Inpatient Rehabilitation of the Pediatric Brain Injury: Interventions and Education for Improved Outcomes after Discharge

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BEST CHILDREN'S HOSPITALS U.S.News RANKED IN 10 SPECIALTIES 2022-23

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Objectives

1. Attendees will understand how to better tailor interventions to a pediatric population.
2. Attendees will learn about dry needling and its implications for improved outcomes in the inpatient rehabilitation setting.
3. Attendees will understand the process of caregiver education to promote the family's readiness for discharge.
4. Attendees will learn how the pediatric inpatient rehabilitation team coordinates a comprehensive discharge plan for patients and their families.

What happens before a rehab admission?

- Therapies start working with patients as soon as medically appropriate
  - Internal inpatient rehab admits vs. outside referrals

- To be admitted to CMH Inpatient Rehab Program:
  - Patient must be stable
  - Patient must be able to tolerate 3 hours of therapy each day
  - Disorders of Consciousness considerations

Treating DoC

- Acute care
  - Life-saving surgeries, shunts, and interventions
  - Pressure injury and contracture prevention
  - Neurostimulant trials
- Rehabilitation
  - Environmental factors (positioning, lighting, time of day, level of stimulation, distractions and restraints)
  - Neurostimulant trials
  - Technologies and adaptive equipment
  - Serial assessments
- After discharge
  - Continuing rehab and recovery
  - Prevention of long-term complications

General behavioral phenotypes of DoC

Behavior	Coma	VS/UWS	MCS	eMCS
Eye Opening	X	√	√	√
Generalized Response	X	√	X	X
Sleep Wake Cycles	X	√	√	√
Localized Response	X	X	√	√
Visual Fixation	X	X	√	√
Visual Pursuit	X	X	√	√
Vocalization	X	X	√	√
Command Following	X	X	*	√
Communication	X	X	*	√
Functional Object Use	X	X	X	√

*Denotes intermittent, inconsistent in behavior.

Interventions

Salience

- Several studies have proven the importance of relevance to the success of recovery when considering intervention strategies
- For our pediatric population, this typically means play!
- We work closely with family/caregivers to determine what activities will be most motivating for our patients.

Kids love games!

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How can we incorporate these into therapy?

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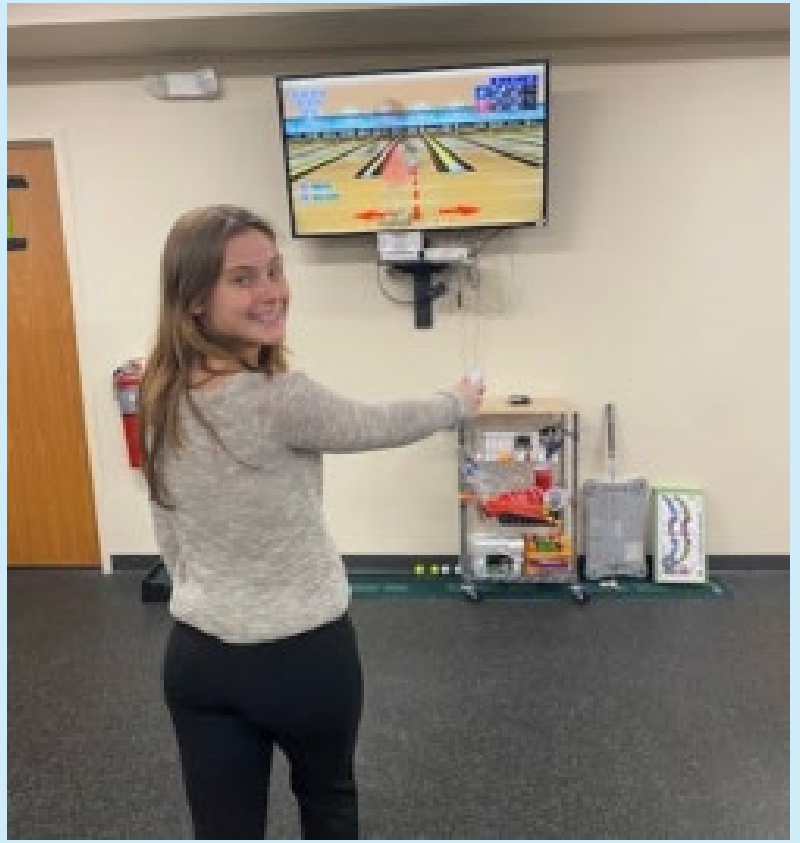

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BlazePods

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Incorporating Other Therapy Services

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AOTAs stance on dry needling

American Occupational Therapy Association

aota.org

Policy E.18: Interventions to Support Occupations

Purpose

- AOTA asserts that interventions to support occupations including but not limited to physical agent modalities (PAMs), dry needling, and other techniques may be used in preparation for, or concurrently with occupations and activities or interventions that ultimately enhance a client's engagement in occupation.

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Dry Needling Precautions

•Cognitive or communication impairments

•Local skin lesions (example: cellulitis, psoriasis, ache)

•Abnormal bleeding tendency (anticoagulant or thrombocytopenia therapy)

•Implants

•Vascular disease

- Fear of needles
- History of traumatic or spontaneous pneumothorax
- Metal allergy
- Severe osteoporosis
- Area of laminectomy
- Scoliosis
- Obesity

Dry Needling Contraindications

- Patient denies consent
- Area over pacemaker with electrical stim
- Compromised immune system
- Local or systemic infections or active tumor
- Pregnancy – 1st Trimester
- Post surgery (Must be cleared by surgeon; Relative contraindication)
- Autoimmune disease (Relative contraindication)
- Controlled anticoagulants (Relative contraindication)

Dry Needling in the Non-traditional population

- DN considered a “relatively new treatment” for addressing spasticity (Mohammadpou, 2021)
  - First case study published in 2007 (Herrero & del Morel) with a 4 y/o child with tetraparesia
- Underlying mechanism not entirely understood
  - Both mechanical and neurophysiological mechanisms hypothesized
- Indication that DN paired with Botox results in improved tone control (Kosem, Ata, & Yilmax, 2022)

DN for Hypertonia & Spasticity

DNHS Procedure:

1. Put muscle in a position of submaximal stretch (close to end range but without applying maximal force)
2. Place needle in suspected TrPs (trigger points) while stabilizing treatment area until there is “a significant cessation in the excessive muscular activity” (usually occurs after twitch response)
3. Maintain the position briefly until the neural release appears or contraction ceases
4. Withdraw needle to skin level and then range muscle again to sub-maximal stretch to look for additional TrPs

DN for Hypertonia and Spasticity

Additional DNHS Recommendations:

- Wait 7-10 days between treatment series (3-4 sessions each) to allow for complete repair of neuromuscular lesion
- Recommend moving in proximal to distal order (due to patterns of pain reference)
- Unlike in ortho population, it is discouraged to needle until all twitch responses and TrPs are resolved (would become too painful)
- Recommend consideration of synergistic muscles to affected muscle
- DN should be followed by neuro re-education

Effects of Dry Needling on Spasticity and Range of Motion- Systematic Review

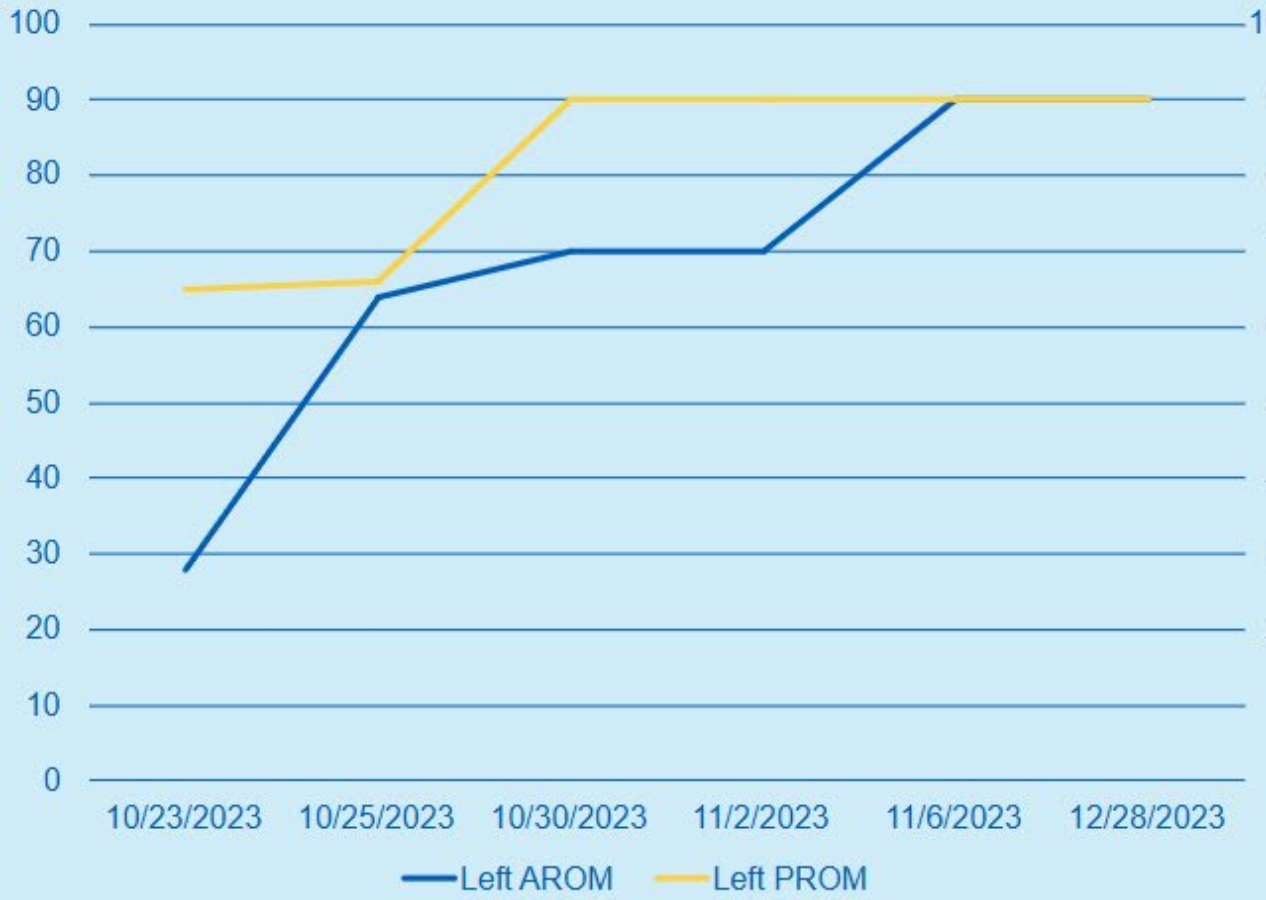
- N = 10 articles
- Findings:
  - 3 out of 4 studies found significant decrease in spasticity
  - 2 out of 2 studies found significant improvements in UE ROM
  - 1 out of 1 study found significant improvements in LE ROM
- Conclusion: *"The findings show strong evidence that the use of dry needling could improve ROM and spasticity and could be useful as an evidence-based physical agent modality to manage spasticity and improve ROM to support functional outcomes."*

(Bynum et al., 2021)

Neuro Case Study - Background

- 17yo with cytotoxic/metabolic/anoxic brain injury due to polysubstance ingestion
- Spasticity increasing rapidly, within weeks developing significant contractures in BUE and BLE
- Interventions trialed before DN: Botox, splinting, NMES
- DN occurred across five sessions (10/23, 10/25, 10/30, 11/2, & 11/6)
- Muscles needled included: biceps, pec minor & major, and lower lats
- Seen at rehab follow up and continued to have WFL range and function

Results - Shoulder External Rotation



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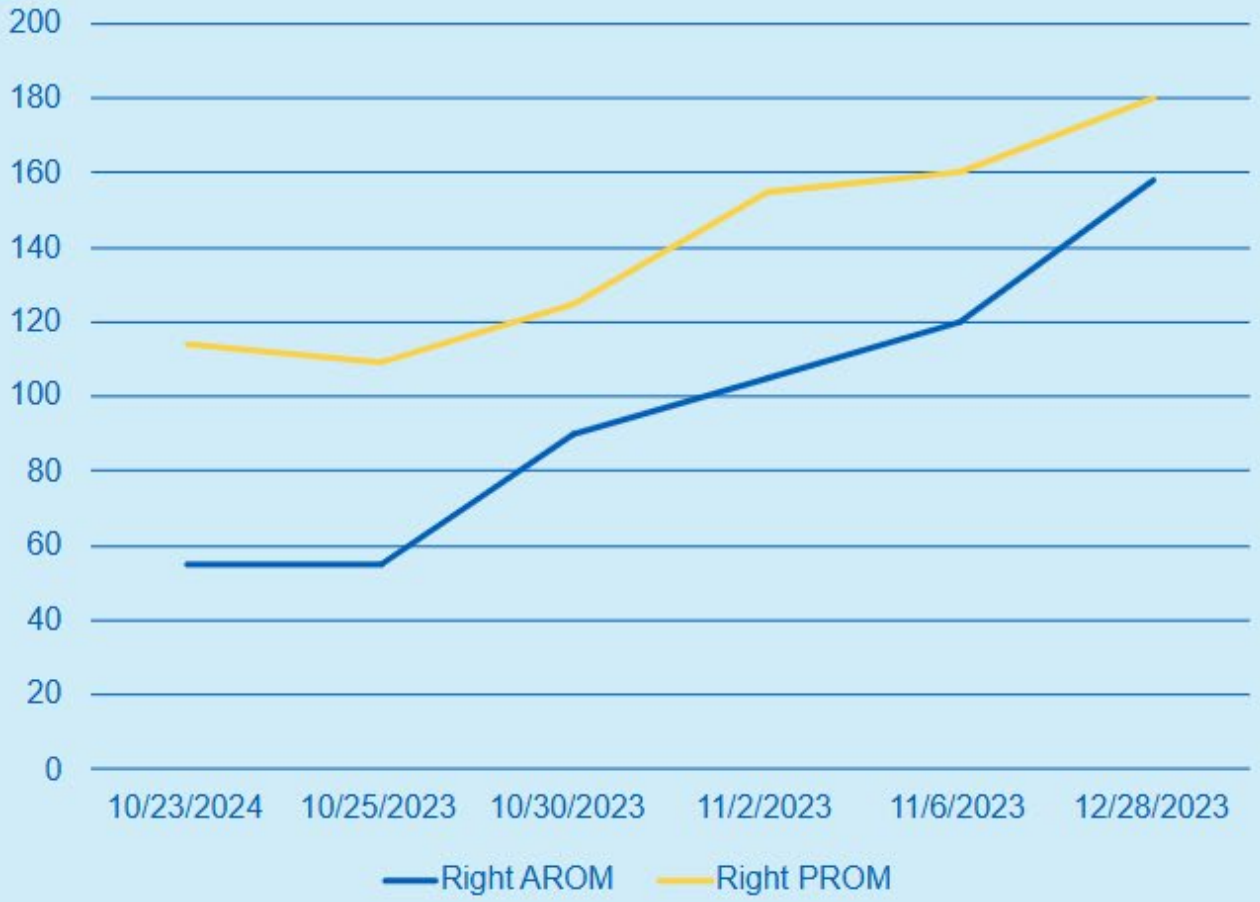
Results – Shoulder Flexion



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Results – Global

	LEFT		RIGHT	
	AROM	PROM	AROM	PROM
Elbow flexion	28	15	42	22
Elbow extension	76	70	150	107
Shoulder external rotation	82	58	70	55
Shoulder flexion	88	86	128	74

***changes in ROM from baseline (10/23/24) to final follow up (12/28/2024)

Dry Needling for Spasticity Management in a Pediatric Patient with Metabolic Brain Injury due to Opioid Overdose

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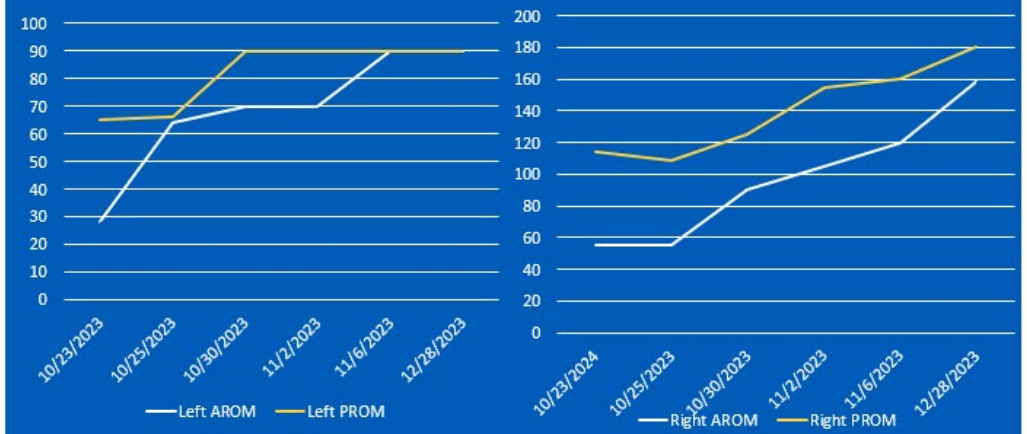
CASE DIAGNOSIS

- Metabolic brain injury can occur after opioid overdose which can result in spasticity
- Spasticity can result in decreased range of motion, pain and impaired function

CASE DESCRIPTION

- 17 y/o M with polysubstance overdose developed worsened spasticity despite conservative management, medications and Botulinum toxin injections
- Dry needling to biceps, latissimus dorsi and pectoralis bilaterally improved range of motion and allowed for more independent transfers and cell phone manipulation

	LEFT		RIGHT	
	AROM	PROM	AROM	PROM
EF	28	15	42	22
EE	76	70	150	107
Shoulder ER	82	58	70	55
Shoulder F	88	86	128	74



Figures 1&2: Shoulder ER

DISCUSSION

- Dry needling has been proven effective for spasticity management in post-stroke patients.
- It has not been widely studied in pediatric populations nor in metabolic brain injury.
- Future studies would be beneficial

CONCLUSION

- Dry needling for spasticity management in the pediatric brain injury population may have significant functional benefits

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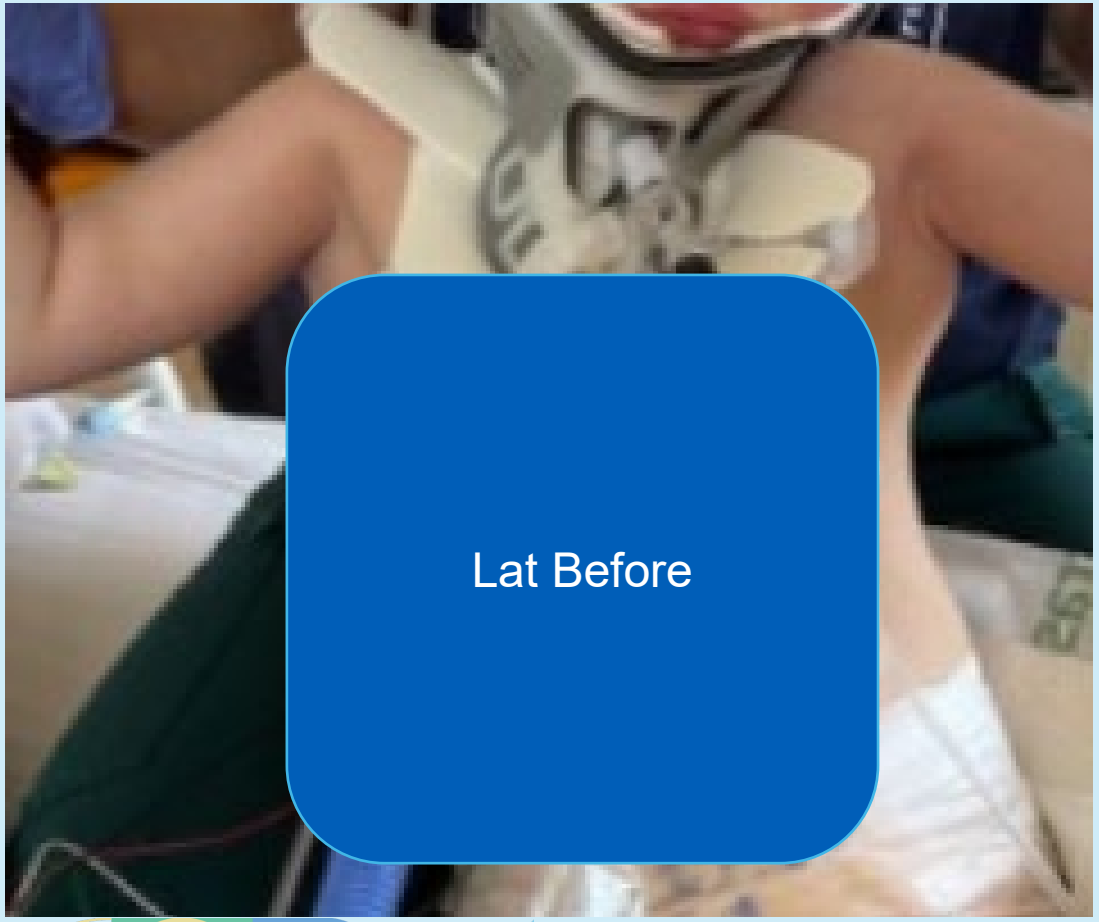
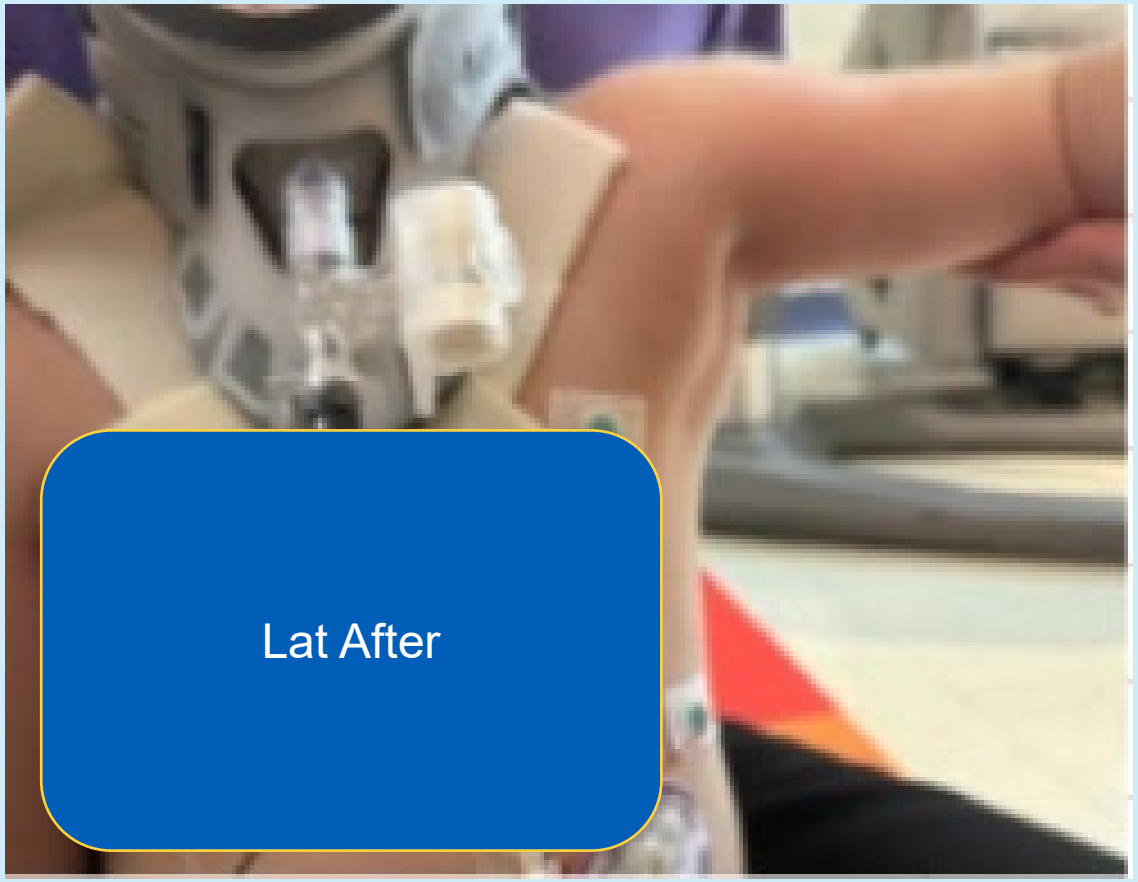
Resting position prior and after DN – no botox





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Caregiver Education

How do we train caregivers?

- Early encouragement to participate
- Including caregivers in therapy sessions
- Practicing handling as often as able and appropriate
  - The importance of our nursing staff in allowing family to have opportunities for practice outside of therapy sessions.

Teaching Sheets

Multidisciplinary Patient Education Record

(Page 1 of 4)

6014-601 MR 01/06

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DATE	RELATIONSHIP	PERSON TAUGHT	IMC
/ /	Patient (P)		
/ /	Family (F1)		
/ /	Family (F2)		
/ /	Family (F3)		
/ /	Family (F4)		
/ /	Family (F5)		
/ /	Other (O1)		
/ /	Other (O2)		

TEACHING METHOD	
Explanation/Discussion	E
Demonstration	D
Video	V
Handout	H
Class	C

EVALUATION	
Negative or no response	N
Listens and asks questions	L
Verbalizes key points in own words	V
Returns demonstration	R
Demonstrates skills with help	H
Demonstrates skills independently	I

INITIAL MOTIVATION CODE (IMC)	
Eager to learn	E
Seems interested	I
Not ready to learn	N
Denies need for education	D
Uncooperative	U

INITIAL ASSESSMENT	EDUCATIONAL OUTCOMES	INITIAL EDUCATION						COMPLETED WITH ASSISTANCE						COMPLETED INDEPENDENTLY					
		DATE	INITIALS	PERSON(S) TAUGHT	METHOD	EVALUATION	NEEDS MORE EDUCATION (√)	DATE	INITIALS	PERSON(S) TAUGHT	METHOD	EVALUATION	NEEDS MORE EDUCATION (√)	DATE	INITIALS	PERSON(S) TAUGHT	METHOD	EVALUATION	NEEDS MORE EDUCATION (√)
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6014-601 MR 01/06 Multidisciplinary Patient Education Record (Page 1 of 4)

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Barriers to Training

- Availability of caregivers
- Hesitancy to participate
- Unclear plan for discharge
- Communication

From Research to Rehab: Supporting Bilingual Clients After TBI

- 22% of Americans are bilingual
- Bilingual Lexical Processing
  - Language Control
    - Executive functioning that regulates cross-language competition
  - Bilinguals rely on executive function for fluent language control

Therapy Recommendations for a Bilingual Child

- Use stronger language or complete assessments in both languages
- Use professional interpreters and not family members
  - Bias or misinterpret “he/she knows it they are just …”
- Provide materials ahead of time for interpreters
  - Check for dialect/region
  - More accurate representation
- Consider assessments may take twice as much time or be strategic with assessment with pertinent testing

Discharge Planning

Family Conference

- Family conferences are a regular part of our inpatient rehab program
- Typically held near the beginning of an admission to review roles and establish goals for discharge
  - Occasionally have a second conference close to discharge if needed
- Determine estimated discharge date at this meeting
- Family is part of the decision-making team

Home Modifications

- Our typical discharge disposition is home
- Early determination of current home set up to allow as much time as potentially needed to make any necessary modifications
- Also consider access to transportation
- School and community access and accommodations

Equipment Needs

- Assistive device
- Orthotics
- Wheelchair
- Shower/Bath Chair
- Type of bed
- Monitoring system

Embrace the Journey: Aging With a Disability

- SCI and TBI panel
  - Shoulders and skin
  - Car transfers
  - Isolation
  - Adaptive Sports
  - Home Adaptions
  - Substance Abuse
  - Reality of returning home
  - Peer Mentor
  - Understanding what you need in a wheelchair
  - Bowel and Bladder
  - Therapist's role

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Discharge Therapy Recommendations

- Rehabilitation & Transition Programs
- Adaptive equipment & funding (including loan closets)
- Financial assistance & grants
- Medicaid waivers
- Adaptive sport & community program
- Supportive group & condition-specific resources

Community Outings

- Allows patients to understand their "new normal" when out in the community
- Can identify areas of function to address prior to discharge
- Helps patients and families feel confident being in their community following discharge

Ready, Set, Home

- Caregivers and patients independently perform cares over a 24-hour period as a "test run" prior to discharge

- Helps to identify gaps in training which can be addressed prior to discharge

Thank you!
Questions?

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References

- Bynum, R., Garcia, O., Herbst, E., Kossa, M., Liou, K., Cowan, A., & Hilton, C. (2021). Effects of dry needling on spasticity and range of motion: A systematic review. American Journal of Occupational Therapy, 75, 7501205030. https://doi.org/10.5014/ajot.2021.041798
- Calvo, Sandra & Navarro, Jorge & Herrero, Pablo & B., Raquel & de Diego-Alonso, Cristina & Marijuán, Pedro. (2017). Electroencephalographic Changes After Application of Dry Needling [DNHS © Technique] in Two Patients With Chronic Stroke. MYOPAIN. 23. 1-6. 10.1080/24708593.2017.1291550.
- Cleaver, Stefani and Philbin, Mary Kate. (2025). *Rancho I-III: A Clinical Perspective* [MOOC]. Shirley Ryan AbilityLab Academy. https://ric.litmos.com/course/25826410?ts=639113565661473990
- Cruz-Montecinos C, Núñez-Cortés R, Bruna-Melo T, Tapia C, Becerra P, Pavez N, Pérez-Alenda S. Dry needling technique decreases spasticity and improves general functioning in incomplete spinal cord injury: A case report. J Spinal Cord Med. 2020 May;43(3):414-418. doi: 10.1080/10790268.2018.1533316. Epub 2018 Oct 22. PMID: 30346254; PMCID: PMC7241526.
- Duman S, Basak T, Adigüzel E, Karakus M. The Relationship Between Care Preparedness and Care Competencies of Caregivers Caring for Individuals With Spinal Cord Injury. Rehabil Nurs. 2026 Jan 12. doi: 10.1097/RNJ.0000000000000529. Epub ahead of print. PMID: 41525502.
- Herrero, Pablo & Mayoral, Orlando. (2010). A Case Study Looking at the Effectiveness of Deep Dry Needling for the Management of Hypertonia. Journal of Musculoskeletal Pain. 15. 55-60. 10.1300/J094v15n02_09.
- Malfait I, Gijsbers S, Smeets A, Hanssen B, Pick A, Peers K, Schillebeeckx F. Safety of dry needling in stroke patients: a scoping review. Eur J Phys Rehabil Med. 2024 Apr;60(2):225-232. doi: 10.23736/S1973-9087.24.08224-8. Epub 2024 Mar 19. PMID: 38502557; PMCID: PMC11114159.
- Mohammadpour F, Ali Oghabian M, Nakhostin Ansari N, Naghdi S, Dommerholt J. Effects of dry needling on post-stroke brain activity and muscle spasticity of the upper limb: a case report. Acupunct Med. 2021 Feb;39(1):69-71. doi: 10.1177/0964528420920294. Epub 2020 Jun 12. PMID: 32529885.
- Panahi F, Ebrahimi S, Rojhani-Shirazi Z, Shakibafard A, Hemmati L. Effects of neurorehabilitation with and without dry needling technique on muscle thickness, reflex torque, spasticity and functional performance in chronic ischemic stroke patients with spastic upper extremity muscles: a blinded randomized sham-controlled clinical trial. Disabil Rehabil. 2024 Mar;46(6):1092-1102. doi: 10.1080/09638288.2023.2190168. Epub 2023 Mar 27. PMID: 36970837.

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- Sánchez-Infante, J., Bravo-Sánchez, A., Esteban-García, P., Jiménez, F., & Abián-Vicén, J. (2022). Changes in Electromyographic Activity of Latent Trigger Points After a Dry Needling Intervention: A Randomized Controlled Trial. Physiotherapy, 117, 72–80. https://doi.org/10.1016/j.physio.2022.09.002
- Sánchez-Infante, Jorge, Navarro-Santana, M. J., Bravo-Sánchez, A., Jiménez-Diaz, F., & Abián-Vicén, J. (2021). Is Dry Needling Applied by Physical Therapists Effective for Pain in Musculoskeletal Conditions? A Systematic Review and meta-analysis. Physical Therapy, 101(3). https://doi.org/10.1093/ptj/pzab070
- S.B. Snider, H. Shi, Y.G. Bodien, C. Howard, X. Sun, A.J. Golby, K.A. Zimmerman, G. Bertolini, S. Magnoni, V. Dunet, M. Oddo, N.S.N. Graham, E. Mallas, F. Moro, P. Mukherjee, N.R. Temkin, S. Jain, D.J. Sharp, B.L. Edlow, & M.D. Fox, Preservation of anticorrelated brain networks predicts recovery after traumatic brain injury, Proc. Natl. Acad. Sci. U.S.A. 122 (52) e2518159122, https://doi.org/10.1073/pnas.2518159122 (2025).
- Sedighimehr N, Zafarshamspour S, Sadeghi M. Effects of dry needling on muscle spasticity of the upper limb in a survivor of traumatic brain injury: a case report. J Med Case Rep. 2022 Jun 14;16(1):237. doi: 10.1186/s13256-022-03408-5. PMID: 35701822; PMCID: PMC9195242.
- Simons, D.G and W.C. Stolov. 1976. Microscopic features and transient contraction of palpable bands in canine muscle. *American Journal of Physical Medicine*. 55(2): 65-88.
- Shen Y, Jiang L, Lai J, Hu J, Liang F, Zhang X, Ma F. A comprehensive review of rehabilitation approaches for traumatic brain injury: efficacy and outcomes. Front Neurol. 2025 Jun 13;16:1608645. doi: 10.3389/fneur.2025.1608645. Erratum in: Front Neurol. 2025 Jul 08;16:1651979. doi: 10.3389/fneur.2025.1651979. PMID: 40584523; PMCID: PMC12202449.
- Valencia-Chulián R, Heredia-Rizo AM, Moral-Munoz JA, Lucena-Anton D, Luque-Moreno C. Dry needling for the management of spasticity, pain, and range of movement in adults after stroke: A systematic review. Complement Ther Med. 2020 Aug;52:102515. doi: 10.1016/j.ctim.2020.102515. Epub 2020 Jul 16. PMID: 32951759.
- Zhang Z, Wang W, Song Y, Zhai T, Zhu Y, Jiang L, Li Q, Jin L, Li K, Feng W. Immediate Effect of Dry Needling at Myofascial Trigger Point on Hand Spasticity in Chronic Post-stroke Patients: A Multicenter Randomized Controlled Trial. Front Neurol. 2021 Oct 29;12:745618. doi: 10.3389/fneur.2021.745618. PMID: 34777214; PMCID: PMC8585994.

Studies demonstrating benefits of inpatient rehabilitation in DoC

- Giacino, J. , J. T. , Katz, D. I. , Schiff, N. D. , Whyte, J. , Ashman, E. J. , Ashwal, S. , Barbano, R. , Hammond, F. M. , Laureys, S. , Ling, G. S. F. , Nakase-Richardson, R. , Seel, R. T. , Yablon, S. , Getchius, T. S. D. , Gronseth, G. S. , Armstrong, M. J. ((2018)) Practice Guideline Update Recommendations Summary: Disorders of Consciousness. Archives of Physical Medicine and Rehabilitation 99: (9), 1699–1709.
- Giacino, J. , Katz, D. I. , Schiff, N. D. , Bodien, Y. (2022). Assessment and rehabilitative management of individuals with disorders of consciousness. In N. D. Zasler, D. I. Katz, R. D. Zafonte, & D. B. Arciniegas (Eds.), Brain Injury Medicine: Principles and Practice (third, pp. 447-461). Demos Medical Publishing.
- Giacino, J. T. , Trott, C. T. ((2004)) Rehabilitative management of patients with disorders of consciousness: Grand rounds. The Journal of Head Trauma Rehabilitation 19: (3), 254–265.
- Giacino, J. T. , Katz, D. I. , Schiff, N. D. , Whyte, J. , Ashman, E. J. , Ashwal, S. , Barbano, R. , Hammond, F. M. , Laureys, S. , Ling, G. S. F. , Nakase-Richardson, R. , Seel, R. T. , Yablon, S. , Getchius, T. S. D. , Gronseth, G. S. , Armstrong, M. J. ((2018)) Comprehensive systematic review update summary: Disorders of consciousness: Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology; the American Congress of Rehabilitation Medicine; and the National Institute on Disability, Independent Living, and Rehabilitation Research. Neurology 91: (10), 461–470.
- Hux, K. (2019) Post-acute rehabilitation effects on functional outcome and discharge disposition of people with severe traumatic brain injury. Brain Injury 33: (10), 1332–1340.
- Kowalski, R. G. , Hammond, F. M. , Weintraub, A. H. , Nakase-Richardson, R. , Zafonte, R. D. , Whyte, J. , Giacino, J. T. ((2021)) Recovery of Consciousness and Functional Outcome in Moderateand Severe Traumatic Brain Injury. JAMA Neurology 78: (5), 548.
- Mackay, L. E. , Bernstein, B. A. , Chapman, P. E. , Morgan, A. S. , Milazzo, L. S. ((1992)) Early intervention in severe head injury: Long-term benefits of a formalized program. Archives of Physical Medicine and Rehabilitation 73: (7), 635–641.
- Pignat, J.-M. , Jöhr, J. , Diserens, K. ((2015)) From disorders of consciousness to early neurorehabilitation using assistive technologies in patients with severe brain damage. Current Opinion in Neurology 28: (6), 587–594.
- Roberts, H. , Greenwood, N. ((2019)) Speech and language therapy best practice for patients in prolonged disorders of consciousness: A modified Delphi study.. International Journal of Language & Communication Disorders 54: (5), 841–854.
- Seel, R. T. , Douglas, J. , Dennison, A. C. , Heaner, S. , Farris, K. , Rogers, C. ((2013)) Specialized Early Treatment for Persons With Disorders of Consciousness: Program Components and Outcomes. Archives of Physical Medicine and Rehabilitation 94: (10), 1908–1923.
- Tepas, J. J. , Leaphart, C. L. , Pieper, P. , Beaulieu, C. L. , Spierre, L. R. , Tuten, J. D. , Celso, B. G. ((2009)) The effect of delay in rehabilitation on outcome of severe traumatic brain injury. Journal of Pediatric Surgery 44: (2), 368–372.
- Weaver, J. A. , Watters, K. , Cogan, A. M. (2022). Interventions Facilitating Recovery of Consciousness Following Traumatic Brain Injury: A Systematic Review. OTJR: Occupation, Participation and Health, 153944922211177.


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