Beyond Curvature: Evaluating Intraoperative Challenges in Adult Spinal Deformities

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I have nothing to declare.

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-Adult deformities are among the most difficult spinal pathologies to manage in terms of:

-Decision-making.

-Challenging surgical cases.

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- Definition of adult deformities?

- Is there recognition between adult deformities and degenerative deformities?

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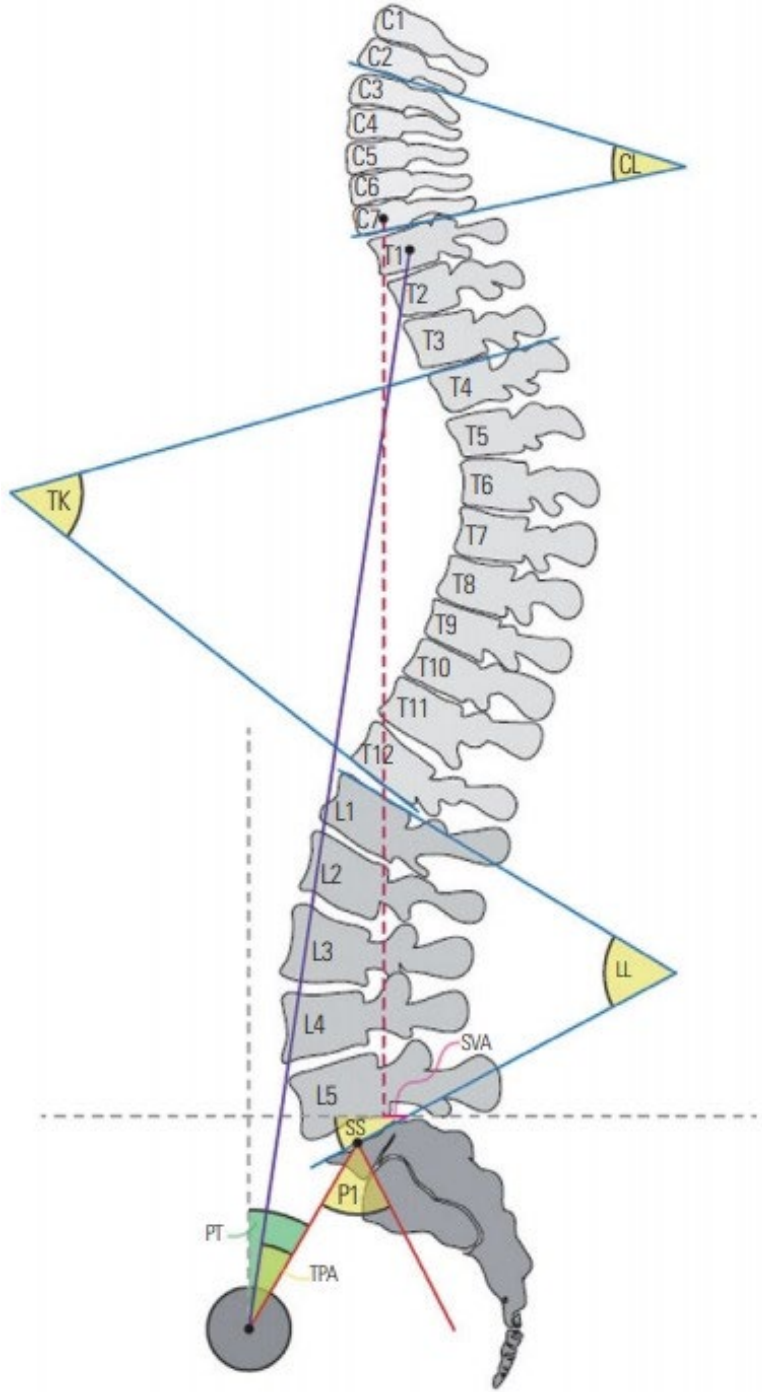
Definitions do not help to recognize which patients are having significant deformities.

Scoliosis and sagittal imbalance terminologies do not define what is significant!

Schwab et al. reported a prevalence of 68% for adult scoliotic deformity in adults aged over 60 years.(1).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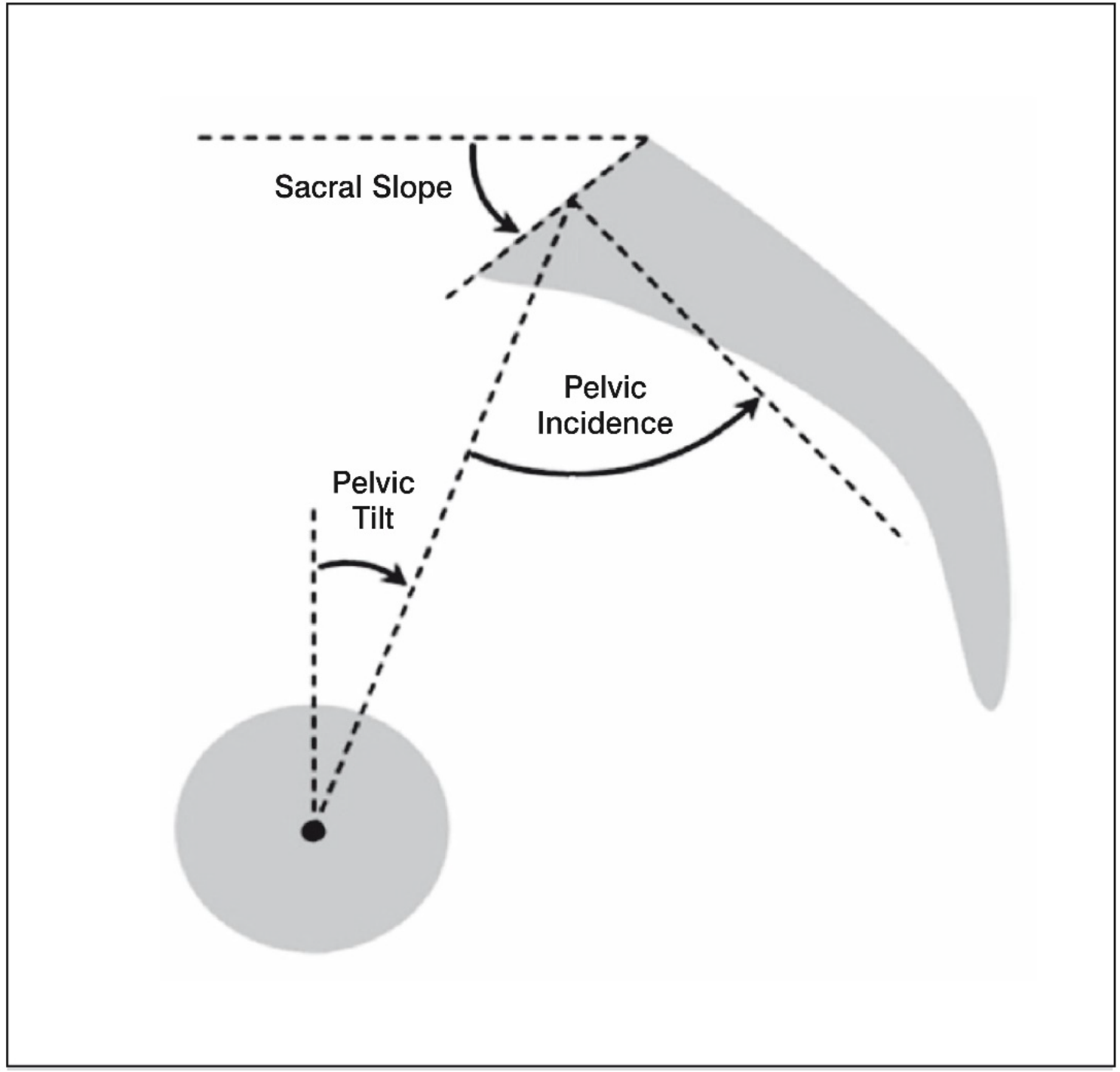
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Incidence
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Classification Systems

-Aebi in 2005 proposed a classification system based on aetiology of the deformity.

-Bess proposed a classification system that was based on clinically significant radiographic parameters.

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Schwab adult spine deformity classification (9)

Currently, the Scoliosis Research Society–Schwab adult spine deformity classification is the standard system.

It relies on radiological parameters including spinopelvic parameters and is strongly corelated with substantial correlations with health-related quality of life.

Reference (5) has detailed description of the classification systems.

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Bridwell (7)categorized adult deformities based on flexibility:

1-a totally flexible deformity that corrects in the supine position.

2- a deformity that partially corrects

3- a totally inflexible deformity.

Rigid deformities require more aggressive approach for appropriate correction.


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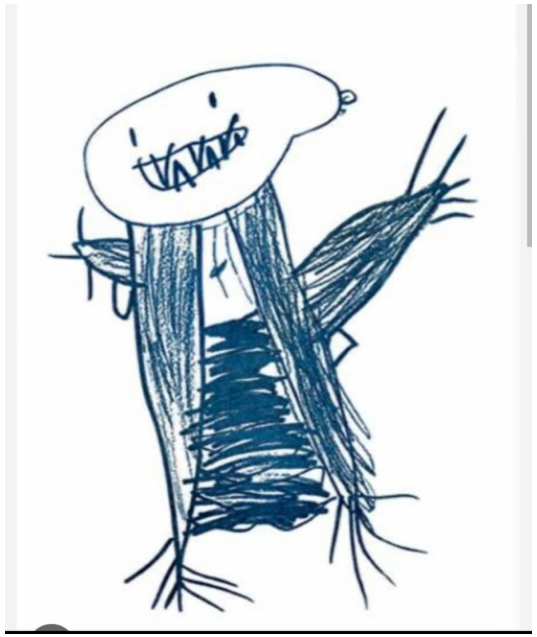
Spinal Surgery!
Science



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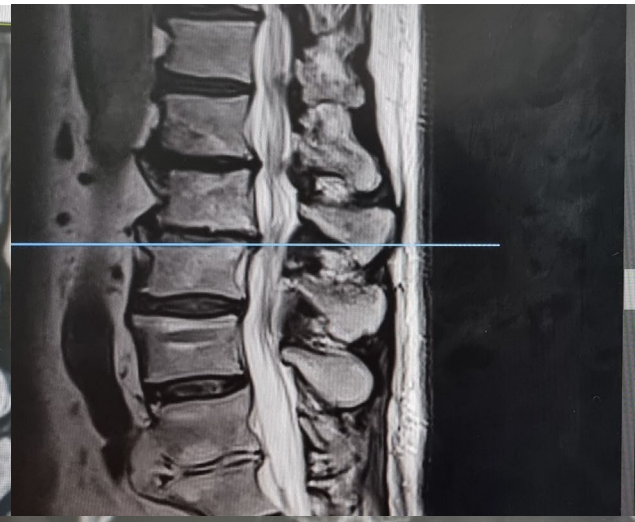
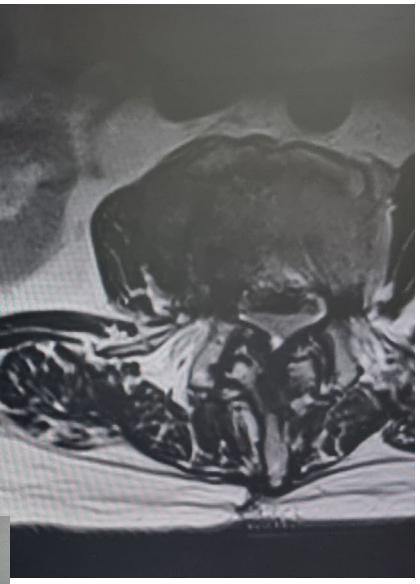
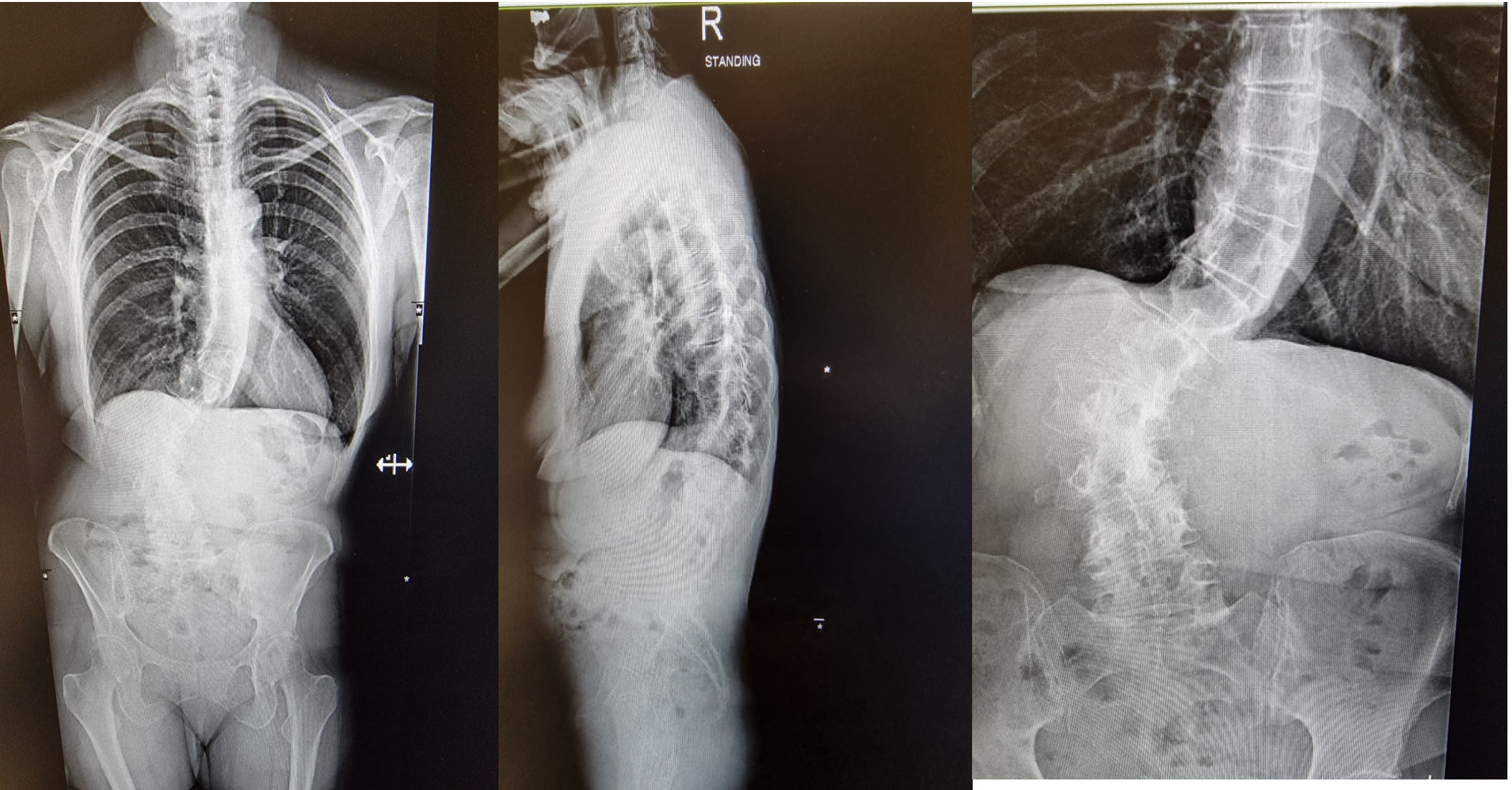
Case based discussions

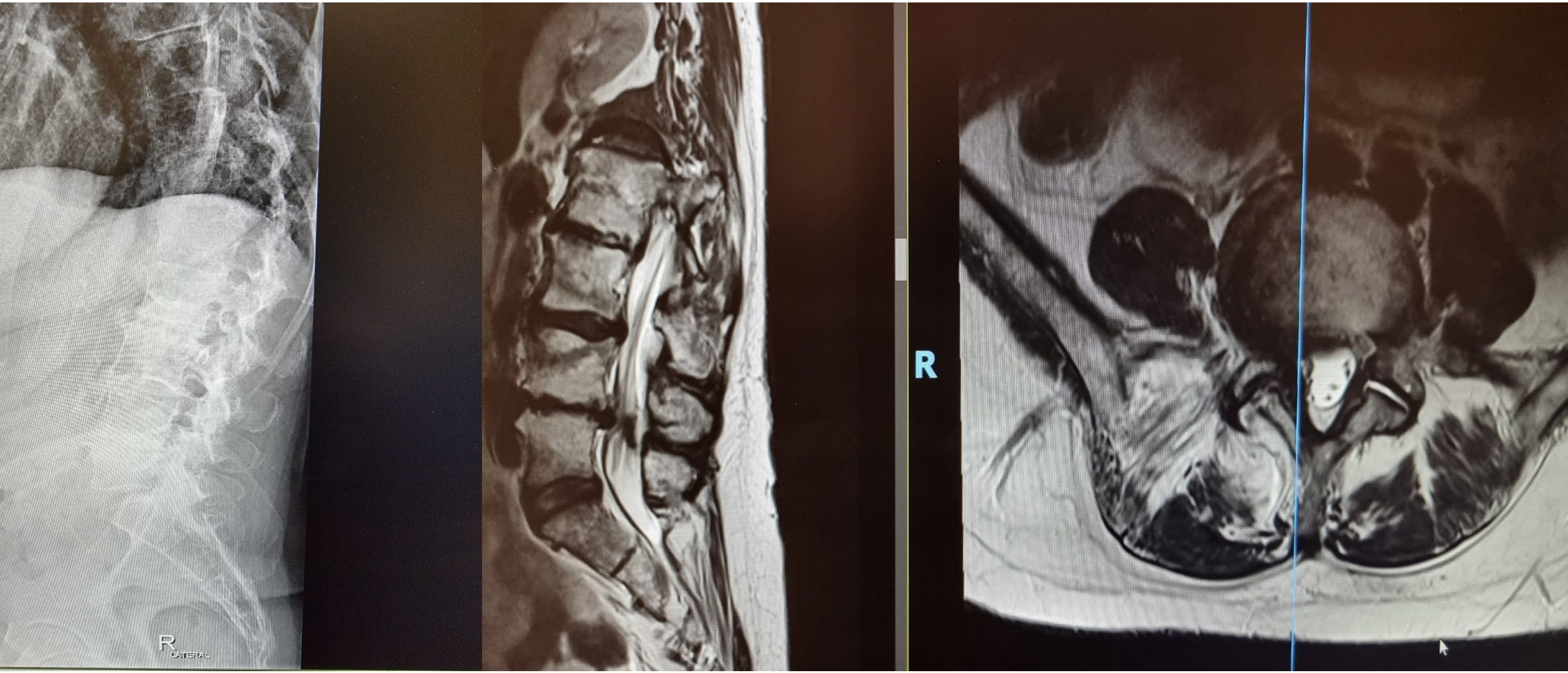
76 year-old, male with multiple comorbidities.





70 years old woman known to have Diabetes, Hypertension, and IHD.

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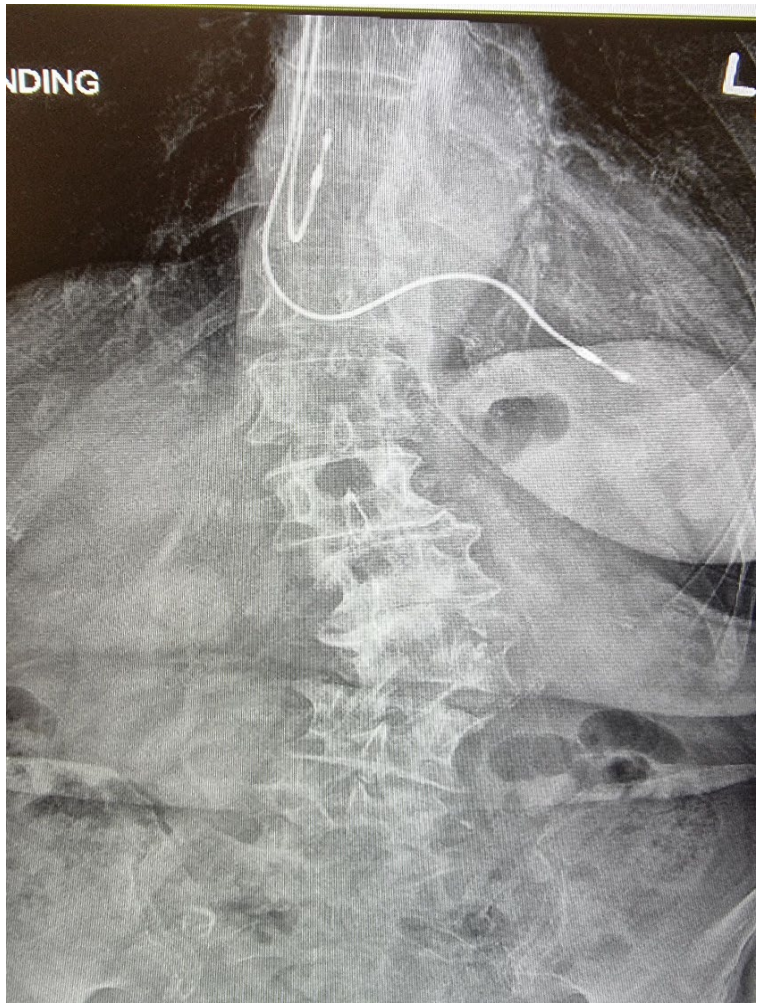
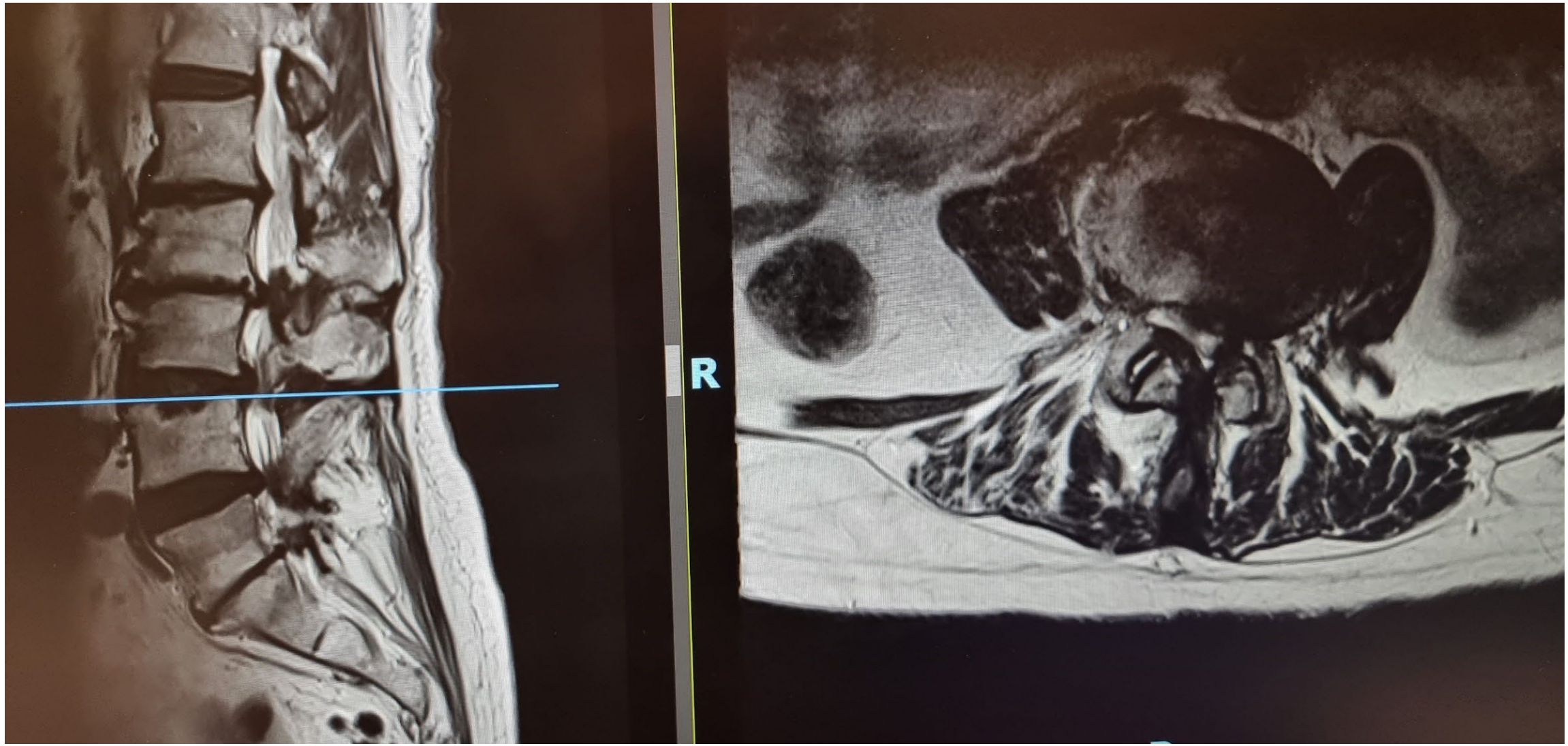
84 years old with severe symptoms, osteoporosis, arrhythmia and cardiac pacemaker.

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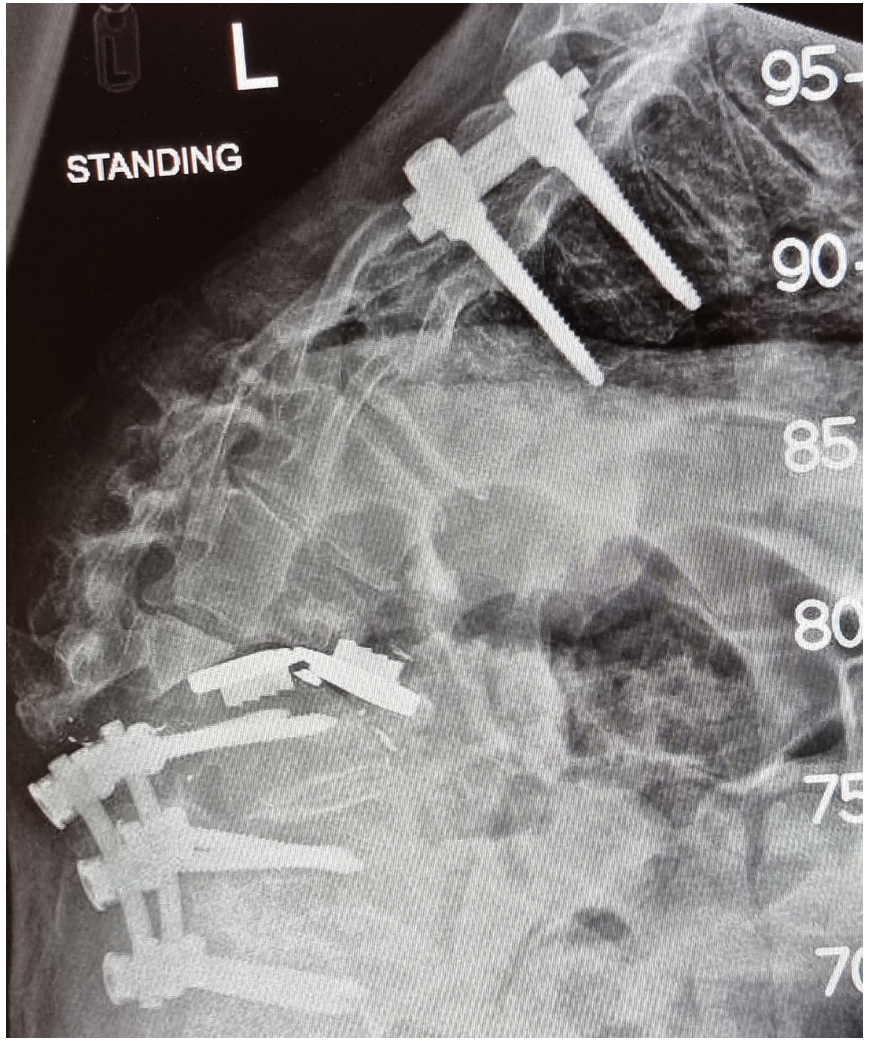
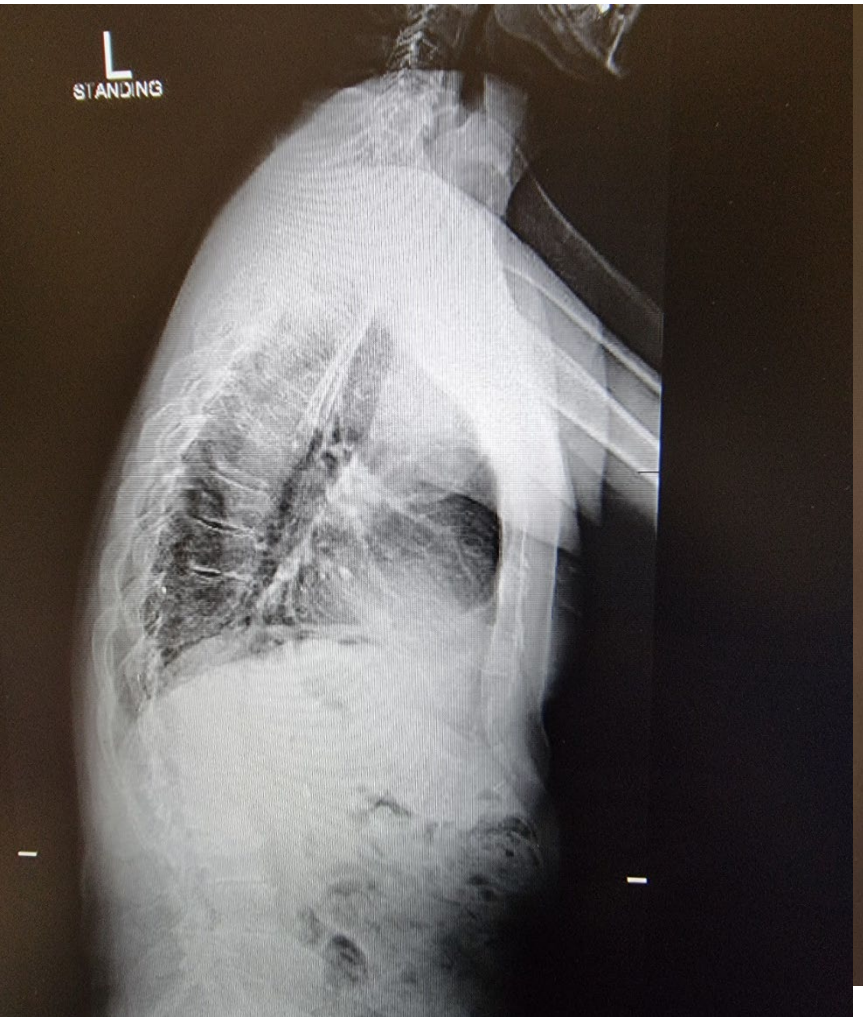
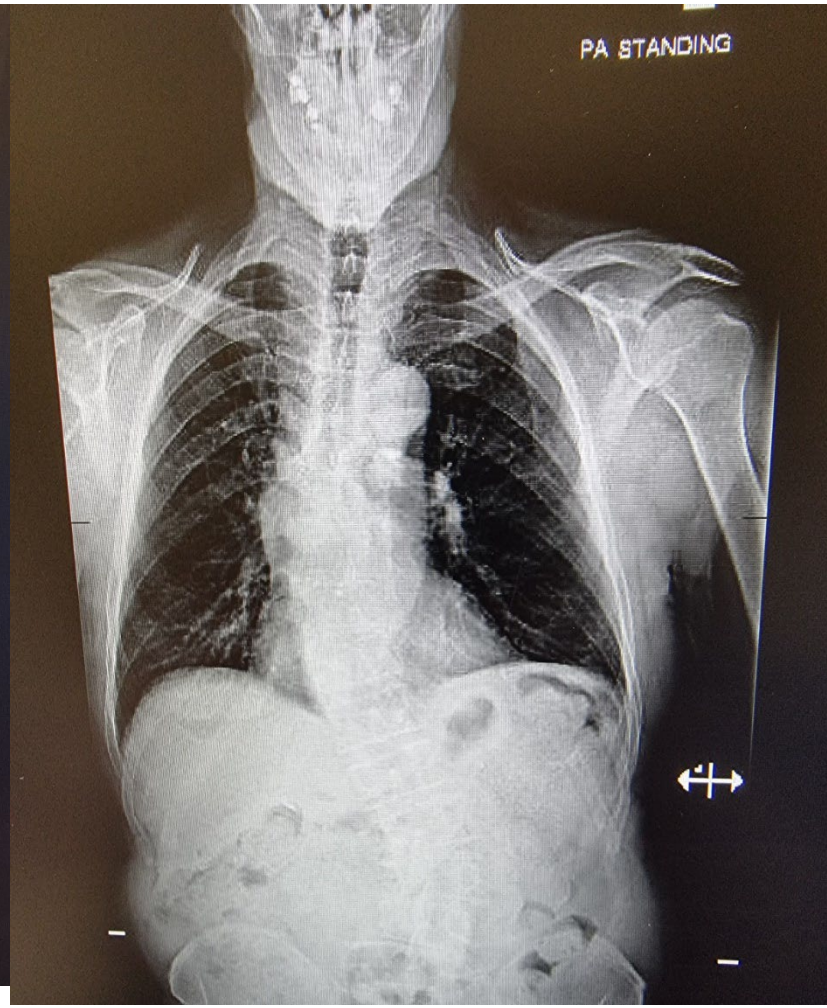
82 year old male with 8 previous surgeries & multiple comorbidities.

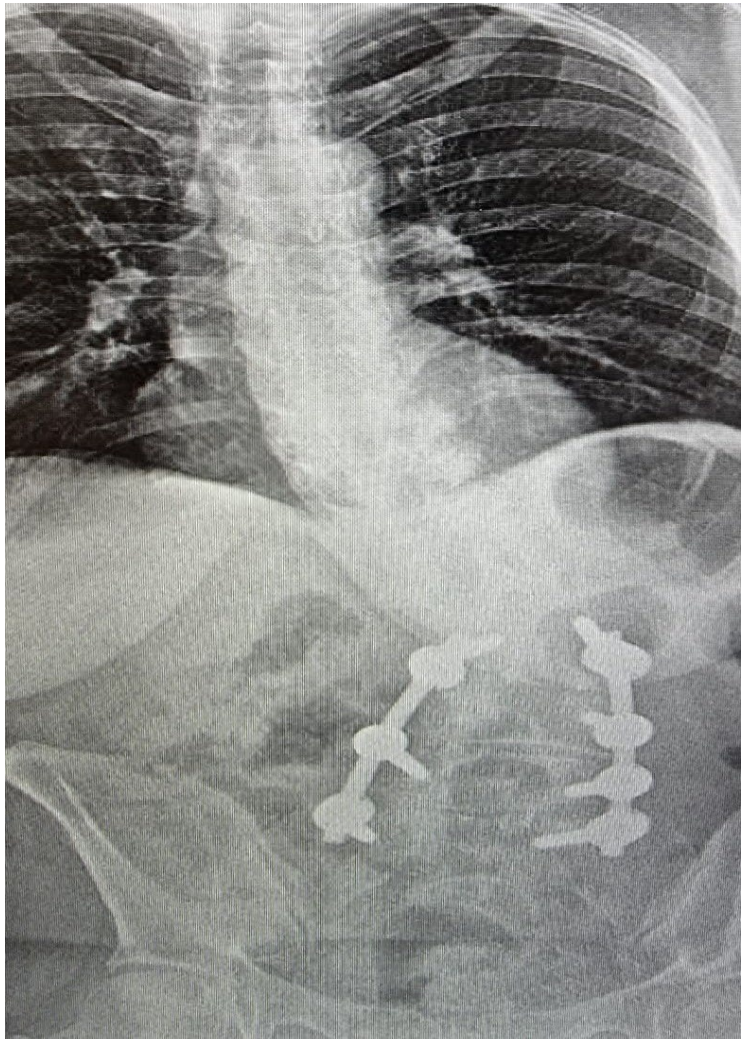


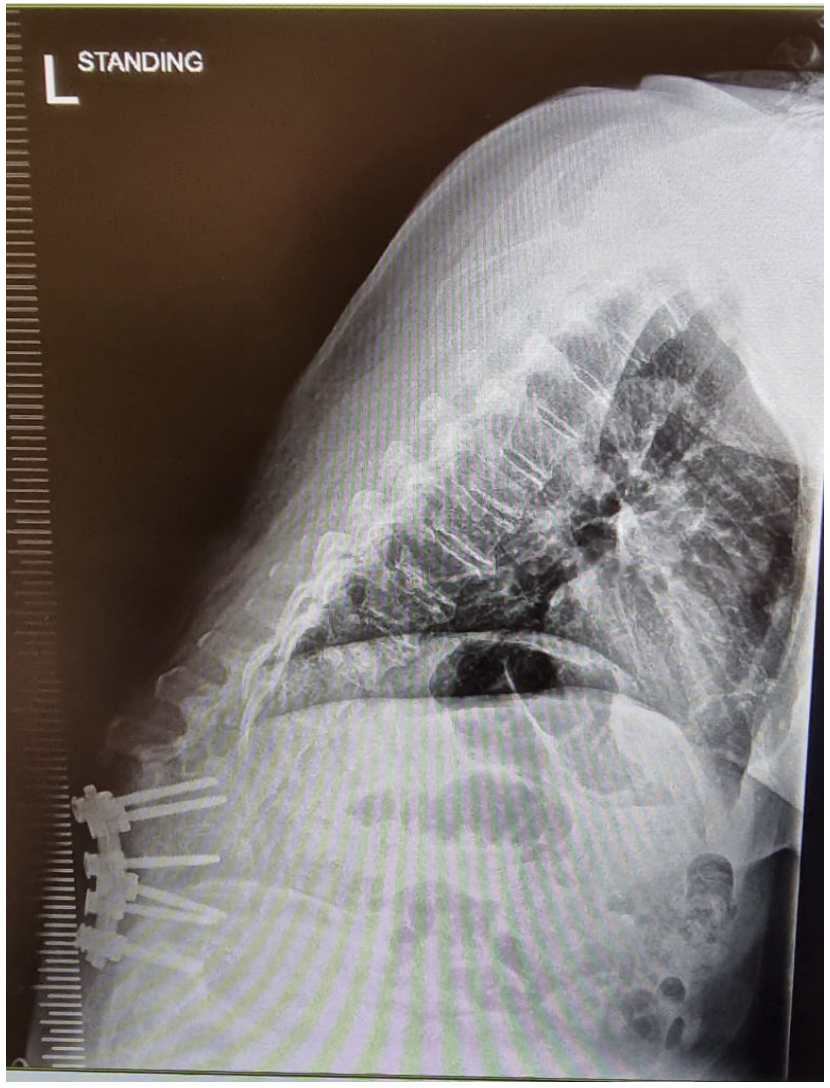
78 years old man. History of IHD, osteoporosis, previous 2 decompression surgeries.





66 Yrs old woman. 7 previous spinal surgeries, Hypertension, Renal Failure & Osteoporosis.



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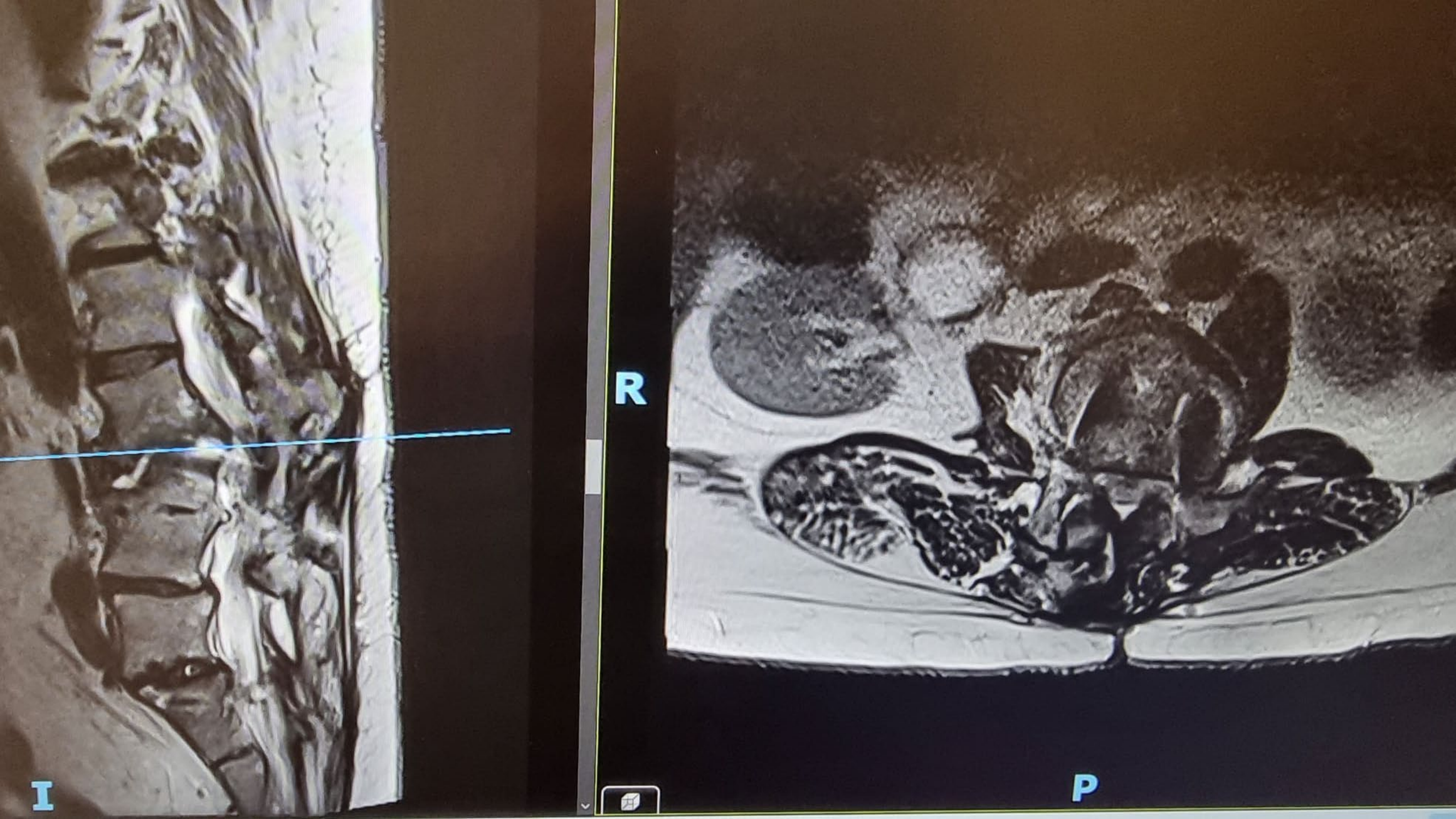
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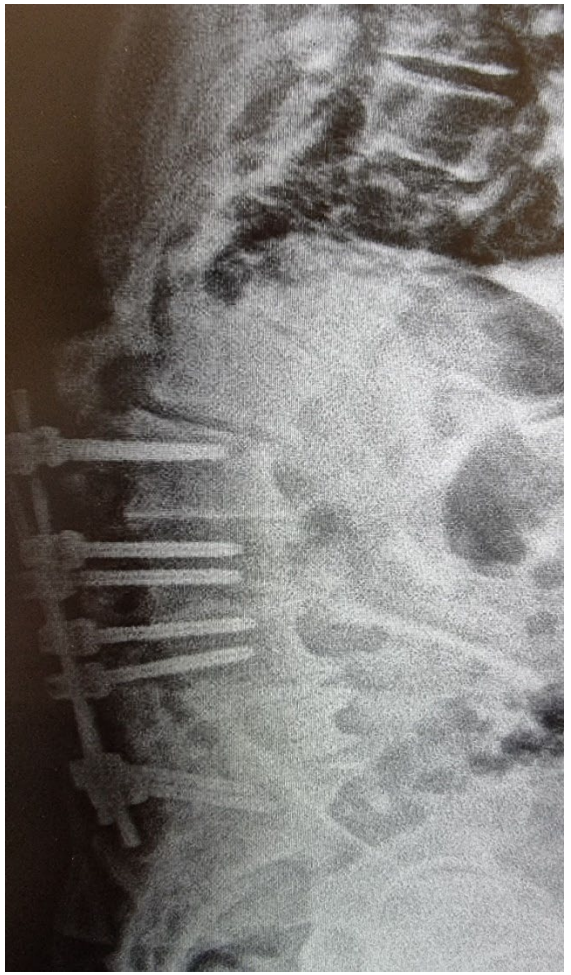
77 years old man, five previous lumbar surgeries, impaired respiratory function, lung cancer survivor, with one lung related to past lobectomy



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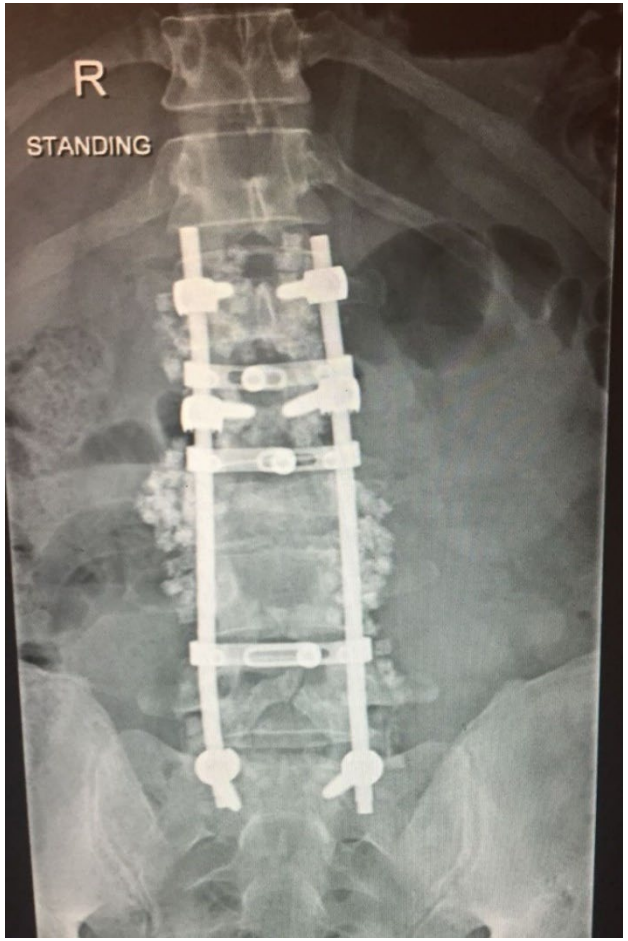
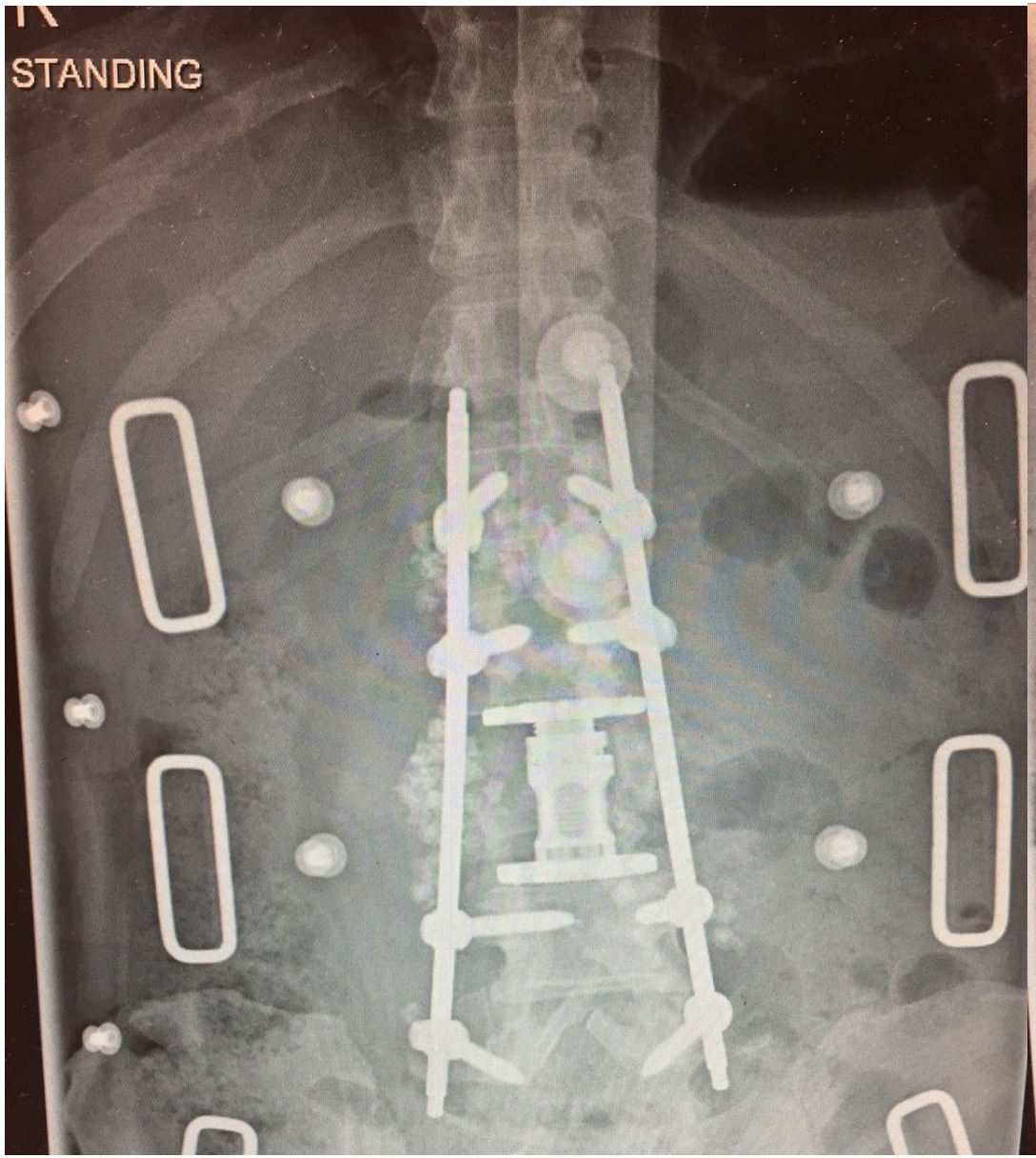
Adult deformities and Traumatic deformities.

-Traumatic deformities.

-Adult deformities

47 years old man, RTA eight months back. Severe progressive pain and lower limb numbness.

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What makes adult deformities special entity and difficult to manage

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The essential aim of any deformity surgery is the restoration of the lordotic curve and so to re-harmonize pelvic incidence/lumbar lordosis match and alignment.

The evidence is that pelvic incidence/lumbar lordosis mismatch ***more than 11°*** is a threshold for spinopelvic malalignment associated with increasing pain and disability.(3).

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L5/S1 Disc and facets.

- Huge stress and load.
- Larger surface area.
- Significant angulation.
- Most of the lordosis.
- Represents the spinal-pelvic articulation.
- And yet, less frequently affected by the significant degenerative process and uncommonly the centre of the degenerative deformity.

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Treatment and Decision Making, what to consider:

-Severity and progression of symptoms.
-Severity of the progression of the deformity.
-Patient selection for surgery is key for successful treatment.
-Co-existent comorbidities.
-Bone quality, osteopenia and osteoporosis.

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-Patient expectation.

-Prolonged recovery.

-High complication rates.

-Significant expense.

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Patient selection for surgery is key for successful strategy.

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Complex deformity correction:

- Rigidity of the deformities is the key.

- Properly chosen instrumentation segments and adequate spinal osteotomies, flexibility and correction could be obtained.

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Posterior spinal osteotomies are graded into 6 grades. From 1 to 6. Starting with grade 1 with partial facet resection ending with grade 6 with 3 vertebral columns resection.(8).

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Key points:

Severity of the deformity?

Flexibility/rigidity of the deformity.

Patient’s fragility(associated co-morbidities) and bone fragility(osteoporosis and osteopenia).

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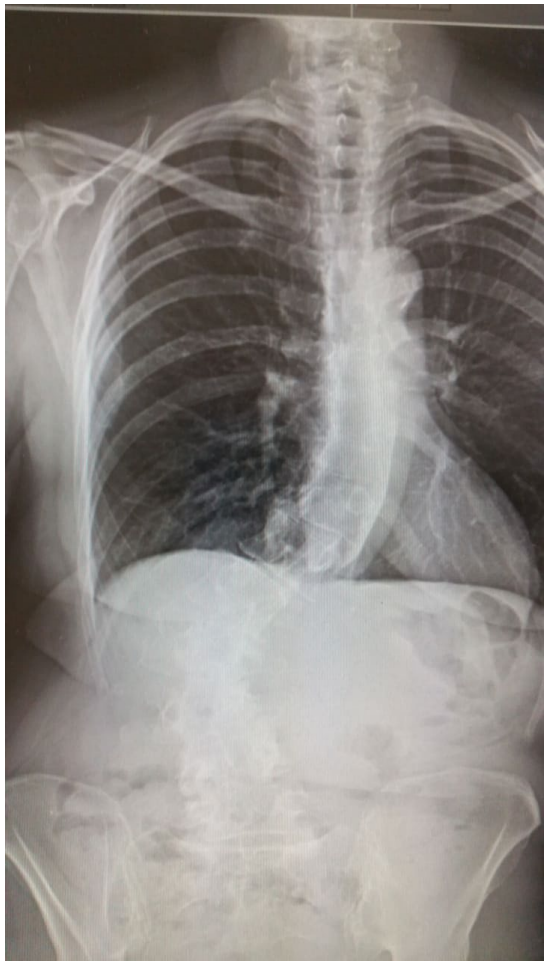
Group1 : Less rigid deformities. Deformities in this group could be corrected with minimally invasive procedures or posterior surgeries with osteotomies involving the posterior neural arch only. Schwab 1 or 2.

Group 2: Rigid deformities.

Group 3: Extremely rigid deformities. When there is bony fusion mass bridging adjacent spinal segments.

Group 2 and 3 need more aggressive release/osteotomy to obtain disconnection and flexibility of the spinal segments in order to achieve adequate deformity correction.

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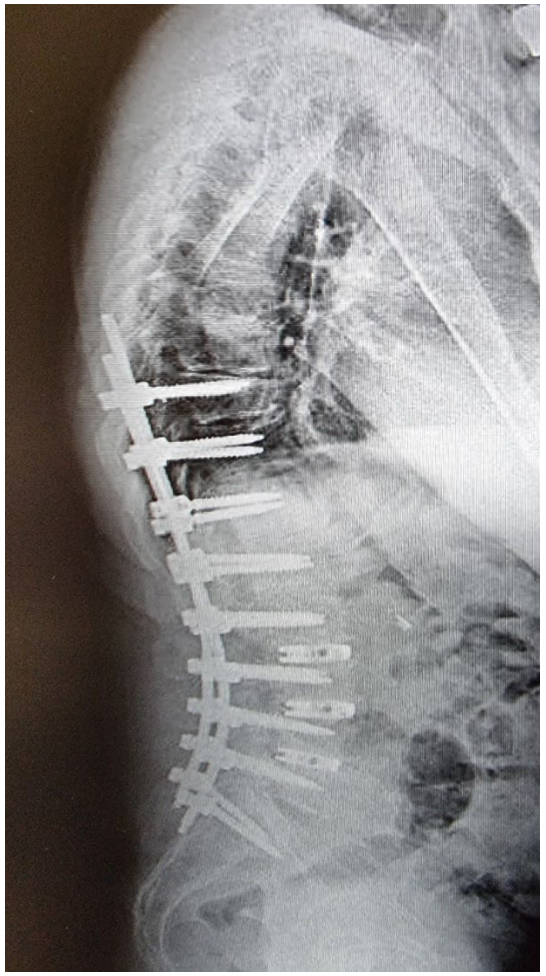

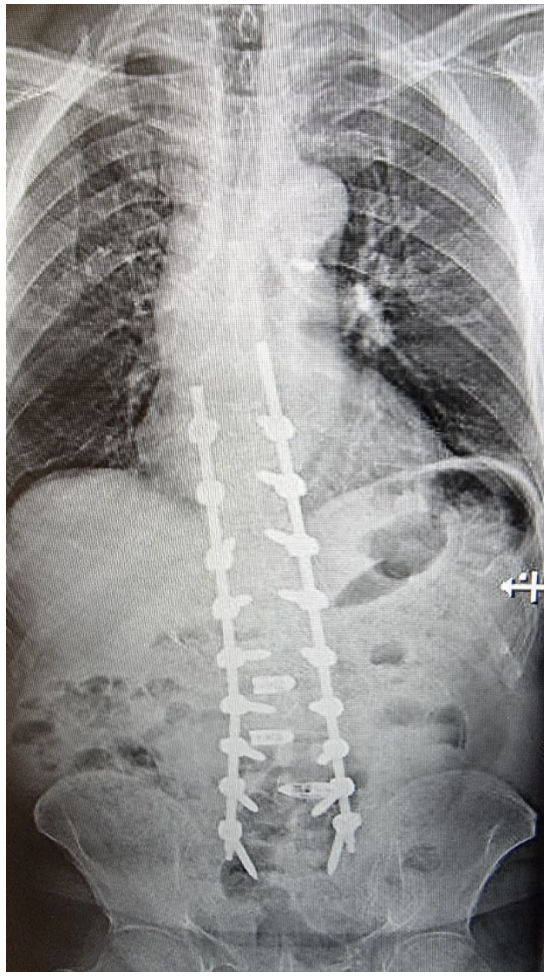


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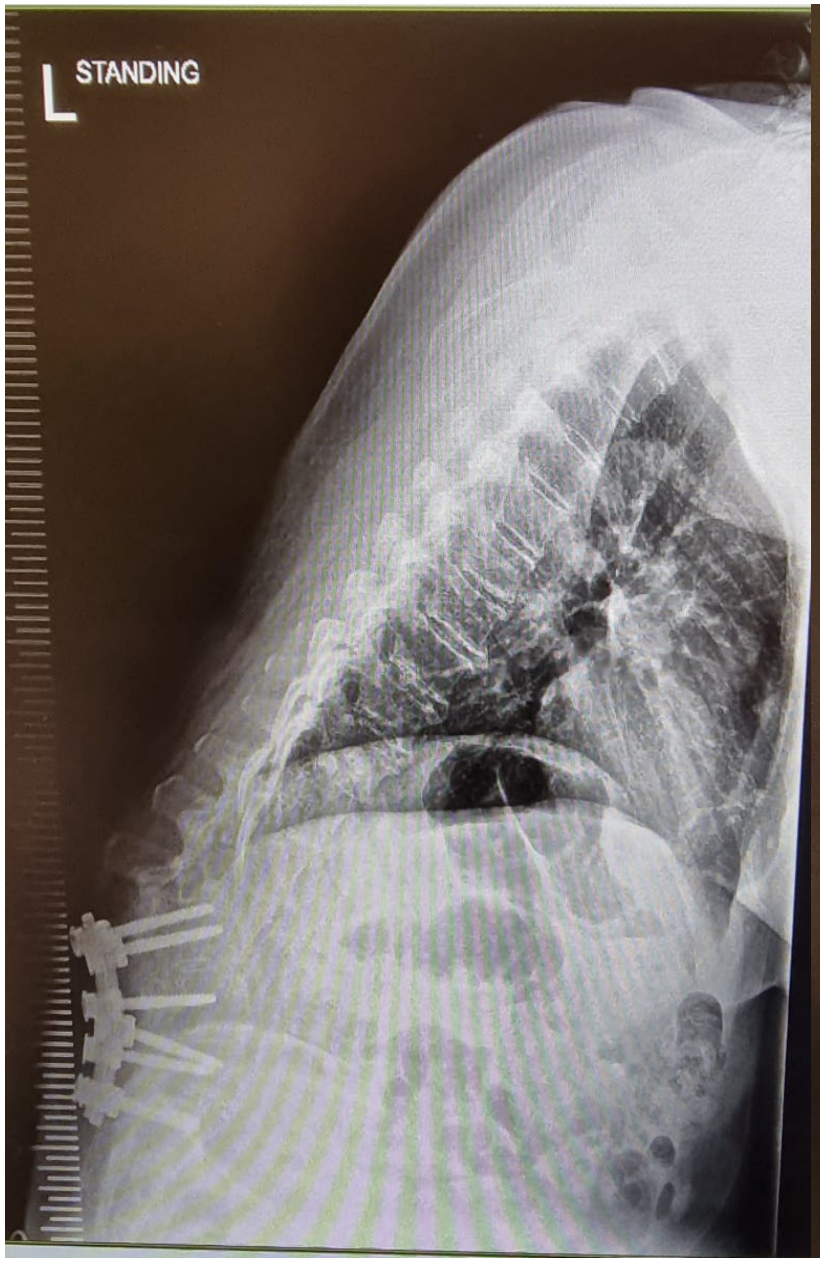
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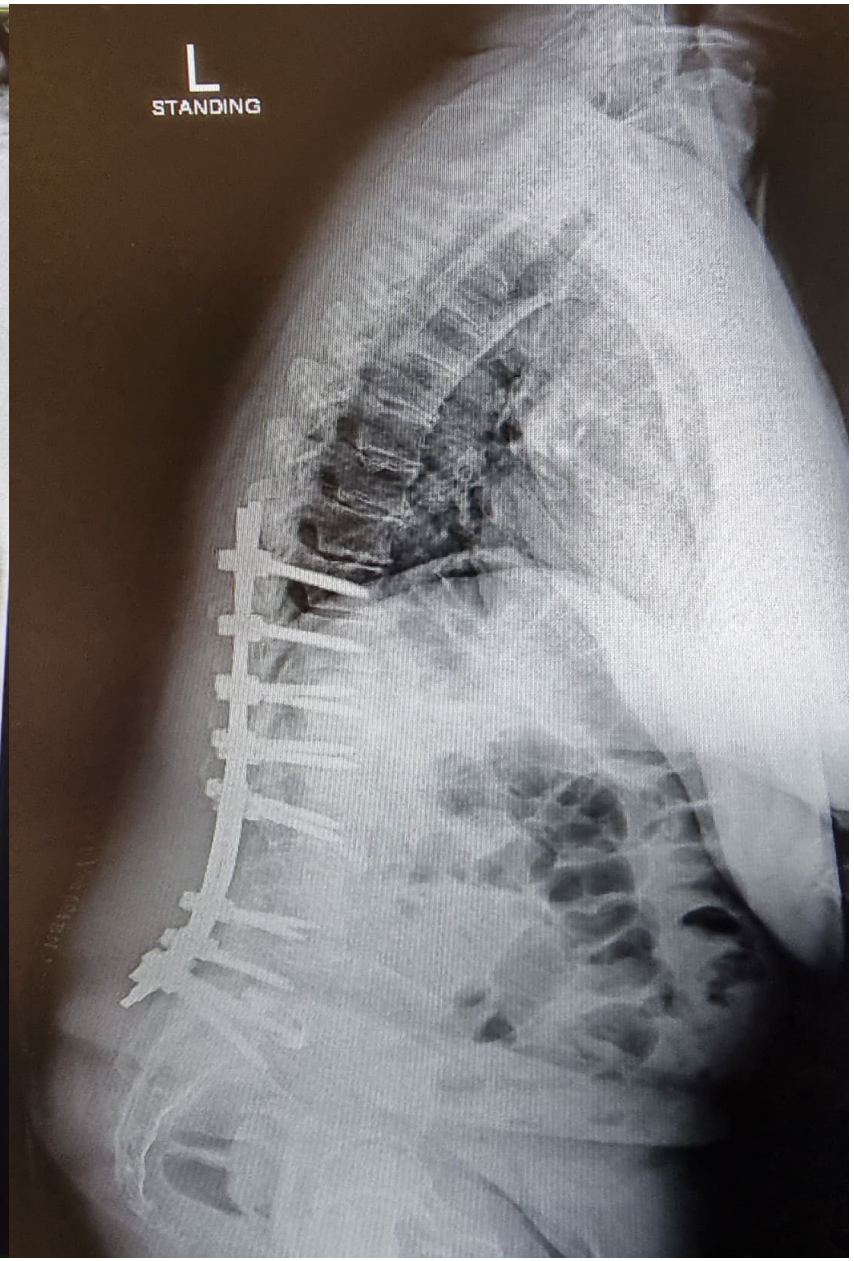
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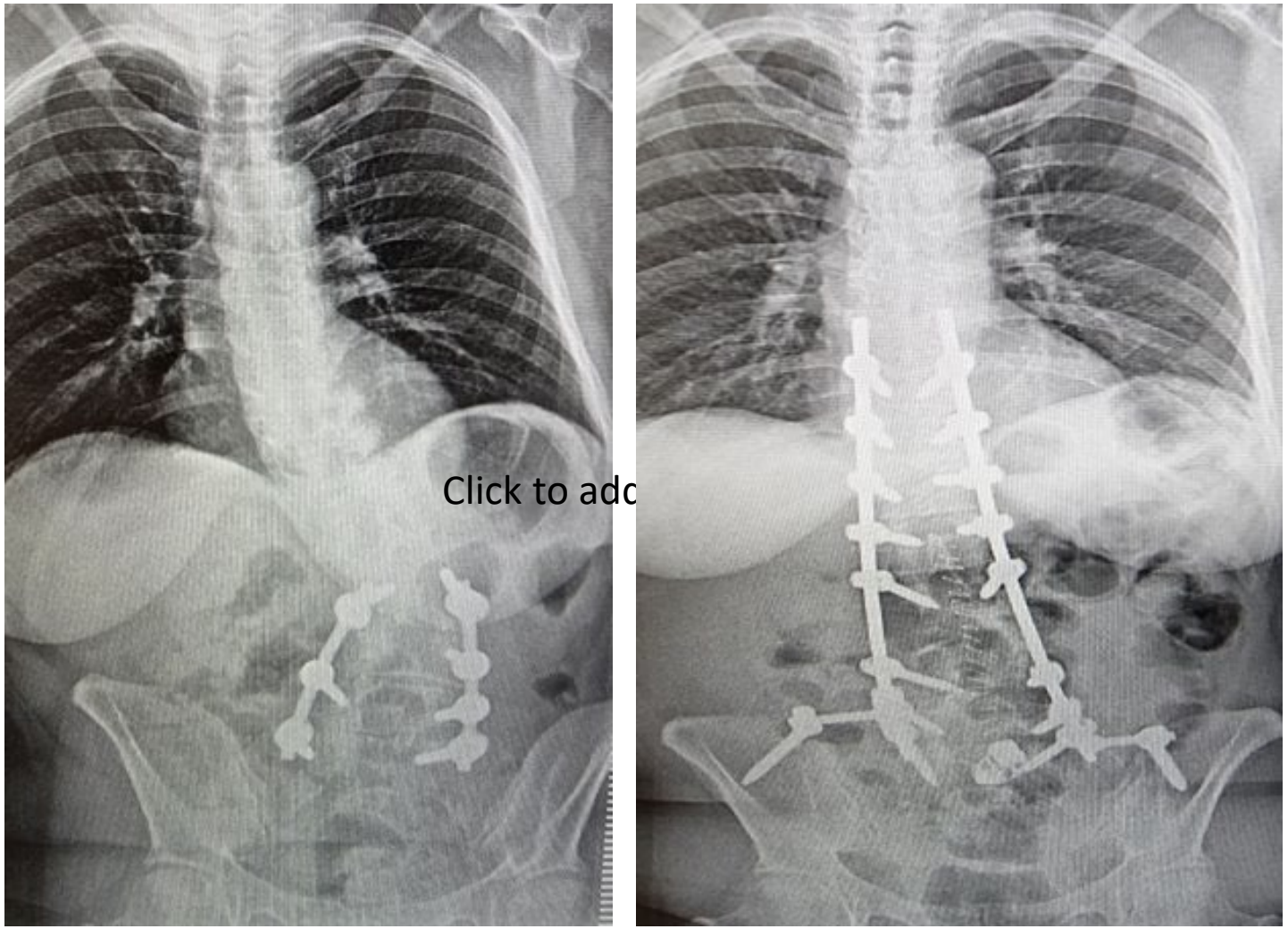
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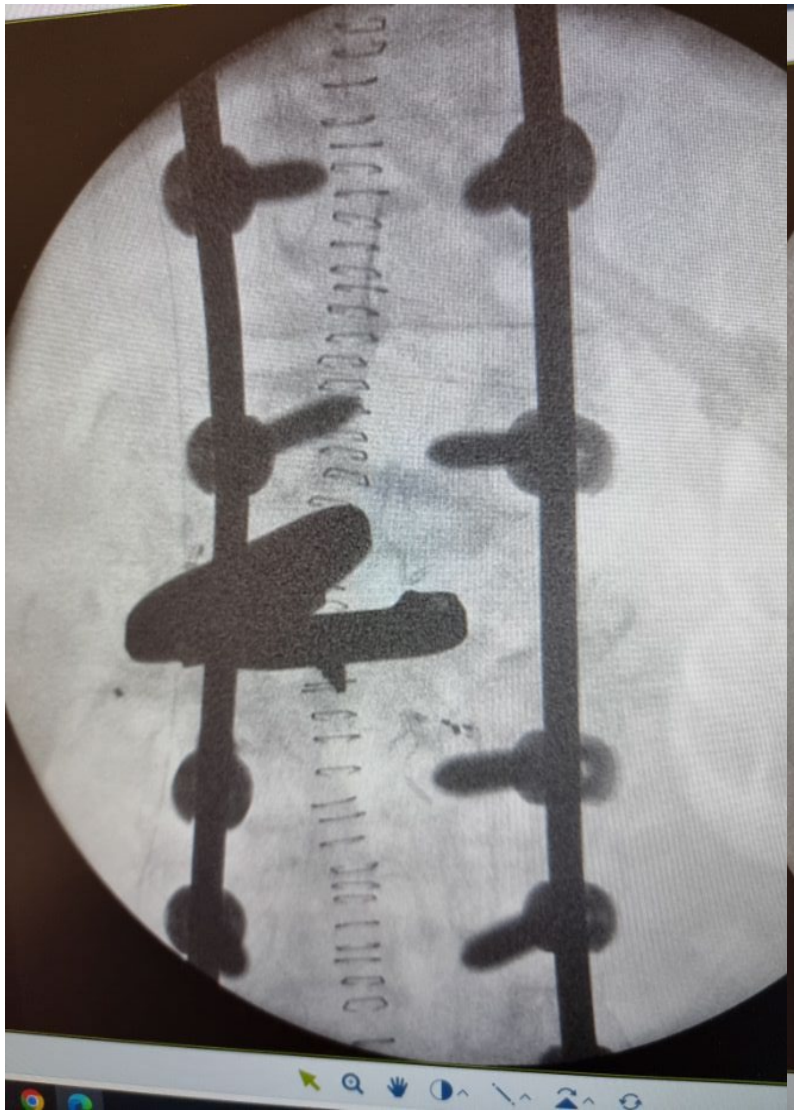

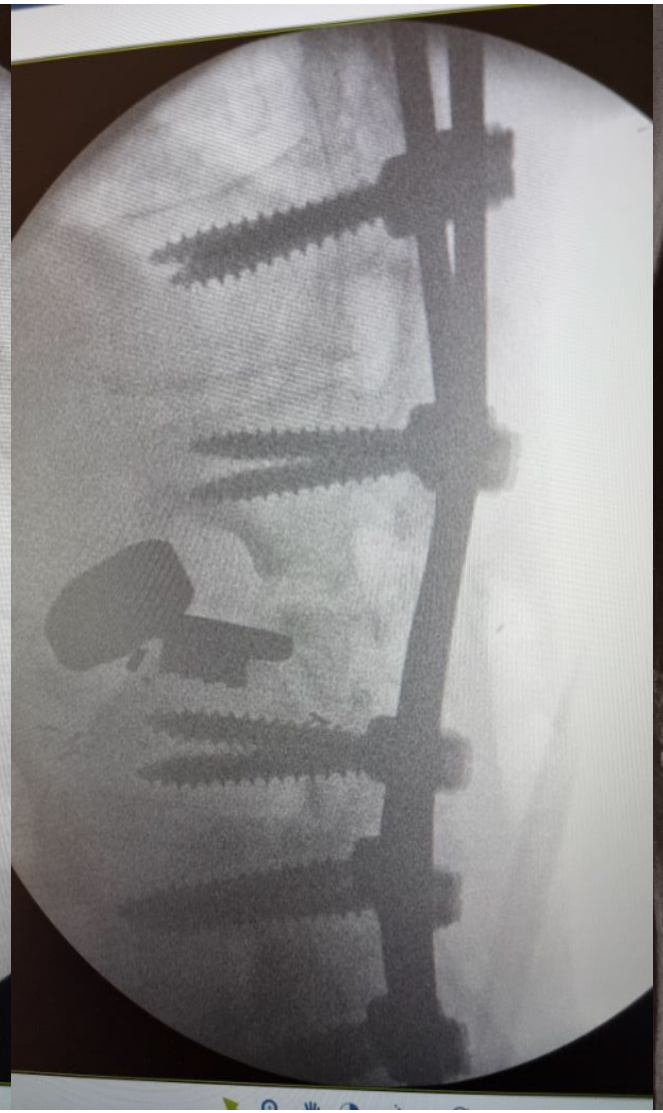

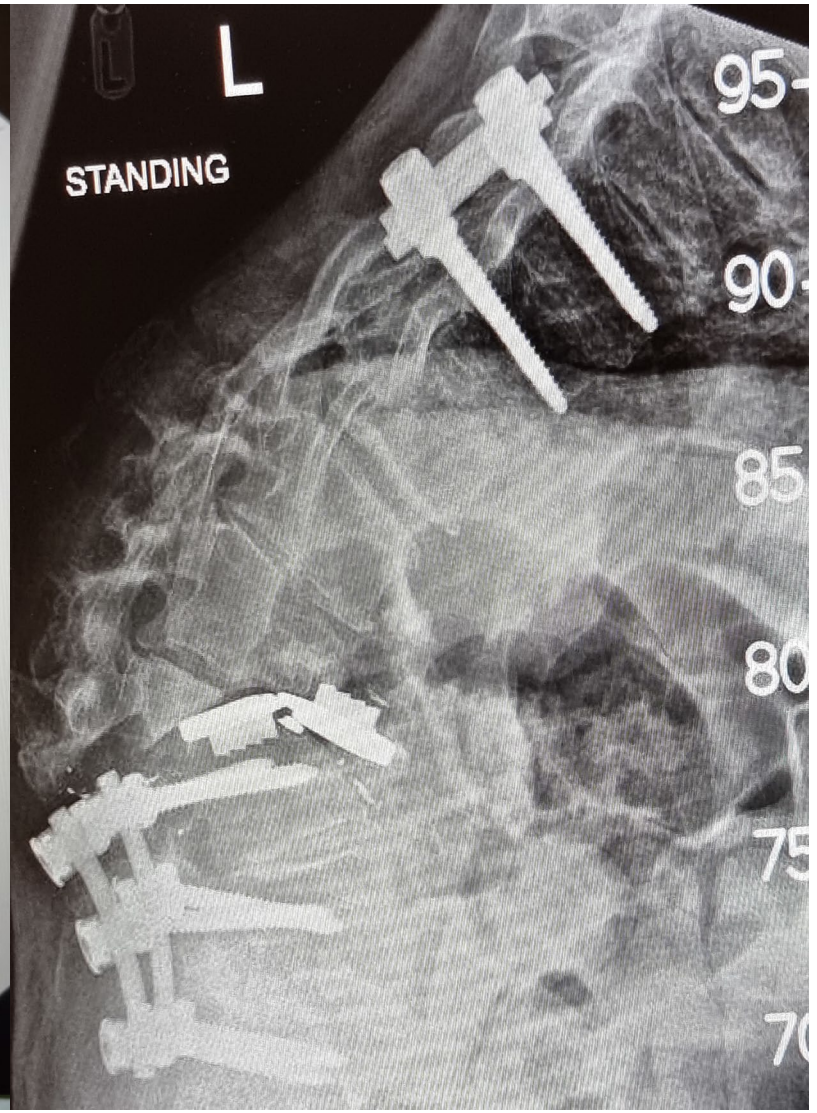
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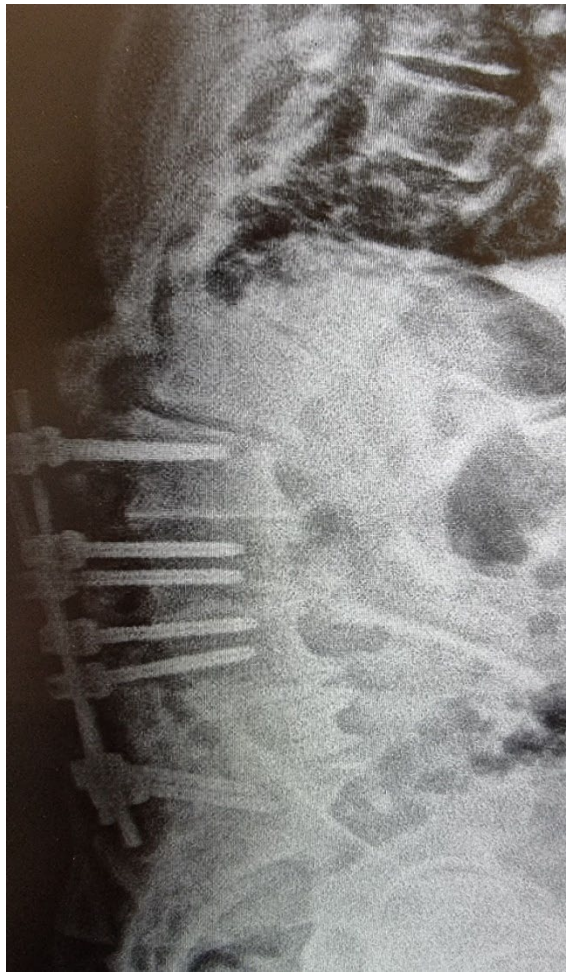

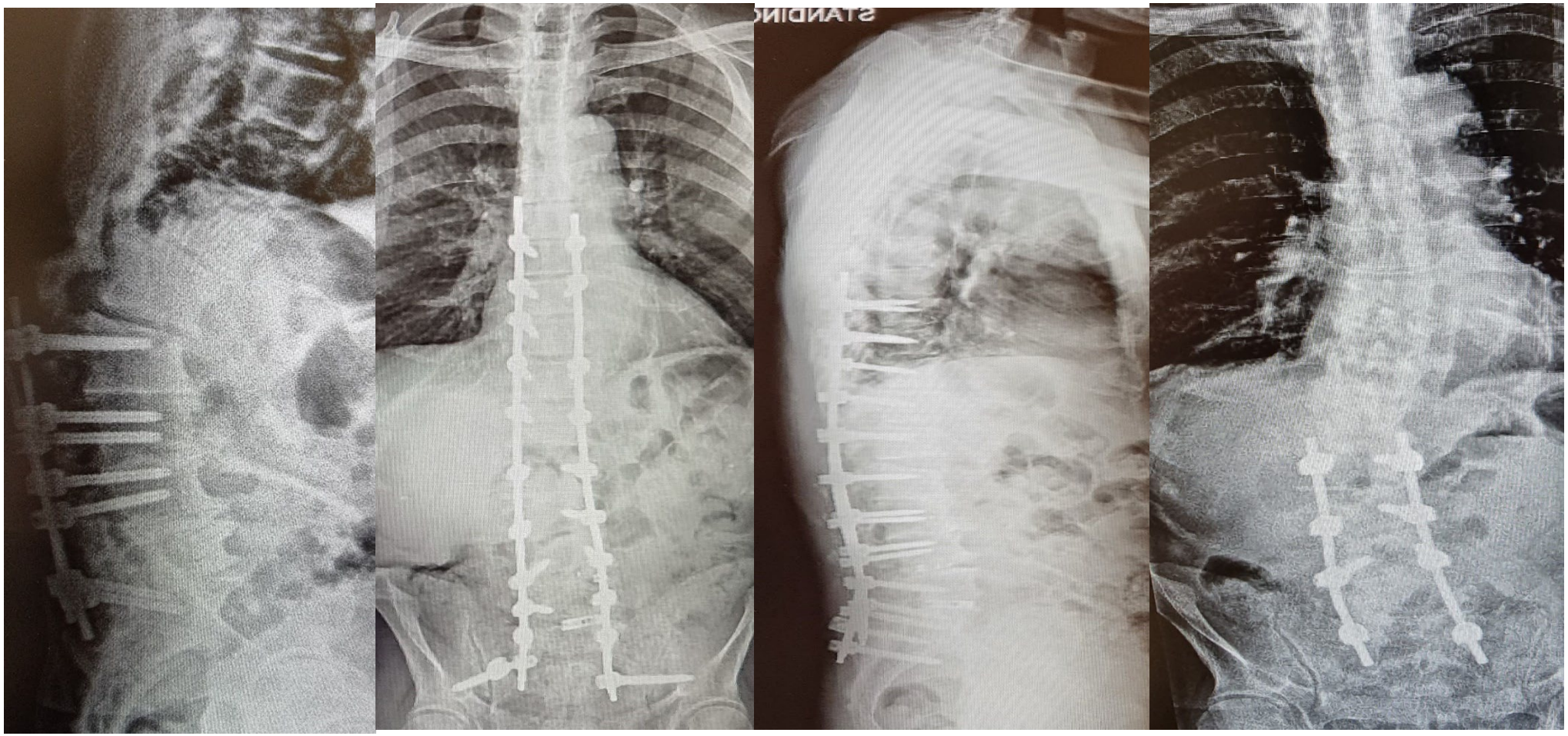


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Conclusion

- Patient selection is the key .
- Three factors to determine intraoperative technical challenges and subsequently may define the ultimate deformity correction and result.
  - Curve rigidity
  - Patient comorbidities and ability to withstand stressful lengthy surgery
  - Bone quality and osteoporosis

Thank You

References

1-Schwab F, Dubey A, Gamez L, et al. Adult scoliosis: prevalence, SF-36, and nutritional parameters in an elderly volunteer population. *Spine (Phila Pa 1976)* 2005;30:1082–5

2- Diebo BG, Shah NV, Boachie-Adjei O, et al. Adult spinal deformity. *Lancet.* 2019;394:160–72.

3-Sparrey CJ, Bailey JF, Safaee M, et al. Etiology of lumbar lordosis and its pathophysiology: a review of the evolution of lumbar lordosis, and the mechanics and biology of lumbar degeneration. *Neurosurg Focus.* 2014;36:E1.

4-Berthonnaud E, Dimnet J, Roussouly P, Labelle H. Analysis of the sagittal balance of the spine and pelvis using shape and orientation parameters. *J Spinal Disord Tech.* 2005;18:40–7.

5- Dagdia L, Kokabu T, Ito M. Classification of adult spinal deformity: review of current concepts and future directions. *Spine Surg Relat Res.* 2018;3:17–26.

6-Kim HJ, Yang JH, Chang DG, et al. Adult Spinal Deformity: Current Concepts and Decision-Making Strategies for Management. *Asian Spine J*. 2020;14(6):886-897. doi:10.31616/asj.2020.0568

7-Bridwell KH. Decision making regarding Smith-Petersen vs. pedicle subtraction osteotomy vs. vertebral column resection for spinal deformity. *Spine (Phila Pa 1976)* 2006;31(19 Suppl):S171–8.

8-Schwab F, Blondel B, Chay E, et al. The comprehensive anatomical spinal osteotomy classification. *Neurosurgery.* 2014;74:112–20.

9-Schwab F, Ungar B, Blondel B, Buchowski J, Coe J, Deinlein D, DeWald C, Mehdian H, Shaffrey C, Tribus C, Lafage V. Scoliosis Research Society-Schwab adult spinal deformity classification: a validation study. Spine (Phila Pa 1976). 2012 May 20;37(12):1077-82. doi: 10.1097/BRS.0b013e31823e15e2. PMID: 22045006.