was defined as the angle centred at the mid-sacral base, perpendicular to the sacral base and centre of the femoral heads (Fig. 3b).[5,6] Pelvic tilt was calculated by the equation PT = PI - ST, as previously defined.[5] Overall, 65/97 (67%) fusion cases had films available for sacral tilt and pelvic incidence measurements.

Table I. All patient demographics and operative factors

Variable	Spine fusion + THA (n = 97)	THA (n = 194)	Total (n = 291)	p-value
Mean age, yrs (SD; range)	71 (9; 40 to 87)	71 (9; 39 to 89)	71 (9; 39 to 89)	N/A*
Gender, n (%)				N/A*
Female	54 (*56*)	108 (*56*)	162 (*56*)	
Male	43 (*44*)	86 (*44*)	129 (*44*)	
Mean BMI, kg/m^2 (SD; range)	30 (6; 19 to 45)	30 (5; 20 to 46)	30 (6; 19 to 46)	N/A*
THA approach, n (%)				N/A*
Anterolateral	49 (*51*)	98 (*51*)	147 (*51*)	
Posterolateral	39 (*40*)	78 (*40*)	117 (*40*)	
Direct anterior	9 (*9*)	18 (*9*)	27 (*9*)	
Femoral head diameter, n (%)				N/A*
28 mm	31 (*32*)	62 (*32*)	93 (*32*)	
32 mm	33 (*34*)	66 (*34*)	99 (*34*)	
36 mm	28 (*29*)	56 (*29*)	84 (*29*)	
40 mm	3 (*3*)	6 (*3*)	9 (*3*)	
44 mm	2 (*2*)	4 (*2*)	6 (*2*)	
Mean inclination, ° (SD; range)	45 (6; 26 to 62)	43 (6; 24 to 60)	44 (6; 24 to 62)	0.009†
Mean anteversion, ° (SD; range)	20 (9; 1 to 46)	18 (8; -15 to 45)	19 (9; -15 to 46)	0.02†
Mean duration of surgery, mins (SD; range)	131 (62; 44 to 315)	124 (55; 39 to 285)	126 (57; 39 to 315)	0.31†

*No statistical tests were conducted for these variables since the groups were matched on them
†Student's *t*-test
THA, total hip arthroplasty; BMI, body mass index; N/A, not applicable

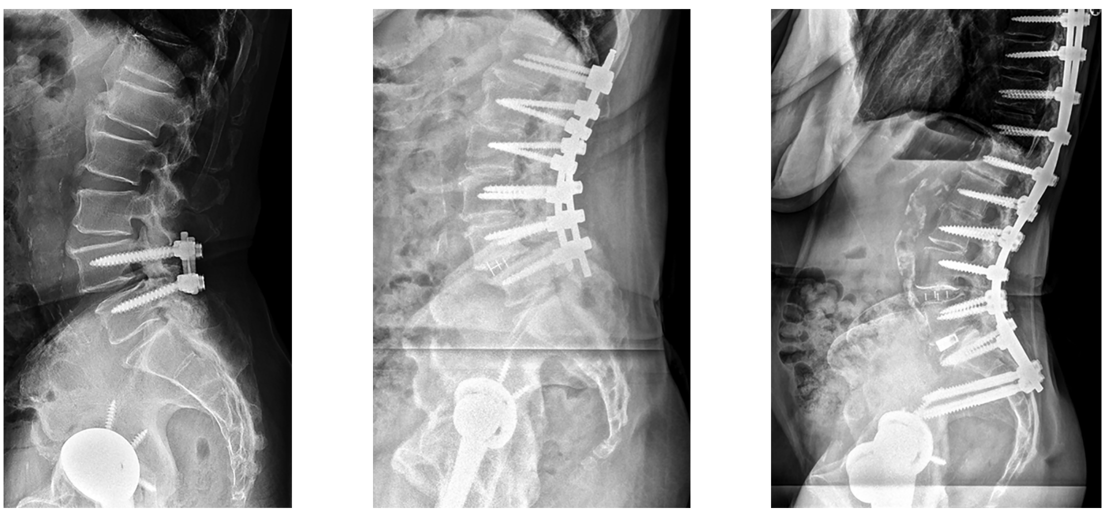


Fig. 2a Fig. 2b Fig. 2c

Lateral radiographs of total hip arthroplasty patients with: a) a one-level of spine fusion; b) a spine fusion of more than two levels; and c) a spine fusion involving the sacrum.

The mean component inclination in patients with previous spinal fusion was 45° (26° to 62°), compared with 43° (24° to 60°; p = 0.009, Student's *t*-test) in control patients. The mean component anteversion in patients with prior spinal fusion was 20° (1° to 46°), which was higher than in controls (mean 18° (-15° to 45°); p = 0.02, Student's *t*-test) but not considered clinically relevant. In patients with prior spine fusion, 47% of spinal fusion patients (46/97) were within the Lewinnek safe zone[10] *versus* 66% of controls (128/194) (p = 0.002, chi-squared test; Fig. 4). Of the spinal fusion patients outside the Lewinnek safe zone, 17 cases had greater than 50° of component inclination, with two cases greater than 60° of inclination; 27 cases had greater than 25° of component anteversion, with two cases demonstrating greater than 35° of anteversion. In the spinal fusion patients with radiographs available, mean sacral tilt was 35° (8° to 72°), mean pelvic incidence was 63° (31° to 102°), and mean anterior pelvic tilt was 27° (8° to 49°).

Statistical analysis. Descriptive statistics were reported as mean (range) or number (percentage) as appropriate. Demographic and surgical factors were compared between prior fusion patients and controls using Student's *t*-tests or Mann–Whitney U test for continuous variables, and chi-squared or Fisher's exact tests for categorical variables. Implant survival was described using the Kaplan–Meier method[16] and causative factors leading to dislocation, reoperation, and revision were assessed using Cox regression. Risk factors examined using a

Table II. Spine fusion type subgroup analysis

Variable	1 fused vertebral level* (n = 43)	2+ vertebral levels* (n = 21)	Fusion involving sacrum (n = 33)	p-value
Mean age, yrs (SD; range)	72 (8; 54 to 84)	71 (8; 55 to 85)	69 (11; 40 to 87)	0.23†
Gender, n (%)				0.25‡
Female	28 (*65*)	10 (*48*)	16 (*49*)	
Male	15 (*35*)	11 (*52*)	17 (*51*)	
Mean BMI, kg/m^2 (SD; range)	29 (5; 21 to 45)	30 (6; 24 to 42)	30 (7; 19 to 42)	0.92†
THA approach, n (%)				0.08§
Anterolateral	27 (*63*)	7 (*33*)	15 (*46*)	
Posterolateral	12 (*28*)	13 (*62*)	14 (*42*)	
Direct anterior	4 (*9*)	1 (*5*)	4 (*12*)	
Femoral head size, n (%)				0.06§
28 mm	13 (*30*)	8 (*38*)	10 (*30*)	
32 mm	20 (*47*)	5 (*24*)	8 (*24*)	
36 mm	8 (*19*)	8 (*38*)	12 (*36*)	
40 mm	0 (*0*)	0 (*0*)	3 (*10*)	
44 mm	2 (*4*)	0 (*0*)	0 (*0*)	
Mean inclination, ° (SD; range)	45 (6; 26 to 61)	45 (6; 36 to 60)	44 (7; 33 to 62)	0.73†
Mean anteversion, ° (SD; range)	19 (9; 1 to 37)	24 (10; 6 to 46)	19 (7; 2 to 31)	0.09†
Sacral tilt				0.28†
n	25	15	25	
Mean, ° (SD; range)	35 (13; 8 to 69)	31 (6; 23 to 42)	37 (12; 15 to 72)	
Pelvic tilt				< 0.01†
n	25	15	25	
Mean, ° (SD; range)	22 (7; 8 to 37)	27 (11; 6 to 49)	32 (10; 15 to 44)	
Pelvic incidence				0.02†
n	25	15	25	
Mean, ° (SD; range)	57 (16; 31 to 100)	59 (13; 34 to 91)	69 (17; 38 to 102)	
Mean time between fusion and THA, yrs (SD; range)	6 (5; 0.3 to 18)	4 (5; 0.3 to 16)	6 (5; 0.4 to 19)	0.50†

*Exclusive of sacrum
†Analysis of variance (ANOVA)
‡Chi-squared test
§Fisher's exact test
BMI, body mass index; THA, total hip arthroplasty

univariate Cox model included the extent of spinal fusion by group, age, gender, BMI, surgical approach, and surgical factors including femoral head size and component inclination and anteversion. All statistical tests were two-sided, and $p < 0.05$ was considered to be statistically significant. The analysis was performed using SAS version 9.4 (SAS Institute Inc., Cary, North Carolina) and R version 3.2.0 (R Core Team, R Foundation for Statistical Computing, Vienna, Austria).

Results

Dislocation rate and risk factors. There were five dislocations (5/97) in the spinal fusion group, all of which occurred within six months of THA (four days to five months). This represented a rate of dislocation at between one and ten years of 5.2% (95% confidence interval (CI) 0.7 to 9.5). In four patients, the dislocation was an isolated event treated by closed reduction; one patient had recurrent instability (three events over six years). In the control group, the rate of dislocation was 1.7% (two dislocations) (95% CI 0 to 3.5) at one year, rising to 2.6% at five years (three dislocations) (95% CI 0 to 5.2), and 4.3% at ten years (four dislocations) (95% CI 0.1 to 8.3; Fig. 5).

Overall, the risk of dislocation was higher in patients who had previously undergone spinal fusion, although this difference did not reach statistical significance (hazard ratio (HR) 1.9, 95% CI 0.5 to 6.4; p = 0.33; Table IV). Patients with a fusion including the sacrum had a statistically significantly higher rate of dislocation than matched controls (HR 4.5, 95% CI 1.1 to 17.5; p = 0.03), while those with fusions restricted to the lumbar spine had a rate of dislocation similar to that of control patients (single level fusion HR 1.2, 95% CI 0.2 to 8.3; p = 0.89; multiple level fusion HR 0.8, 95% CI 0.03 to 18.7; p = 0.88). Subgroup analysis of the sacral fusion group demonstrated a higher rate of dislocation in those with a longer fusion segment; however, this did not reach statistical significance (Table IV).

Four dislocated hips in the prior spine fusion group underwent THA via a posterolateral approach and had dislocated posteriorly, while one dislocated hip in the prior fusion group underwent an anterolateral approach and had dislocated anteriorly. In these five dislocated patients, the mean inclination was 44° (35° to 51°), mean anteversion was 16° (7° to 20°), mean sacral tilt was 43° (39° to 47°), mean pelvic incidence was 83° (78° to 88°), and mean pelvic tilt was 39° (37° to 44°).

Implant survival free of revision and reoperation. At ten years, survival free of revision for any cause was 93% (95% CI 86 to 100) in the fusion group and 95% (95% CI 90 to 99) in controls (Fig. 6). The risk of revision was not significantly

Table III. Sacral fusion subgroup analysis

Variable	Sacral fusion ≥ 2 levels* (n = 21)	Sacral fusion L5-S1 (n = 12)	THA only (n = 194)	p-value
Mean age, yrs (SD; range)	67 (11; 40 to 87)	72 (9; 58 to 86)	71 (9; 39 to 89)	0.12†
Gender, n (%)				0.74‡
Female	10 (*48*)	6 (5*0*)	108 (*56*)	
Male	11 (*52*)	6 (*50*)	86 (*44*)	
Mean BMI, kg/m² (SD; range)	29 (7; 19 to 42)	31 (7; 21 to 42)	30 (5; 20 to 46)	0.65†
THA approach, n (%)				0.58§
Anterolateral	8 (*38*)	7 (*58*)	98 (*51*)	
Posterolateral	11 (*52*)	3 (*25*)	78 (*40*)	
Direct anterior	2 (*10*)	2 (*17*)	18 (*9*)	
Femoral head size, n (%)				0.76§
28 mm	7 (*33*)	3 (*25*)	62 (*32*)	
32 mm	5 (*24*)	3 (*25*)	66 (*34*)	
36 mm	7 (*33*)	5 (*42*)	56 (*29*)	
40 mm	2 (*10*)	1 (*8*)	6 (*3*)	
44 mm	0 (*0*)	0 (*0*)	4 (*2*)	
Mean inclination, ° (SD; range)	43 (7; 33 to 62)	46 (17; 36 to 58)	43 (6; 24 to 60)	0.35†
Mean anteversion, ° (SD; range)	21 (7; 3 to 31)	15 (7; 2 to 25)	18 (8; -15 to 45)	0.06†
Sacral tilt				0.48†
n	15	10		
Mean, ° (SD; range)	36 (11; 15 to 59)	40 (15; 23 to 72)		
Pelvic tilt				0.05†
n	15	10		
Mean, ° (SD; range)	35 (10; 17 to 44)	27 (8; 15 to 37)		
Pelvic incidence				0.59†
n	15	10		
Mean, ° (SD; range)	71 (18; 38 to 102)	67 (16; 41 to 90)		

*Excluding L5-S1
†Analysis of variance (ANOVA)
‡Chi-squared test
§Fisher's exact test
BMI, body mass index; THA, total hip arthroplasty

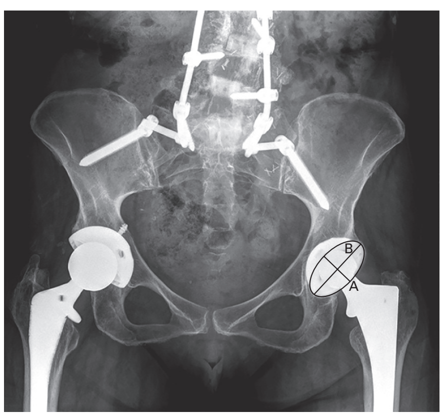


Fig. 3a

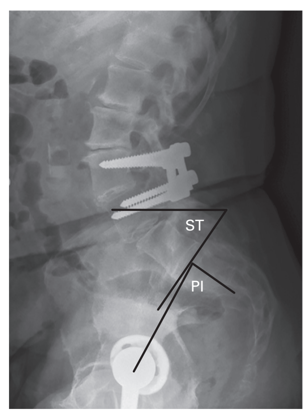


Fig. 3b

a) Radiological method of measuring acetabular component anteversion ($AV = \sin^{-1}(A/B)$) on an anteroposterior radiograph, with A being the short diameter and B being the long diameter of the component. b) Radiological method of measuring sacral tilt (ST), defined as the angle formed between the sacral slope and a horizontal reference line;[6] and pelvic incidence (PI), defined as the angle centred at the mid-sacral base, perpendicular to the sacral base and centre of the femoral heads.[5,6]

different between groups (fusion *vs* control: HR 1.2, 95% CI 0.3 to 4.1; p = 0.82). Causes of revision in the prior spine fusion group were infection in two cases, periprosthetic femoral fracture in one case, and aseptic loosening of the femoral component in one case. In controls, causes of revision were due to dislocation in three patients (one immediately postoperatively, one acute dislocation, and one for recurrent dislocations), trunnionosis in one case, and aseptic loosening of the femoral component in one case.

Taking all cause reoperation as the endpoint, ten-year survival was 90% (95% CI 82 to 99) in the fusion group, compared with 95% (95% CI 90 to 99) in controls (Fig. 7). Again, there

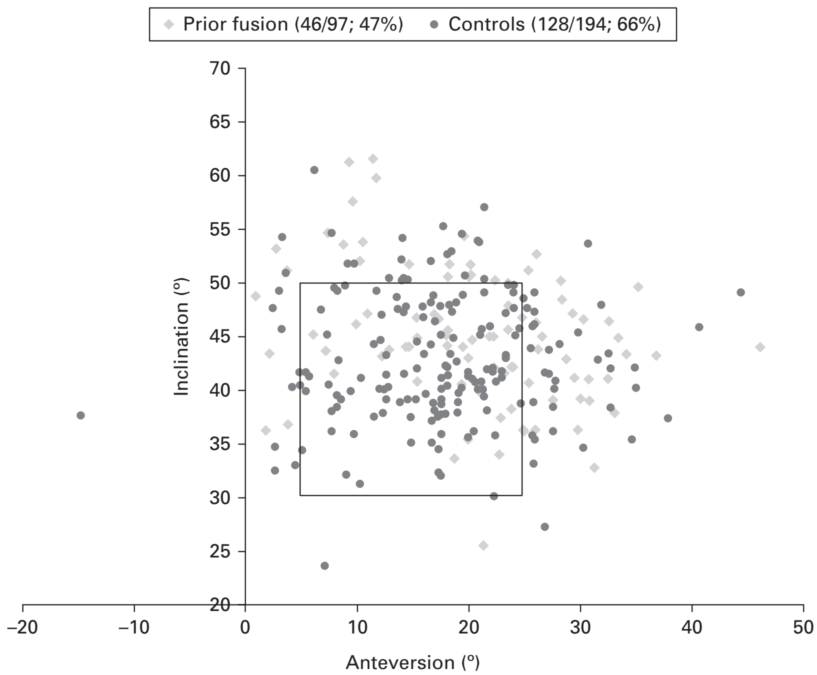
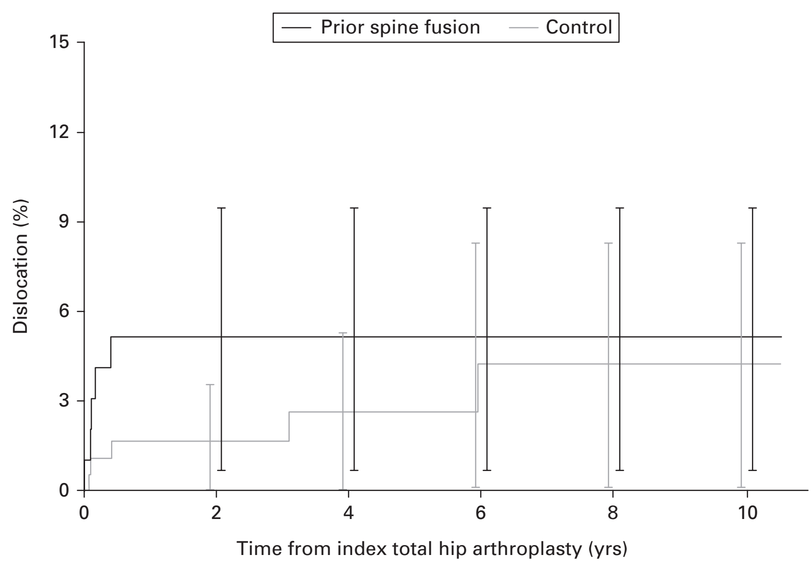


Fig. 4

Depiction of total hip arthroplasties within Lewinnek's safe zone (square).



Number at risk						
Prior spine fusion	97	81	55	38	30	20
Control	194	145	90	59	45	39

Fig. 5

Kaplan–Meier survivorship curve of time to first dislocation in patients with a prior spine fusion group *versus* the control group.

was no statistically significant difference between groups (HR 2.4, 95% CI 0.8 to 6.7; p = 0.1).

Clinical outcomes. The mean HHS at most recent follow-up was 81 (28 to 100) in the fusion group and 84 (41 to 100) in controls (p = 0.03); the preoperative mean HHS was 50 in each group. Following deaths and losses to follow-up, there was a small difference in degree of improvement favouring the control group (27 points in the fusion group and 35 in the control group) but this did not reach statistical significance (p = 0.07, Student's *t*-test).

Table IV. Dislocation risk

Variable	n	Hazard ratio (95% CI)	p-value
Fusion			
Yes	97	1.9 (0.5 to 6.4)	0.33
No	194	1	
Fusion subgroups			
One fused vertebral level*	43	1.2 (0.2 to 8.3)	0.89
2+ vertebral levels*	21	0.8 (0.03 to 19.9)	0.88
Fusion involving sacrum	33	4.5 (1.2 to 17.5)	0.03
No fusion	194	1	
Sacral fusion subgroups			
Fusion involving sacrum (L5-S1 only)	12	4.5 (0.6 to 34.1)	0.14
Fusion involving sacrum (≥ 2 levels)†	21	5.1 (1.1 to 23.1)	0.03

*Exclusive of the sacrum
†Exclusive of L5-S1
CI, confidence interval

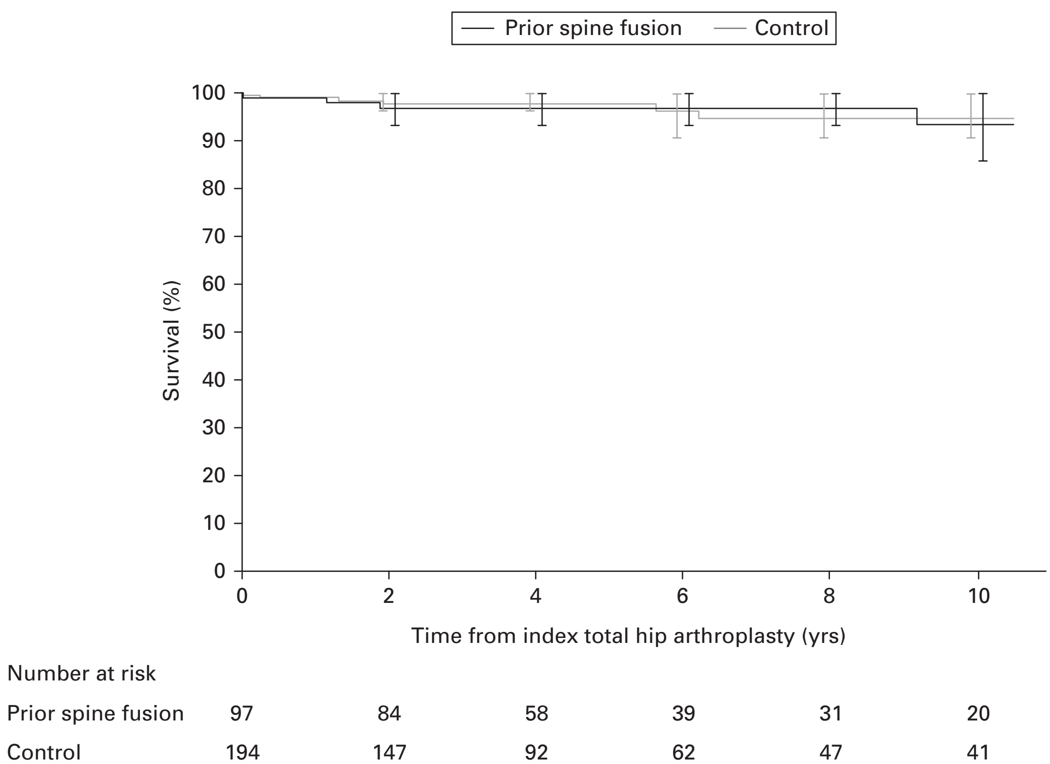


Fig. 6

Kaplan–Meier survival free of any revision in the prior spine fusion group *versus* the control group.

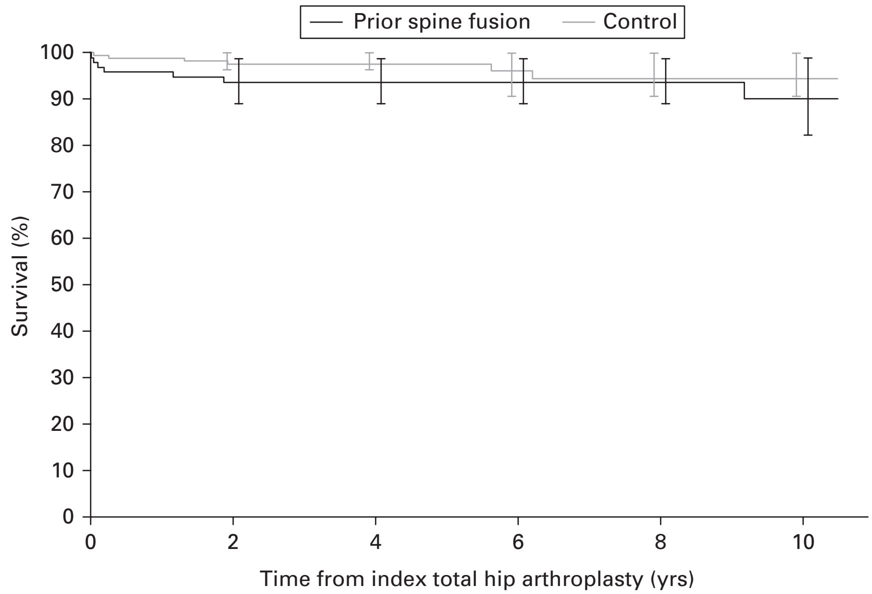
Other complications. In the one-level spine fusion group there were two cases (two hips) of superficial wound dehiscence (5%), one case of heterotopic ossification (2%), and one case of deep venous thrombosis (2%). In the two-or-more-level fusion group, there was one case of superficial wound dehiscence (5%). In the sacral fusion group, there were two cases (two hips) of heterotopic ossification (6%).

Discussion

Dislocation following primary THA remains a concern despite decades of investigating improvements in implant design and surgical technique.[17-23] The results of this study demonstrate that previous spinal fusion involving the sacrum, especially sacral fusions involving two or more lumbar levels, significantly increases the risk for dislocation after primary THA compared with control patients.

Berry et al[24] reported a cumulative dislocation rate after primary THA in 6623 patients (1.9%) at one year, steadily increasing to 7% at 25 years. Our one-year rate of dislocation (5.2%) in patients who have undergone spinal fusion suggests that the burden of this complication in this group of patients is substantial.

Other studies have also identified spinal fusion to be a significant risk factor for dislocation after primary THA.[25-28] Buckland



Number at risk

Prior spine fusion	97	81	57	38	30	19
Control	194	146	91	61	46	40

Fig. 7

Kaplan–Meier survivorship free of any reoperation in the prior spine fusion group *versus* the control group.

et al[25] studied a similar patient cohort of 14 747 patients using the Medicare database and found that patients with three to seven levels of lumbar fusion had a 4.1% dislocation rate, and those with one to two levels of fusion had a 2.9% dislocation rate, compared with 1.5% at one year for controls. However, sacral involvement was not explicitly identified, and no radiological analysis was performed in that study. Lazennec et al[28] studied the impact of spinal fusion on component orientation and reported no dislocations in a cohort of 93 patients with various levels of spinal fusion undergoing THA. However, no follow-up was reported.

All dislocations in the present study occurred early, and the incidence remained unchanged thereafter. There was a trend in this study for a higher rate of dislocation following a posterolateral approach compared with an anterolateral approach, but the numbers are small and it is difficult to draw meaningful conclusions. However, the optimal approach in this high-risk cohort is a matter for further study.

In this series, ten-year survival free of revision was 93% in the fusion group and 95% in controls. To our knowledge, this series is the first to report on long-term survival specifically in THA following spinal fusion. While the difference in survivorship between the fusion and control groups of the current study was not determined to be significant, it may be attributed to the tendency for surgeons to employ more conservative approaches when managing dislocations in this cohort (i.e. closed reduction).

Lazennec et al[28] reported that longer fusions and fusions involving the pelvis altered sacral slope during postural transitioning by up to a mean -7.9°, with a mean change in anteversion correlated to a 0.9° decrease for each additional level of spine fusion. This alters the anatomical alignment of the lumbopelvic complex by increasing anterior pelvic tilt and limiting lumbar spine flexion during movement.[7,27,29] Moreover, fusions involving the L5-S1 joint can lose physiological lumbar lordosis, which accentuates the difference between native anatomical anteversion and inclination of the acetabulum and the positioning of the component.

Similar concepts have been articulated by Stefl et al,[6] who recognized that patients with the highest risk of prosthetic impingement were those with stiff spines secondary to osteoarthritis or to surgical fusion. In spinal realignment procedures, the restoration of lumbar lordosis has a strong negative correlation with a decrease in pelvic tilt. Our study results showed a mean anterior pelvic tilt of 27° in all patients with spine fusion, well below the normal proposed range (42° to 64°) on lateral standing radiographs.[6] Similarly, dislocated patients who had undergone fusions had a mean pelvic tilt of 39°, still suggesting pathological lordosis of the sacrum, despite a small sample size. The increased mean pelvic incidence also corresponds with findings on sagittal spinal deformity by DelSole et al,[30] who demonstrated that patients with spinal fusion who dislocated had a mismatch between their pelvic incidence and their lumbar lordosis due to reduced lumbopelvic motion when changing posture. Given that the fusion and control cohorts had similar component anteversion in this study, pelvic incidence–lumbar lordosis mismatch may have influenced the increased risk of anterior impingement and thus posterior prosthetic dislocation.[29]

This study is limited by a small sample size, given that such patients are infrequently treated. To mitigate this limitation, we chose a case-control design. The low event rates limited statistical calculations to univariate analysis. Additionally, preoperative lateral spinopelvic films are not routinely obtained prior to THA. Future studies might consider prospectively comparing postoperative lateral spinopelvic films using pelvic tilt and sacral slope with preoperative measurements as previously described.[5,6,30] Other factors such as neurological, muscular, or dynamic variables might account for instability risk beyond the mechanical structure of the hip, and should be acknowledged as potential instigators of dislocation as well.

In conclusion, spinal fusions prior to THA increase the risk of early dislocation relative to patients who have not undergone fusion. Fusion involving the sacrum, specifically with two or more levels of lumbar involvement, is a key risk factor for dislocation, and precise preoperative templating and execution of THA is recommended in this high-risk cohort.

Take home message

- Lumbosacral spinal fusions prior to total hip arthroplasty increase the risk of dislocation within the first six months.
- Fusions involving the sacrum with multiple levels of lumbar involvement notably increased the risk of postoperative dislocation compared with a control group and other lumbar fusions.

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