Increased risk of flexion impingement and posterior instability following Total Hip Arthroplasty

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INTRODUCTION:
Posterior instability during deep flexion is a commonly identified risk factor in total hip arthroplasty (THA), which can lead to posterior edge loading, anterior impingement and/or dislocation of the implants. The purpose of this study was to investigate the risk of posterior instability due to adverse spinopelvic mobility (SPM) before and after THA.
METHODS:
In this study, 555 patients underwent standing and flex-seated radiographs pre-operatively, and one-year post-THA (mean follow-up: 13±2 months). Anterior Pelvic Plane Tilt (PT), Lumbar Lordosis (LL) and Pelvic Femoral Angle (PFA) were measured in each position along with changes between postural positions (ΔXX) and the Hip User Index (HUI).
Risk of flexion impingement was determined by ΔPT≥20° (Figure-1). Patients were stratified into 4 risk groups for pre- vs post-op flexion risk: Group-1 Pre-No/Post-No, Group-2 Pre-No/Post-Yes, Group-3 Pre-Yes/Post-No, Group-4 Pre-Yes/Post-Yes.
A classifier model was evaluated to predict post-operative flexion risk from pre-operative parameters using Area-Under-Curve Receiver-Operator-Characteristic (AUC-ROC) analysis.
RESULTS:
Pre-operatively, 13% of patients were at risk of flexion impingement (Group-3+Group-4), which increased to 29% post-operatively (Group-2+Group-4) (p<0.001).
23% of patients developed a flexion risk post-operatively not present pre-operatively (Group 2). Patients in Group 2 had less ΔLL (37° vs 42°) and higher ΔPT (27° vs 6°), ΔPFA (110° vs 88°) and HUI (76 vs 68%) post- vs pre-operatively (all p<0.001).
Compared with Group-1 patients (absent any flexion risk pre- and post-operatively), Group-2 had a higher change in ΔPT pre- to post-operative (20° vs 7°), tended to be older (69 vs 64), were more likely to be female (71% vs 48%) and had lower ΔLL both pre- (42° vs 48°) and post-operatively (37° vs 45°) (Table-1, all p<0.001).
Sensitivity and specificity of the classifier was 76% and 70% respectively, with AUC accuracy of 80% (Figure-2). Gender, age, low lumbar flexion (ΔLL≤20°) and Sagittal Deformity (PI-LL≥20°) were found to be strong predictors.
DISCUSSION AND CONCLUSION:
Post-operatively, nearly one in four patients exhibited a flexion risk (ΔPT≥20°) between seated and standing positions which was not identified pre-operatively, elevating their risk for posterior instability. At risk patients tended to be older, female and have a stiffer spine pre-operatively than those that showed no flexion risk both pre- and post-op.

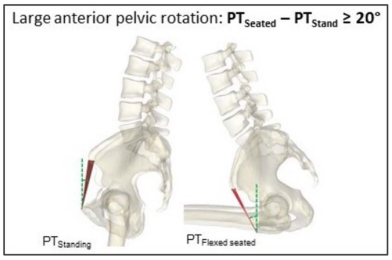

Figure 1 The risk of flexion impingement was determined by ΔPT≥20°.

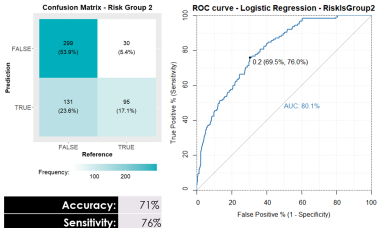

Figure 2. Confusion matrix and ROC-AUC classifier results for predicting patients who are at risk for impingement in flexion postop but not preop.

Table 1: Mean spinopelvic measurements by flexion risk group

Class	Group 1: No Risk	Group 2: Post Risk	Group 3: Pre Risk	Group 4: Both Risk	All Data
ΔPT≥20° Risk Pre	FALSE	FALSE	TRUE	TRUE	-
ΔPT≥20° Risk Post	FALSE	TRUE	FALSE	TRUE	-
(n) Patients	357	125	39	34	555
% Total	64%	23%	7%	6%	100%
% Female	48%	71%	77%	82%	57%
Age At Surgery	64	69	70	73	66
ΔPT Pre	-1°	6°	26°	27°	4°
ΔPT Post	6°	27°	10°	30°	12°
ΔPT Post-Pre	7°	20°	-15°	3°	8°
PT Stand Post-Pre	-2°	-2°	1°	0°	-2°
PT Seated Post-Pre	5°	18°	-15°	3°	7°
LF Pre	48°	42°	36°	33°	45°
LF Post	45°	37°	37°	30°	41°
ΔPFA Pre	81°	88°	105°	109°	86°
ΔPFA Post	92°	110°	95°	113°	98°
HUI% Pre	63%	68%	75%	77%	66%
HUI% Post	68%	76%	73%	79%	71%