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Casting for Early Onset Scoliosis: The Pitfall of Increased Peak Inspiratory Pressure

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Background

- Serial cast correction plays a large role as a treatment option for progressive EOS
- Body casting can lead to restriction of chest and abdominal expansion and result in decreased chest wall compliance.
 - Many of these patients are already compromised
- No studies on ventilation in casting for EOS

Methods

- After obtaining IRB approval, we reviewed the records of patients with EOS who underwent serial casting under GA between 2007-2010
- The anesthesia technique was standardized
- Data were obtained during **39** serial cast correction procedures performed under GA in **seven** children

Casting technique

- The procedure was performed on a casting table
- A stockinet layer was applied over the trunk and abdomen
- Cast was applied using the **elongation, derotation** and **flexion** technique described by Cotrel and Morel
- Anterior and posterior windows were made in the cast to allow abdominal/chest expansion and curve derotation as described by Mehta
- d'Astous and Sanders, *JPO* 2009



Courtesy of Jacques d' Astous MD













Anesthesia technique

- Standardized:
 - children were intubated with rigid ET tubes,
 - tidal volume was held constant at 8-10 cc/kg**
 - using **volume control ventilation**
- PIP recorded at baseline before cast (PIP1)
- after cast application prior to window (PIP2)
- after window cutout prior to extubation (PIP3)

Radiological measurements

- Cobb angles,
- Rib vertebral angle difference (RVAD),
- apical vertebral rotation (AVR) measured with the Nash and Moe method
- phase of the apical rib were recorded
- Measurements recorded before casting and at follow-up

No.	Diagnosis	Sex	Age at Presentation (months)	Initial Treatment	Age at First Casting (months)	No. of Casts	Age at Follow-up (months)	Follow-up Since First Cast	Status
1	ISS Pierre Robin	m	6	brace	12	5	35	23	VEPTR surgery
2	IIS	m	12	brace	26	8	66	40	continue cast
3	IIS	f	24	brace	42	7	67	25	Shilla procedure
4	IIS	m	6	brace	24	4	44	20	brace
5	ISS, Diastrophic dysplasia	f	7	brace	23	5	36	13	continue cast
6	ISS	m	6	brace	14	5	27	13	continue cast
7	IIS	m	7	observatio n	12	5	35	23	brace

Male, 12 months

Cobb - 31°, RVAD- 14°



Lat Cobb - 30°



Initial treatment in Wilmington brace At 26 months - casting

Thoracic Cobb 41°, RVAD 14
Lumbar Cobb 56°

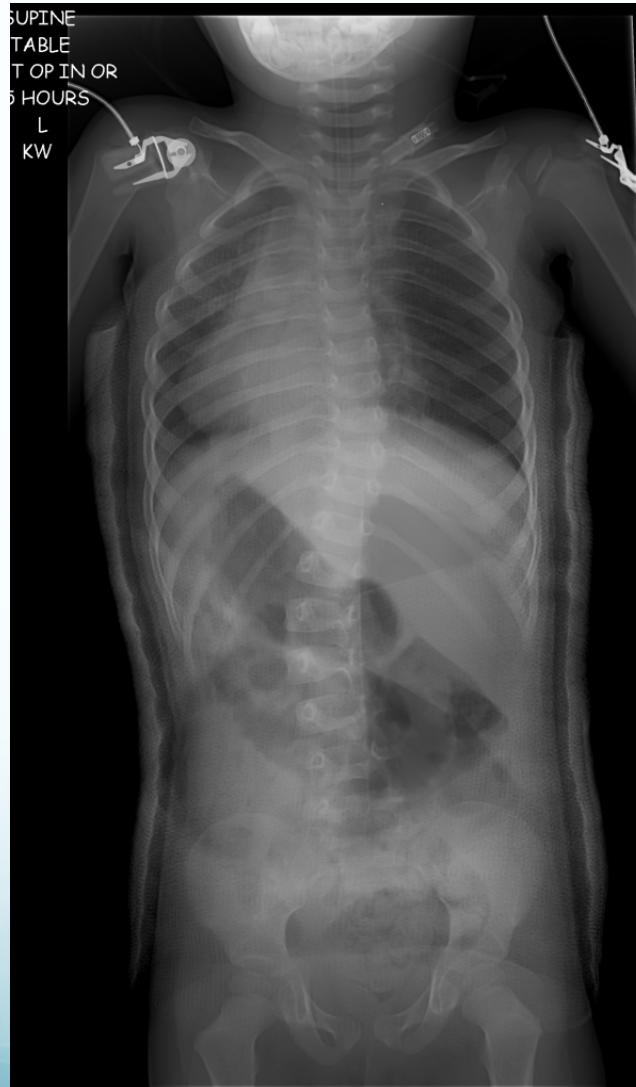
Lat Cobb 30°



Clinical Photos

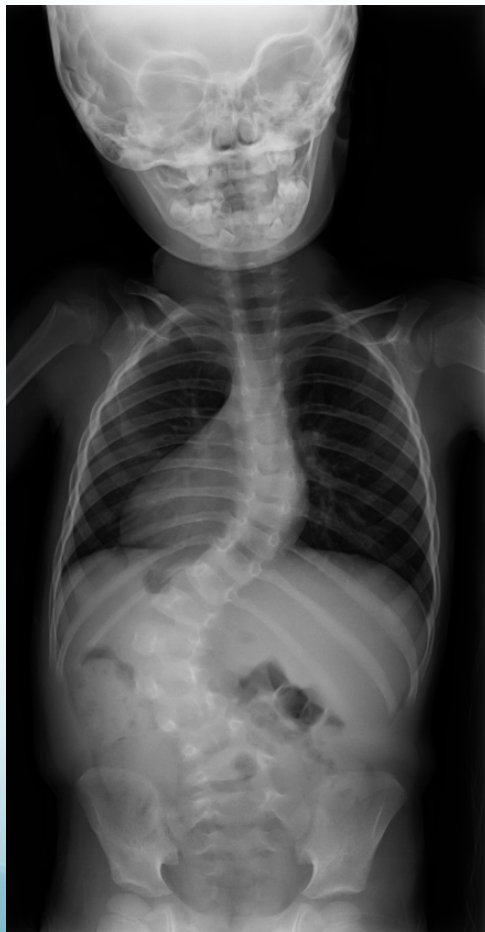


Lumbar Cobb 24°



...lost to follow up until age
32 months

Cobb 70°

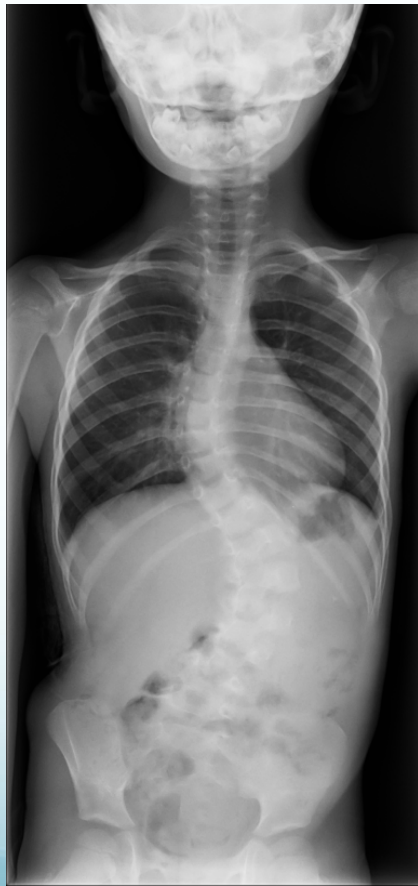


Lumbar Cobb 35°



36 months

Lumbar 68°, Thoracic 48°



Lumbar 35°

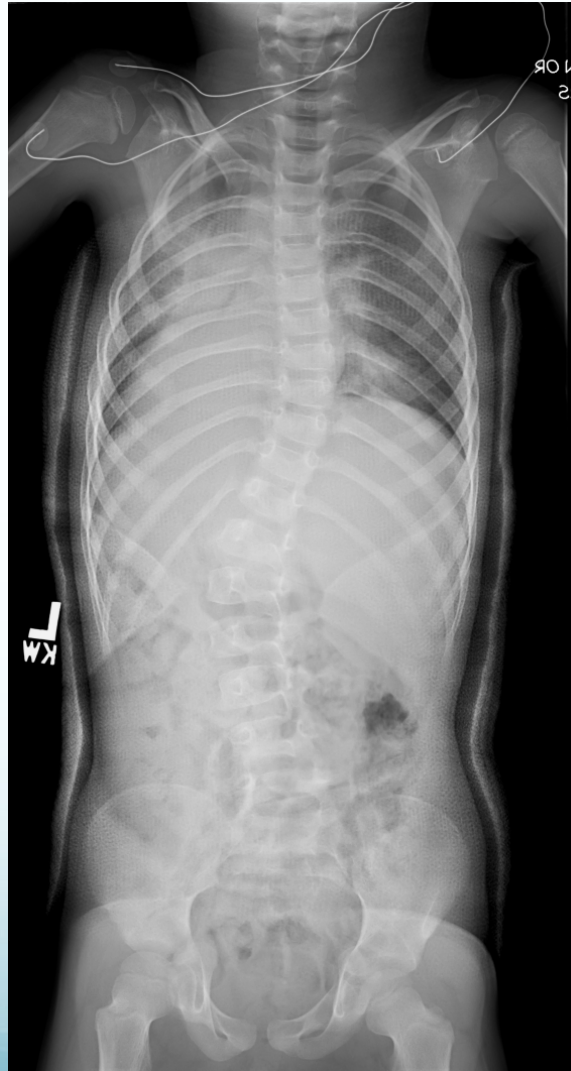


42 months

Cobb 67°



48 months
Cobb 32°



54 months

Cobb 58°



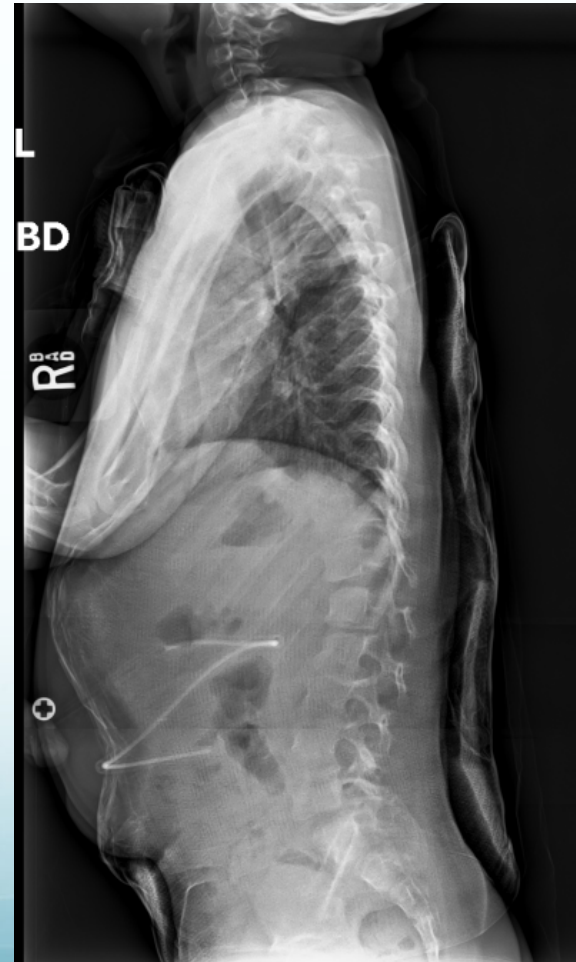
60 months

Cobb 50°

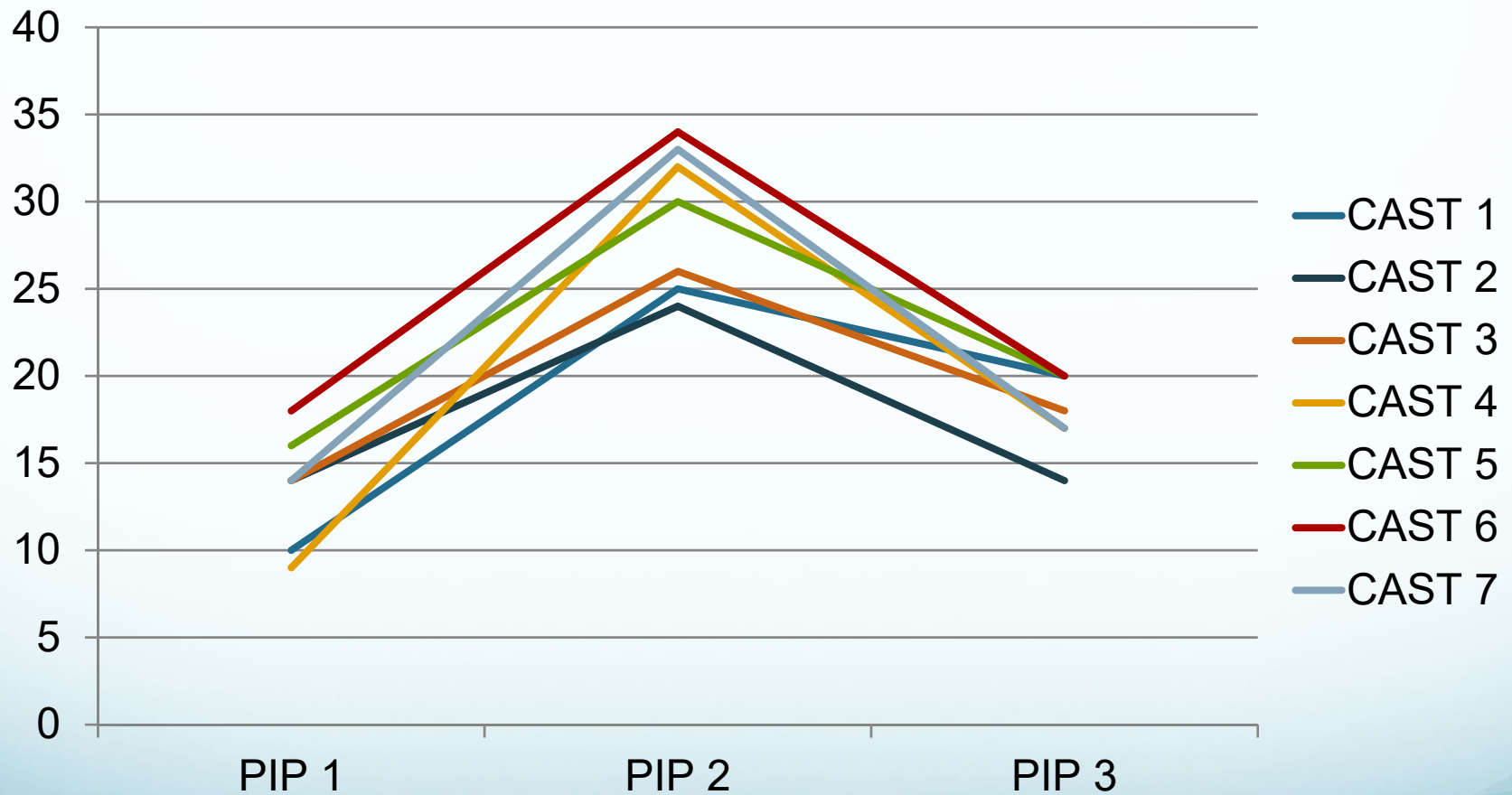


66 months

Cobb 51°



Changes in PIP



Results n = 39

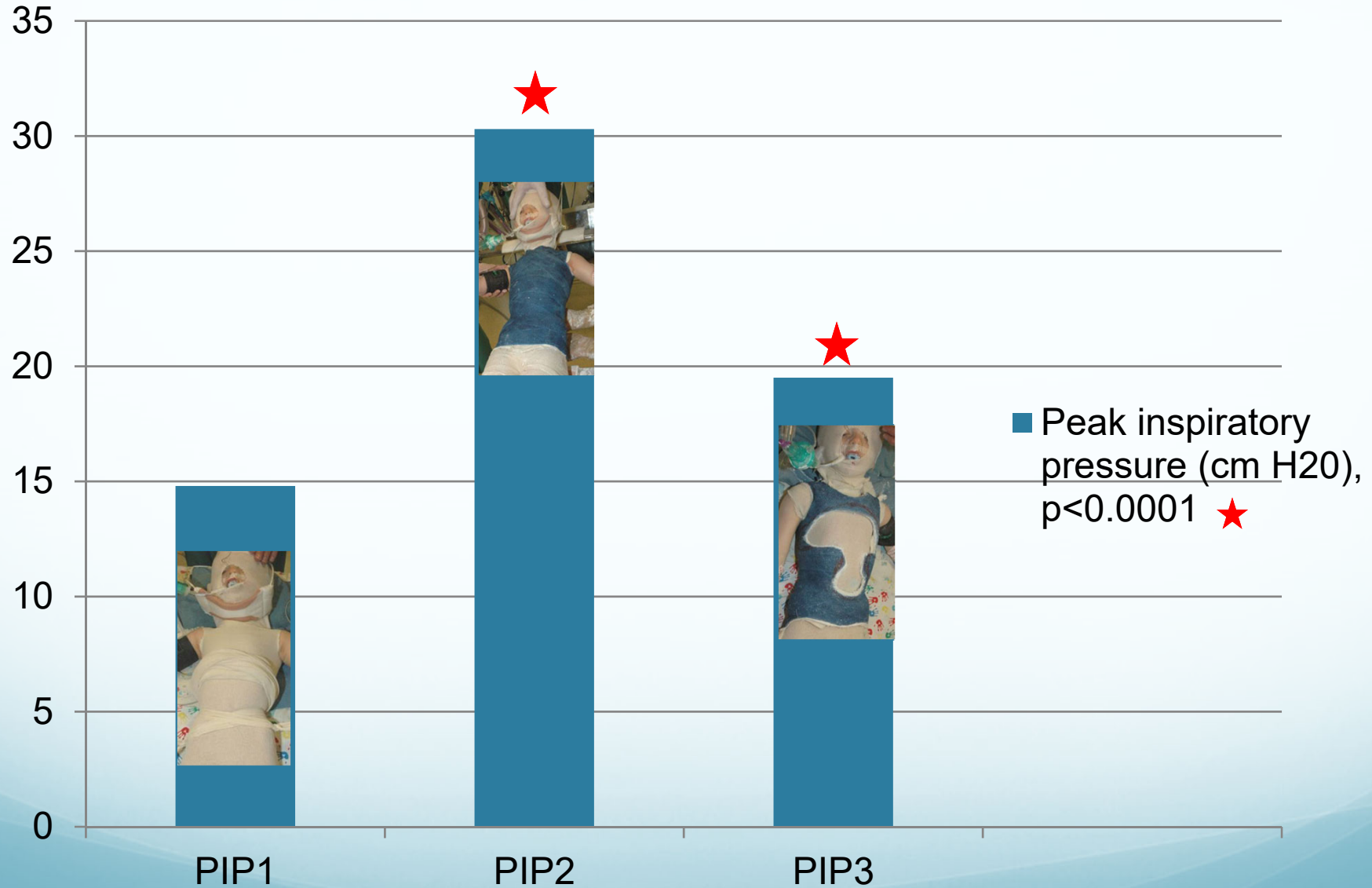
variable	Mean	SD	Range	F (df)	<i>p</i>
PIP 1	14.8	5.5	2-27	43.9(2)	<0.0001
PIP 2	30.3	9.6	3-50		
PIP 3	19.5	6.8	3-33		

PIP1- Peak inspiratory pressure before cast application

PIP2- Peak inspiratory pressure after cast application

PIP3- Peak inspiratory pressure after window cut -out

Peak inspiratory pressure (cm H₂O), p<0.0001



Pressure Increase

- There was a 104% increase after casting and 32% increase after window cut-out from the baseline PIP levels.
- There was a significant difference in PIP on repeated measures ANOVA, $f = 43.8$, $p < 0.0001$.

Complications

- Intra-operatively there was difficulty in maintaining ventilation during 2 procedures and one hypotensive episode.
- One patient developed hypoxemia after casting and another patient had delayed difficulty in breathing.

Radiological results

- There was an improvement in thoracic Cobb angles in four patients
- arrest of curve progression in one patient
- and worsening curve magnitude in two patients.

Table 4. Radiological values

Pt No.	Pre-casting						At Follow-up						
	Thoracic Cobb (degrees)		RVAD	Phase	AVR	Lumbar Cobb (degrees)		Thoracic Cobb (degrees)		RVAD	Phase	AVR	Lumbar Cobb (degrees)
AVR	AVR	AVR				AVR	AVR						
1	60	36	2	3	46	2	86	39	2	3	70	2	
2	41	14	1	2	56	2	40	14	2	2	51	2	
3	39	14	1	1	44	2	60	17	2	2	53	2	
4	22	12	1	1	29	2	15	14	1	1	25	1	
5	35	30	1	2	45	2	32	28	1	2	30	1	
6	76	35	2	2	33	1	66	50	2	2	46	1	
7	63	31	1	2	46	2	15	16	1	1	-	-	

AVR, Nash and Moe apical vertebral rotation; RVAD, rib vertebral angle difference in degrees

Limitations

- We had a small number of patients who underwent serial cast correction
- The group of patients was heterogeneous with IIS and ISS patients
- There are inherent limitations of a retrospective study design
- In spite of these limitations, this study addressed an important and clinically relevant question, and the findings of increased PIP were seen in a consecutive series.

Conclusions

- Casting resulted in an increase in PIP due to the transient restrictive pulmonary process, the PIP reduced after windows were cut out but not to baseline.
- In patients with underlying pulmonary disease, the casting process may induce respiratory complications.

Significance

- Be aware of the restrictive nature upon a patient's chest wall and abdomen of body casts
- Pay particular attention to increases in peak inspiratory pressures prior to belly window cutout
- Be prepared to manually ventilate the patient with a secure airway if necessary.
- **Not a contraindication to casting**

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