

# CT Classification System of Intervertebral Disc Features for PCO Surgeries

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## Goals of Present Study

- Determine effect of disc space characteristics on lordosis addition in posterior column osteotomy (PCO) surgery
- Create guide for surgeons to decide how many and which levels to operate on for maximum results with least invasion

## Background/Introduction

During development, the spinal column takes on a natural set of curvature. Disruption of the curves causes instability, pain, and degenerative problems. As the United States average life span has continued to lengthen, we have also seen an increase in patients with degenerative spinal disorders and disruption of natural curvature.

PCO is a common surgical procedure for treating patients with curve deformities. There is much literature on why this procedure is chosen, how it is completed, and common results. Effects of global sagittal balance on PCO outcomes has also been studied extensively. However, there is no current literature describing effects of intervertebral disc characteristics (such as disc height, segmental lordosis, vacuum disc, etc.) affect surgical outcome.

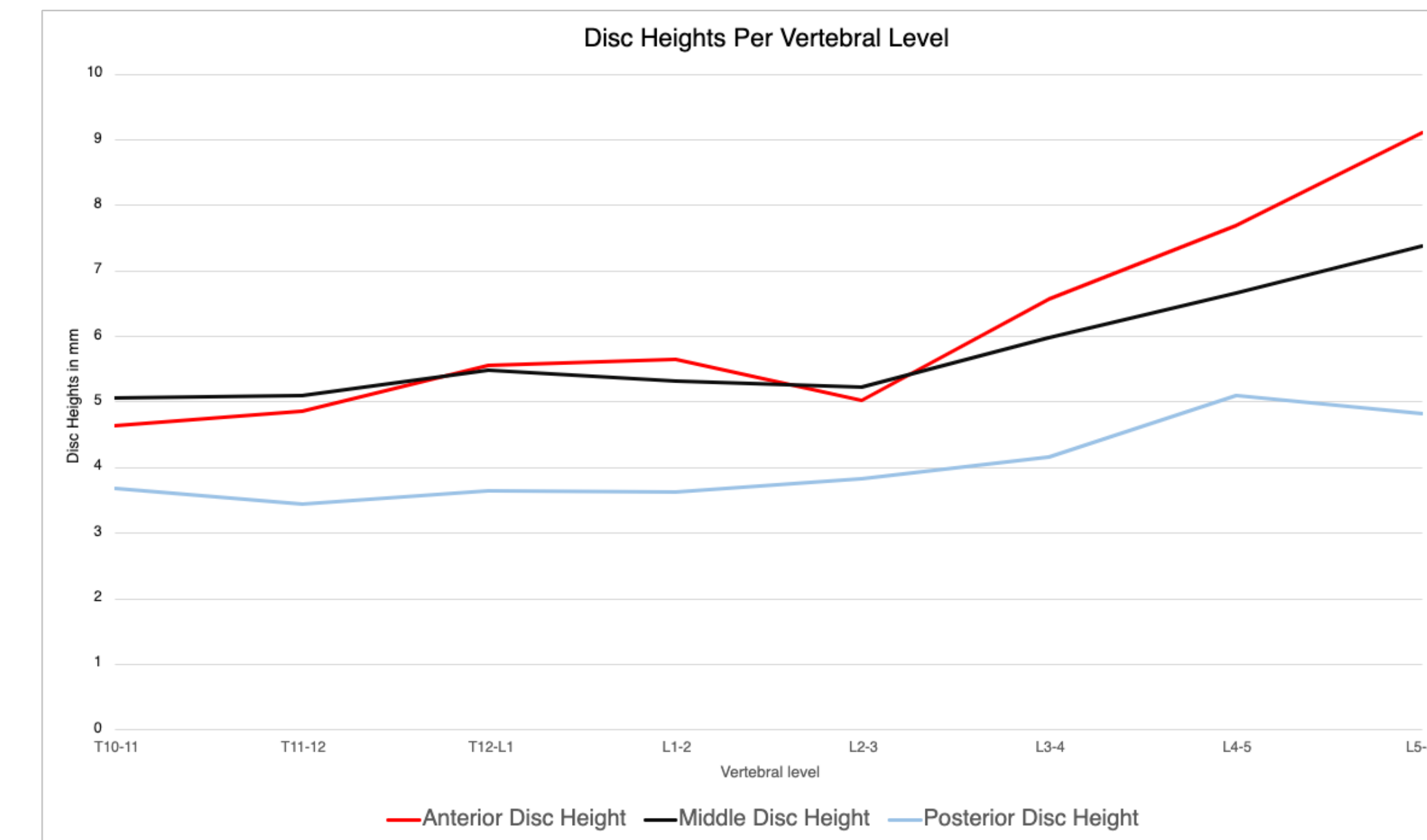
## Methodology

- Retrospective study of spinal deformity patients over 18yo with long segment (5+ level) fusion and PCO surgery between 2013 and 2018 at a single center.
- Preoperative, early and late postoperative standing scoliosis x-rays and preoperative supine CT scans
- T10 to sacrum disc features as follows:
  - Anterior, middle, posterior disc heights
  - Segmental disc lordosis
  - Vacuum disc
  - Osteophyte
  - Spondylolisthesis grade
- Global sagittal measurements (Cobb angles and vertical axis) were also collected.

## Results

- 62 patients; 42 F: 20 M
- Average age 63.6 and BMI 31.71 kg/m<sup>2</sup>
- Average disc heights are as follows with each increasing further down the spine (Graph 1):
  - anterior 6.142 mm
  - middle 5.778 mm
  - posterior 4.041 mm

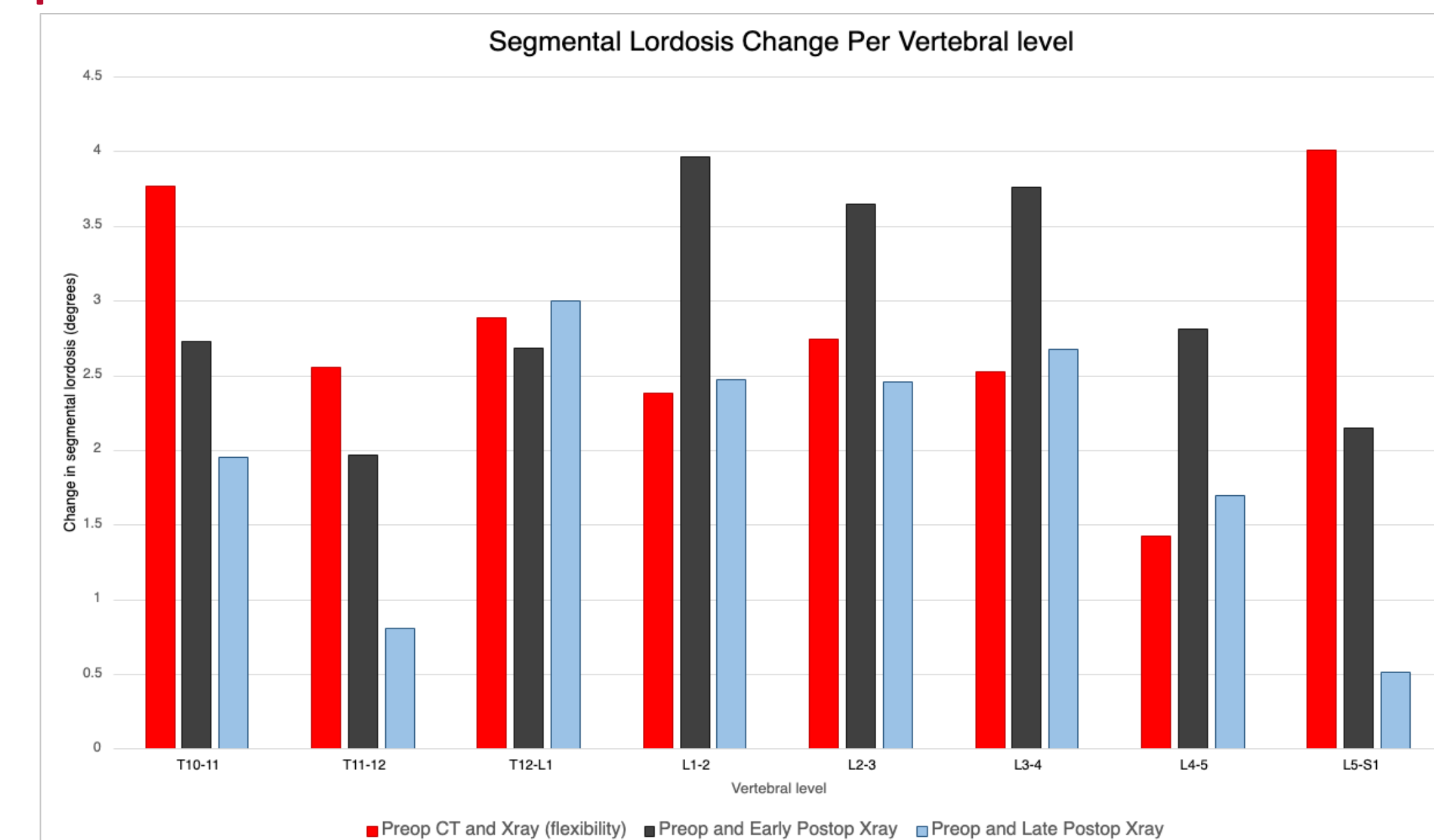
Graph 1



Graph 1: Disc Heights Per Vertebral Level  
Preoperative Xray anterior, middle, and posterior disc heights were larger, on average, lower in the spine (L3-S1) and smaller in the upper region of our analysis (T10-T12). Anterior disc height was greater than middle disc height except at T10-11 and L2-3, and both were always greater than posterior disc height.

- The greatest flexibilities (change in lordosis between pre-op x-ray and CT) were at T10-11 and L5-S1 (Graph 2-red)
- Average change between pre-op and early post-op segmental lordosis (Graph 2- black) were greatest at levels L1 through L4
- Average change in segmental lordosis between pre-op and late post-op x-rays (Graph 2-blue) were consistently less than early changes - T12-L1 was an exception

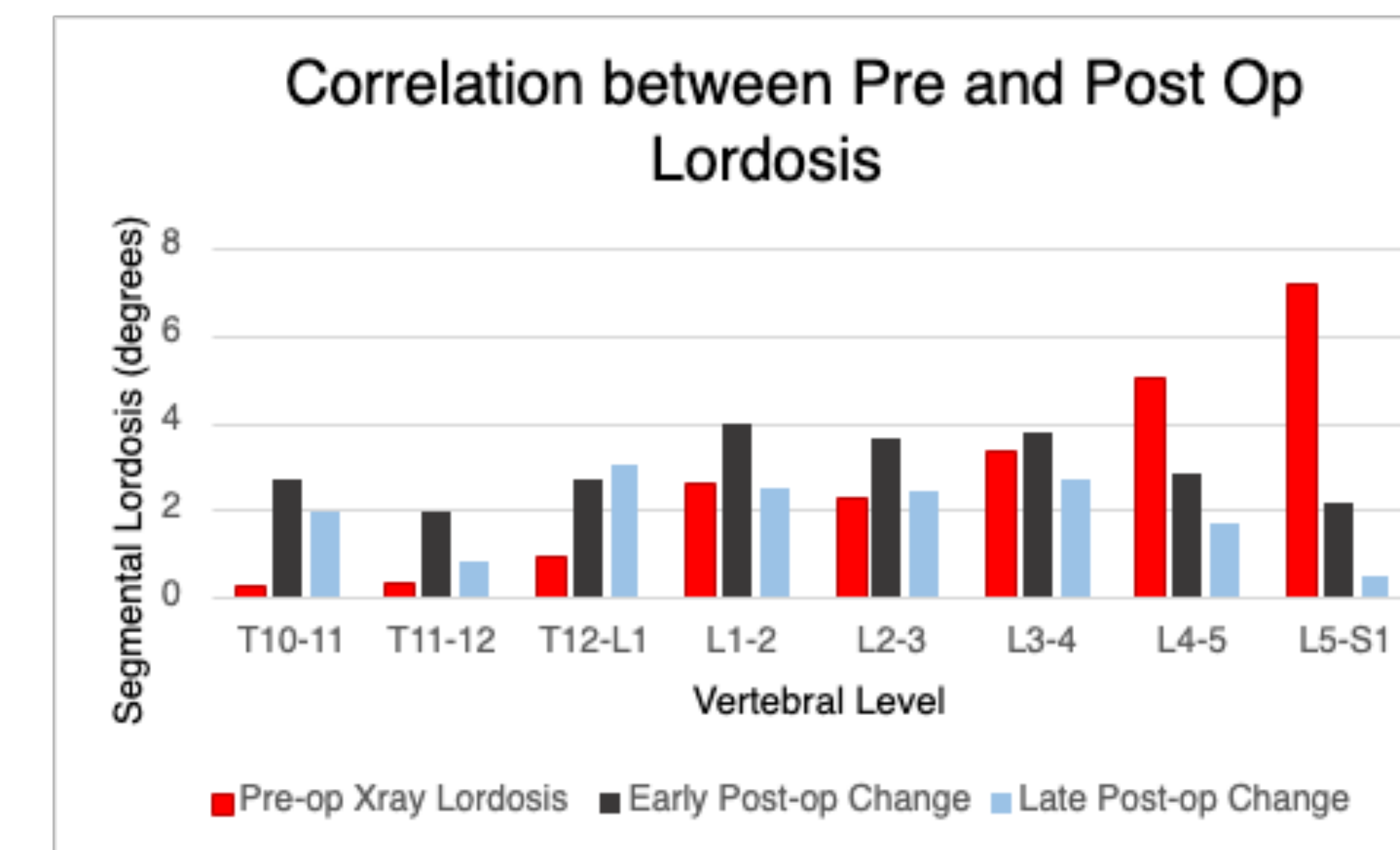
Graph 2



Graph 2: Segmental Lordosis Change Per Vertebral level  
Red bar shows flexibility measure – difference in preoperative supine CT lordosis and standing scoliosis Xray lordosis. Black bars show early change in segmental lordosis (pre-op x-ray segmental lordosis-early post-op x-ray segmental lordosis) and blue bar show late post-operative segmental lordosis changes. No statistically significant correlation between flexibility and post-operative changes in lordosis

- Preoperative segmental lordosis was larger in lower lumbar spine than in lower thoracic spine (Graph 3)
- Negative correlation between preoperative lordosis and early postoperative lordosis

Graph 3



Graph 3: Correlation between Pre and Post Op Lordosis  
There is a statistically significant negative correlation between preoperative Xray segmental lordosis and postoperative lordosis in the lumbar region, specifically early postoperative change.

## Discussion

### Disc Heights

Although our results (Graph 1) were similar to other published articles - lower lumbar vertebral discs are taller in height than upper lumbar and lower thoracic disc heights - our average disc heights were shorter in all levels and regions (anterior, middle, posterior) than other literature<sup>(1)</sup>.

Anterior disc height was always larger than posterior disc height, showing positive lordotic curvature at each segment or level.

Obese patients are noted to experience increased mechanical load, diminished blood supply, and chronic inflammation<sup>(2)</sup>. These factors may account for the observed reduction in disc height as our average BMI was over 30.

### Segmental Lordosis Changes

Similar to disc heights, our results showed less degrees lordosis added at all levels compared to what existing literature suggests is commonly obtained<sup>(3)</sup>.

Preoperative flexibility (difference in segmental lordosis between standing X-rays and supine CTs) showed no statistically significant correlation in operative changes in lordosis.

There was a significant negative correlation between preoperative Xray segmental lordosis and early postoperative change in lordosis in the lumbar region (Graph 3). This relation is especially prominent between T12 through S1.

## Conclusions

This project showed the significance of measuring preoperative sagittal measures, disc heights, and segmental lordosis when planning PCO surgeries.

However, our study showed limitations in not only the number of patients examined with PCOs, but also limitations in our patient demographics.

It's important to note that while our study had 62 patients, not all patients had a PCO at each level studied here. There were more PCOs completed at the T11-L2 levels than the other levels which may affect our data. Additionally, our patient population had an average BMI over 30 kg/m<sup>2</sup> (obese).

## Next Steps

- Increase sample size for all levels to approximately the same amount
- Include more patients in healthy weight and overweight BMI range (18-29.9 kg/m<sup>2</sup>)
- Narrow analysis to thoracolumbar junction (T10-L2) to determine if these levels have greater effect on increasing lordosis of entire lumbar region
- Examine the following disc features effects of lordotic change: vacuum disc grade, auto-fusion, osteophyte grade, and spondylolisthesis grade and direction

## Acknowledgements

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## References

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