

Meeting Reports/Abstracts

Natural History of Adult Spinal Deformity: How Do Patients with Less Than Optimal Surgical Outcomes Fare Relative to Non-Operative Counterparts?

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Introduction

Management of adult spinal deformity (ASD) increasingly favors operative intervention, however complication rates remain high. This study compares health-related-quality-of-life (HRQL) metrics of patients with suboptimal surgical outcomes to non-operative management, which approximates the natural history of ASD.

Methods

This is a retrospective analysis of operative and non-operative patients (≥18yo) from a single-center ASD database. Patients with baseline and 2-year follow-up were included. For non-operative patients, decision to forego surgery was made by the patient. Operative patients were selected for "suboptimal outcomes," defined as any reoperation, major complication, or ≥2 severe SRS-Schwab modifiers at 2-years. Suboptimal operative (SOp) vs. natural history (NH) groups were propensity score matched (PSM) by age, deformity, Oswestry-Disability-Index (ODI), and comorbidities. Means comparison tests assess differences in improvement and rates of achieving minimal clinically important difference (MCID) in ODI and Scoliosis- Research-Society-22 (SRS-22).

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- a Rachel Joujon-Roche is a fourth-year medical student at Zucker School of Medicine and a research fellow under the guidance of spine surgeon, Dr. Peter Passias, in the Department of Orthopaedic Surgery at NYU Langone. Dr. Passias and his research team study the surgical correction of complex spinal deformities.

[Visit Dr. Passias's profile on the New York Spine Institute Website](#)

[Conflicts of Interest Statement for Ms. Joujon-Roche](#)

- b [Conflicts of Interest Statement for Peter Tretiakov](#)

- c [Conflicts of Interest Statement for Oscar Krol](#)

- d [Conflicts of Interest Statement for Tyler Williamson](#)

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- f [Conflicts of Interest Statement for Lara Passfall](#)

- g [Conflicts of Interest Statement for Dr. Vira](#)

[Visit the Open Payments Data Page for Dr. Vira](#)

- h Dr. Passias is a world leader in the surgical treatment of spinal disorders. Dr. Passias and his research team study the surgical correction of complex spinal deformities.

[Visit Dr. Passias's profile on the New York Spine Institute Website](#)

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Results

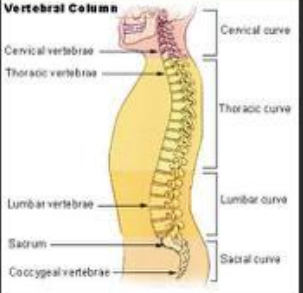
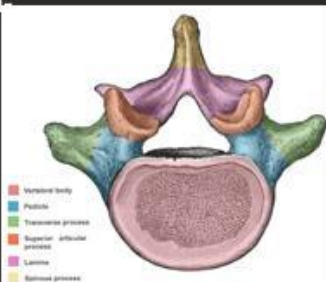
After PSM, 74 patients were included (37-SOp; 37-NH). SOp and NH groups were not significantly different in baseline demographics, HRQLs, or radiographic deformity (Table 1). At 2Y, SOp patients had greater improvement in ODI and higher rates of reaching MCID, both p -values $< .001$. SOp patients had significantly better SRS-22-Total, SRS-22-Pain and SRS-22-Satisfaction scores at 2Y, all p -values $< .001$. Finally, significantly more SOp patients gained ≥ 1 MCID in SRS-Activity and SRS-Pain, both p -values $< .002$.

Conclusion

Compared to the natural history of ASD, operative patients with suboptimal outcomes still experience significantly greater improvement in HRQLs. Such divergent outcomes at 2Y, highlight the stagnation and deterioration associated with the disease process. Spine surgeons should consider the outcomes associated with the natural history of ASD when weighing risks and benefits of operative intervention.

Background:

- Complications and reoperations after surgical correction of adult spinal deformity (ASD) remain high.
- In fact, a literature review across 25 studies ($n=1196$) by Teles et. al found the average rate of:
 - Post-operative complications was 39.62%
 - Revision was 15.71%
- At the same time, this same literature review found non-operative management had no effect on patient reported pain, disability or quality of life

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Introduction

Surgical correction of adult spinal deformity (ASD) is associated with a relatively high rate of post-operative complications and revisions. At the same time, non-operative alternatives have not shown to be particularly effective in improving quality of life for ASD patients.

This is the first of four award-winning presentations from the inaugural Medical School Orthopedic Society (MSOS) symposium. MSOS is a medical student-run initiative with a mission to support “research and educational opportunities for students interested in orthopedic surgery.”

This presentation was given by Rachel Joujon-Roche, a fourth-year medical student at Zucker School of Medicine and a research fellow under the guidance of spine surgeon, Dr. Peter Passias.

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Objectives & Hypothesis:

- This study aimed compare deformity and health-related-quality-of-life (HRQL) metrics of patients with suboptimal surgical outcomes to non-operative management, which approximates the natural history of ASD.
- Based on clinical experience, we hypothesized that despite suboptimal outcomes, operative patients would demonstrate greater improvement in HRQLs and deformity when compared to the natural history of disease.



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Objectives and Hypothesis

In this context, this study aimed to compare deformity and health relative quality of life (HRQoL) metrics in patients with suboptimal surgical outcomes to those undergoing non-operative management, which presumably approximates the natural history of ASD.

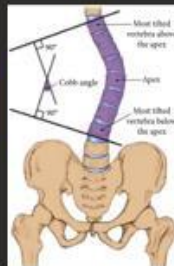
Based on clinical experience, we hypothesized that despite suboptimal outcomes, operative patients would demonstrate greater improvement in HRQLs and deformity when compared to the natural history of disease.

Materials & Methods:

- Retrospective analysis of ASD patients prospectively enrolled in a single-surgeon ASD database
- Database Inclusion:
 - All patients were ≥ 18 years
 - ≥ 1 of the following:
 - Pelvic Tilt (PT) $> 25^\circ$
 - Cobb angle $> 20^\circ$
 - Sagittal Vertical Axis (SVA) $> 5\text{cm}$
 - Thoracic kyphosis (TK) $> 60^\circ$

Cobb Angle:

- 10 – 20 mild scoliosis
- 20 – 40 moderate
- > 40 severe



SRS-Schwab Sagittal Modifiers:

Global Alignment C7-S1 SVA

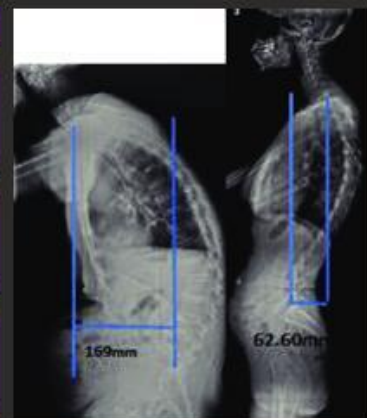
0: SVA $< 4\text{ cm}$
 +: SVA 4 – 9.5 cm
 ++: SVA $> 9.5\text{ cm}$

PI-LL Mismatch

0: PI-LL $< 10^\circ$
 +: PI-LL $10^\circ - 20^\circ$
 ++: PI-LL $> 20^\circ$

Pelvic Tilt

0: PT $< 20^\circ$
 +: PT $20^\circ - 30^\circ$
 ++: PT $> 30^\circ$



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Materials and Methods

This is a retrospective analysis of patients prospectively enrolled in a single-center ASD database. All database patients were ≥ 18 years old and met at least one of the following radiographic requirements: Pelvic Tilt (PT) $> 25^\circ$, Cobb angle $> 20^\circ$, Sagittal Vertical Axis (SVA) $> 5\text{cm}$ or Thoracic kyphosis (TK) $> 60^\circ$.

Materials & Methods:

• Inclusion:

- Operative and Non-Operative ASD Patients ≥ 18 years old with baseline (BL) and 2-year (2Y) radiographic and HRQL data were included.
- While all patients were offered operative intervention, for non-operative patients, the decision to forego surgery was made by the patient.
- Operative patients were included if they had a "suboptimal outcome"

Suboptimal Outcome ≥ 1 :

- Reoperation within 2-years
- Major Complication
- ≥ 2 ++ SRS-Schwab modifiers at 2Y

• Statistical Analysis:

- Suboptimal operative (SOp) and Natural History (NH) (i.e. non-operative) patients were propensity score matched (PSM) by:
 - Age
 - Deformity at baseline (SVA, PI-LL)
 - Charlson Comorbidity Index (CCI)
 - SRS-22 Total (a health-related quality of life (HRQL) metric developed for scoliosis patients)
- Means comparison tests analyzed differences in demographics, HRQLs, and deformity between PSM'd groups.
- Further, ANCOVA and logistic regressions assessed 2Y outcomes between groups, while accounting for baseline demographics, deformity, and HRQLs where appropriate.
- 2Y Outcomes analyzed:
 - HRQLs
 - minimum clinically important difference (MCID)
 - Deformity
 - By Sagittal Alignment

Operative and Non-Operative ASD Patients ≥ 18 years old with baseline (BL) and 2-year (2Y) radiographic and HRQL data were included. While all patients were offered operative intervention, for non-operative patients, the decision to forego surgery was made by the patient. Operative patients were included if they had a "suboptimal outcome," which was defined as reoperation within 2-years, any major complication, or presence of ≥ 2 severe (++) SRS-Schwab modifiers at follow-up.

Suboptimal operative (SOp) and Natural History (NH) patients were propensity score matched (PSM) by baseline age, deformity, Charlson Comorbidity Index (CCI) and SRS-22 Total. Means comparison tests analyzed differences in demographics, HRQLs, and deformity between PSM'd groups. Further, ANCOVA and logistic regressions assessed 2Y HRQL and deformity outcomes between groups, while accounting for baseline demographics, deformity, and HRQLs where appropriate.

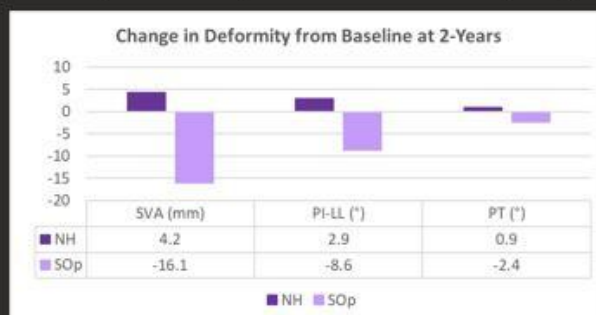
Results:

Demographics	NH	SOp	Cohort	p
Age (years)	56.2	57.3	56.8	>.05
Gender (% F)	83.1	85.7	84.4	>.05
BMI (kg/m ²)	26.7	25.4	26.0	>.05
CCI	1.2	1.0	1.1	>.05

Baseline Deformity	NH	SOp	Cohort	P
SVA (mm)	34.5	40.3	37.4	>.05
PI-LL (°)	8.4	12.0	10.2	>.05
PT (°)	21.5	23.9	22.7	>.05

Baseline HRQLs	NH	SOp	Cohort	p
ODI	28.4	32.1	30.3	>.05
SRS-22 Activity	3.6	3.5	3.5	>.05
SRS-22 Pain	3.0	3.0	3.0	>.05
SRS-22 Satisfaction	3.1	3.0	3.1	>.05
SRS-22 Total	3.3	3.3	3.3	>.05

- After PSM, 142 patients remained, with 71 patients in each group
- Groups had similar demographics and BL deformity (all $p > .05$).
- ANCOVA comparing radiographic deformity 2-year follow-up found that NH patients were significantly more deformed in:
 - SVA (estimated marginal means NH: 40.6 vs. SOp: 22.4mm, $p = .013$)
 - PT (estimated marginal means NH: 23.4° vs. 20.5°, $p = .003$)
 - PI-LL (estimated marginal means NH: 12.7 vs. SOp: 2.0, $p < .001$)



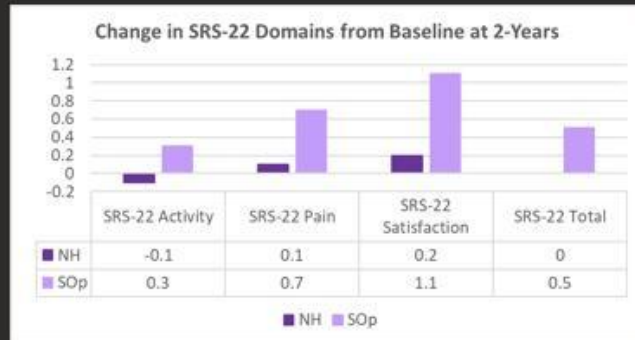
Results

After PSM, 142 patients remained, with 71 patients in each group. Groups had similar age, gender, BMI, CCI, and baseline deformity (all $p > .05$). ANCOVA comparing radiographic deformity 2-year follow-up found that NH patients were significantly more deformed in SVA (NH: 40.6 vs. SOp: 22.4mm, $p = .013$), PT (NH: 23.4° vs. 20.5°, $p = .003$), and PI-LL (NH: 12.7 vs. SOp: 2.0, $p < .001$).

Results:

At 2Y, multivariable logistic regression found that SOp patients had:

- 3.5x higher odds of reaching MCID in ODI (95% CI: 1.4 - 8.9)
- 5.0x higher odds of reaching MCID in SRS Activity (95% CI: 2.3 - 10.8)
- 4.2x higher odds of reaching MCID in SRS Pain (95% CI: 1.9 - 9.2)
- 9.0x higher odds of reaching MCID in SRS Total (95% CI: 2.9 - 28.2)



SRS-22 total and individual domains are scored from 1 – 5, with higher values being better. T-test of NH and SOp groups found change from baseline was significantly different in all domains, with SOp patients improving in all metrics.

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Further, multivariable logistic regression found that SOp patients had 3.5x higher odds of reaching minimum clinically important difference (MCID) in ODI (95% CI: 1.4 - 8.9), 5.0x higher odds of reaching MCID in SRS Activity (95% CI: 2.3 - 10.8), 4.2x higher odds of reaching MCID in SRS Pain (95% CI: 1.9 - 9.2), and 9.0x higher odds of reaching MCID in SRS Total (95% CI: 2.9 - 28.2).

Discussion:

- Similar to findings by *Teles et al*, patients in the natural history group did not demonstrate improved quality of life outcomes at 2-year follow-up. In fact, across HRQL metrics studied, suboptimal operative patients had 3.5x – 9.0x higher odds of achieving MCID.
- Furthermore, despite including severe SRS-Schwab modifiers at 2-years in the definition of suboptimal outcomes, ANCOVA found that SOp patients were significantly less deformed in all sagittal deformity measures compared to those in the natural history group.

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Discussion

Similar to previous findings, patients in the natural history group did not demonstrate improved quality of life outcomes at 2-year follow-up. Moreover, across HRQL metrics studied, suboptimal operative patients had 3.5x – 9.0x higher odds of achieving MCID. Furthermore, despite including severe SRS-Schwab modifiers at 2-years in the definition of suboptimal outcomes, ANCOVA found that SOp patients were significantly less deformed in all sagittal deformity measures compared to those in the natural history group.

Conclusion:

- Compared to the natural history of ASD, operative patients with suboptimal outcomes still experience significantly greater improvements in HRQLs postoperatively.
- Such divergent outcomes at 2Y, highlight the stagnation and deterioration in outcomes associated with the natural history of ASD.
- Spine surgeons and patients should consider the outcomes associated with the non-operative course when weighing risks and benefits of operative intervention.

Thank you!

Conclusion

Compared to the natural history of ASD, operative patients with suboptimal outcomes still experience significantly greater improvements in HRQLs postoperatively. Such divergent outcomes at 2Y highlight the stagnation and deterioration in outcomes associated with the natural history of ASD. Spine surgeons and patients should consider the outcomes associated with the non-operative course when weighing risks and benefits of operative intervention.

Disclosures:

Peter G. Passias

- Allosource: Other financial or material support
- Cervical Scoliosis Research Society: Research support
- Globus Medical: Paid presenter or speaker
- Medtronic: Paid consultant
- Royal Biologics: Paid consultant
- Spine: Editorial or governing board
- SpineWave: Paid consultant
- Terumo: Paid consultant
- Zimmer: Paid presenter or speaker

Disclosures

The other authors reported nothing to disclose.



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