



Comparison of Rates of Pedicle Screw Malplacement Between a Freehand Technique and 3D Printed Guides in Adolescent Idiopathic Scoliosis

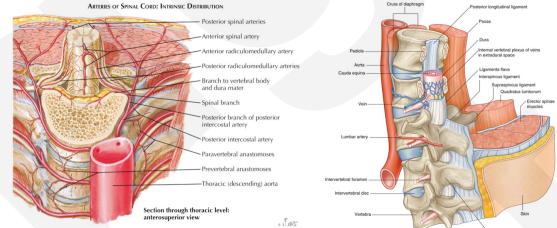
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Introduction

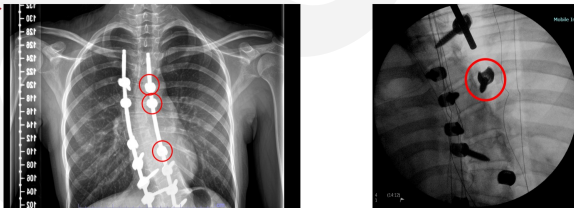
- Reducing pedicle screw malplacement is important for risk reduction



Adapted from: Arteries of Spinal Cord: Intrinsic Distribution (1)
 (1) Netter PH, Jones HL, Machado GGL, Polans JA. Netter Collection of Medical Illustrations: Nervous System, Part II - Spinal Cord and Peripheral Motor and Sensory Systems
 (2) Drake RL, Vogt AV, Mitchell AW. Gray's Anatomy for Students, 3rd ed. Philadelphia: Elsevier Saunders; 2012.



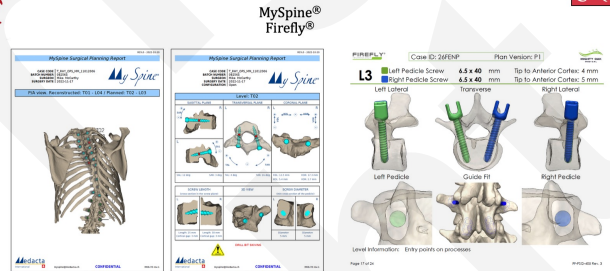
Malplaced Screws



- Previous data in our hospital with 5070 screws placed in total, found 10% were malplaced on postop XR
- Accuracy with freehand technique varies across literature (3%-55%)¹⁻⁶
- Various methods of reducing malplacement have been introduced (C-arm, O-arm, VR, robotic navigation, 3DPG)

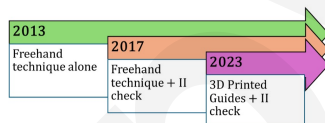


3D PRINTED GUIDES



Method

- 195 primary AIS corrections were performed by a single surgical team in our hospital between January 2013 and May 2025
 - Consistent surgical technique and implant use
 - Homogenous patient group
- Postoperative XR imaging interpreted by a single consultant spinal surgeon and student
- Variables compared using one-way ANOVA

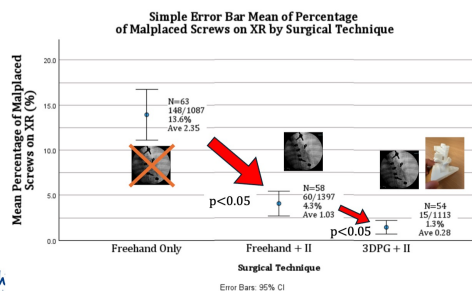


Results

- 28 males and 167 females (N=195) were included
- 3,597 screws were placed in total
- Mean of 18.45 (SD±3.40, range 12-28) screws placed per patient
- 223 screws (6.2%) were identified as malplaced on postop XR
- Mean of 1.14 (SD±, range 0-8) screws malplaced per patient
- 50% of patients were found to have at least one malplaced screw

Freehand Only	63pts, 1087 screws
Freehand + II	78pts, 1397 screws
3DPG + II	54pts, 1113 screws

Rates of Screw Malplacement



Results

	Freehand Only (n=63)	Freehand + II (n=78)	3DPG + II (n=54)	Significance
Screws per Patient	17.25	18.03	20.44	p<0.05
Number of Levels	13.38	13.12	12.91	Nil significance
Op Time	184mins	190mins	162mins	p<0.05
Average Blood Loss	767ml	852ml	708ml	Nil significance
Length of Stay	7.1 days	6.7 days	5.3 days	p<0.05
Time per Screw	10.8mins	10.6mins	8.0mins	p<0.05
Change Cobb Angle	35.83°	39.65°	44.52°	p<0.05

1. Time per screw was calculated as a fraction of total operating time.
2. Change in Cobb angle is significantly different between the freehand only and 3DPG + II groups only.
3. Operating time, length of stay and time per screw are all significantly different between the 3DPG + II group and both freehand groups. The freehand only and freehand + II groups did not display a statistically significant difference.
4. Preop Cobb angle, postop Cobb angle, and the number of levels instrumented were not significantly different between groups.

Results

- 17 patients (8.7%) underwent revision surgery:
 - Freehand Only: 12pts (19.0%)
 - Freehand + II: 3pts (3.8%)
 - 3DPG + II: 2pts (3.7%)
- No intraoperative neuromonitoring events occurred in this cohort.

	Freehand Only (n=63)	Freehand + II (n=78)	3DPG + II (n=54)	Significance
Preop CT Dose	0.0mGycm ²	17.9mGycm ²	540.8mGycm ²	p<0.05
Intraop II Dose	12.2mGycm ²	155.8mGycm ²	82.4mGycm ²	p<0.05
Postop CT Dose	123.4mGycm ²	44.4mGycm ²	24.9mGycm ²	p<0.05
Total Radiation Dose	133.0mGycm ²	215.0mGycm ²	833.1mGycm ²	p<0.05

1. Intraop II dose and postop CT dose are significantly different between the freehand only group and both groups which use II. The II groups did not display a statistically significant difference.
2. The total dose of radiation was significantly different between the 3DPG + II group and both freehand groups. The freehand groups did not show statistical significance.

Conclusions

- 3DPGs used alongside intraoperative image intensification provides the greatest reduction in pedicle screw malplacement out of the techniques observed in this study
- Intraoperative image intensification alone significantly reduced pedicle screw malplacement in AIS patients
- The use of 3DPGs reduces theatre time and time in hospital in AIS patients, while having no significant effect on intraoperative blood loss
- Revision rates decreased from 19% to ~4% with the introduction of intraoperative image intensification

References

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