

# **Efficacy of preoperative Halo-gravity traction in severe NF-1 and CS with rotatory subluxation in thoracic spine**

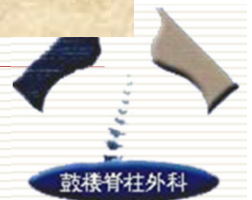
**Bang-ping Qian MD, Zhen Liu MD, Yong Qiu MD**

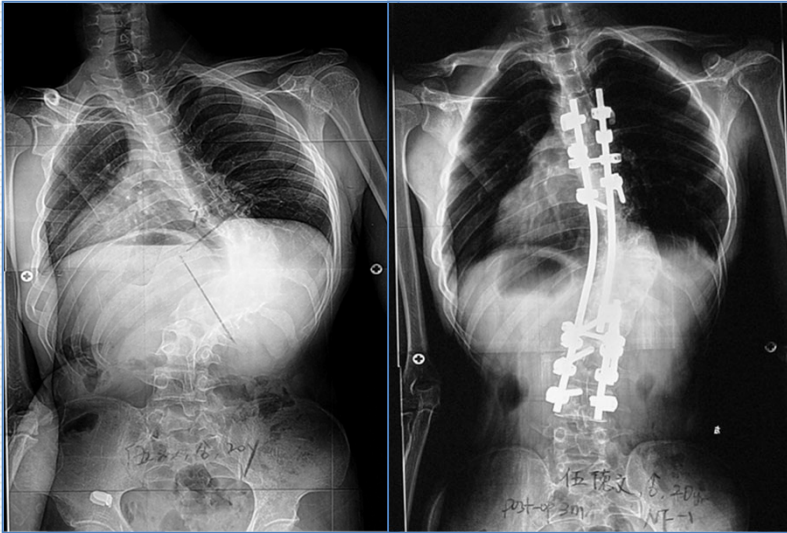
**Drum Tower Hospital**

**Nanjing University Medical School , Nanjing, China**

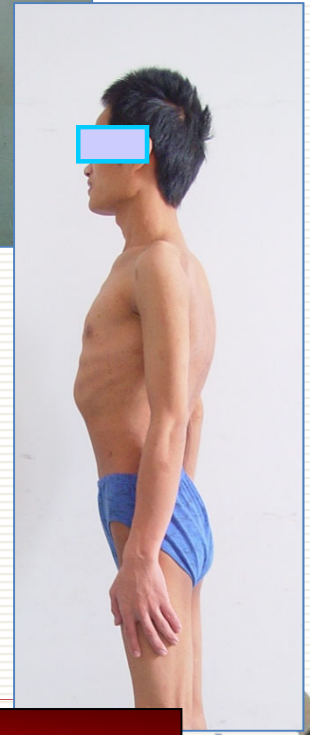


**Spine Surgery, Drum Tower Hospital, Nanjing University, China**

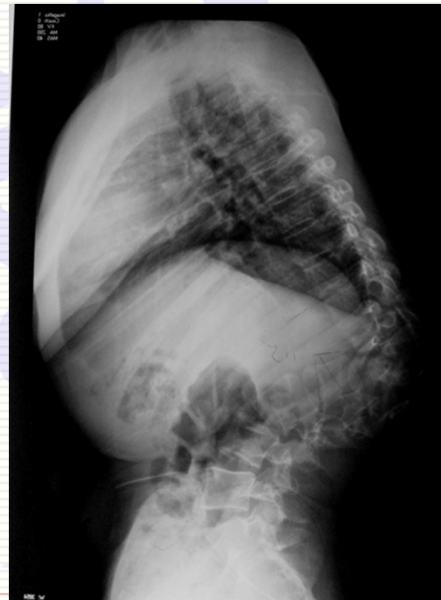




# 3345, 2 yrs post-op

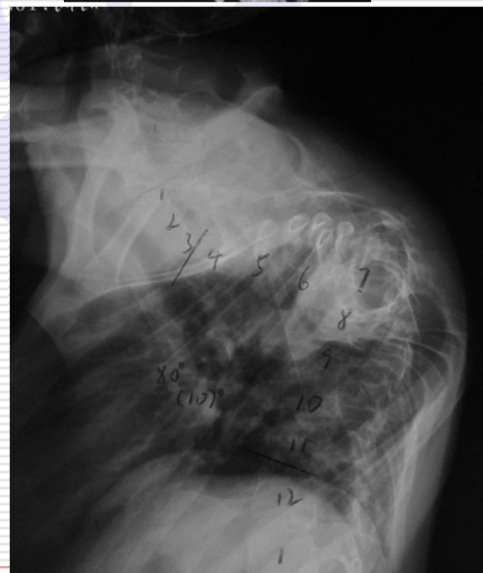
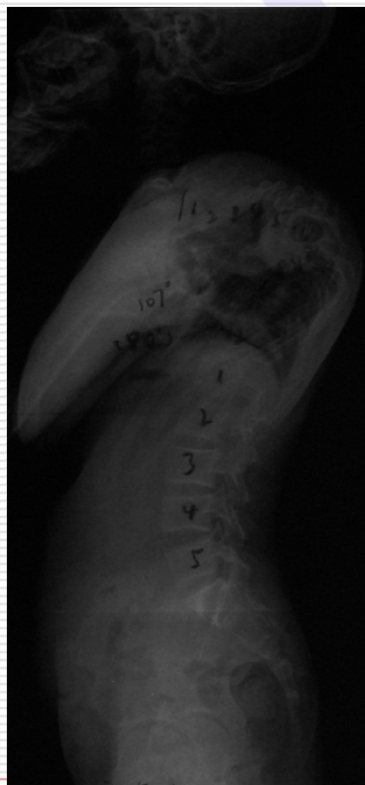
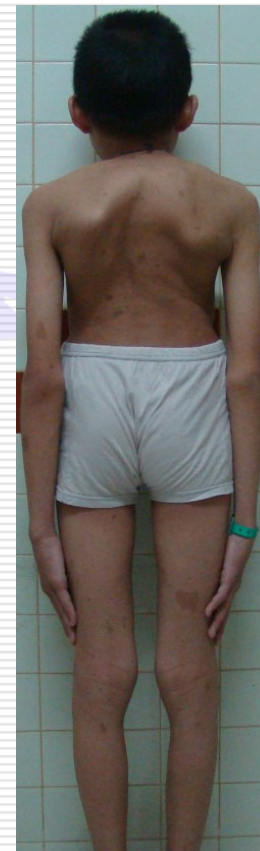
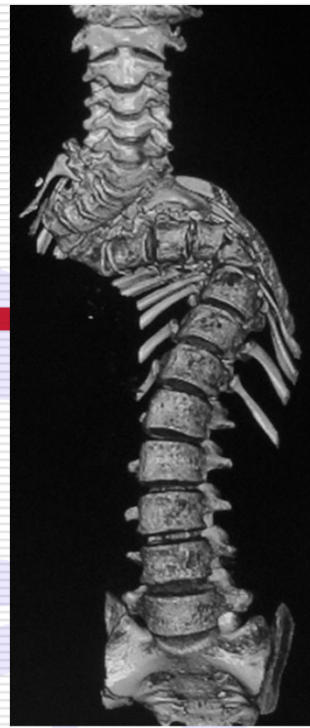


**Unbelievable but possible !**

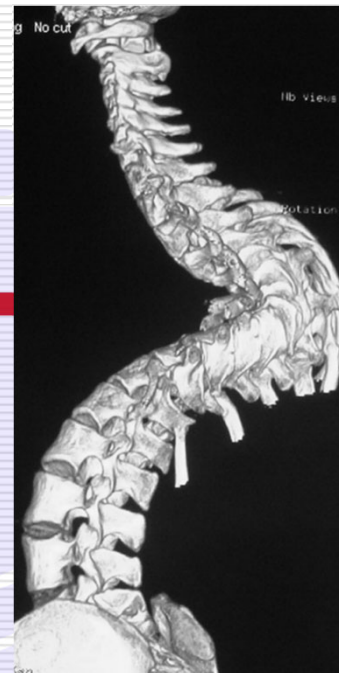


**Difficult but achievable !**





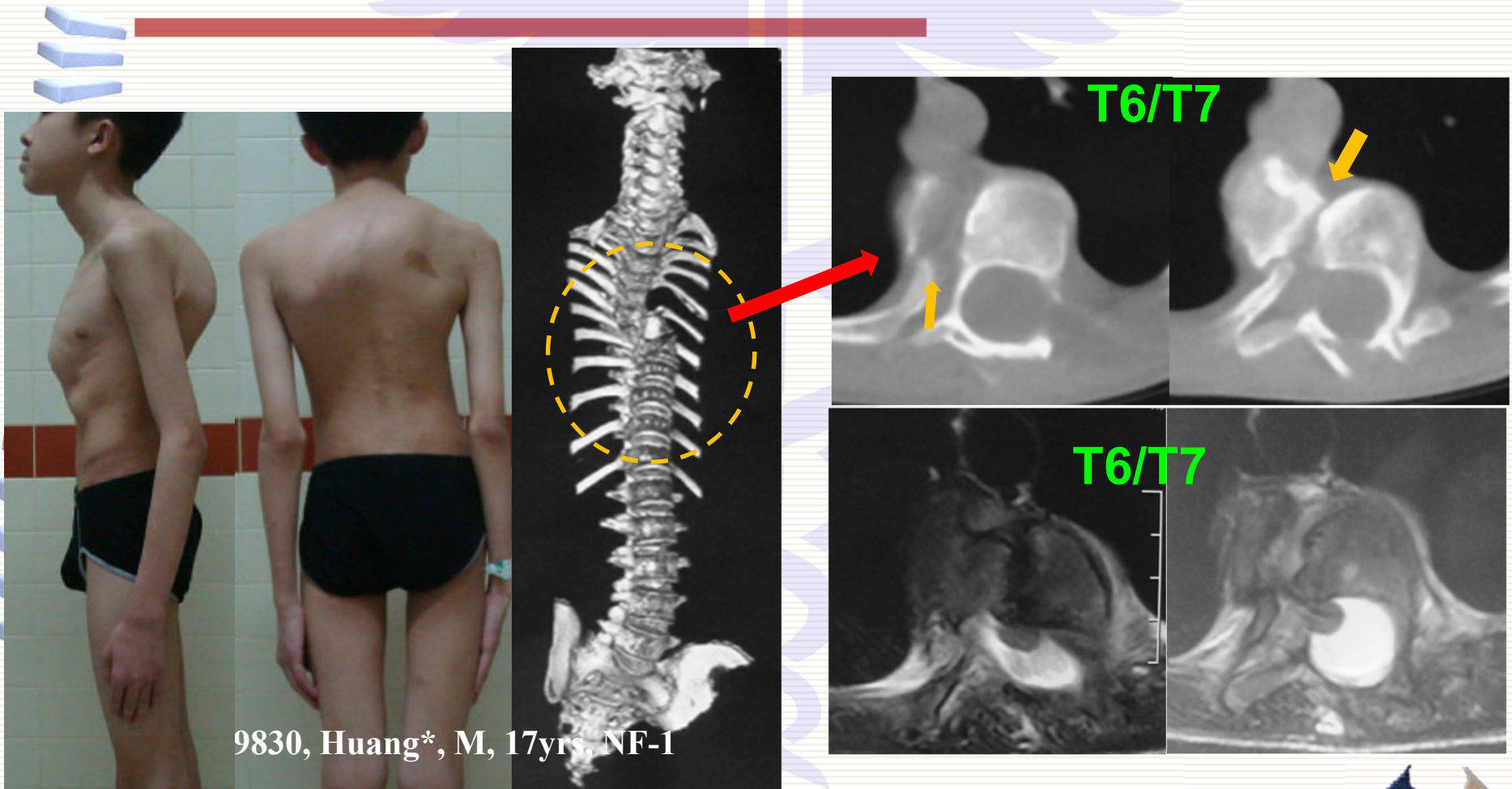
**Challenging and technically demanding !**



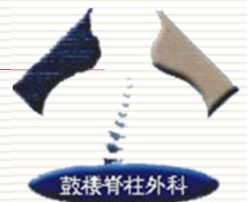
**Challenge!**

表脊柱外科

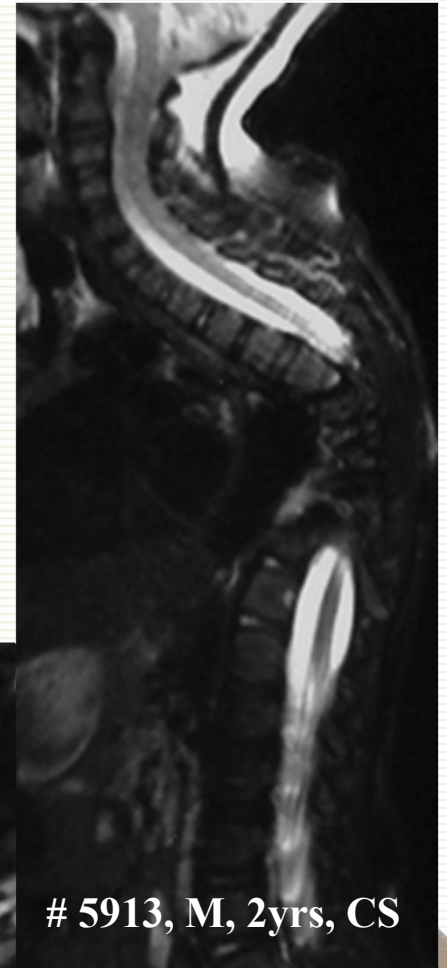
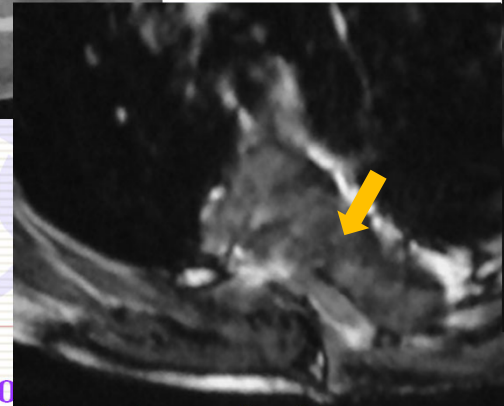
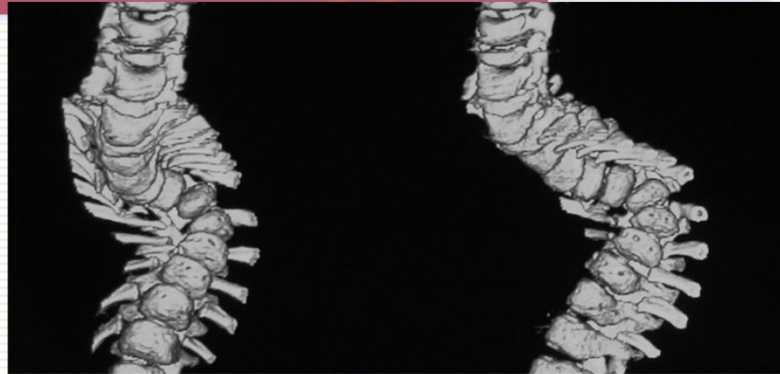
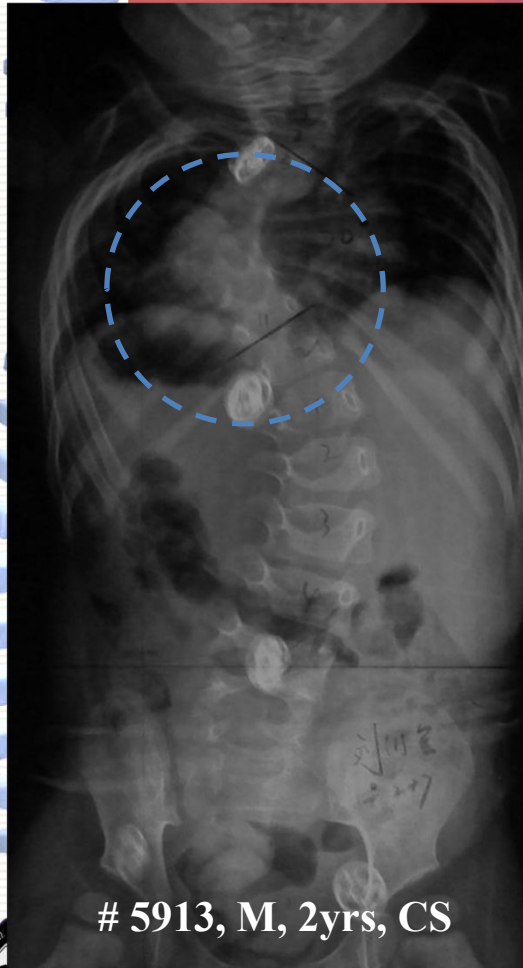
# Rotatory subluxation



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# Rotatory subluxation



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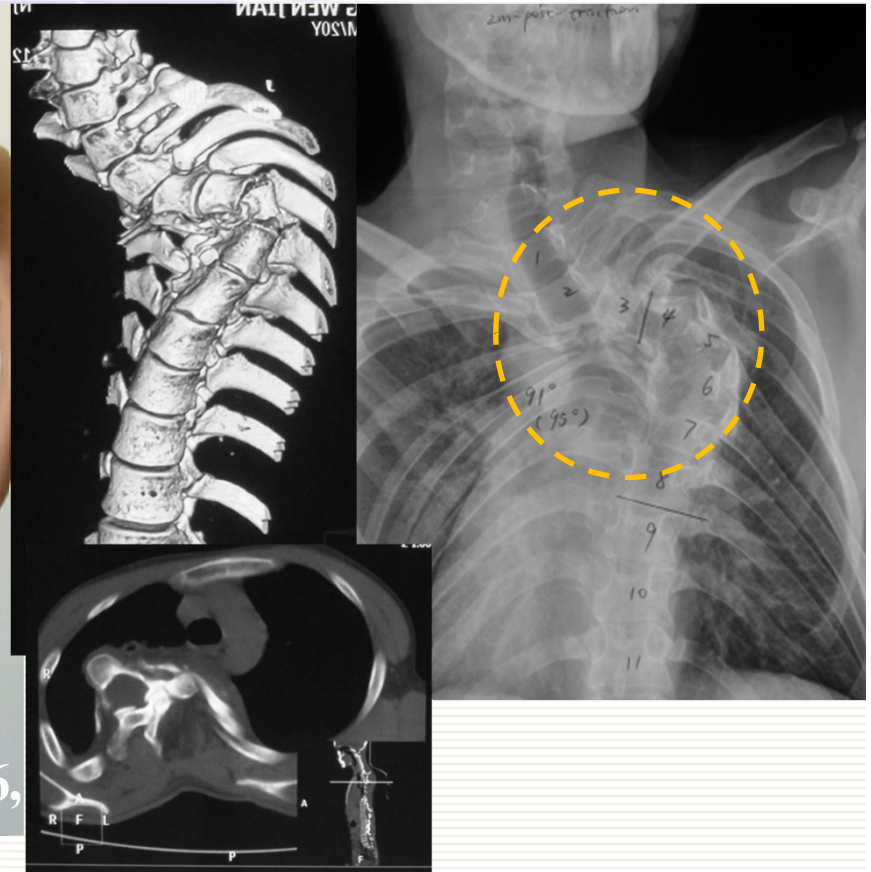


# Definition of rotational dislocation

- ☐ Displacement between two groups of vertebrae;
- ☐ Each included in a lordoscoliotic segment;
- ☐ Rotated in opposite directions.

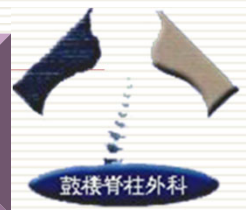


#10716,

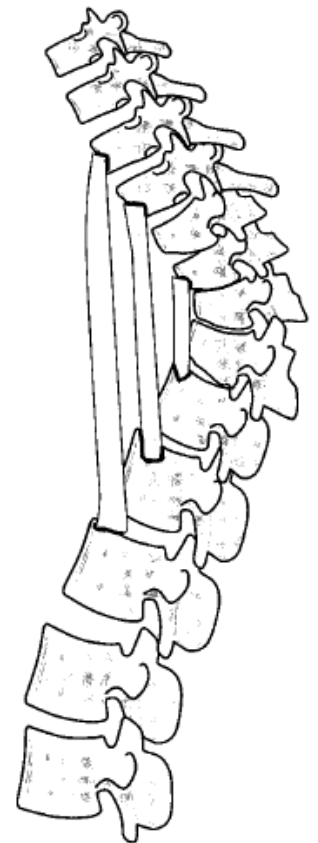
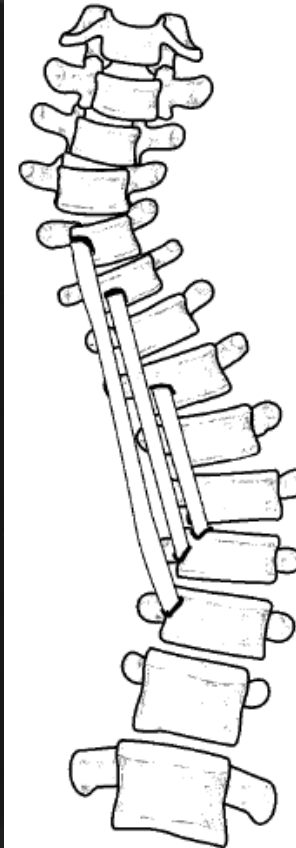
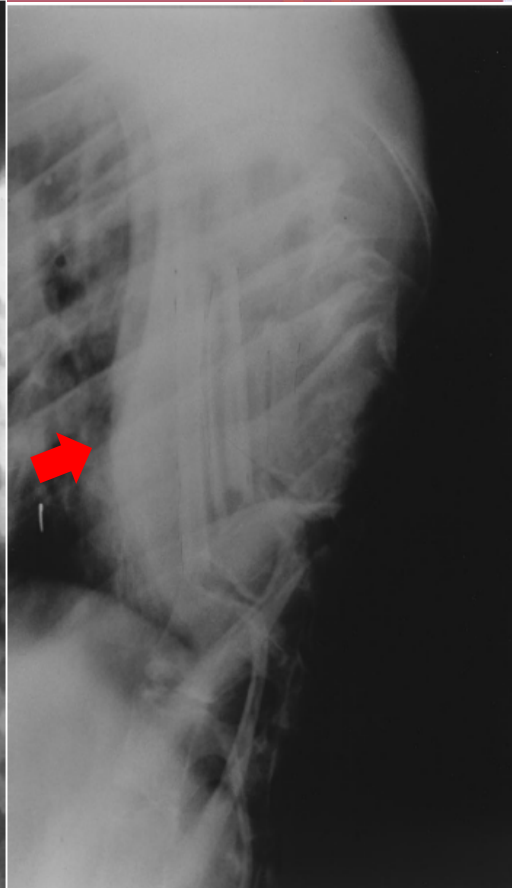
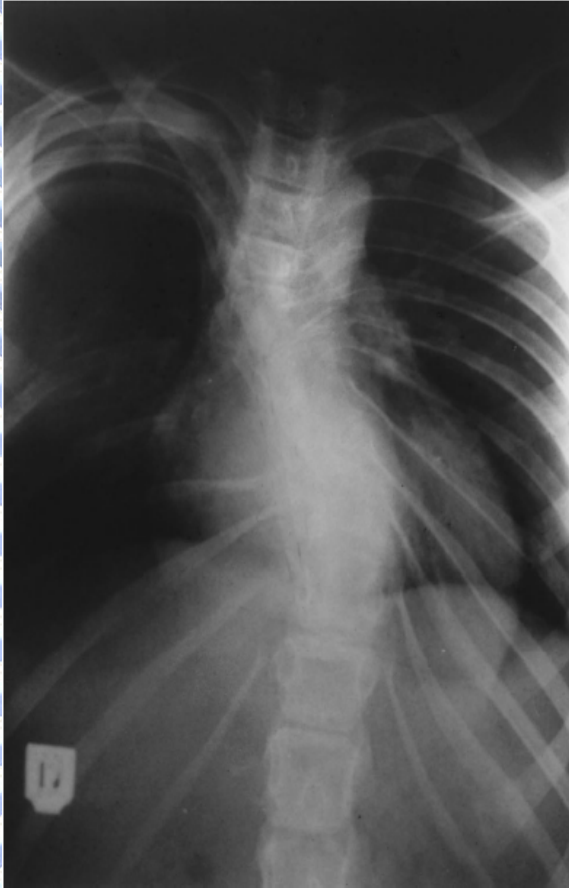


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Duval-Beaupère G, Dubousset J. de l'Appareil Moteur  
1972;58:323-5.

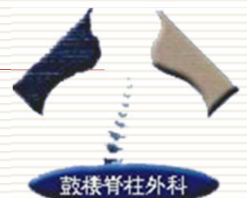


# Surgical treatment

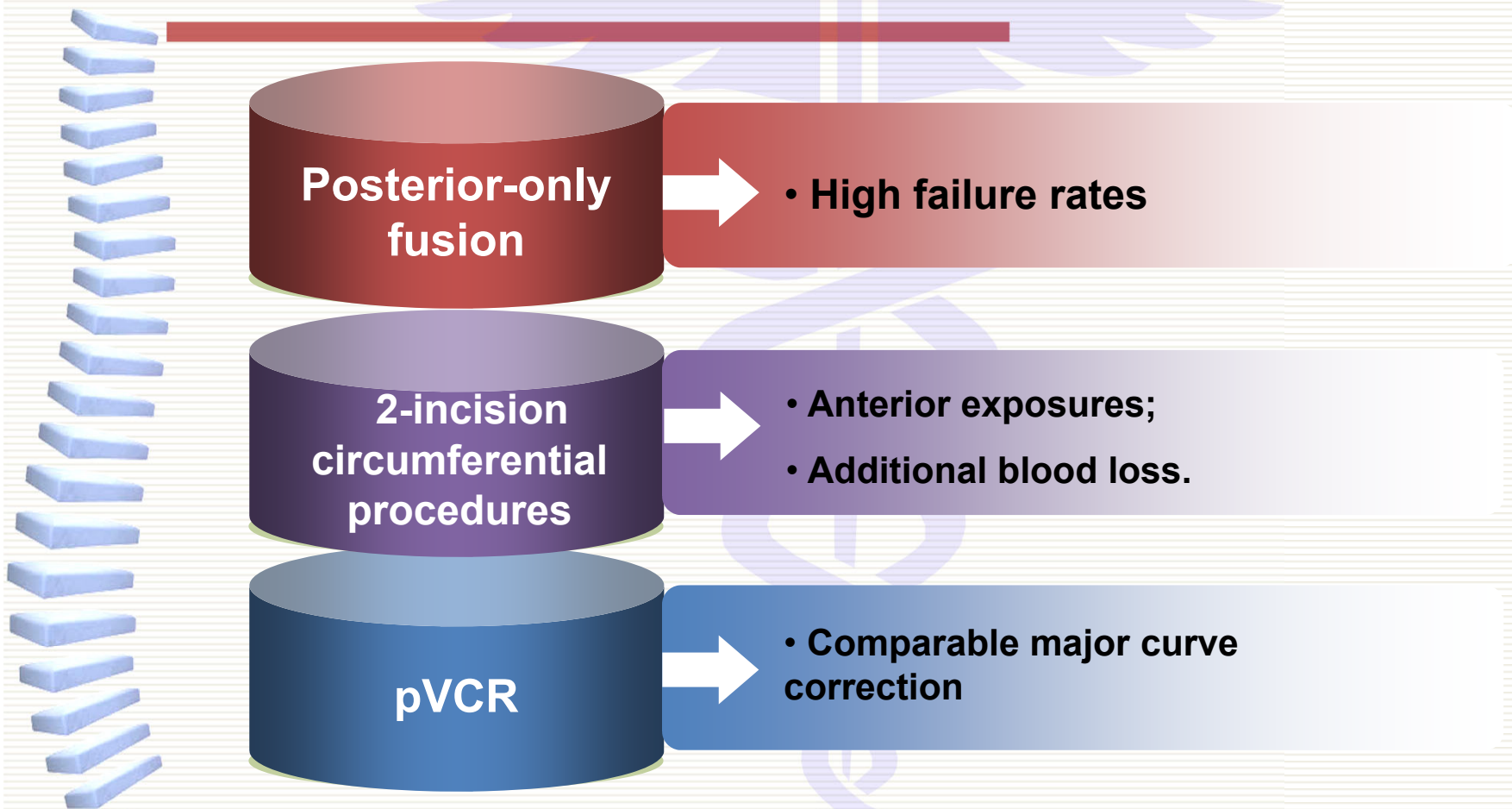


Reinhard D. Zeller, Jean Dubousset. Spine 2000;25,1092-7.

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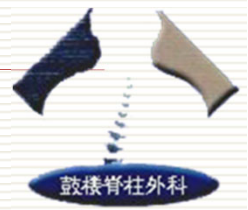


# Surgical strategy



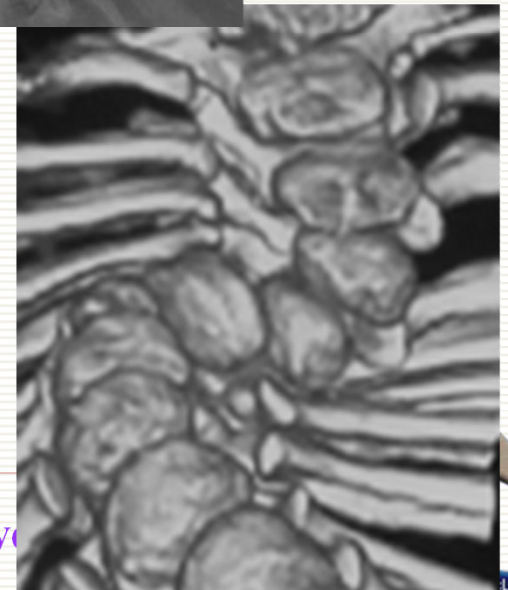
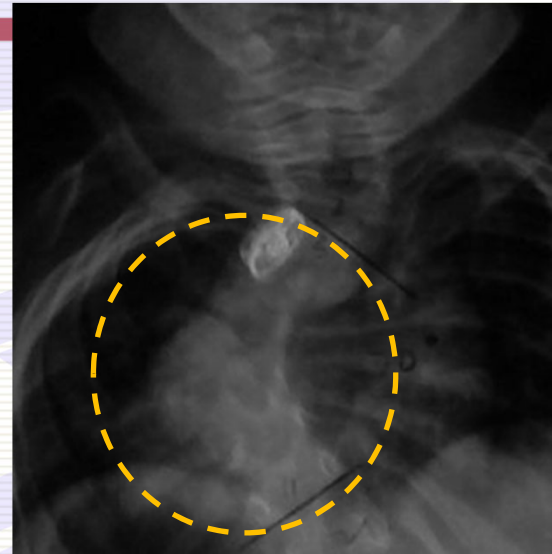
Geoffrey ES, Lawrence G. Lenke , and Ian GD. Spine  
2012;37,E1659-64.

Spine Surgery, Drum Tower Hospital, Nanjing University, China

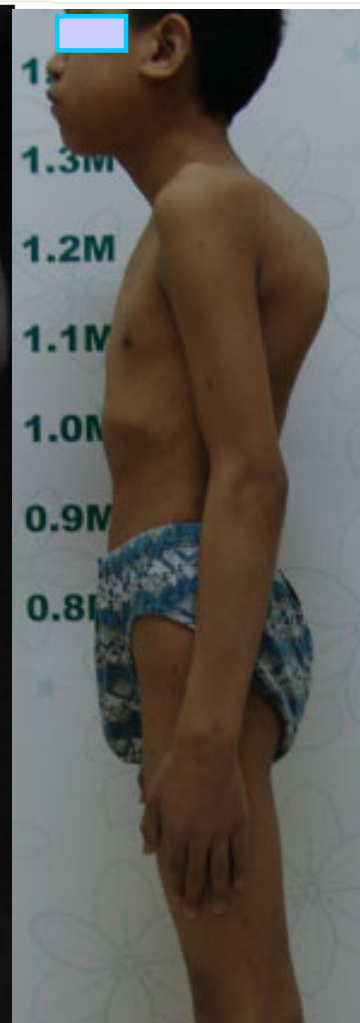
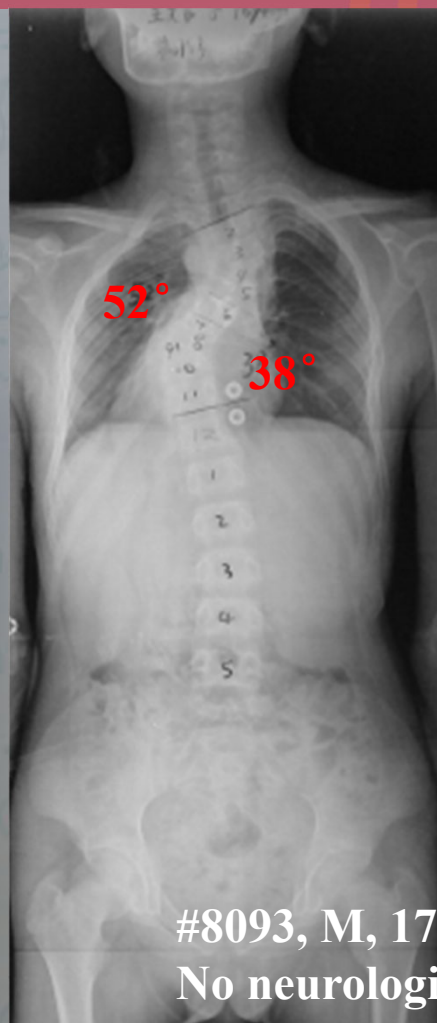


# High risk of surgery

- **High apex;**
- **Poor blood supply (Mid thoracic region);**
- **Abnormal, complex anatomy of spine;**
- **Discontinuity of canal.**



# High risk of surgery



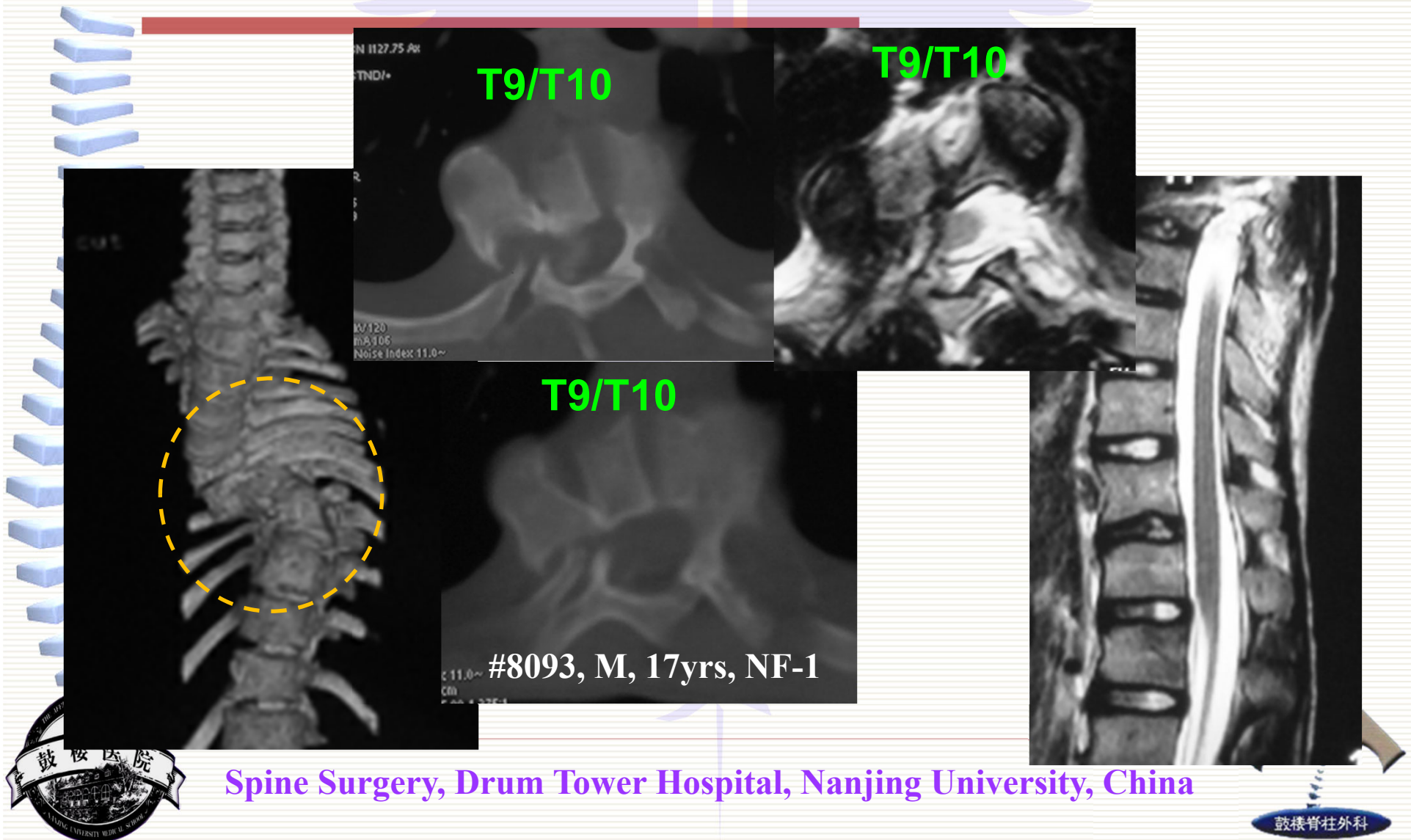
#8093, M, 17yrs, NF-1  
No neurologic deficit

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# High risk of surgery



# High risk !

## Natural history of RS

- Progression;
- Neurological impairment.



Surgery

- Rapid correction can increase the risk of neurological compromise

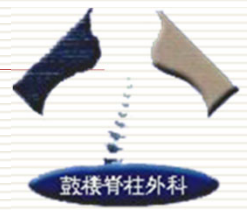


Spine Surgery

Reinhard D. Zeller, Jean Dubousse. Spine 2000;25,1092-7.

Anthony Rinella, Lawrence Lenke, Camden Whitaker, et al. Spine 2005;30,475-82.

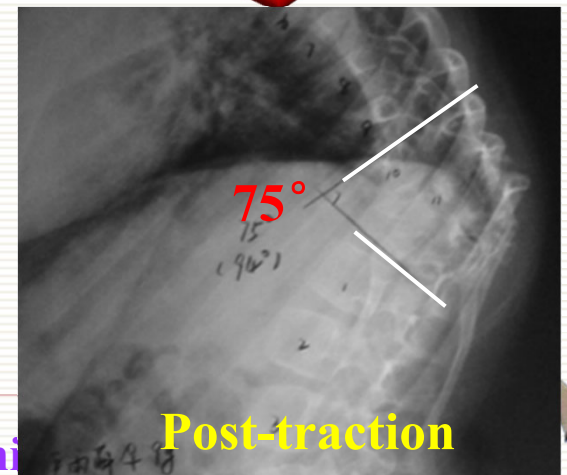
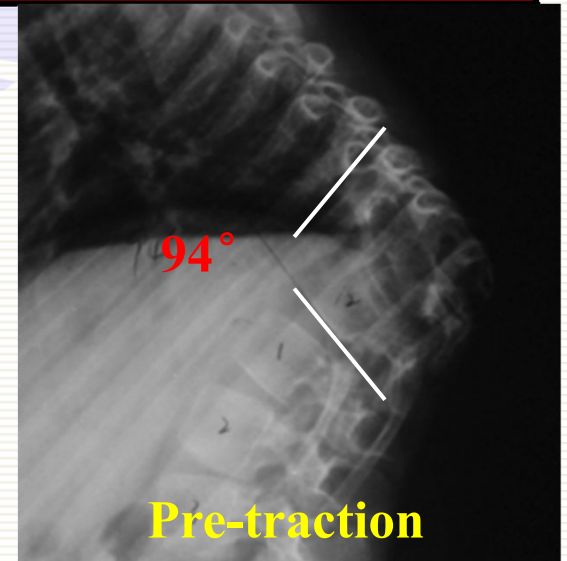
China



# Preoperative Halo-gravity traction

## Advantages

- Nutritional status
- Pulmonary function
- Neurologic deficits
- Curve severity
- Gradual correction
- Better correction
- Intraoperative neurologic complications



Ernest L. Sink, Lori A. Karol, James Sanders, et al. J Pediatric Orthopaedics;2001,21:519-524.

Uni

# Surgical strategy

Our Experience:

## Mechanism

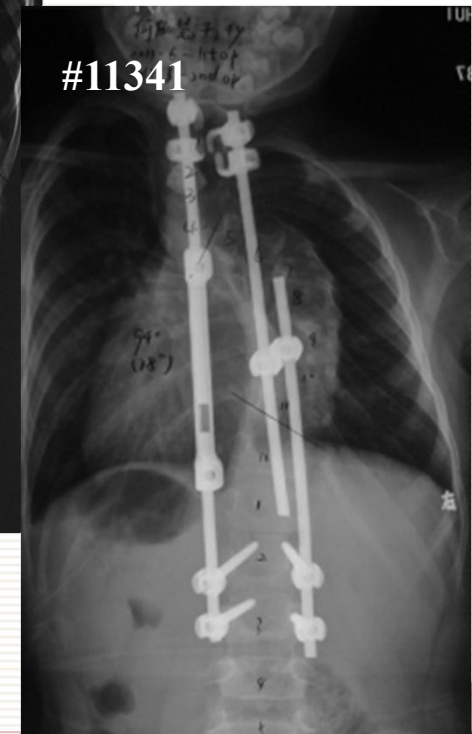
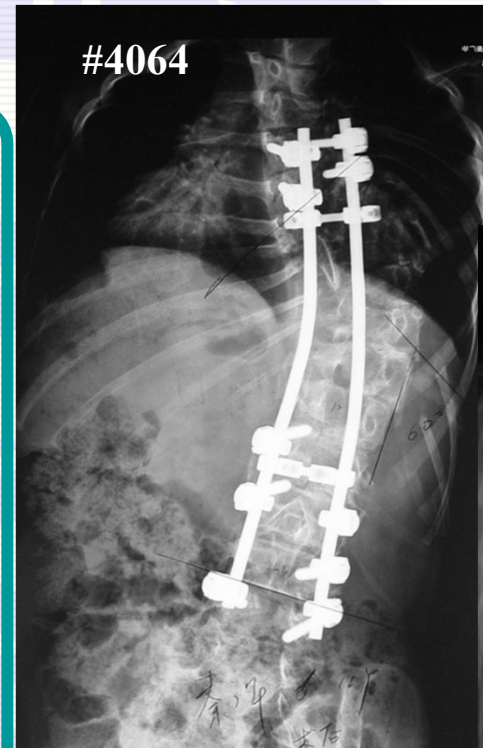


- ✓ Realign dislocated spine;
- ✓ Restore the continuity of spinal cord;
- ✓ Correct spinal deformity gradually.

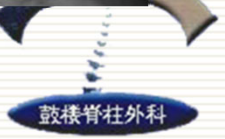


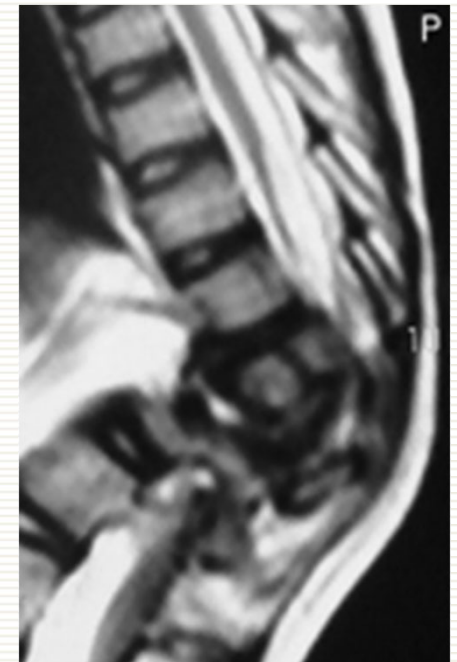
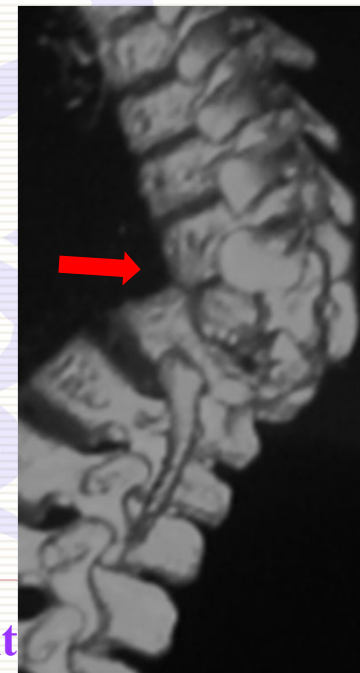
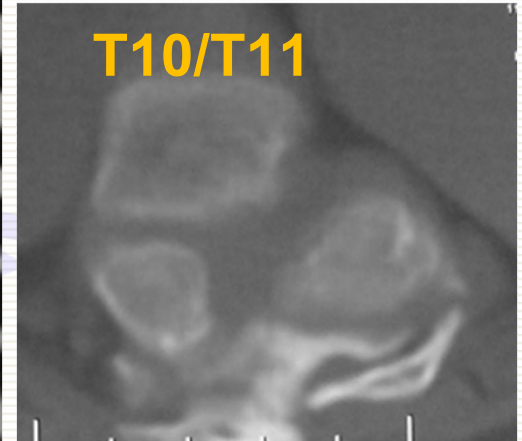
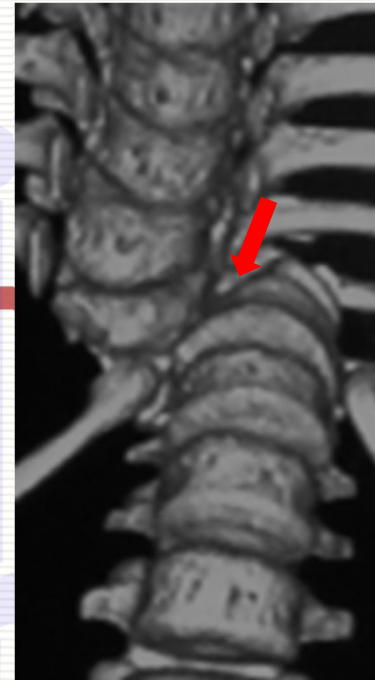
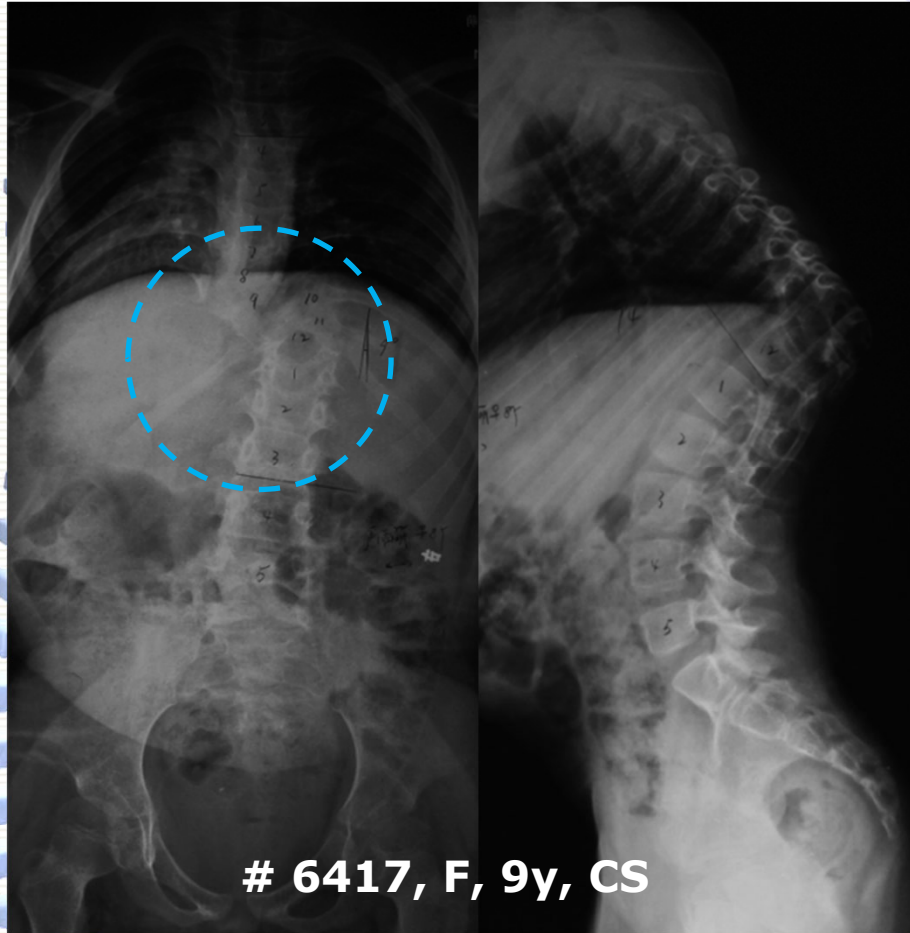
# Surgical strategy

- PSF;
- In situ fusion;
- PSF+  
concave side  
strut graft



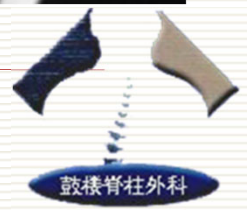
Spine Surgery, Drum Tower Hospital, Nanjing University, China

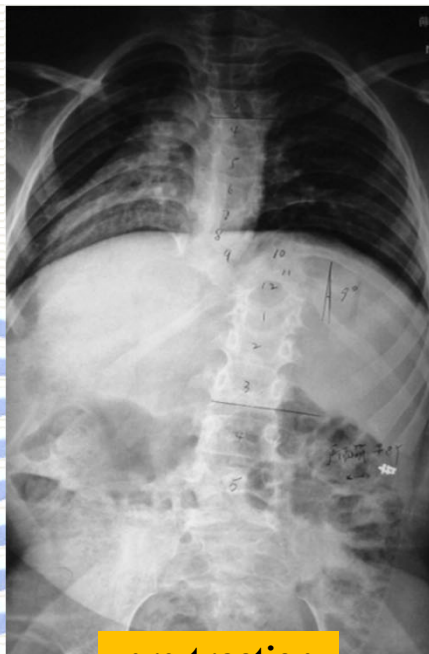




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University, China

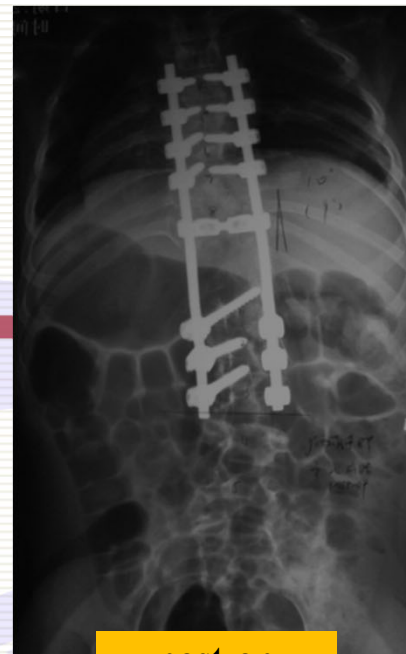




pre-traction



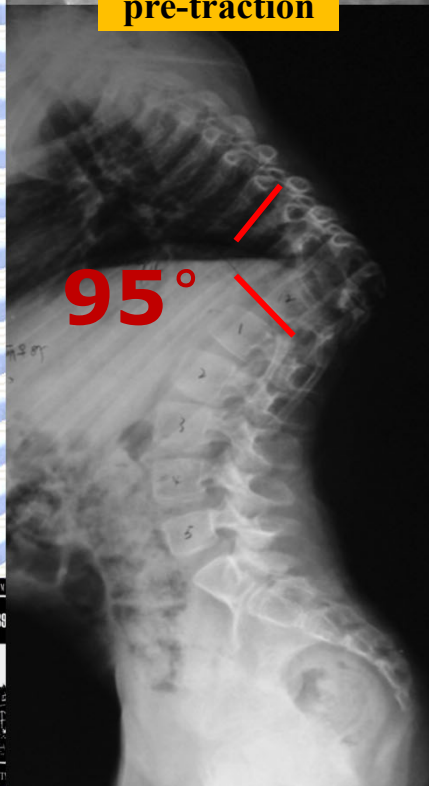
2m-post-traction



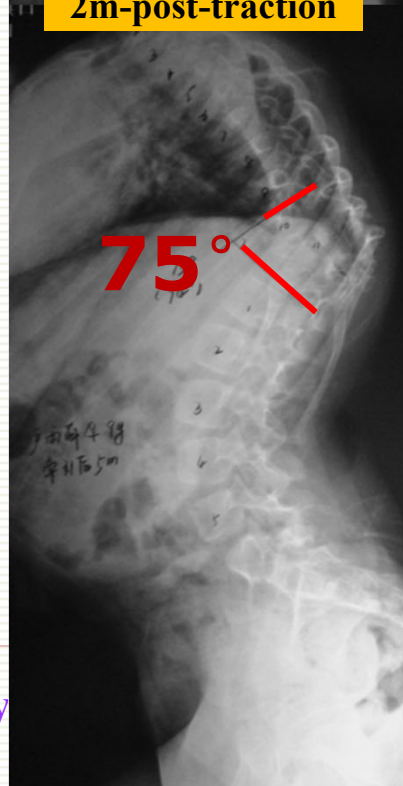
post-op



2 yr -post-op



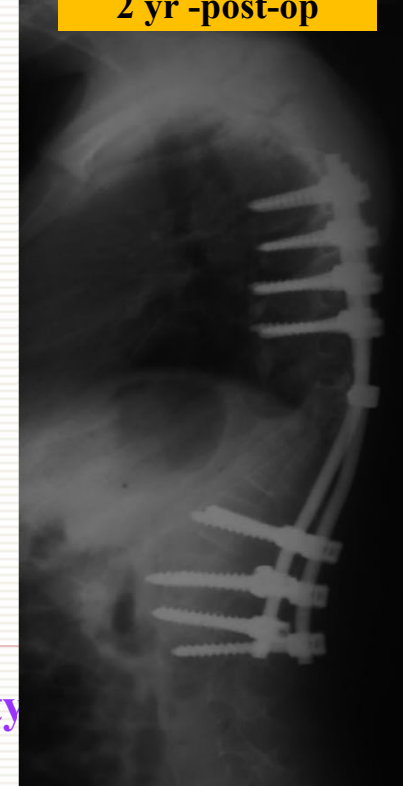
95°



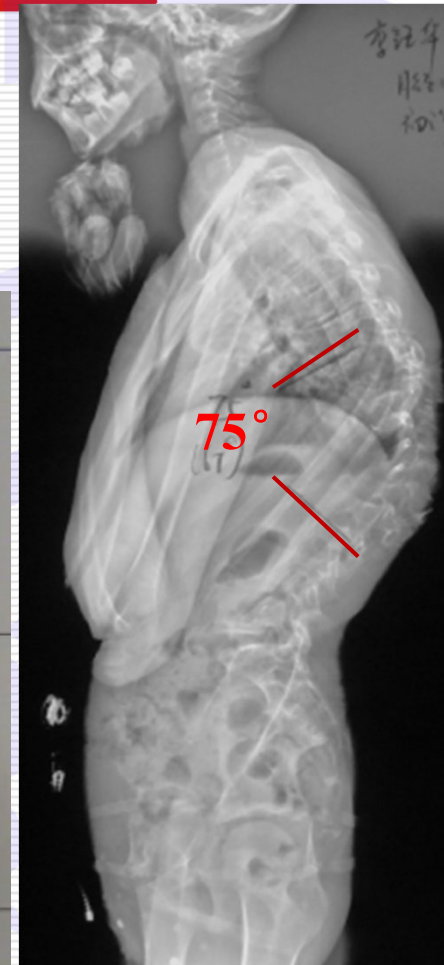
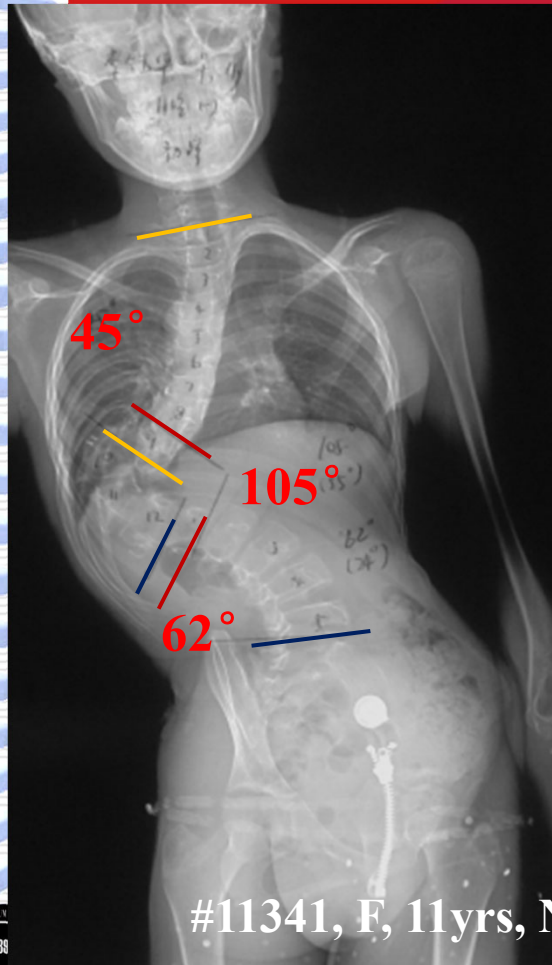
75°



20°  
(P4)



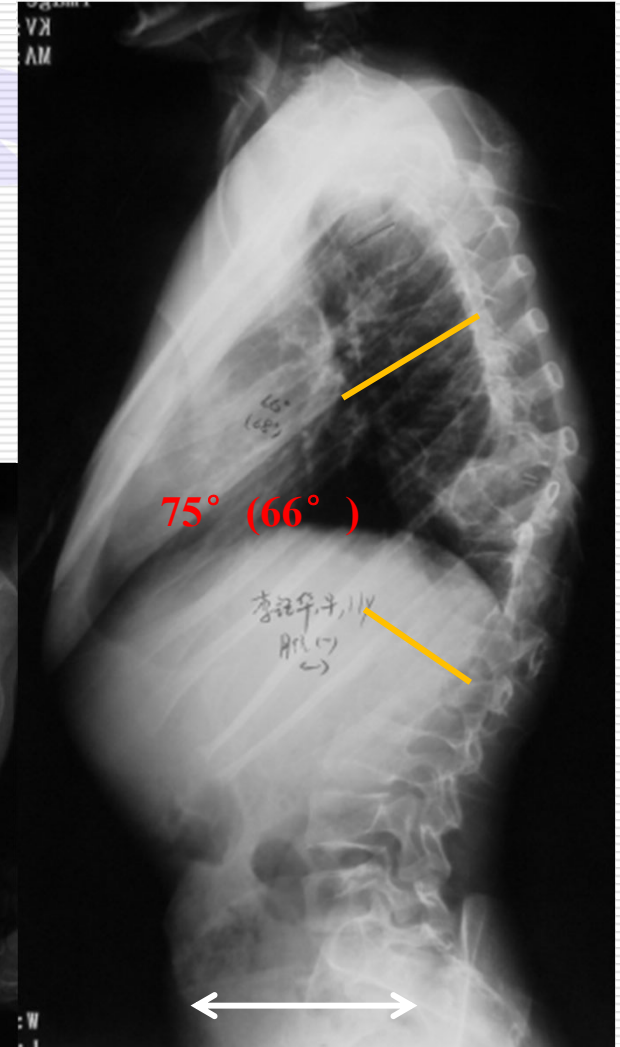
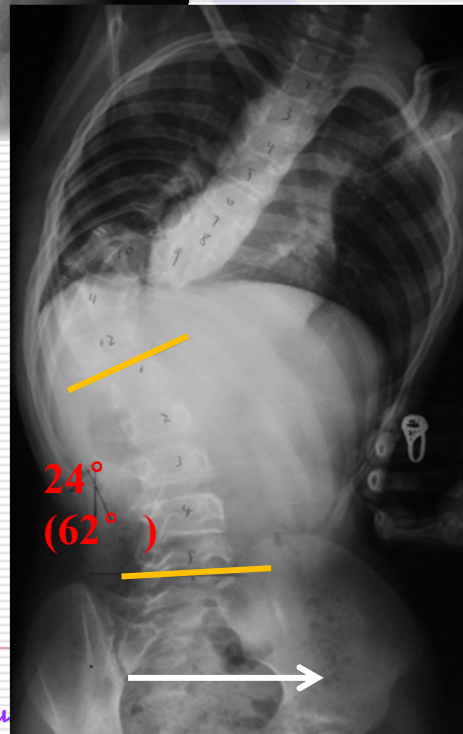
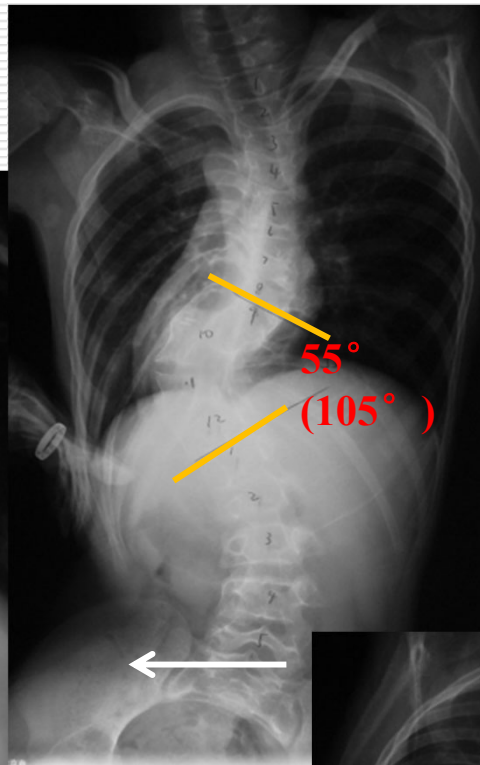
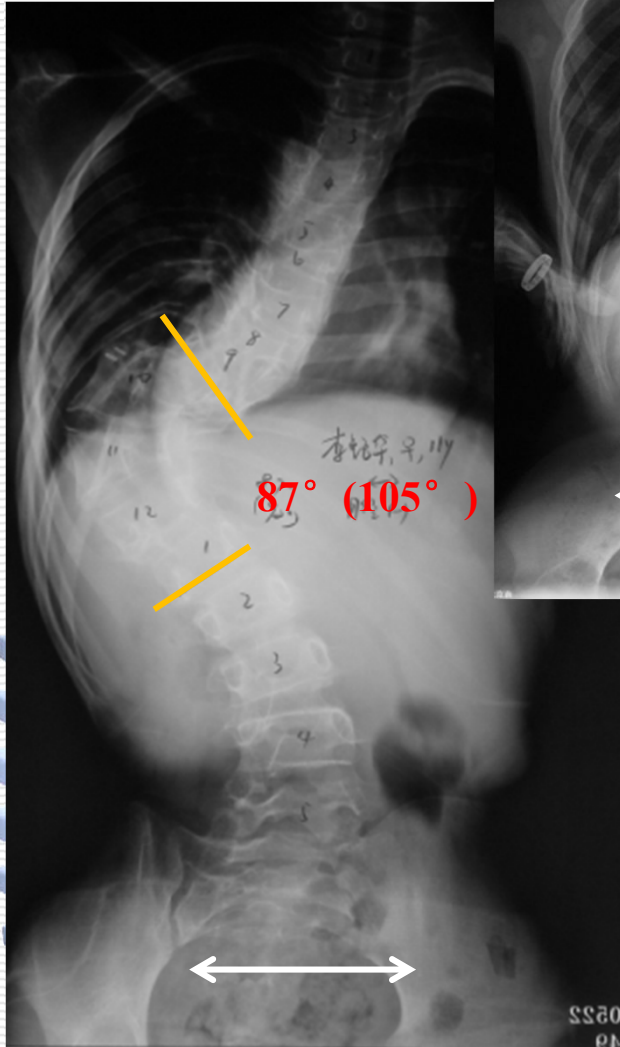
# Surgical strategy



Spine Surgery

Hospital, Nanjing University

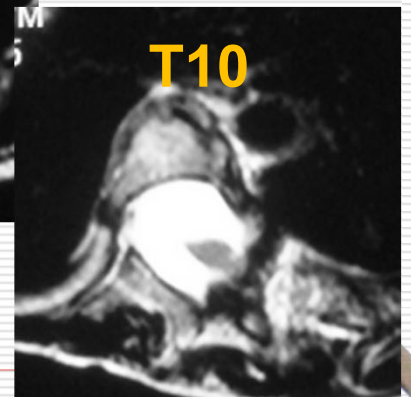
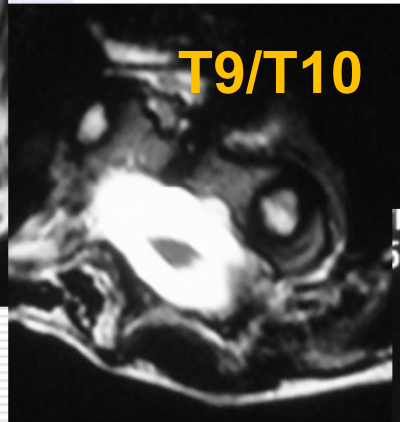
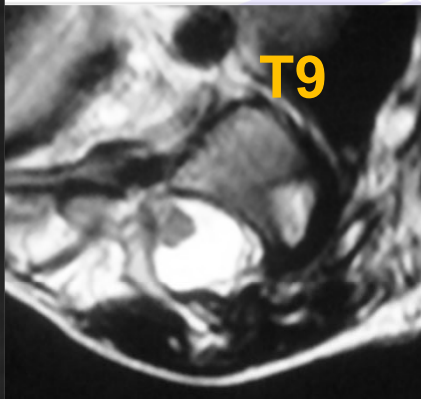
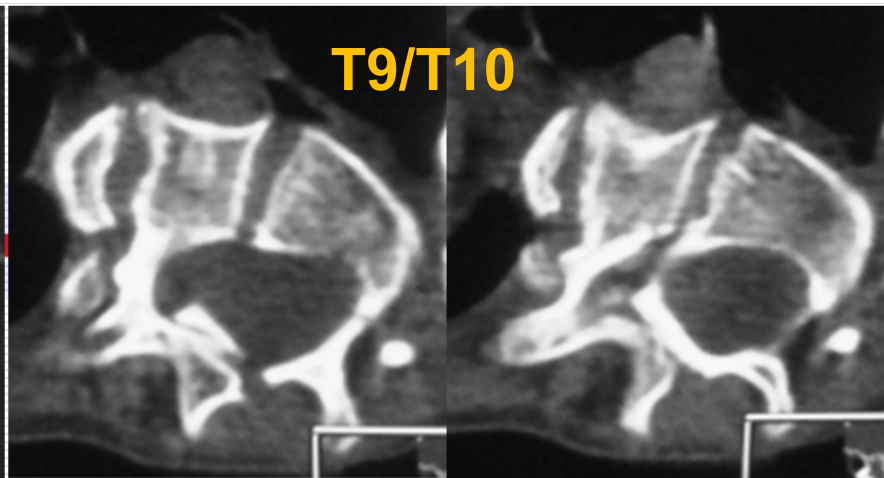
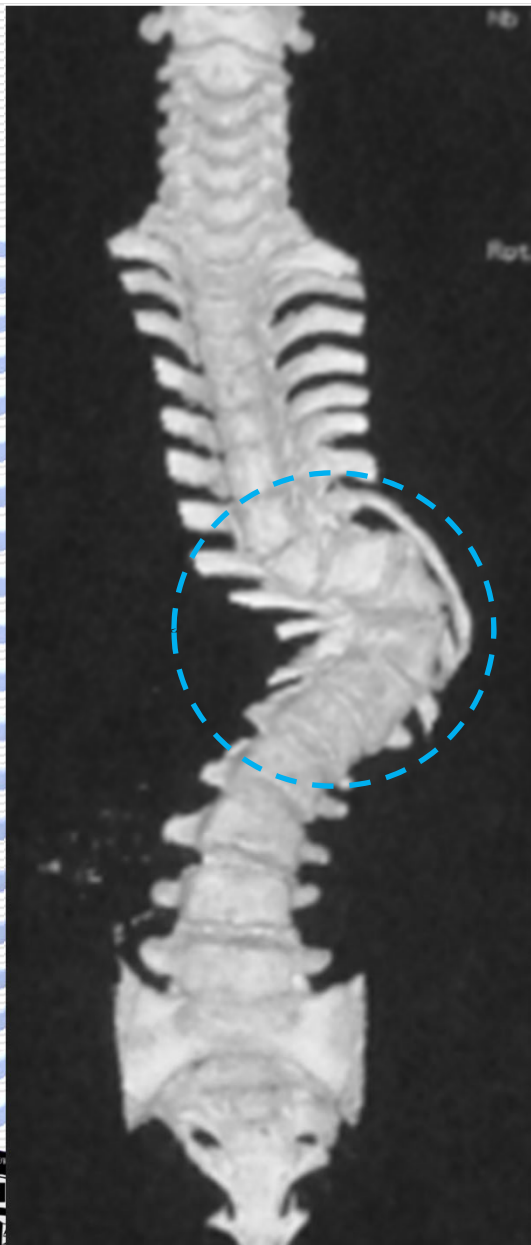
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Spine Surgery, Drum

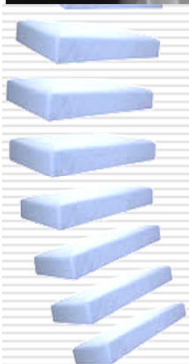
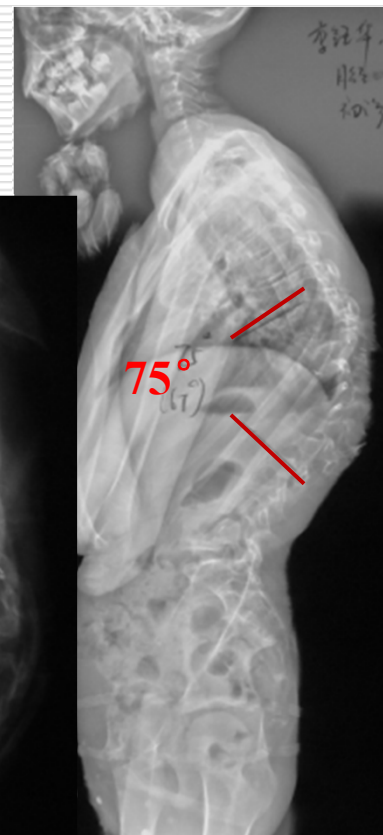
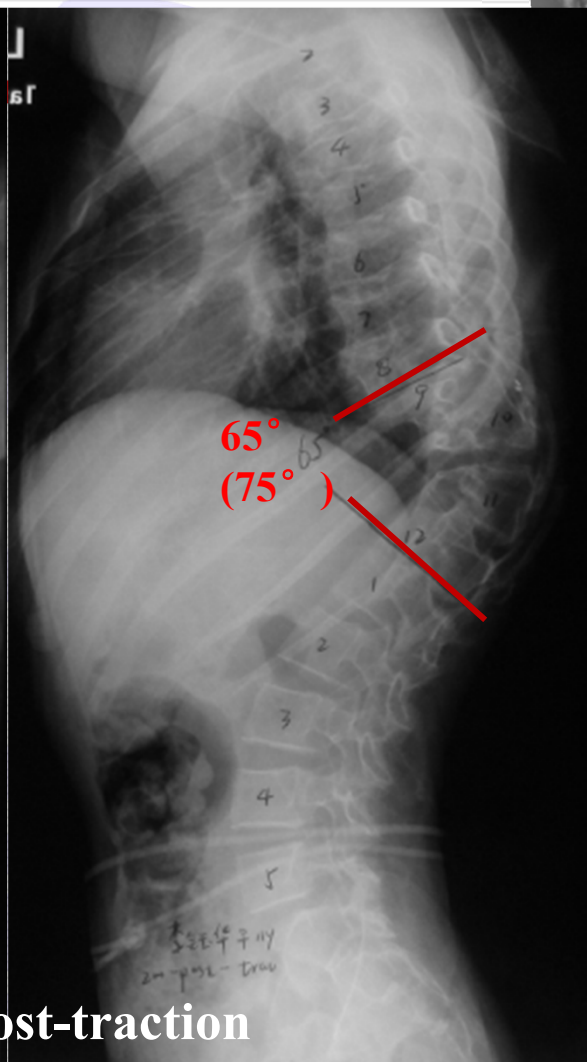
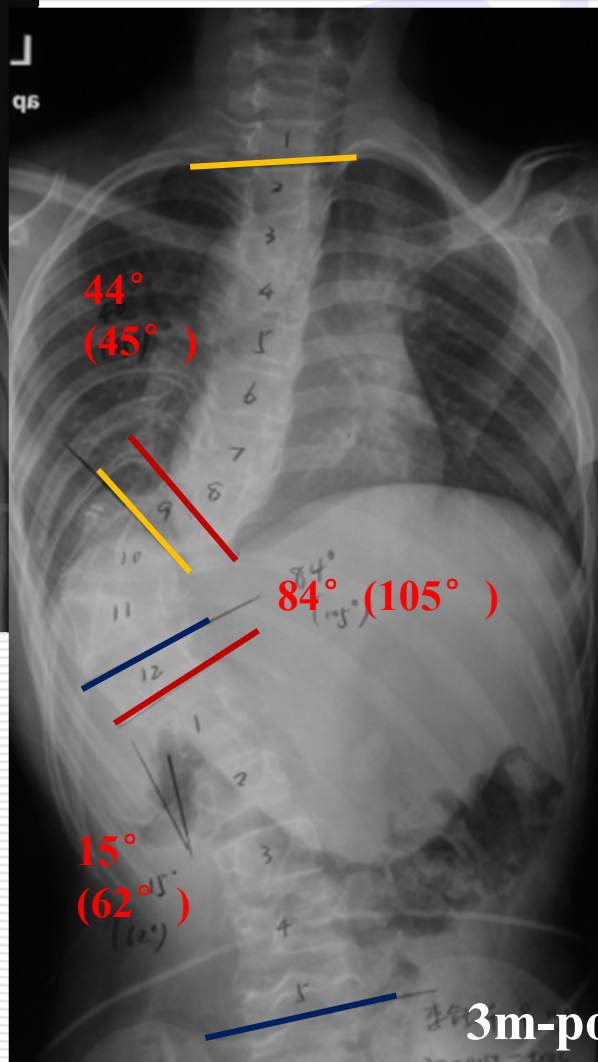
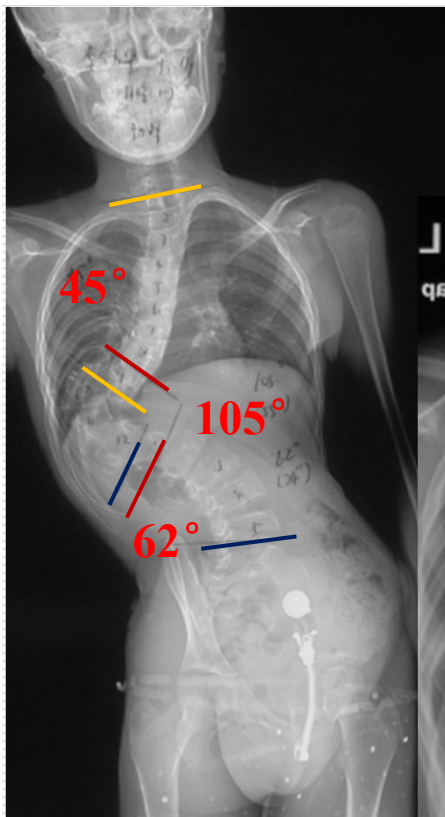
University





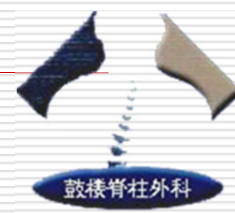
Spine Surgery, Drum Tower Hospital, Nanjing University

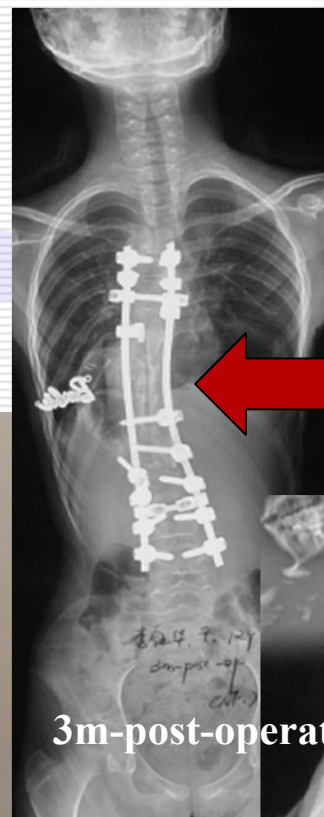
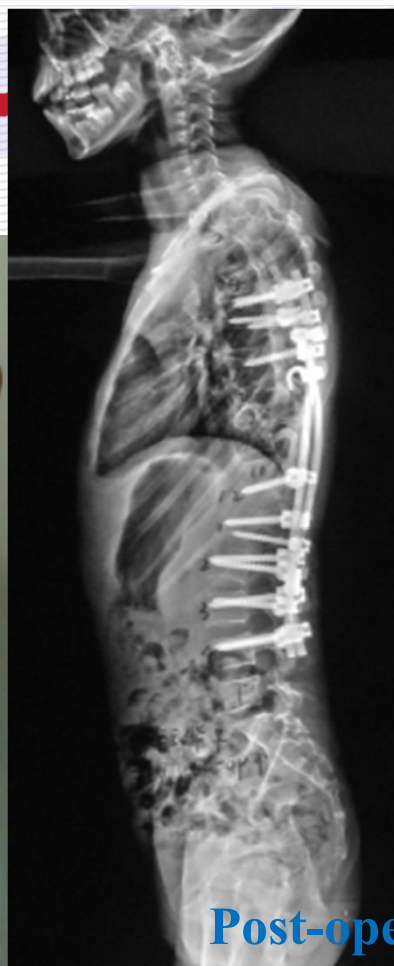
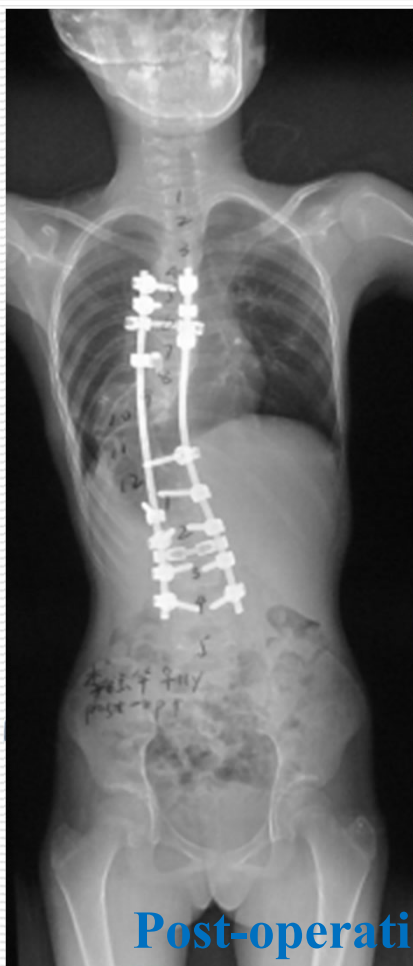
鼓楼脊柱外科



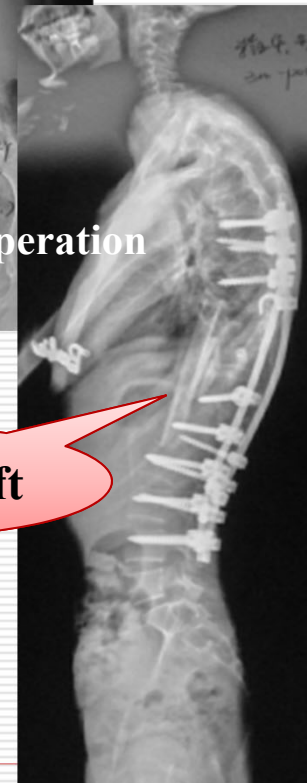
3m-post-traction

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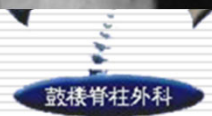




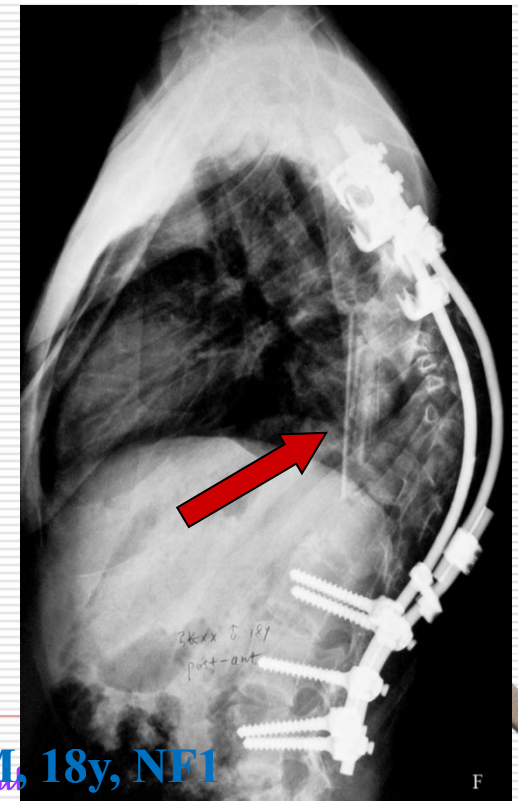
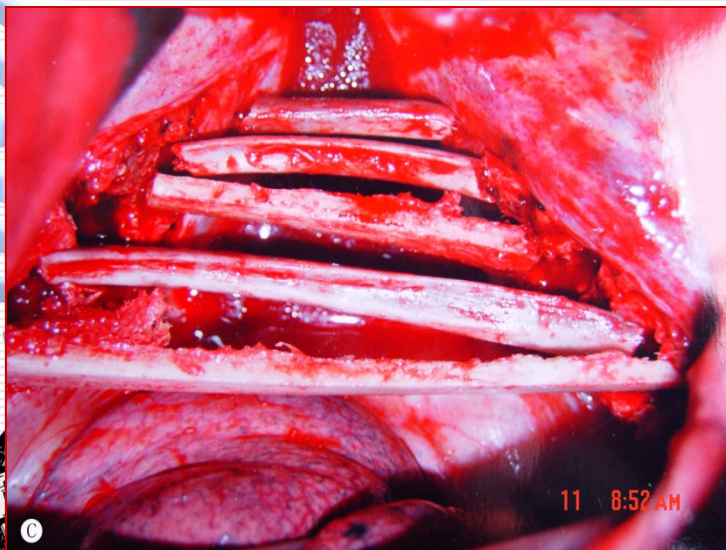
Strut graft



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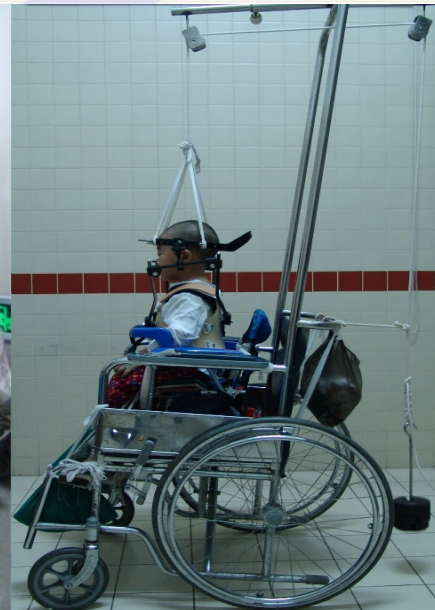
# Concave strut graft



#2829, Zhang KS, M, 18y, NF1

# Objective

**To evaluate the efficacy of preoperative HGT in severe NF-1 and CS with rotatory subluxation.**



# Materials and methods

**N=22**

**NF-1:11**

**Pretreatment, post-traction:**

- ✓ Magnitude of RS
- ✓ Neurological complications
- ✓ Major curve
- ✓ Global kyphosis
- ✓ Pulmonary function

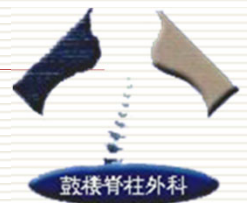
**CS:11**

**Pretreatment, post-traction:**

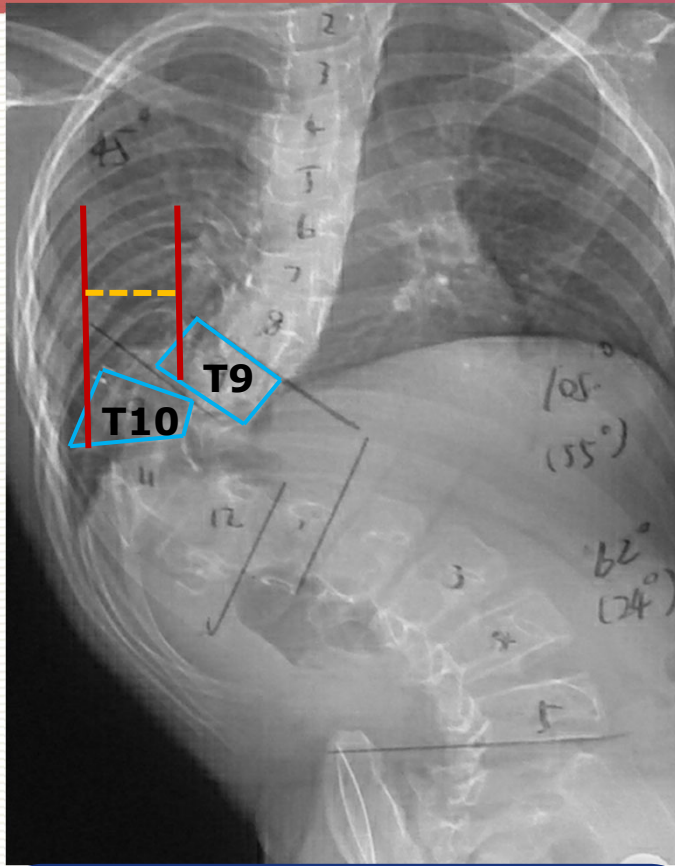
- ✓ Magnitude of RS
- ✓ Neurological complications
- ✓ Major curve
- ✓ Global kyphosis
- ✓ Pulmonary function



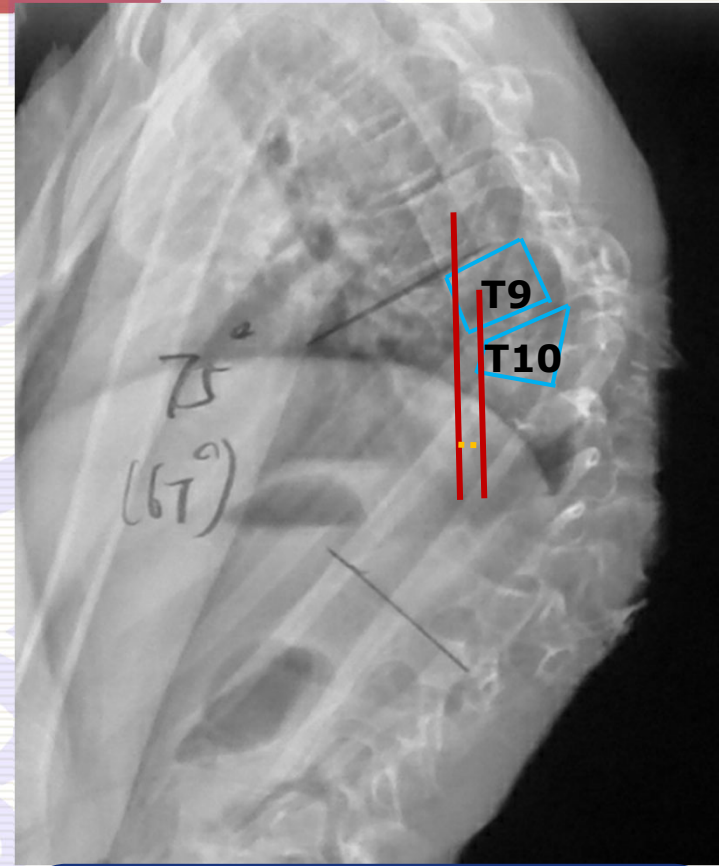
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# Measurement of lateral/anterior translation



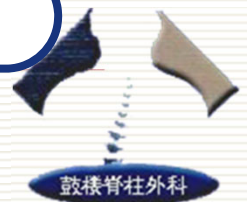
**Lateral translation**



**Anterior translation**



Spine Su Brett AF, William CH, John MR, et al. Spine; 2009,34:603-8. City, China



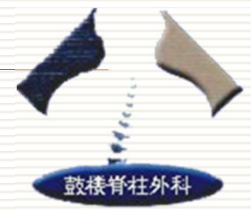
# Results

Table 1. Efficacy of HGT in all patients

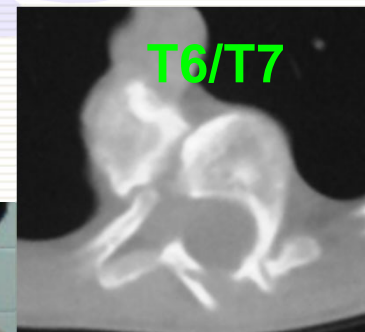
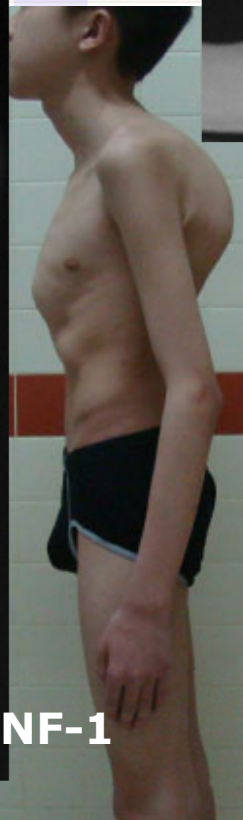
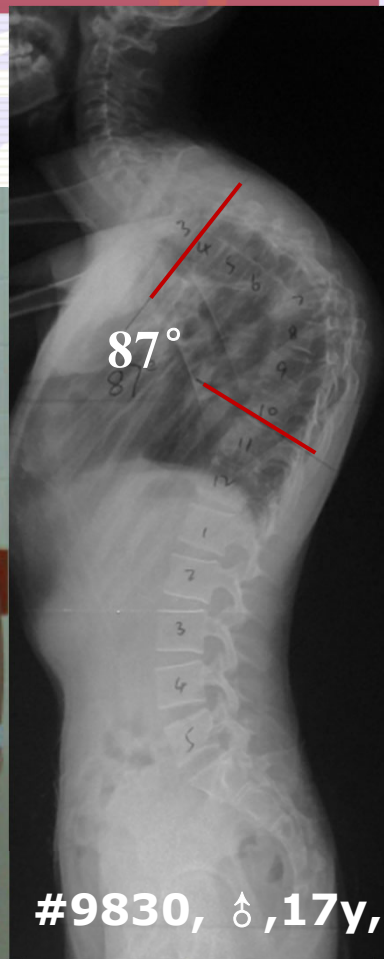
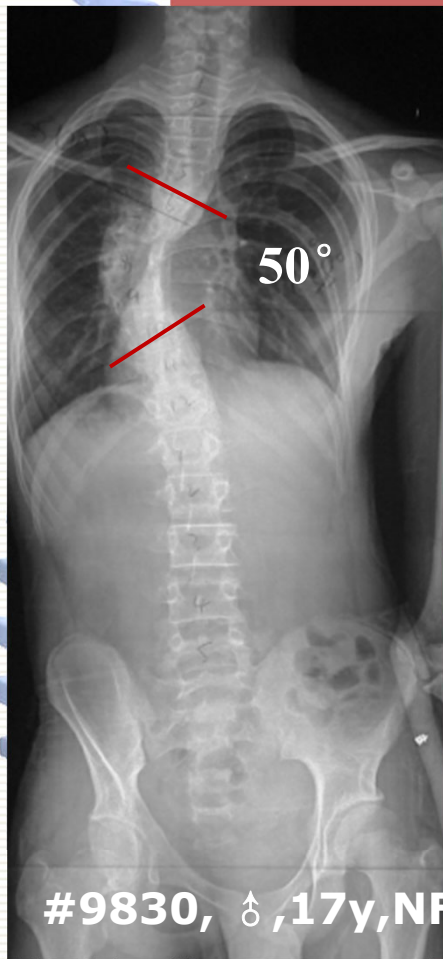
	Pre-traction	Post-traction	Correction rate (%)	P
Major curve	$105.45 \pm 34.26$	$81.23 \pm 32.68$	$21.07 \pm 14.08$	*
Global kyphosis	$79.27 \pm 22.53$	$66.89 \pm 23.06$	$22.81 \pm 15.54$	*
Lateral translation(mm)	$9.37 \pm 5.28$	$6.41 \pm 3.67$	$30.31 \pm 14.54$	*
Anterior translation(mm)	$7.57 \pm 3.52$	$5.03 \pm 2.35$	$34.76 \pm 22.22$	*



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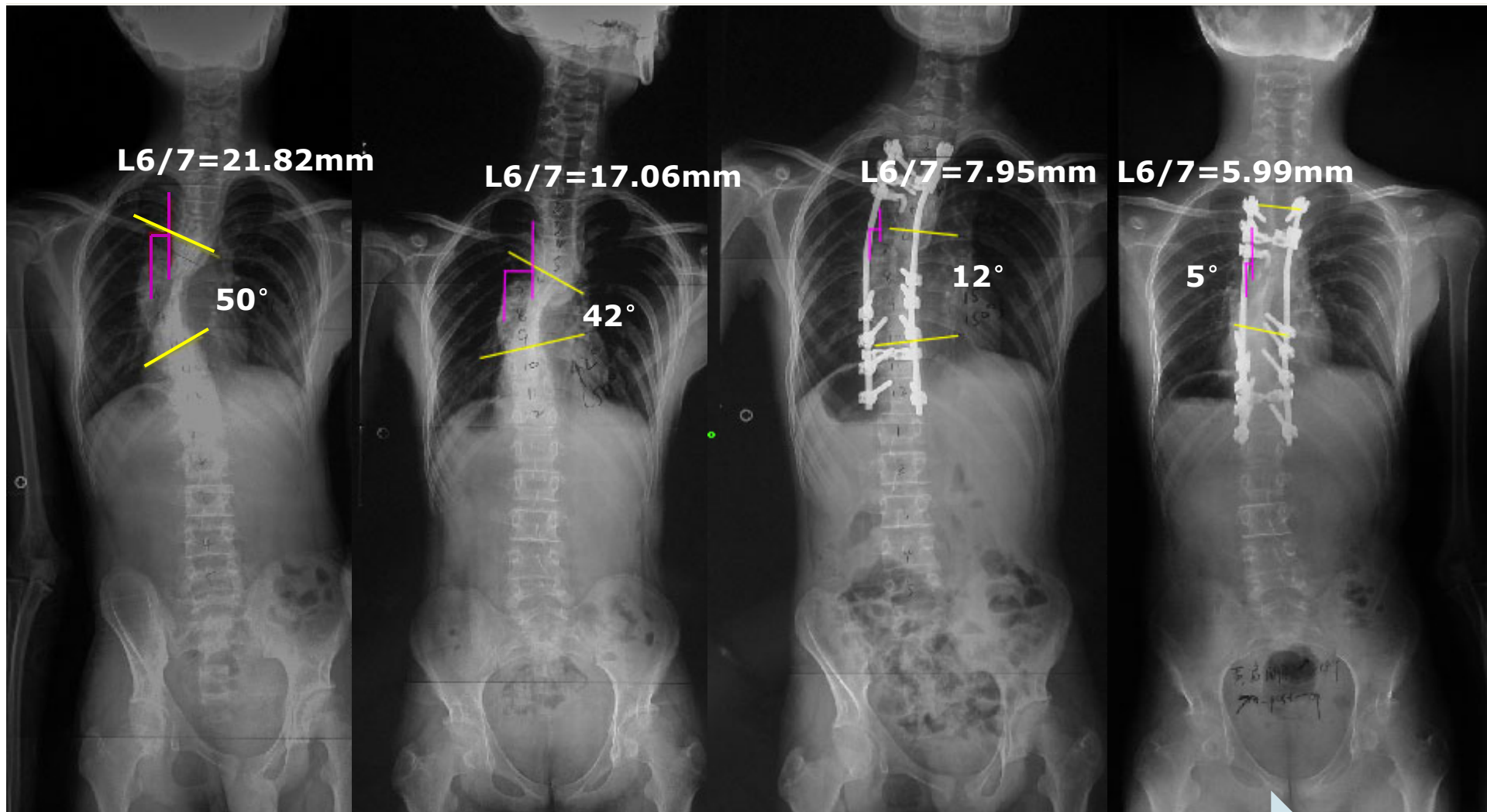


# NF-1 with RS



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Pre-traction

3m-post-traction

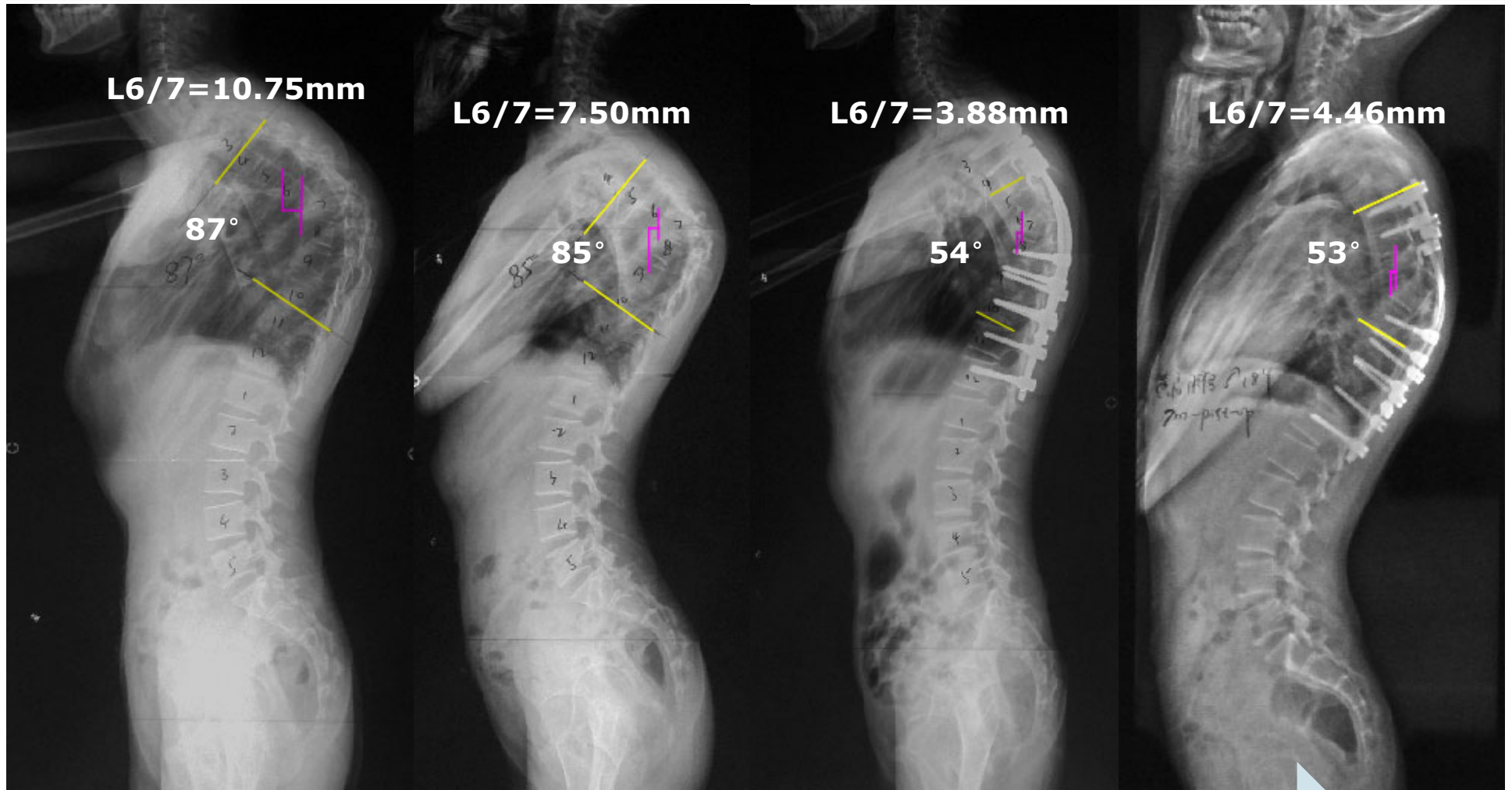
Post-op

7m-post-op



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Pre-traction

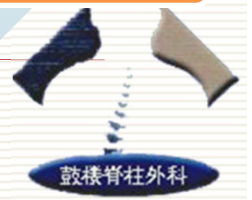
3m-post-traction

Post-op

7m-post-op



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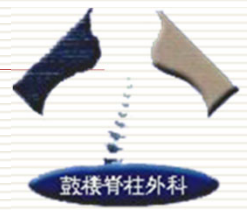
# Results

Table 2. Efficacy of HGT in NF-1

NF-1	Pre-traction	Post-traction	Correction rate (%)	P
Major curve	$90.30 \pm 26.10$	$69.67 \pm 23.21$	$24.60 \pm 14.56$	0.002
Global kyphosis	$75.6 \pm 16.30$	$59.00 \pm 14.58$	$23.75 \pm 14.27$	0.006
Lateral translation(mm)	$10.48 \pm 6.75$	$7.61 \pm 4.09$	$32.66 \pm 14.89$	0.01
Anterior translation(mm)	$8.47 \pm 3.31$	$5.40 \pm 2.55$	$37.59 \pm 22.92$	0.003



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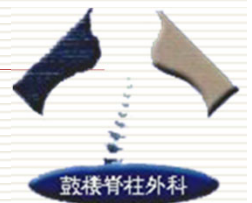
# Results

Table 3. Efficacy of HGT in CS

CS	Pre-traction	Post-traction	Correction rate (%)	P
Major curve	$127.55 \pm 16.49$	$100.90 \pm 23.31$	$17.53 \pm 12.63$	0.003
Global kyphosis	$83.45 \pm 27.13$	$74.78 \pm 26.95$	$21.87 \pm 16.67$	0.004
Lateral translation(mm)	$8.26 \pm 2.80$	$5.90 \pm 2.55$	$27.96 \pm 13.80$	0.0001
Anterior translation(mm)	$6.67 \pm 3.49$	$4.67 \pm 2.06$	$31.94 \pm 21.13$	0.017



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# Results

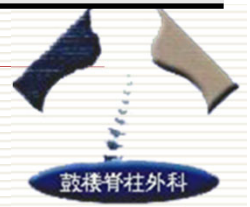
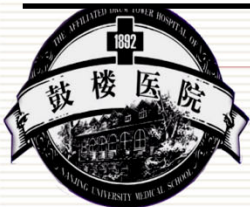
Table 4. Changes in patients with neurological deficits

	Patient number	sex	age	traction
NF1	1	M	20	+
	2	M	18	-
	3	M	18	+
CS	4	M	6	+
	5	F	10	+
	6	M	8	-
	7	F	15	-

“+”: improved after traction

“-”: no change after traction

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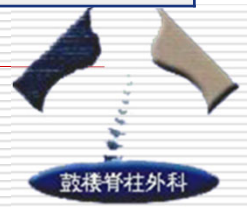
# Results

Table 5. Results of surgical correction in all patients

All patients	Pre-op	Post-op	Final follow-up
Major curve	$105.45 \pm 34.26$	$51.2 \pm 12.7$	$53.6 \pm 12.1$
Global kyphosis	$79.27 \pm 22.53$	$36.3 \pm 10.8$	$36.8 \pm 11.5$
Lateral translation(mm)	$9.37 \pm 5.28$	$5.2 \pm 3.2$	$5.1 \pm 4.1$
Anterior translation(mm)	$7.57 \pm 3.52$	$4.9 \pm 3.7$	$4.6 \pm 2.8$



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# Complications

## Complications of HGT

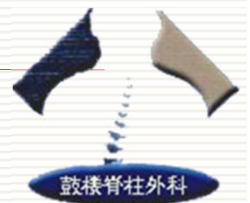
Pin loosening: 3 case

Superficial pin site infections: 1 case

Numbness of the mouth: 2 case



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# Perioperative surgical complications



CS  
(2  
case)



**Srcew  
malposition**

NF-1  
(1 case)



**Srcew  
malposition (T7)**

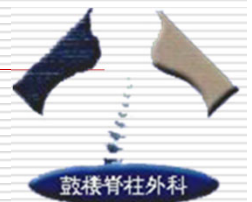
NF-1  
(1 case)



**Intraoperative  
massive  
blood loss**



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## Clinical Outcome of Halo-gravity

Author	Year	Patients	Etiology	Coronal Correction ( ° )	Sagittal Correction ( ° )
Watanabe	2010	21	severe scoliosis ( $\geq 100^{\circ}$ )	61	24
Zeller	2000	11	short sharp angled kyphosis	28	45
Sink	2001	19	neuromuscular, idiopathic, and congenital scoliosis	39	48
Janus	2000	20	severe scoliosis in osteogenesis imperfecta	31	40
Rinella	2005	33	severe scoliosis, kyphoscoliosis, or kyphosis	46	34
Park	2013	525	severe scoliosis, kyphoscoliosis, or kyphosis	40	46
<b>Current study</b>	<b>2014</b>	<b>22</b>	<b>congenital scoliosis, NF-1</b>	<b>56</b>	<b>45</b>

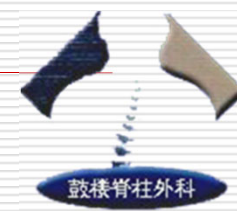
# Surgical Outcome of Rotational Dislocation in Kyphoscoliotic Deformities

Author	Year	Patients	Etiology	Coronal Correction (°)	Sagittal Correction (°)
Vandenbroucke	1997	2	NF-1	29	35
Zeller	2000	11	short sharp angled kyphosis	31	48
Stoker	2012	1	NF1	42	53
<b>Current study</b>	<b>2014</b>	<b>22</b>	<b>congenital scoliosis, NF-1</b>	<b>38</b>	<b>47</b>

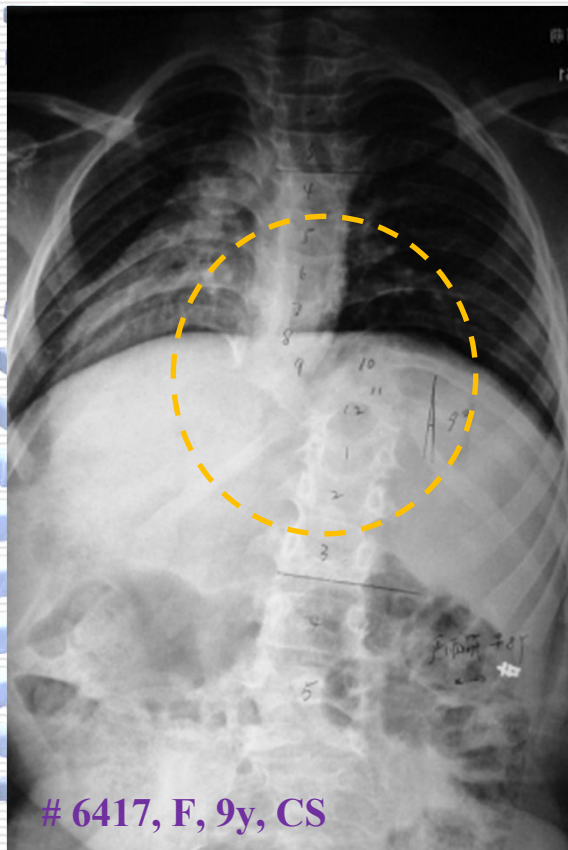
Scoliosis



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# Mechanism of rotational subluxation



Rotated in opposite  
directions

Anterior column  
malformation

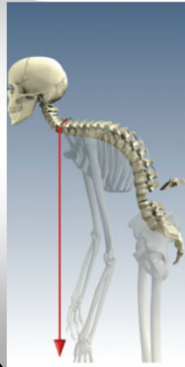


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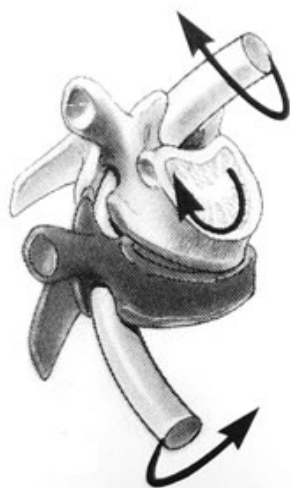
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# Neurologic Deficits

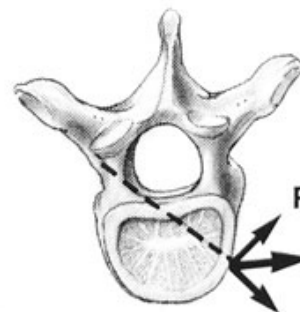
## Mechanism



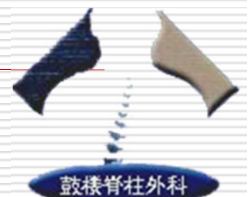
- ✓ Not From Compression
- ✓ Just From Canal Discontinuity



NJGLYY



Rotation  
E

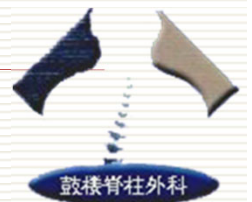


# Conclusions

Preoperative HGT is a safe, well-tolerated method to improve coronal curve and sagittal kyphosis for CS and NF-1 patients associated with rotational subluxation.



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*Thank you!*

