

A Retrospective Analysis of Pedicle Screw Placement in the Surgical Treatment of Adolescent Idiopathic Scoliosis Over a 10 Year Period: The Impact of Image Intensifier and 3D Printed Guides



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1. Background

Pedicle screw malplacement during surgery for adolescent idiopathic scoliosis (AIS) can result in serious complications, such as neurological deficit and vascular injury ¹. It is therefore imperative to monitor screw malplacement rates in clinical practice and explore methods to reduce it. In our hospital, various surgical techniques were used over the last decade. Between 2013 and 2016, a freehand technique, reliant on the use of anatomical landmarks to determine the entry point for the screws, was used without any additional intraoperative imaging. Intraoperative image intensification (II) was introduced in 2017 to check freehand screw placement prior to rod insertion. In 2023, the use of Medacta MySpine[®] guides², created with pre-operative CT imaging, became routine, replacing the freehand technique. Screw placement again being checked with intraoperative image intensification prior to rod insertion.

2. Aims

- Review intra- and post-operative imaging for adolescent idiopathic scoliosis (AIS) patients
- Compare the rates of screw malplacement between the various surgical techniques used in our hospital
- Compare the proportion of screws identified as malplaced on post-operative x-ray and CT imaging
- Review revision rates following instrumented fusion for AIS

3. Methods

- A complete list of operations carried out between January 2013 and December 2023 was obtained from the Bluespier database, with patients undergoing primary instrumented fusion to treat AIS between the ages of 10 and 18 being included in the study
- Radiological imaging stored on the Synapse database was interpreted by a consultant spinal surgeon to assess screw placement
- Data analysis carried out using IBM SPSS Software Version 27



Figure 1. An example of a pedicle screw that is malplaced laterally, identified using post-operative CT imaging



Figure 2. An example of a pedicle screw that is malplaced laterally, identified using intra-operative image intensification

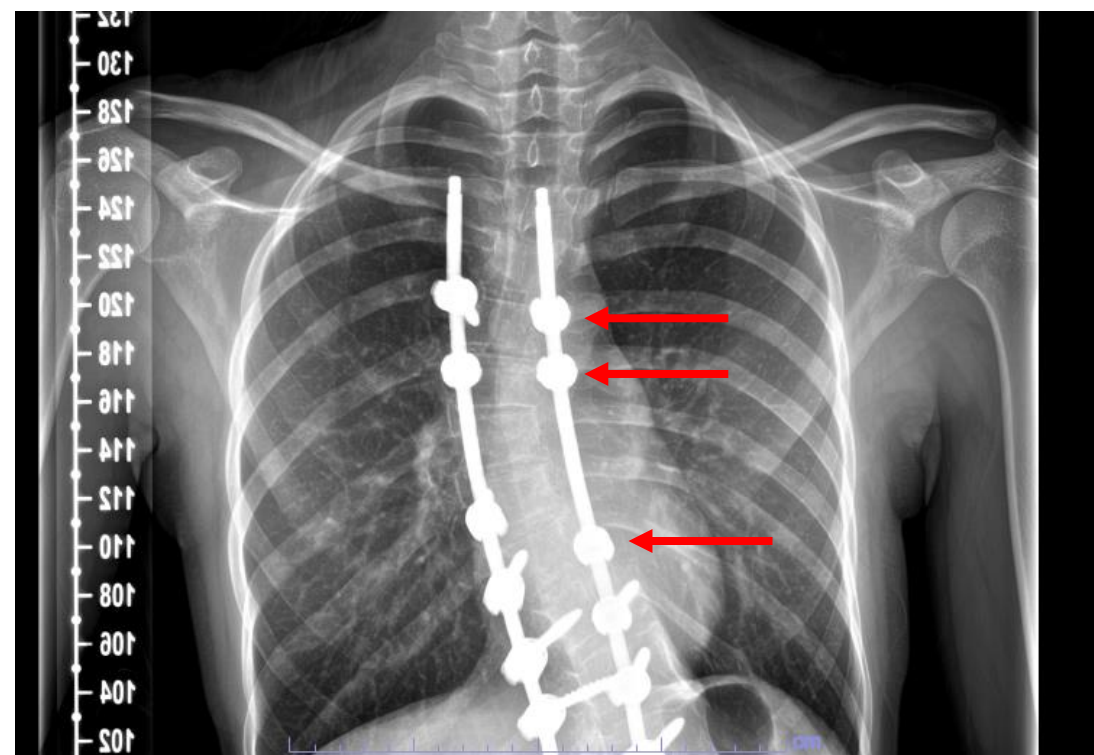


Figure 3. An example of multiple screws that are malplaced laterally, identified using post-operative X-ray imaging

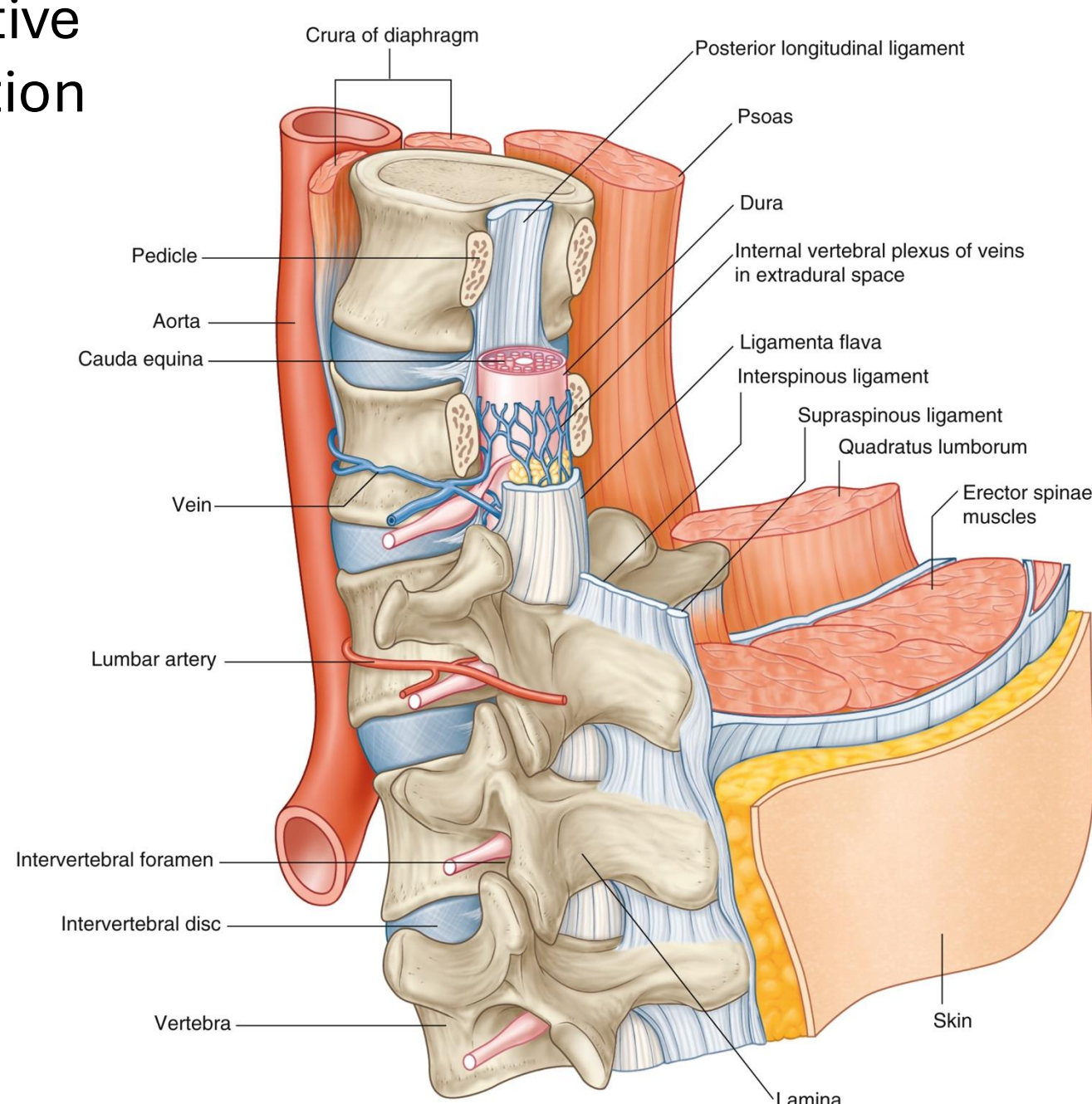


Figure 4. Arrangement of structures in the vertebral canal and the back (lumbar region) (3)

4. Results

226 girls and 39 boys (N=265) were included in this study, with a mean age at operation of 14.6 years. A total of 5070 screws were placed over the 10-year period, with a mean of 19.13 screws per patient (SD±3.98, range 11-29). Of total screws placed, 516 (10%) were malpositioned, with an overall average of 1.95 malpositioned screws per patient (SD±1.85, range 0-8). 71% of patients had at least one missed screw. 61 patients (23%) required post-operative CT imaging, with a total of 1230 screws. Overall, 23 patients (9%) underwent revisional surgery (any reason). The mean number of months from the date of surgery to revisional operation was 27.2 months (SD±27.2).

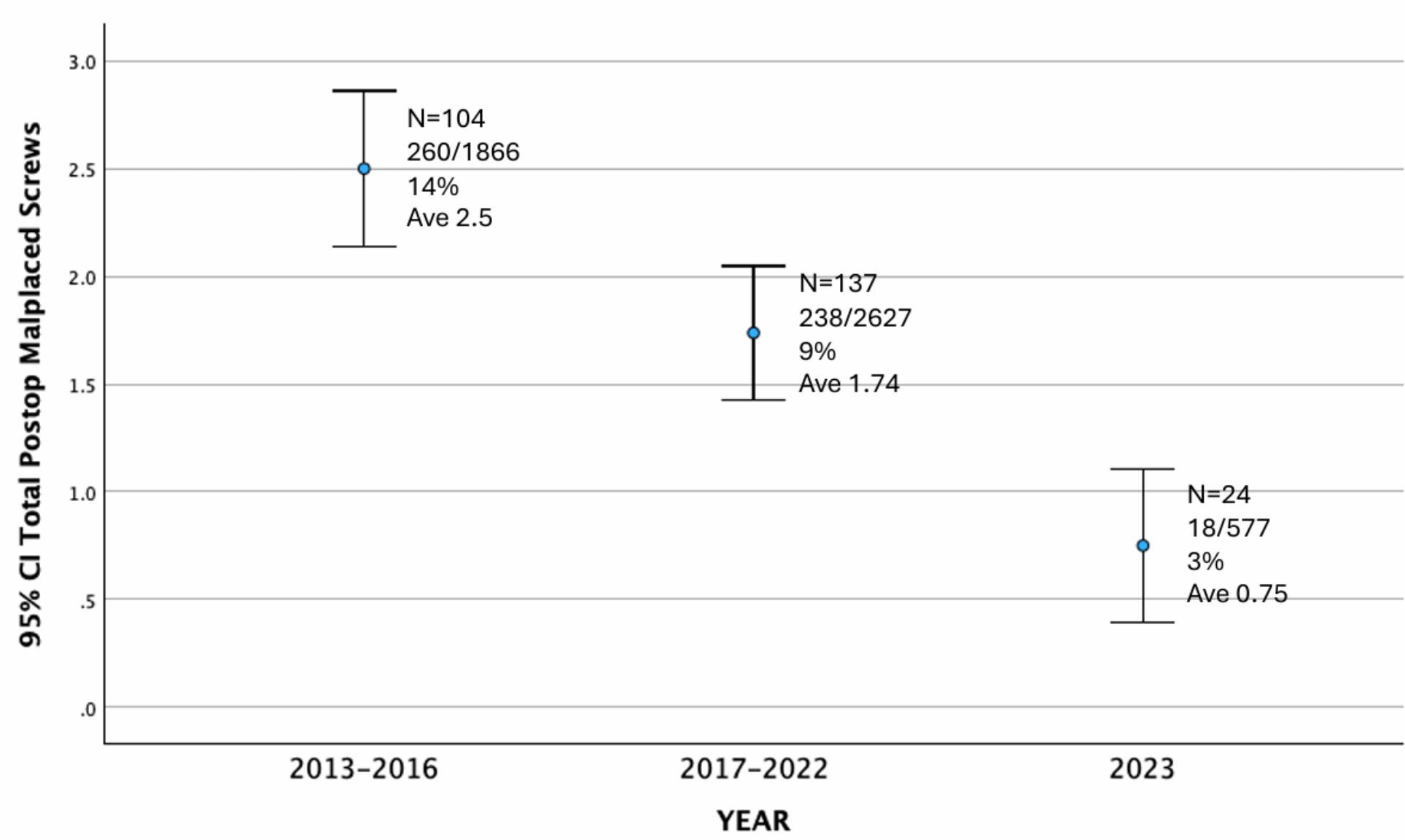


Figure 5. Depicts the decrease in the average number of malplaced screws per patient between 2013 and 2016, 2017 and 2022, and in 2023. These time periods correspond with the different operative techniques used

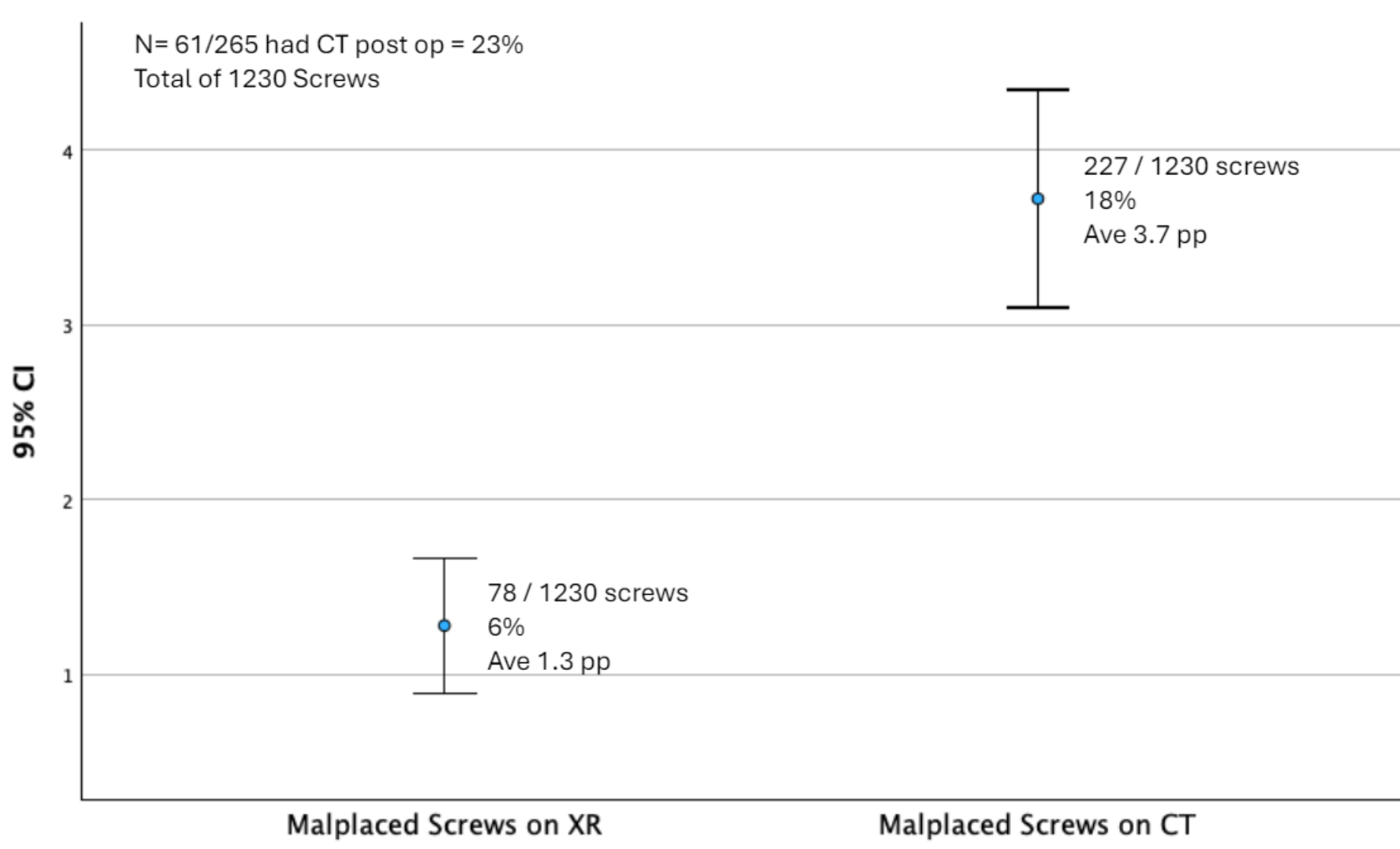


Figure 6. Demonstrates the increase in the number of malplaced screws identifiable on post-operative CT imaging compared to X-ray

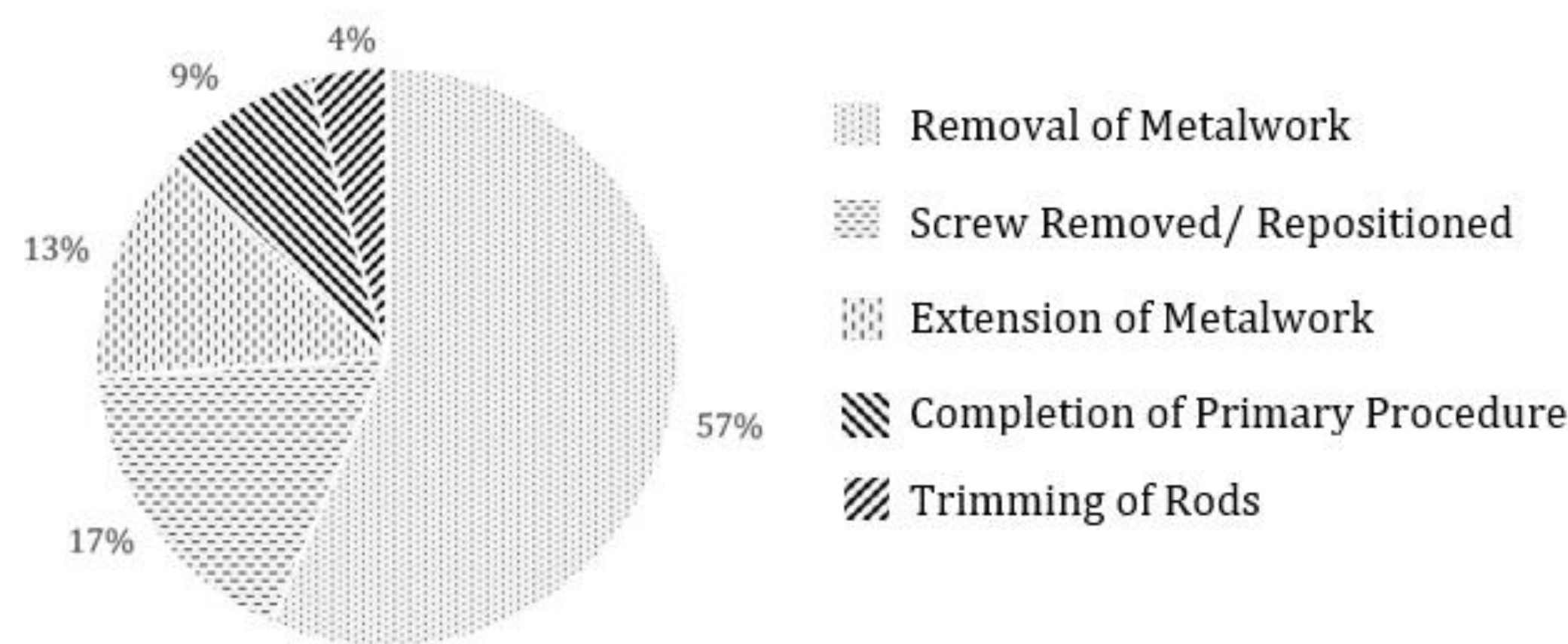


Figure 7. Pie chart representing the proportion of revision procedures carried out

5. Conclusions

- Intraoperative image intensification alone reduces the average number of malpositioned screws per patient from 2.5 to 1.7
- The additional use of Medacta MySpine[®] guides further reduces this average to 0.75
- The use of surgical guides, created from pre-operative imaging, combined with the use of intraoperative image intensification, is an effective method for reducing pedicle screw malplacement during instrumented fusion to treat AIS

6. References

1. Hicks J. Complications of Pedicle Screw Fixation in Scoliosis Surgery: A Systematic Review. Spine J. 2009;9(10):77S. 2. Medacta. MySpine. 2024 [Accessed 22 Apr 2024]. Available from: <https://www.medacta.com/EN/home-myspine> 3. Drake RL, Vogl AW, Mitchell AWM. Gray's Anatomy for Students. 5th ed. Philadelphia: Elsevier Saunders; 2024.