What are the optimal age cutoffs for osteoporosis and osteopenia screening in patients undergoing lumbar fusion surgery?

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INTRODUCTION: Impaired bone quality is an established and modifiable risk factor for adverse outcomes after lumbar fusion surgery (LFS). While bone mineral density (BMD) measurements are recommended for women ≥ 65 years and men ≥ 70 years in the United States (US) by the US Preventive Service Task Force (USPSTF), specific evidence-based recommendations for spine surgery patients are needed. As undiagnosed osteoporosis prior to surgery is an issue, this study aims to analyze the optimal age-cut offs for osteoporosis and osteopenia screening in patients undergoing LFS.

METHODS: Patients ≥ 50 years were reviewed from an institutional database of prospectively enrolled patients undergoing LFS. All patients had a preoperative lumbar spine computed tomography (CT) scan as per standard of care. Patients with external CT not suitable for quantitative computed tomography (qCT) bone mineral density measurements were excluded. Osteoporosis was defined as either previously diagnosed osteoporosis or a qCT BMD < 80 mg/cm^3. Osteopenia was defined as BMD < 120 mg/cm^3 in accordance with the recommendations of the American College of Radiologists. Descriptive and comparative statistics, and receiver operating characteristics (ROC) analysis with Youden-Index or sensitivity optimization of an age cutoff to detect undiagnosed osteoporosis, osteoporosis, or osteopenia prior to LFS was performed.

RESULTS:

Out of 599 patients, 84 (14 %) were excluded due to unsuitable CT scans. The remaining 515 patients (56% female) were included. The median age was 66 years (interquartile range (IQR) 60 -73), and the median body mass index 29 kg/m^2 (IQR 26 -33). The overall prevalence of impaired bone quality (osteoporosis or osteopenia) was 70% (66% in male and 73% in female patients). Osteoporosis was identified in 34% (22% in male and 44% in female) patients, 38% of which (68% of male and 27% of female osteoporosis cases) were previously undiagnosed, corresponding to 13% (15% in females and 12% in males) of the total cohort.

An age threshold of 70 years of age in males (sensitivity 0.60, specificity 0.72, AUC 0.71) and 65 in females (sensitivity 0.79, specificity 0.53, AUC 0.70) was determined as optimal for the detection of osteoporosis by ROC analysis with Youden index optimization (Table 1). For the detection of impaired bone status (either osteopenia or osteoporosis), the age thresholds were 63 for males and 65 in females. In patients undergoing LFS and stating no history of osteoporosis, age predicted previously undiagnosed osteoporosis in male patients (age threshold 70) similar to those optimal for the detection of osteoporosis in all patients, while the ones in female (64) patients was slightly lower.

When performing ROC analysis with sensitivity optimization, osteopenia screening starting at ages 61 and 62 in male and female patients respectively, and for osteoporosis in males aged 64 and females aged 65 was optimal. The optimal cutoff for undetected osteoporosis was 65 years in both men and women.

DISCUSSION AND CONCLUSION: The Youden index optimized sex-specific age cutoffs for detecting osteoporosis were consistent with USPSTF recommendations. However, performance in LFS patients was fair (AUC 0.70–0.74), particularly in men, in which 40% of cases would be overlooked due to a sensitivity of 60%. This aligns with the higher prevalence of undiagnosed osteoporosis in males. More evidence is needed on the use of noninvasive diagnostic tools for preoperative osteoporosis screening in female LFS patients under 65 and male patients under 70 to identify osteoporotic cases in these populations. Furthermore, an individual risk/benefit analysis of radiographic BMD screening prior to LFS with sensitivity optimized lower age cutoffs than USPSTF recommendations seems advisable.

Table 1: Receiver operating curve (ROC) analysis results for sex specific age cutoffs for the detection of impaired bone quality, osteoporosis and preoperatively undetected osteoporosis. Optimization for Youden index or sensitivity were performed as indicated.

	Optimization	Patients	Cutoff	AUC	Sensitivity	Specificity
Impaired bone quality[1] (Osteopenia or Osteoporosis)	**Youden index**	Male	63	0.71	0.73	0.67
		Female	65	0.70	0.69	0.62
	Sensitivity	Male	61	0.71	0.78	0.50
		Female	62	0.70	0.77	0.50
Osteoporosis[1]	**Youden index**	Male	70	0.72	0.60	0.76
		Female	65	0.71	0.79	0.53
	Sensitivity	Male	64	0.72	0.82	0.52
		Female	65	0.71	0.80	0.51
Undiagnosed osteoporosis[2]	**Youden index**	Male	70	0.74	0.65	0.76
		Female	64	0.73	0.88	0.49
	Sensitivity	Male	65	0.74	0.82	0.53
		Female	65	0.73	0.85	0.51

[1] in all patients (n = 515)
[2] in patients stating the absence of osteoporosis (n = 407)
AUC = area under the curve