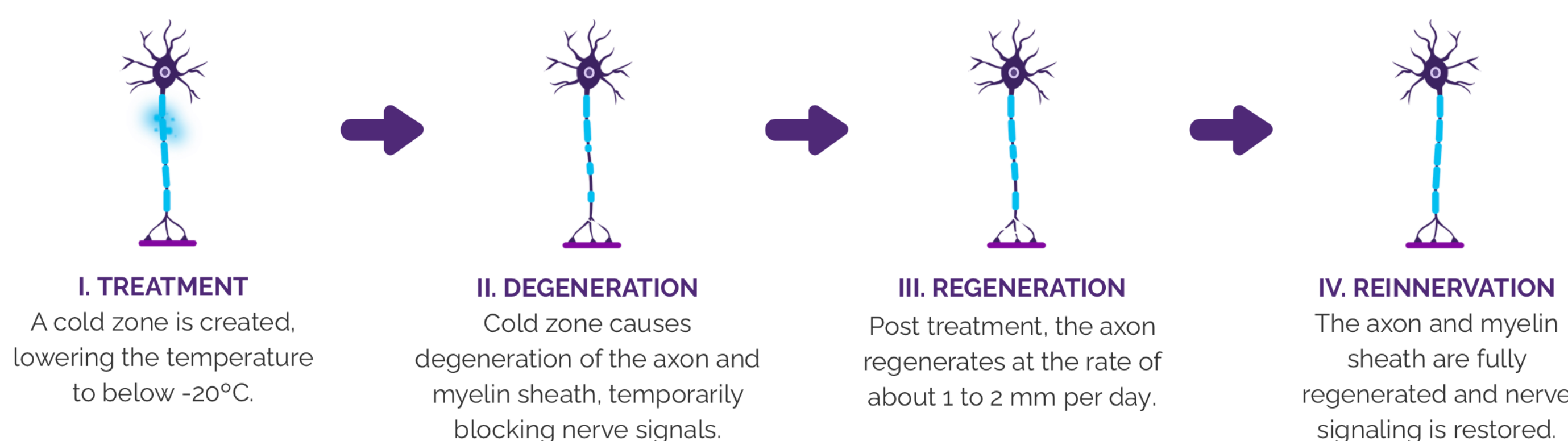


Background

- Inadequate analgesia following rib fractures → adverse outcomes
- Contemporary multimodal pain control limitations:
 - Adverse medication effects
 - Temporary nature of neuraxial or regional blockade
 - Limited indications for surgical stabilization of rib fractures (SSRF)
- Cryoneurolysis of intercostal nerves (CIN) provides reversible analgesia
 - Cryo-injured axons gradually regenerate
 - Median analgesic duration: 2 weeks to 5 months*
 - Intraoperative CIN + SSRF → decreased opioid use†



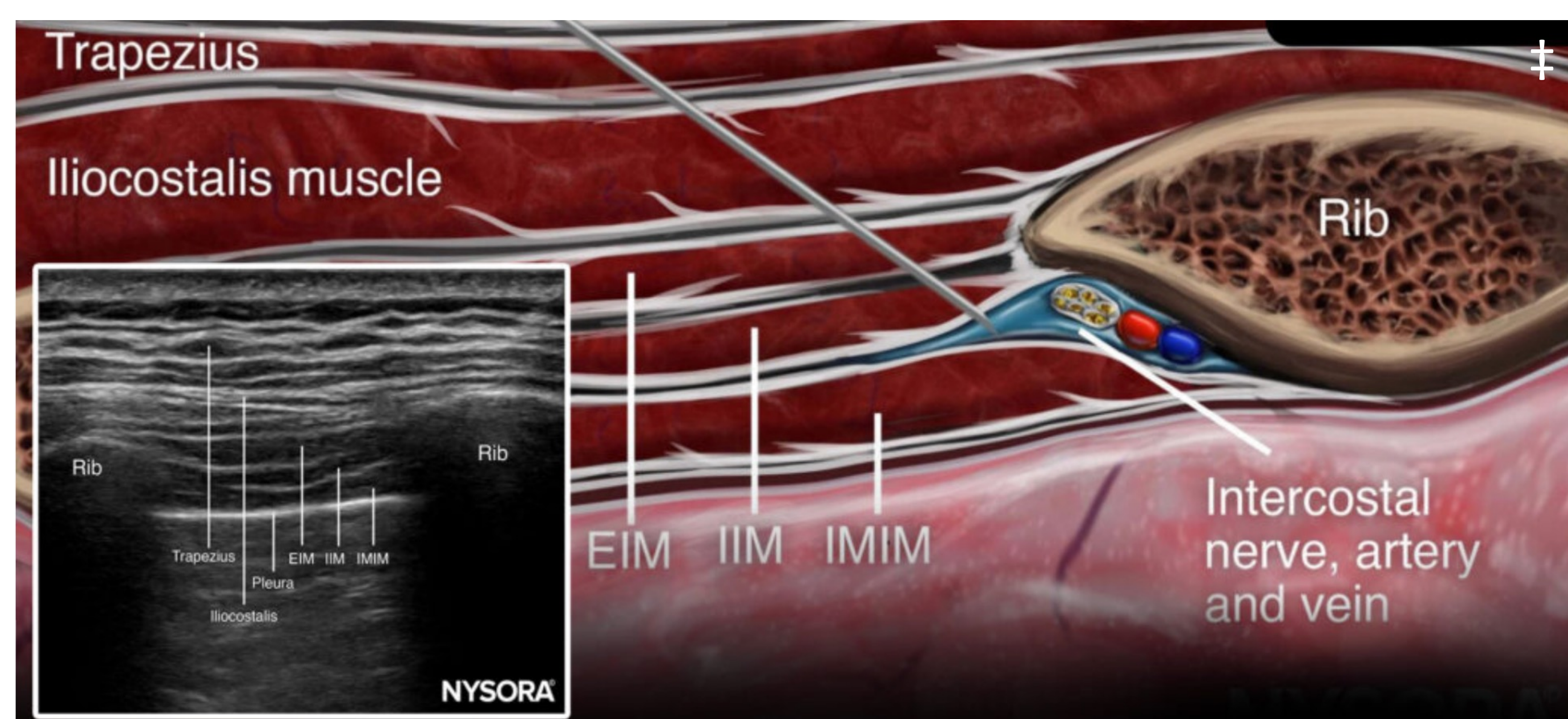
* Ilfeld et al. *Expert Rev Med Devices*. 2016; 13(8):713-725
† Marturano et al. *Injury*. 2023;54(9):110803.
Image courtesy of Pacira Biosciences, Inc.

Objectives/Aims

- To examine the safety profile and analgesic effects of ultrasound-guided percutaneous cryoneurolysis of intercostal nerves (USPCNIN) as an adjunct opioid-sparing treatment modality of acute traumatic rib fractures

Methods

- Single-institution case series
- USPCNIN used as an adjunct to standard multimodal rib fracture analgesic management
- Inclusion criteria
 - 18-64 years of age
 - Acute traumatic 3rd-9th rib fractures
 - Pre-procedure pain score $\geq 5/10$
 - Ineligible for SSRF
- Procedure
 - Bedside USPCNIN of intercostal nerves 3-9 using iovera® Smart Tip 2190 (Pacira Biosciences, Inc.)
 - Performed by an attending chest wall trauma surgeon within 24 hours of study enrollment



Outcomes Measures

- Primary**
 - Daily numeric pain score
 - Daily narcotic equivalents
 - Hospital length of stay
- Secondary**
 - 30-day mortality
 - Need for ICU admission
 - 30-day rib fracture-specific readmissions
 - Long-term pain and quality of life as measured by MPQ PRI, GOS-E, and SF-12 scores at 30, 90, and 365 days

‡ Courtesy of NYSORA, an educational organization focusing on anesthesia, pain, ultrasound, and musculoskeletal medicine.

Results

- Total of 9 patients enrolled
- Median (IQR) hospital length of stay: 4 (3, 6) days
- No procedure-related adverse events or rib-specific readmissions

Table 1: Demographics and Injury Characteristics

Demographics		Total (n=9)
Age (years)		53 (42, 53)
Sex		
	Male	5 (56%)
	Female	4 (44%)
Mechanism of Injury		
	Fall	1 (11%)
	MVC	2 (22%)
	MCC	2 (22%)
	BCC	2 (22%)
	PVA	2 (22%)
Injury Severity Score		18 (12, 28.5)
Admission GCS		15 (14, 15)
Concomitant Injuries		
	BCVI	0
	Facial Fracture	1 (11%)
	Intracranial Hemorrhage	0
	Long Bone Fracture	1 (11%)
	Pelvic Fracture	1 (11%)
	Solid Organ Injury	2 (22%)
	Spine Fracture	1 (11%)

Table 2: Pre-Intervention Pain Control

		Total (n=9)
Initial Pain Score		6.0 (5.5, 6.5)
Pre-Intervention MME		119.75 (42.5, 138.5)
Prescribed Analgesics		
	Acetaminophen	9 (100%)
	Gabapentin	8 (89%)
	Ketamine Infusion	0
	Lidocaine Infusion	8 (89%)
	Neuraxial/Regional Blockade	0
	NSAIDs	1 (11%)

Table 3: Wilcoxon Signed-Rank Test for Opioid Use and Pain Scores

		p Value
Pre-Intervention MME	Discharge MME	0.03
119.75 (42.5, 138.5)	49.5 (15.7, 81)	
Pre-Intervention PPI	Discharge PPI	0.08
10 (8, 10)	7 (6, 10)	
Discharge PPI	30-Day Follow-Up PPI	0.008
7 (6, 10)	4 (2, 6)	

MVC: motor vehicle collision; MCC: motorcycle collision; BCC: bicycle collision; PVA: pedestrian versus automobile collision; GCS: Glasgow Coma Scale; BCVI: blunt cerebrovascular injury; MME: morphine milligram equivalents; NSAIDs: non-steroidal anti-inflammatory drugs; PPI: present pain intensity; IQR: interquartile range.

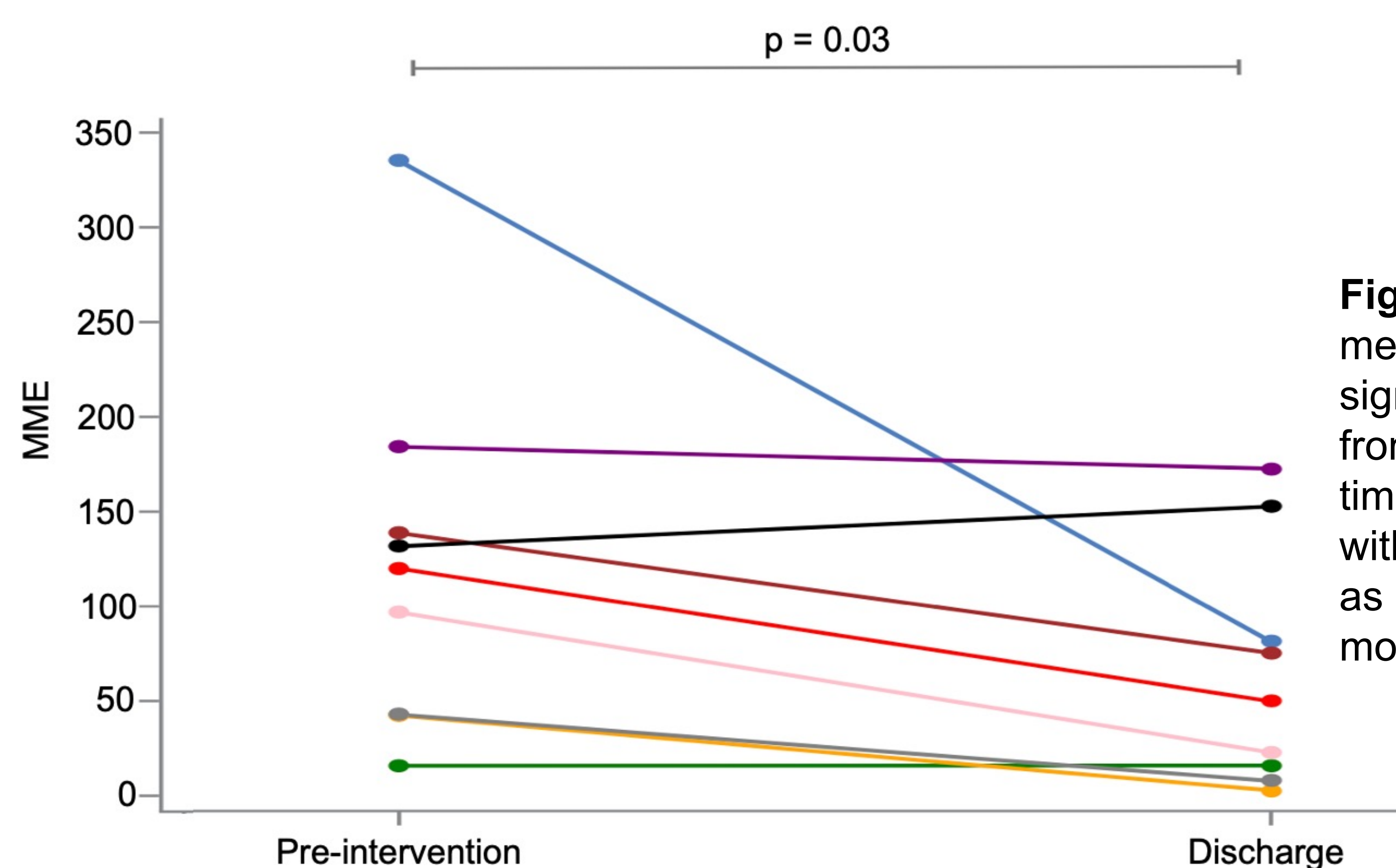


Figure 1. Opioid use, measured in MME, significantly decreased from pre-intervention to the time of discharge ($p = 0.03$) with the use of USPCNIN as an adjunct analgesic modality.

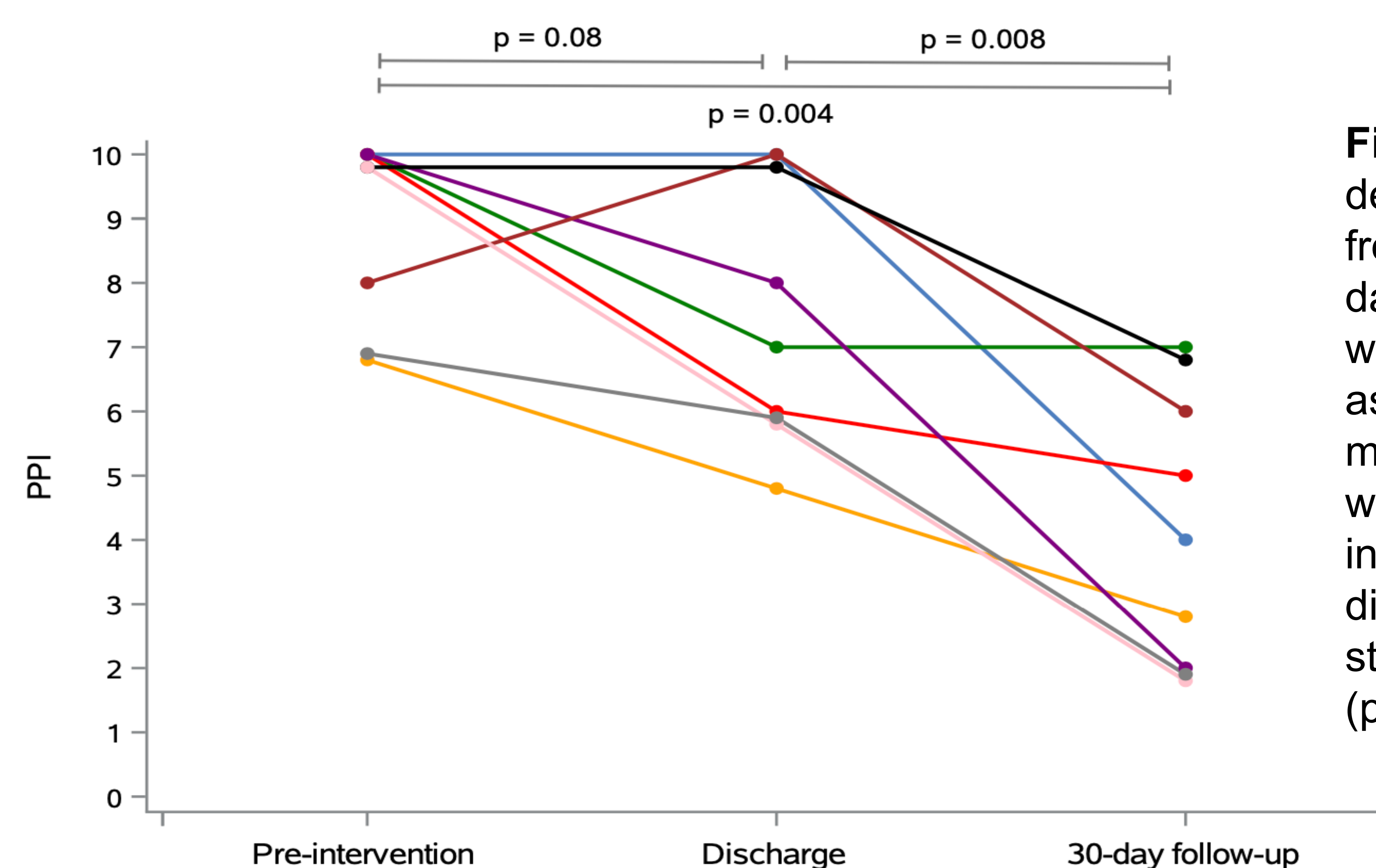


Figure 2. Pain scores decreased significantly from pre-intervention to 30-day follow-up ($p = 0.004$) with the use of USPCNIN as an adjunct analgesic modality. A similar trend was seen from pre-intervention to time of discharge, but was not statistically significant ($p = 0.08$).

Conclusions

Ultrasound-guided percutaneous cryoneurolysis of intercostal nerves is an effective, opioid-sparing, minimally-invasive, bedside procedure that can be safely performed by trauma surgeons to augment conventional analgesic strategies for successful management of acute traumatic rib fractures.

Future Directions

A larger, multicenter, randomized control trial is needed to further discern the benefits of USPCNIN as an adjunct analgesic modality.

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