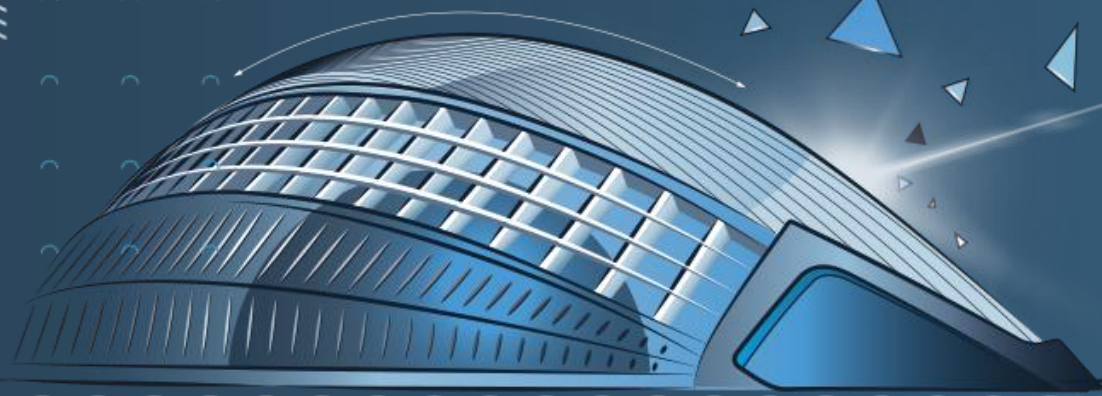


sense

Spine Expert NetworkTM
for Science & Education



How forced fixation affects patients' clinical outcomes

Prof. David Noriega

SENSE

2nd International
Spine Expert Symposium

June 23 – 25, 2022 / Valencia – Spain

Hospital Clínico
Universitario
de Valladolid



ASD Rate Long Term

Eur Spine J (2016) 25:1550–1557
DOI 10.1007/s00586-016-4469-5

ORIGINAL ARTICLE

Adjacent segment degeneration and revision surgery after circumferential lumbar fusion: outcomes throughout 15 years of follow-up

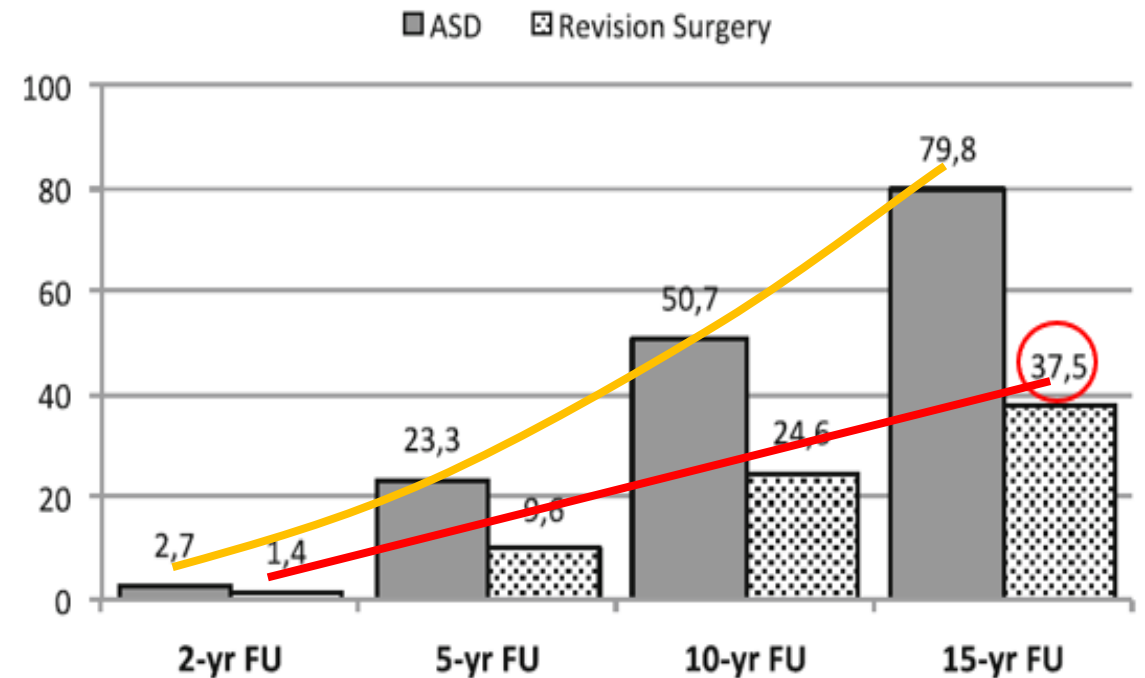
José L. Maruenda¹ · Carlos Barrios² · Felipe Garibo¹ · Borja Maruenda³

79.8% with radiological ASD

75% patients reported that they were dissatisfied with their outcome

At 15-year follow-up **37.5 %** of the patients required a new surgical treatment because of ASD.

ASD and Reintervention rates



ASD Rate Long Term

Spine SPINE Volume 43, Number 23, pp E1384–E1388
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CLINICAL CASE SERIES

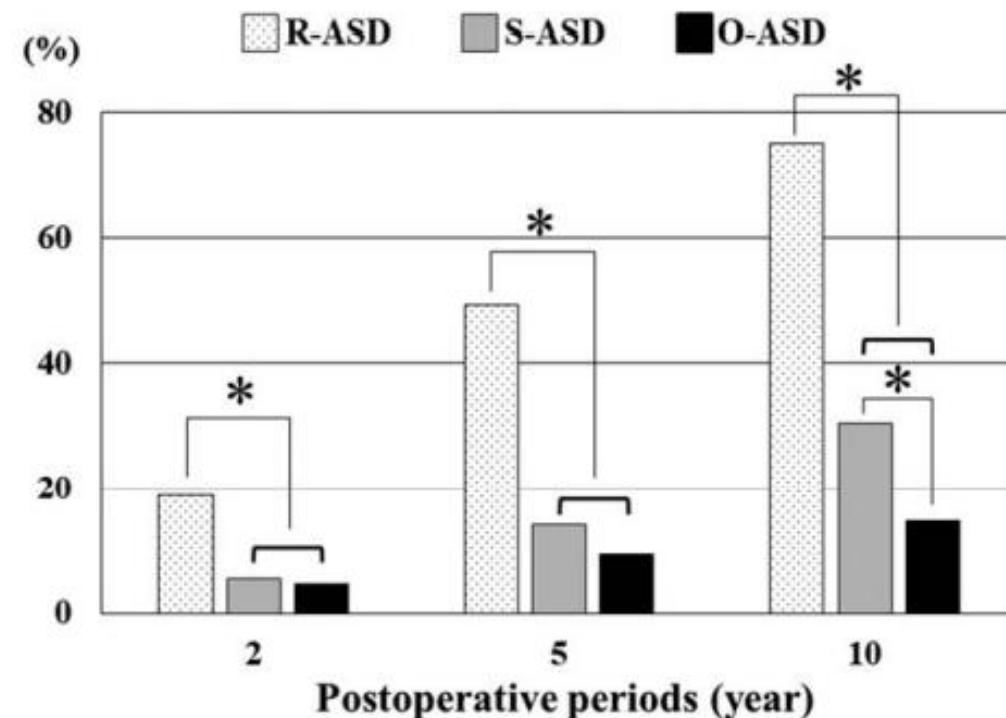
Adjacent Segment Disease After Single Segment Posterior Lumbar Interbody Fusion for Degenerative Spondylolisthesis

Minimum 10 Years Follow-up

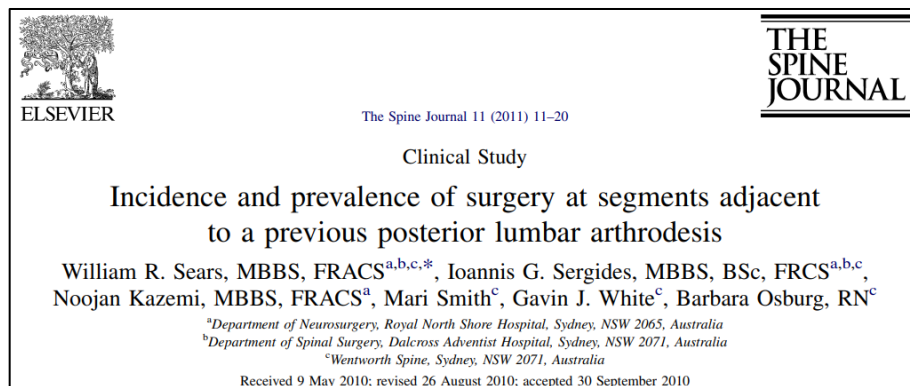
Shinya Okuda, MD, PhD, Yukitaka Nagamoto, MD, PhD, Tomiya Matsumoto, MD, PhD, Tsuyoshi Sugiura, MD, PhD, Yoshifumi Takahashi, MD, and Motoki Iwasaki, MD, PhD

- 128 patients who underwent PLIF for L4 degenerative spondylolisthesis and could be followed for at least 10 years.
- Mean follow-up period was 12.4 years (range: 10-20 years)

Revision Surgery due to ASD 15% at 10 years.
At final FU the revision rate was 24% (31/128 patients)



ASD Rate Long Term



- 912 patients who underwent
- 1,000 consecutive PLIF procedures
- Mean FU duration: 5.2 years (range, 5 months -16 yrs)

Table 4

Mean annual incidence (over first 10 years with 95% CI) and prevalence rates (percentages with standard errors) of surgery for ASD after all fusions and single-, two-, and three/four-level fusions

Number of levels fused	ASD annual incidence			
	mean, % (95% CI)	5 y Prevalence, % (SE)	10 y Prevalence, % (SE)	15 y Prevalence, % (SE)
All patients	2.5 (1.9–3.1)	13.6 (1.3)	22.2 (2.0)	27.3 (2.7)
One level	1.7 (1.3–2.2)	9.0 (1.4)	15.7 (2.3)	22.2 (3.5)
Two levels	3.6 (2.1–5.2)	17.2 (3.2)	30.9 (5.1)	36.1 (5.9)
Three/four levels	5.0 (3.3–6.7)	28.9 (5.2)	40.2 (6.9)	40.2 (6.9)

ASD, adjacent segment disease; 95% CI, 95% confidence interval; SE, standard error.

Revision Surgery Rate

Revision rates reported at 2 years FU

Degenerative			Deformity		
Lak	2020	19.2%	Bari	2020	28%
Irmola	2018	12.5%	Pitter	2019	19.9%
Rienmuller	2015	15.0%	Glassman	2015	13%
Kim	2013	9.4%	Blamoutier	2012	25%
Deyo	2013	9.8%	Mok	2009	21.3%

Risk of revision has increased in the last decades

SPINE Volume 34, Number 8, pp 832–839
©2009, Lippincott Williams & Wilkins

Reoperation After Primary Fusion for Adult Spinal Deformity
Rate, Reason, and Timing

Spine Deformity  Spine Deformity 3 (2015) 199–203

www.spine-deformity.org

Revision Rate After Adult Deformity Surgery

 THE SPINE JOURNAL

The Spine Journal 13 (2013) 1230–1237

Clinical Study

Reoperation rate after surgery for lumbar spinal stenosis without spondylolisthesis: a nationwide cohort study

Spine Deformity  Spine Deformity xx (2019) 619–626

www.spine-deformity.org

Revision Risk After Primary Adult Spinal Deformity Surgery: A Nationwide Study With Two-Year Follow-up

Frederik T. Pitter, MD^{a,*}, Martin Lindberg-Larsen, MD, PhD^b,
Alma B. Pedersen, MD, PhD, DMSc^c, Benny Dahl, MD, PhD, DMSc^d,
Martin Gehrchen, MD, PhD^a

Revision Surgery Rate

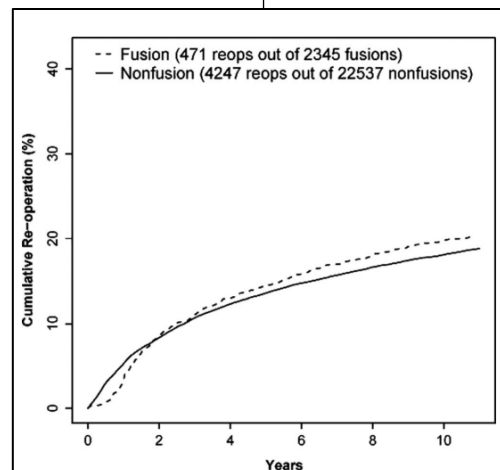
SPINE Volume 32, Number 3, pp 382-387
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Reoperation Rates Following Lumbar Spine Surgery and the Influence of Spinal Fusion Procedures

Brook I. Martin, MPH,*† Sohail K. Mirza, MD, MPH,†† Bryan A. Comstock, MS,*†
Darryl T. Gray, MD, ScD,†§|| William Kreuter, MPA,†§ and Richard A. Deyo, MD, MPH*††§

11-years FU

- 20.1% revisions
- 49.5% due to device complications
- 23.6% pseudoarthrosis



Spine Deformity
<https://doi.org/10.1007/s43390-020-00112-6>

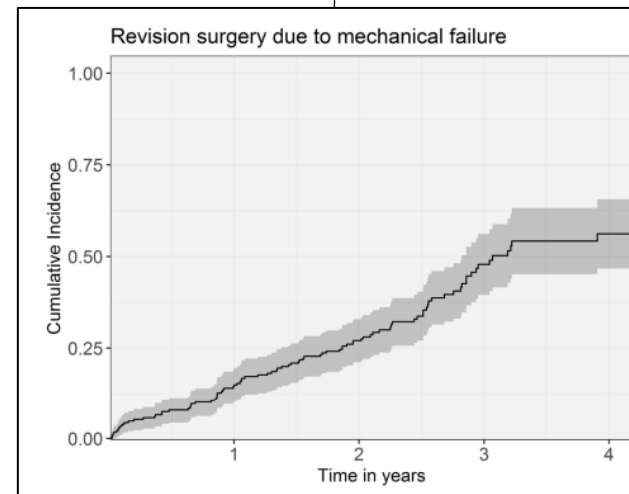
CASE SERIES

Surgical correction of Adult Spinal Deformity in accordance to the Roussouly classification: effect on postoperative mechanical complications

Tanvir Johanning Bari¹ · Lars Valentin Hansen¹ · Martin Gehrchen¹

Received: 2 January 2020 / Accepted: 25 March 2020
© Scoliosis Research Society 2020

Rod breakage in 54.5% of patients (127/233)



ELSEVIER

The Spine Journal ■■ (2017) ■■ ■■

THE SPINE JOURNAL

Clinical Study

Long-term outcomes of transforaminal lumbar interbody fusion in patients with spinal stenosis and degenerative scoliosis

Swamy Kurra, MBBS^a, William F. Lavelle, MD^{a,*}, Michael P. Silverstein, MD^b,
Jason W. Savage, MD^c, R. Douglas Orr, MD^b

7.5-years FU

41% revisions (48% in 1-level TLIF)

Rates increasing up to >40% in long-term FU studies

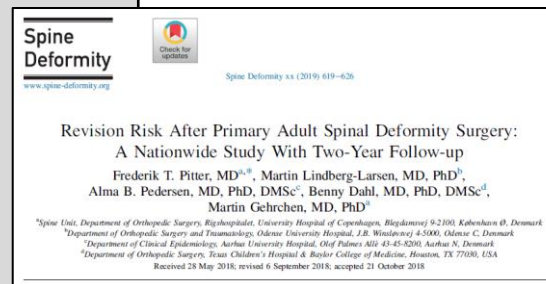
Revision Surgery

Main Reasons for Revision Surgery

1. MECHANICAL FAILURES

≈ 70%

- Implant Failure
 - screw loosening/breakage
 - rod breakage
- Pseudarthrosis
- Adjacent Segment
 - ASD
 - PJK



2. INFECTION

≈ 10%



Is there a common factor?

The incidence of FBSS is reported in the literature 10% and 40%¹⁻⁵

The rates are similar to several decades ago².
The incidence increases with more complex surgeries¹.

FBSS etiology:

Stenosis, Disc herniation, Fibrosis, Spinal instability, Facet joint pain, ASD, Pseudoarthrosis, Neuropathic pain, Hardware failure, Discitis, Myofascial pain, Psychological: anxiety, depression, Nerve injury, Infection, Sacro-Iliac joint dysfunction, Synovial cyst, Fibromyalgia, Radiculopathy, Arachnoiditis....

The Failed Back Surgery Syndrome

Pitfalls Surrounding Evaluation and Treatment

Carl M. Shapiro, DO

Pain Medicine

Pain Medicine 2011; 12: 577-606
Wiley Periodicals, Inc.

Journal of Pain Research

Dovepress

open access to scientific and medical research

Open Access Full Text Article

REVIEW

Failed back surgery syndrome: current perspectives

Syndrome

Acta Neurochir (2012) 154:1213-1217
DOI 10.1007/s00701-012-1380-7

CLINICAL ARTICLE

Clinical outcome of instrumented fusion for the treatment of 100 patients

SPINE Volume 32, Number 3, pp 382-387
©2007, Lippincott Williams & Wilkins, Inc.

Reoperation Rates Following Lumbar Spine Surgery and the Influence of Spinal Fusion Procedures

Brook I. Martin, MPH,*† Sohail K. Mirza, MD, MPH,†‡ Bryan A. Comstock, MS,*†
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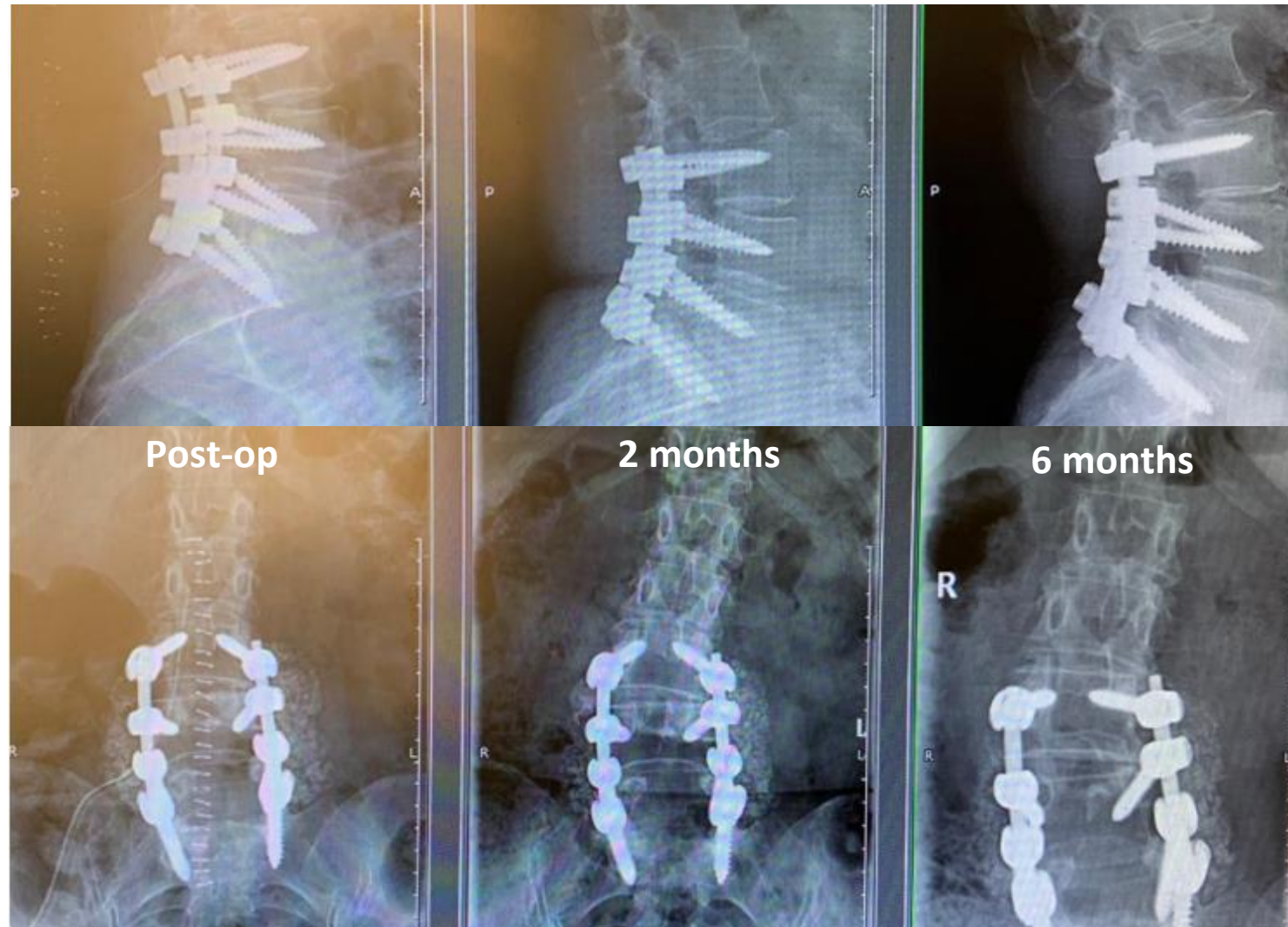
Impact of Screw Head/Rod Mismatch

A retrospective observational clinical study

Clinical and Radiological Review of Patients with a Thoraco-Lumbo-Sacral Fusion to Analyze Risk Factors for Adjacent Segment Disease (ASD)

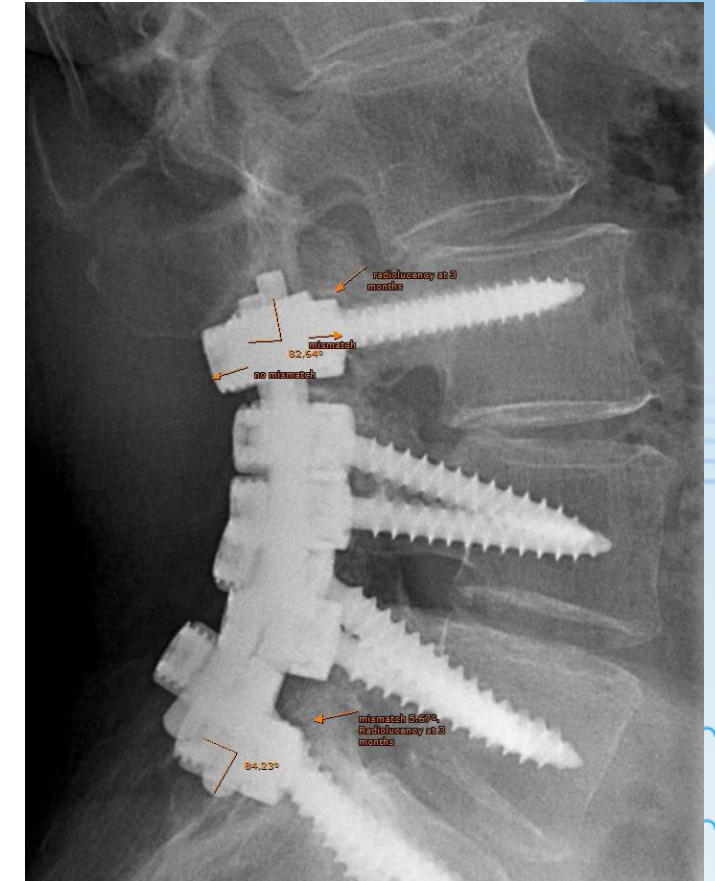


Impact of Screw Head/Rod Mismatch



Impact of Screw Head/Rod Mismatch

- A **Screw/Rod mismatch** is a clear sign of **Stress overload**
- Law of conservation of energy applies
- Stress overload in the construct is **unloaded into surrounding tissues** (Bone & Soft tissues)
- This unloading process has a **major impact** on Spine Biomechanics and alignment
- **Is there an impact on patient's Clinical and/or Radiological Outcomes?**



Impact of Screw Head/Rod Mismatch

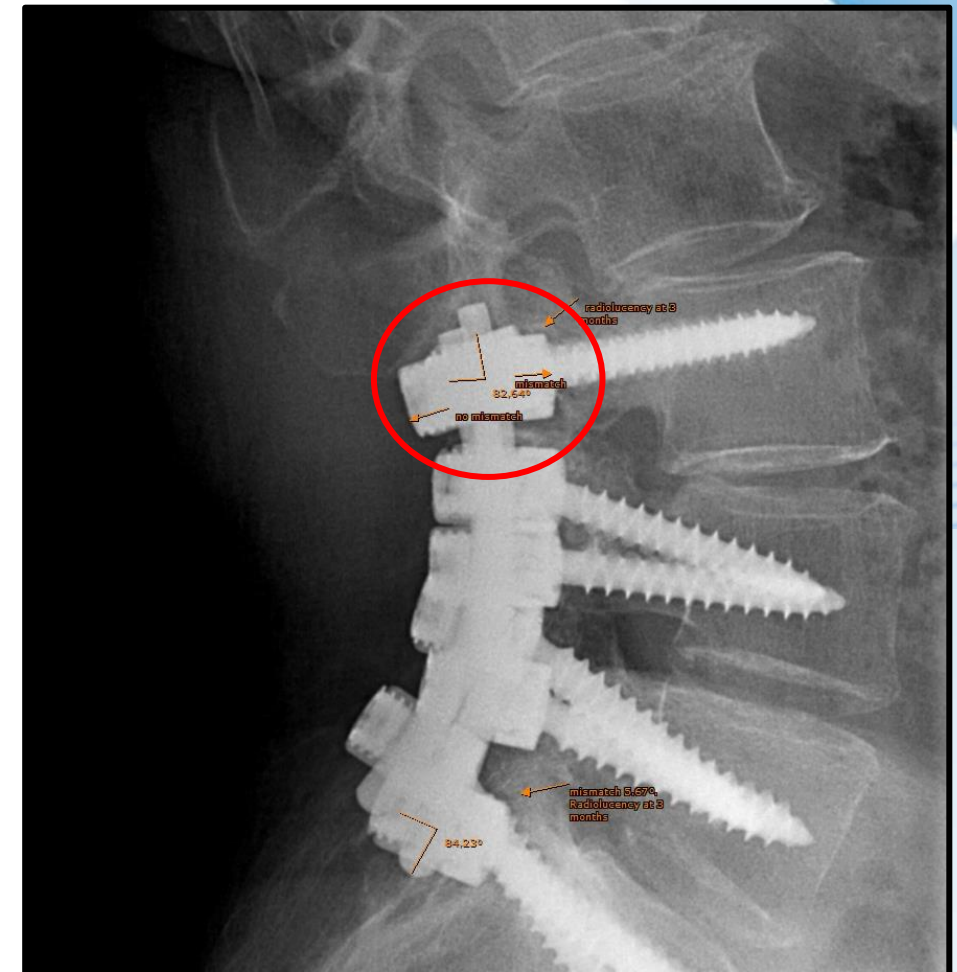
STUDY OBJECTIVE

To analyze “hardware mismatches” that may influence & impact the:

- Development of fast appearing ASD
- Clinical patient outcomes – VAS (pain)
- Risk of revision surgery

Measuring in radiographs – screw-head/rod relation
Comparing the group of patients where a screw head/rod “mismatch” was seen vs. group of patients without a “mismatch”

Mismatch group	NO 90° alignment
NO mismatch group	90° alignment



Impact of Screw Head/Rod Mismatch

STUDY MATERIAL

- Retrospective review of patients who underwent fusion surgery for predominantly degenerative pathologies with pedicle screw/rod systems in the hospital database.
- Clinically and radiologically complete preoperative, postoperative, and follow-up data was required to be available.
- 1,183 patient charts/radiographs were screened from patients treated in the dept. until January 2019.
- 406 patients met the inclusion criteria for the study.
- Mean FU time was 5 years (range: 1-7years)

Patient Demographics

	Mean (SD) / N (%)
Total N = 406	
Age in years	50,4 (10,7)
Preoperative VAS pain	7,2 (0,4)
Gender	
Male	151 (37,2%)
Female	255 (62,8%)
Diagnosis [§]	
Degenerative disc disease	120 (29,6%)
Stenosis	107 (26,4%)
Fracture	45 (11,1%)
Failed back surgery	44 (10,8%)
Deformity	42 (10,3%)
Spondylolisthesis	38 (9,4%)
Inflammation	4 (1,0%)
Others	10 (2,5%)

In the 406 patients, a total of 3,016 pedicle screws were implanted between T2 and S2

Number of levels fused	
1	135 (33,3%)
2	120 (29,6%)
3	62 (15,3%)
4	25 (6,2%)
5	9 (2,2%)
6	10 (2,5%)
7	7 (1,7%)
8	13 (3,2%)
9	3 (0,7%)
10	8 (2,0%)
11	5 (1,2%)
12	3 (0,7%)
13	4 (1,0%)
14	2 (0,5%)

Impact of Screw Head/Rod Mismatch

In 42.1% of the patients (171/406) a screw-head/rod mismatch was found in at least one of the pedicle screws, affecting 20.3% of the pedicle screws (613/3016).

ASD

Among the patients showing newly developed sign of radiological ASD at the superior adjacent level at the final Follow Up:

83.9 % of them were found in the “mismatch” group (47/56)

ASD - Newly developed at final FU			
	Without Mismatch N=235	With mismatch N=171	P-value
No	96.2% (226)	72.5% (124)	<0.001
Yes	3.8% (9)	27.5% (47)	

Comparison of the two groups Without and With mismatches revealed statistically significant differences.

Impact of Screw Head/Rod Mismatch

PAIN

Pain (VAS) at final Follow Up:

Patients in the mismatch group experienced significantly more pain

Pain (VAS) at final FU)			
	Without Mismatch N=235	With mismatch N=171	P-value
Mean (SD)	1.4 (0.8)	2.8 (0.8)	<0.001

Comparison of the two groups Without and With mismatches revealed statistically significant difference.

Impact of Screw Head/Rod Mismatch

REVISION

The overall revision incidence was 11.8% (48/406)

Among these Revision cases:

95.8% of them were found in the “mismatch” group (46/48)

Revision Procedure			
	Without Mismatch N=235	With mismatch N=171	P-value
No	99.1% (233)	73.1% (125)	<0.001
Yes	0.9% (2)	26.9% (46)	

Comparison of the two groups Without and With mismatches revealed statistically significant difference.

Impact of Screw Head/Rod Mismatch

When comparing patients who underwent intraoperative correction and/or reduction with those who did not, there were statistically significant differences in screw mismatch and revision incidence.

Table 3. Screw mismatch and revision by intraoperative correction/ reduction procedure

Outcome	Without correction/reduction N=365 N (Column %)	With correction/reduction N=41 N (Column %)	Statistical test P-value
Screw mismatch			0,004
No	220 (60,3%)	15 (36,6%)	
Yes	145 (39,7%)	26 (63,4%)	
Revision procedure			0,001
No	329 (90,1%)	29 (70,7%)	
Yes	36 (9,9%)	12 (29,3%)	

Clinical Case

- Male 67yo
- Cervical disc arthroplasty 14 years ago
- DDD + spondylo + spinal stenosis L4-L5



Clinical Case

- Male 67yo
- Cervical disc arthroplasty 14 years ago
- DDD + spondylo + spinal stenosis L4-L5



L4-L5 spinal stenosis, PreOP

PreOP x-ray



L3-L4 PreOP normal disc space

Spinopelvic parameters

IP 55°
LL 40°
PT 23°
SS 27°



Clinical Case



PostOP



6 weeks PostOP
Left-caudal screw
pullout

Mismatch: 85.04°

- IP 55°
- LL 44°
- PT 20°
- SS 27°



12 weeks
MRI

Clinical Case



CT 16 weeks PostOP
VAS - WORSENING
Mismatch cranial screw 86°

PI 55°
LL 46°
PT 19°
SS 30°

MRI 19 weeks PostOP



Clinical Case

Final x-ray control



Conclusions

- Orthogonal relationship between rod-screw plays an important role in clinical-radiological outcomes
- Control of the spinopelvic parameters is mandatory
- Mismatch of the rod-screw interface should be considered as an important actor in unexpected outcomes