



3-D Image-Based Computer Navigation Reduces Needle Malposition Rates in Balloon Kyphoplasty



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Disclosures

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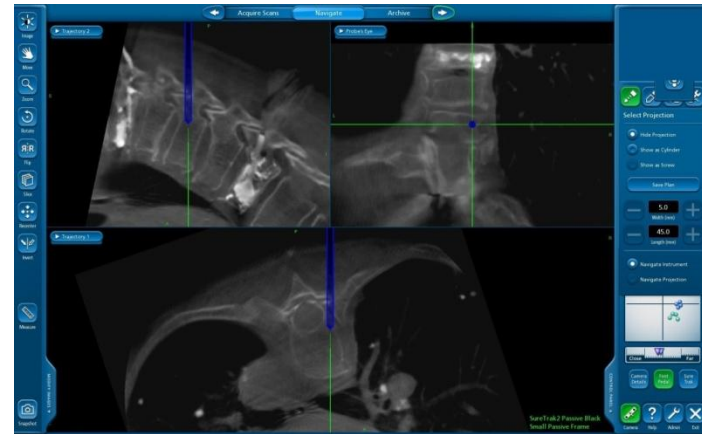


Introduction

- Balloon Kyphoplasty (BK) as a form of cement vertebral augmentation is gaining wide acceptance as treatment for:
 - Osteoporotic vertebral compression fractures
 - Pathologic vertebral fractures
- Conventionally performed via 2-D fluoroscopy (C-arm)
- Advantages:
 - Minimal tissue disruption
 - Quick recovery
 - Reliable pain relief
 - Prevention of further fracture collapse



Introduction



- Image-based computer navigation has been finding applications in spine surgery
 - More accurate pedicle screw placement
- 2-D navigation now evolving to 3-D navigation (coronal, sagittal and axial)
- Benefit of navigation in BK procedures has not been established.



Introduction

- Question: Is there a difference brought about by 3-D navigation in balloon kyphoplasty procedures?
 - Needle placement accuracy
 - Radiation exposure time
 - Cement leakage rate



Methods: Retrospective Comparison

NAVIGATED BK

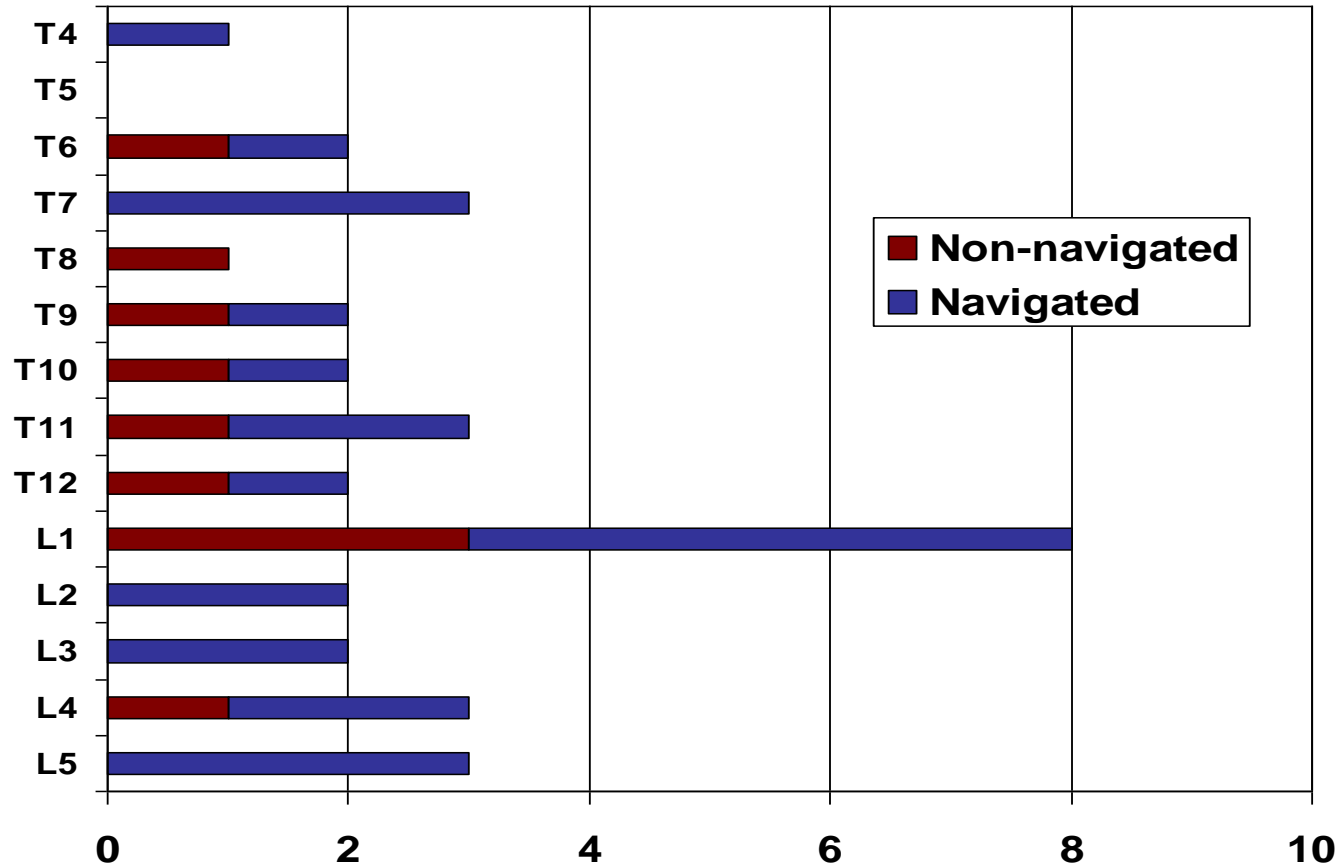
- 22 cases (37 levels)
- Intraoperative CT scanner (O-arm) with computer navigation system (Stealth)
- 3-D scan (O-arm) to confirm needle placement
- 3-D scan (O-arm) to confirm cement containment

NON-NAVIGATED BK

- 9 cases (11 levels)
- 2-D fluoroscopy (O-arm) without navigation
- 3-D scan (O-arm) to confirm needle placement
- 3-D scan (O-arm) to confirm cement containment

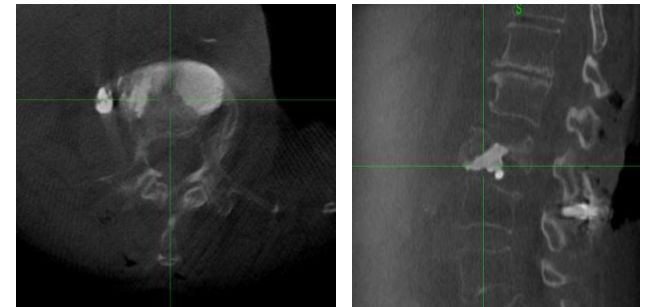
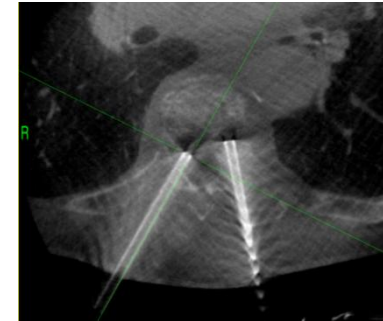


Distribution of BK cases by spinal level



Methods

- Independent image review of post-needle placement 3-D images:
 - Needle malposition: revised or not revised
- Independent image review of post-cement injection 3-D images:
 - Cement leak
 - Intradiskal
 - Intraspinal
 - Paravertebral
 - Circulatory
- Radiation exposure time:
 - 2-D fluoroscopy
 - 3-D scans (13 sec standard definition; 26 sec high definition)
 - Total



Results: Needle Placement and Cement Containment

	<u>Navigated</u> (n=37)	<u>Non-navigated</u> (n=11)	t test
Trocar Needle Malposition	2 (5%)	3 (27%)	p=0.04
Intradiskal Leak	1 (4%)	1 (9%)	p=0.35
Circulatory Leak	0	0	NA
Intraspinal Leak	1 (4%)	1 (9%)	p=0.35
Paravertebral Leak	6 (25%)	2 (18%)	p=0.70
Overall cement leak (total)	8 (33%)	4 (27%)	p=0.18



Results: Radiation Exposure Time

<i>Mean Values Per Level</i>	<u>Navigated</u>	<u>Non- navigated</u>	<i>Mann-Whitney U test</i>
<i>3D Fluoro Time</i>	44 sec	34 sec	p=0.184
<i>2D Fluoro Time</i>	51 sec	91 sec	p=0.008
<i>Total (2D + 3D) Radiation Exposure Time</i>	98 sec	125 sec	p=0.102



Discussion

- Improved needle placement accuracy with navigation consistent with literature on navigated pedicle screw placement.
 - 95.2% (nav) vs. 90.3% (non-nav) accuracy rates for pedicle screws
 - Kosmopoulos *Spine* 2007.
- Lack of difference in cement leakage rates is not surprising, as cement injection is done without navigation.
 - Other factors: fracture configuration, integrity of endplates, vertebral body wall, volume of cement, cement viscosity, etc.



Discussion

- 3D Image-based navigation requires intraoperative 3D scan (13 or 26 sec radiation exposure) for image registration.
 - Concern regarding possible increased radiation exposure
 - However, no increase in overall radiation exposure time
 - Decreased 2D fluoro time
 - Possible decreased radiation exposure to surgical team(?)
- Limitation: Radiation exposure time is simplistic method of determining radiation exposure.



Conclusion

- 3-D Navigation provides added safety to BK procedures by reducing needle malposition rates.
 - 5% vs. 27%
- 3-D Navigation did NOT lead to increased radiation exposure despite added step of obtaining intraoperative 3-D scan for image registration.
 - Countered by reduced need for intraoperative 2D imaging



Thank You!



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