Routine Use of O-arm Following Pedicle Screw Placement: A Break-Even Cost Analysis

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INTRODUCTION: Using an O-arm to assess thoracolumbar pedicle screw positioning prior to wound closure is an increasingly common practice. While the O-arm may identify malpositioned pedicle screws, universal application of O-arm imaging increases radiation exposure, surgical time, and risk of contaminating the surgical field.

METHODS: A break-even cost analysis was utilized as the cost-effectiveness model. Institutional and literature values were used for the variables within the break-even formula, which includes the cost of intraoperative O-arm use, cost of return to the OR, and the rate of return to the OR for pedicle screw repositioning. Cost of intraoperative O-arm use was determined by average charges at our institution while also considering cost per minute of OR time. Cost of revision surgery ranged from $23,000 to $33,000. The break-even formula solves for a final ("break-even") revision rate that would need to be attained with the universal use of O-arm imaging in order to neutralize cost. Calculating the difference between the initial and final revision rates provides the absolute risk reduction (ARR).

RESULTS: The cost of the O-arm ranges from $413 to $968 with an average of additional intraoperative time ranging from 10 to 25 minutes, respectively. At $413, the initial pedicle screw revision rate of 2.1% requires an ARR of 1.8% to be cost-effective considering a revision cost of $23,000. With the same values but considering O-arm cost at $968, ARR increases to 4.21%. At a revision rate of 2.1% and revision cost of $33,000, the ARRs decrease to 0.85% and 2.93% at O-arm costs of $413 and $968, respectively. Adjusting initial revision rate along a range from 0.5% to 2.5% does not change ARR.

DISCUSSION AND CONCLUSION: Using an O-arm to assess thoracolumbar pedicle screw position prior to wound closure is cost-effective at the lowest estimated cost of O-arm utilization while accounting for the high estimated cost of revision surgery. To break-even on cost, one return to the OR would need to be avoided every 80 surgeries by application of the O-arm. At higher costs of O-arm use or lower cost of revision surgery, routine O-arm use to check pedicle screw positioning is not cost-effective.

Table 1. Cost-effectiveness of O-arm imaging for assessment of pedicle screw positioning[1]

Cost of revision	Added OR time (min)	Intraoperative O-arm Cost (USD)	Break-even Revision Rate (%)	Break-even ARR (%)
$23,000	10	413	0.30	1.80
	15	598	-0.50	2.60
	20	783	-1.30	3.40
	25	968	-2.11	4.21
$33,000	10	413	0.85	1.25
	15	598	0.29	1.81
	20	783	-0.27	2.37
	25	968	-0.83	2.93

ARR, absolute risk reduction; OR, operating room; USD, United States Dollar
[1]Considering an initial revision rate of 2.1%

Table 2. Varying initial revision rate does not affect cost-effectiveness[1]

Initial Revision Rate (%)	Break-even Revision Rate (%)	Break-even ARR (%)
0.50	-0.75	1.25
0.70[2]	-0.55	1.25
1.00	-0.25	1.25
1.25	0.00	1.25
1.50	0.25	1.25
2.00	0.75	1.25
2.10	0.85	1.25
2.50	1.25	1.25
3.00	1.75	1.25
3.50	2.25	1.25

ARR, absolute risk reduction; USD, United States Dollar
[1]Considering O-arm cost of $413 and cost of revision procedure $33,000
[2]Lower limit literature value

Table 3. Cost-effectiveness increases with increasing cost of revision[1]

Cost of Revision (USD)	Break-even Revision Rate (%)	Break-even ARR (%)
10,000	-2.03	4.13
15,000	-0.65	2.75
20,000	0.04	2.07
23,000[2]	0.30	1.80
30,000	0.72	1.38
33,000[3]	0.85	1.25
40,000	1.07	1.03
50,000	1.27	0.83
60,000	1.41	0.69

ARR, absolute risk reduction; USD, United States Dollar
[1]Considering an initial revision rate of 2.1% and cost of O-arm $413
[2]Lower limit literature value
[3]Upper limit literature value