GUIDELINE TITLE: HALO GRAVITY TRACTION FOR COMPLEX SPINAL DEFORMITY	**Document No:** pending **Version No:** 1

Document Type: Clinical: Nurse Practice Guideline	
Owner: Janet Judge[1], Lauren Vickers[2] **Title:** ANP Paediatric Spinal Disorders[1], CNS Paediatric Spinal Disorders[2]	**Author:** Janet Judge[1], Lauren Vickers[2] **Title:** ANP Paediatric Spinal Disorders[1], CNS Paediatric Spinal Disorders[2]
Date of Approval: 06/02/2024	**Effective Date:** 06/02/2024

CONTENTS

1.0 INTRODUCTION

- Patients attending CHI at Crumlin with complex spinal deformity may undergo application of Halo Gravity Traction (HGT) as part of their surgical management.
- HGT is part of a staged approach in the management of severe spinal deformities. This staged approach helps to mitigate the risk associated with surgery in complex cases (Boachie-Adjei et al., 2021).
- HGT is a traditional method of skeletal traction used to correct severe spinal deformity prior to surgery (Frank et al., 2023). HGT is a type of external fixator. It involves application of a Halo ring to the child's skull, which is held in place using between 4 - 8 pins. A handle attaches to the ring, where weights can be attached via a clip and pulley system (see Appendices for pictures).
- HGT aims to improve curve flexibility through applying gradual traction, which in turn reduces neurological risks. Studies have shown that progressive preoperative traction improves preoperative pulmonary status, nutrition and helps assess and predict neurological function (Koller et al., 2012; Pourtaheri et al., 2016; Liu et al., 2022).
- HGT therapy may be ongoing for 4 – 6 weeks; however, the severity of the curve and patient response to HGT will define the duration of treatment. Any changes in treatment plan must be communicated by the primary Orthopaedic Consultant (Roye et al., 2020).

2.0 GUIDELINE STATEMENT

This guideline provides the written instructions about how to ensure safe high quality care delivery to patients undergoing preoperative HGT ahead of complex spinal deformity surgery.

3.0 SCOPE

Nursing staff caring for children undergoing HGT as part of a staged approach to complex spinal deformity/scoliosis surgery.

4.0 DEFINITIONS / TERMS

HGT: Halo Gravity Traction

PEWS: Paediatric Early Warning System

GCS: Glasgow Coma Scale

5.0 OBJECTIVES

The purpose of this guideline is to highlight the key principles underpinning the care of a child or young person undergoing HGT. This guideline should support nursing staff in the delivery of high quality nursing care.

6.0 GUIDELINE STEPS

***Knots secured by Orthopaedic team**

6.1 GATHERING THE NECESSARY EQUIPMENT

- Traction bed from bed stores
- Bars for bed frame
- HALO Wheelchair
- Pulleys x4
- Traction cord
- Water bags
- Sleek tape
- Weighing scales
- Basin
- Jug

6.2 SETTING UP TRACTION BED

- To set up a traction bed, begin by turning the bed so the foot is the head/ head is the foot. This facilitates use of counter traction. See images.
- Ensure traction bed is in correct working order and safe for use (i.e. functional brakes, working side rails and secure fastening/alignment of traction bars.
- Roughly measure out 3 meters of cord, feed through the traction pulley and attach one end of cord to the clip and secure by a fisherman's knot x3 secure with sleek tape and attach the opposite end of cord to the Halo handle.
- Secure the pulley to both ends of the cord and tie a number of simple knots.
- Using the sleek tape to secure the knots.
- Once both pulleys are attached to traction cord using knots and sleek tape ensure proper alignment of the head, shoulders and hips of the child in the bed
- If the child or young person is lying in bed the pulley should sit directly cranial to/inline and slightly above their head their head, their head should sit squarely above their shoulders, and their shoulders in line with their hips
- Ensure once the child or young person is in either the bed or the chair that the weights remain off the floor and the line of traction cord runs directly through the pulleys.
- If the child or young person is seated, the same applies as above. (RCN, 2021; GOSH, 2023).
- **Please discuss removal or time off traction on a case-by-case basis with the consultant in charge and this decision is clearly documented in the HCR.**

7.0 CARE OF HALO GRAVITY TRACTION

Action	Rationale
• Preparation • The patient should be prepared preoperatively for HGT with age appropriate language and pictures. This should include a baseline weight, PEWS, GCS, and spinal neurovascular assessment.	• To gain informed consent and promote adherence to treatment. To have a comparative baseline to allow for early detection of changes (GOSH, 2023).
• Cranial Nerve Exam and ASIA performed by the Orthopaedic team.	• To have a comparative baseline to allow for early detection of changes
Pin site Care • Check pin sites once per shift (minimum) and observe for signs and symptoms of infection and pain/discomfort. • Pin site cleaning should commence 48 hours post-operatively, then on alternating days once clean and dry. Clean with sterile water and sterile gauze. • Cleaning of pin sites should increase in the presence of drainage. • Notify team if pin loosening/infection/increased ooze noted. • Early swabbing of suspected infected pin sites.	• Increasing pain at pin sites, frank drainage of pus, swelling, and spreading of redness may indicate infection (RCN, 2022). To prevent infection and facilitate early treatment and management if infection present. • Pin site infection maybe appropriately treated with antibiotics. • If a pin site infection persists pin exchange or removal may be indicated (Sarro et al., 2010; Roye et al., 2020; RCN, 2022; GOSH, 2023).
Torqueing • The Orthopaedic SpR/Consultant must torque (tighten) the Halo pins to the correct tension using the torque wrench. This usually occurs 24-48 hours post-operatively. **Consider administering analgesia 30-60 minutes prior to torqueing**. • This is done once only, unless more specifically requested. Note: the locking nuts must be loosened prior to pin tightening torque.	• To ensure the pins are tight and secure. The torque is determined by the Orthopaedic Consultant and is based on the patient's age, bone density and total number of pins (Roye et al., 2020; GOSH, 2023). • To optimize patient comfort.
Weight • Starting weights should be small and reflect the patient's body weight. Weights may be increased daily or on alternate days, depending on the treatment plan. • The goal weight to be achieved will be prescribed by the Orthopaedic Consultant (this may range from 30-50% of the patient's body weight). • Goal weight may be achieved in approximately 2-4 weeks. • ASIA and cranial nerve examination should be conducted and documented daily and within 60 minutes of any traction weight increases by the team. • Water weights are used in CHI at Crumlin. They must be double-checked every shift against the	• To ensure patient's neurovascular status is not compromised (Roye et al., 2020; GOSH, 2023). • To ensure patient comfort. • To ensure an achievable treatment plan and goal (Roye et al., 2020). • To maintain safety and identify early complications. • To ensure water has not spilled or evaporated. To ensure the correct weight is applied and to maintain accurate documentation (GOSH, 2023).

prescription in the medical notes and documented accordingly.	
Duration • Duration of HGT is dependent on flexibility and curve magnitude, and is determined by the Consultant. • HGT generally lasts between 4-6 weeks. • Additional time maybe added if benefits>risks.	• To ensure optimal outcomes in treatment (Roye et al., 2020).
Maintenance • HGT should be maintained overnight as tolerated. • Patient should be nursed with the head of the bed elevated at all times. Weight should be free from floor. • Patients should be nursed on Sp02 monitor overnight. • NGT and PEG feeding should occur when the patient is awake during the day. • Oral feeding should occur when patient is sitting out in traction wheelchair, where possible.	• To provide counter traction while in bed. • To maintain safety. • To maintain safety. • To maintain safety.
Imaging • Spinal x-rays (whole spine AP and lateral) should be performed at least weekly until target weight reached. As per clinical assessment. • Lateral C-spine x-rays should be included with spinal radiology during HGT, this may be by inclusion in the lateral full spinal x-ray.	• To monitor for effectiveness of HGT.
Post-operative Observations • Standard post-operative PEWS score (Q15 mins X 1 hour, Q30 mins X 2 hours, Q1 hourly X 4 hours, 4 hourly thereafter). • Neurological observations with PEWS in immediate post-operative period, then during transfers and weight increases. Increase frequency with any changes in neurological status and inform team. • Spinal Neurovascular observations to be performed in line with Neurological observations	• Changes in Neurological status and in Spinal Neurovascular observations require urgent review by the Orthopaedic team and nurse in charge. • To facilitate early intervention of any complications. To maintain safety.
Ambulation • The transfer of the patient from traction bed to chair must be discussed with the Orthopaedic consultant for confirmation on need to maintain traction.	• To maintain patient and staff safety
Emergency Management • In the event of an emergency, please follow PPPG's. Please note that weights and traction can be removed immediately without consultation to provide emergency care.	

8.0 MANAGEMENT OF HALO GRAVITY TRACTION COMPLICATIONS

Neurological Changes • With any neurological changes a full • PEWS, GCS and spinal neurovascular assessment should be performed. **Team should be notified immediately of all changes.** • Daily ASIA's must be performed by the Orthopaedic team • An urgent senior Orthopaedic (registrar, fellow or Consultant) review is required for any changes in motor function or cranial nerves • Orthopaedic team to request a cervical spine x-ray • If symptoms persist following the above steps an MRI spine is required	• To facilitate effective nursing assessment and prompt, clear communication of new found complication to a member of the Orthopaedic team. • Cranial Nerve dysfunction and sensorimotor dysfunction are potential complications of HGT. Stretch neuropathies can be predicted with daily neurological exams, including complete sensorimotor assessment and cranial nerve examination (Roye et al., 2020; Verhofste et al., 2020).
• In the event of any CRANIAL NERVE changes – remove recently added weight • In the event of any MOTOR changes – remove ALL traction weight	
Pin Site Infection • Monitor and care for pin sites as detailed above.	• To facilitate early intervention and management of infection. • In the event of a confirmed pin site infection; • 1st line treatment antibiotics as per CHI cellulitis antibiotic protocol. • A persistent pin site infection not improving on an antibiotic may require a pin exchange or removal (Roye et al., 2020).

*Cranial Nerve Palsy is a potential complication of HGT – Cranial Nerve Palsy should be assessed daily by the SpR. or Fellow through a cranial nerve exam (see below) or with any increase in traction weight. It can be useful for nursing staff to observe these assessments to further support their nursing care – see Appendix 1.

9.0 IMPLEMENTATION PLAN

These guidelines represent the up to date, evidence-based principles underpinning care of a child undergoing HGT for complex spinal deformity. These guidelines define the delivery of high quality, evidence-based, safe nursing care. Nursing staff caring for children undergoing HGT should use this guideline in conjunction with the Orthopaedic team in their provision of care. Nursing staff will be trained at ward level by both senior nursing colleagues and the Orthopaedic team. Additionally, attendance at the biannual spinal study day will be encouraged for all nursing staff involved in the care of a child on HGT.

10.0 EVALUATION AND AUDIT

Consistency of the application of this document may be audited, if indicated by a member of the Spinal Disorders Team.

11.0 REFERENCES

Boachie-Adjei, O., Sacramento-Dominguez, C., Ayamga, J., Sackeyfio, A., Duah, H.O., Yankey, K.P., Akoto, H., Hodes, R., Wulff, I., Pellise, F. and FOCOS Spine Research Group, (2021) Characterization of complex vertebral transposition (gamma deformity)> 180 degrees: clinical and radiographic outcomes of halo gravity traction and vertebral column resection (VCR). *Spine Deformity*, *9*, pp.411-425.

Bruce, E.A., Williss, J., and Gibson F. (2nd ed.) (2023) *The Great Ormond Street Hospital Manual of Children and Young People's Nursing Practices.* West Sussex: John Wiley & Sons Ltd.

Frank, S. a., et al. (2023). "Evaluation of outpatient halo-gravity traction in patients with severe scoliosis: development of a monitoring device." Spine deformity 11(2): 351-357.

Koller, H., et al. (2012). "The impact of halo-gravity traction on curve rigidity and pulmonary function in the treatment of severe and rigid scoliosis and kyphoscoliosis: a clinical study and narrative review of the literature." European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society 21(3): 514529.

Liu, D., et al. (2022). "Efficacy of Halo-Gravity Traction in the Perioperative Treatment of Severe Scoliosis and Kyphosis: A Comparison of Adolescent and Adult Patients." World neurosurgery 166: e70-e76.

Pourtaheri, S., et al. (2016). "Preoperative halo-gravity traction with and without thoracoscopic anterior release for skeletal dysplasia patients with severe kyphoscoliosis." Journal of children's orthopaedics 10(2): 135-142.

RCN (2021) Traction Principles and Application. London: Royal College of Nursing. Available at: https://www.rcn.org.uk/Professional-Development/publications/traction-principles-and-application-uk-pubhttps://www.rcn.org.uk/Professional-Development/publications/traction-principles-and-application-uk-pub-009-816009-816 (Accessed 11 September 2023).

Roye, B.D., Campbell, M.L., Matsumoto, H., Pahys, J.M., Welborn, M.C., Sawyer, J., Fletcher, N.D., McIntosh, A.L., Sturm, P.F., Gomez, J.A. and Roye, D.P. (2020) Establishing consensus on the best practice guidelines for use of halo gravity traction for pediatric spinal deformity. *Journal of Pediatric Orthopaedics*, *40*(1), pp.e42-e48.

Sarro, A., Anthony, T., Magtoto, R. and Mauceri, J. (2010) Developing a standard of care for halo vest and pin site care including patient and family education: a collaborative approach among three greater Toronto area teaching hospitals. *Journal of Neuroscience Nursing*, *42*(3), pp.169-173.

Scoliosis Research Society (2023) *SRS Education Resource Centre.* Available at: https://educationresources.srs.org/early-onset-scoliosis/congenital-scoliosis-and-kyphosis (Accessed 12 September 2023).

Starship (2020) *Traction for paediatric orthopaedic patients at Starship.* Available at: https://starship.org.nz/guidelines/traction-for-paediatric-orthopaedic-patients-at-starship/ (Accessed 11 September 2023).

Verhofste, B.P., Glotzbecker, M.P., Birch, C.M., O'Neill, N.P. and Hedequist, D.J., 2019. Halo-gravity traction for the treatment of pediatric cervical spine disorders. *Journal of Neurosurgery: Pediatrics*, *25*(4), pp.384-393.

12.0 APPENDICES

FIGURE 1: TRACTION BED

FIGURE 2: WATER BAG, JUG, SCALES

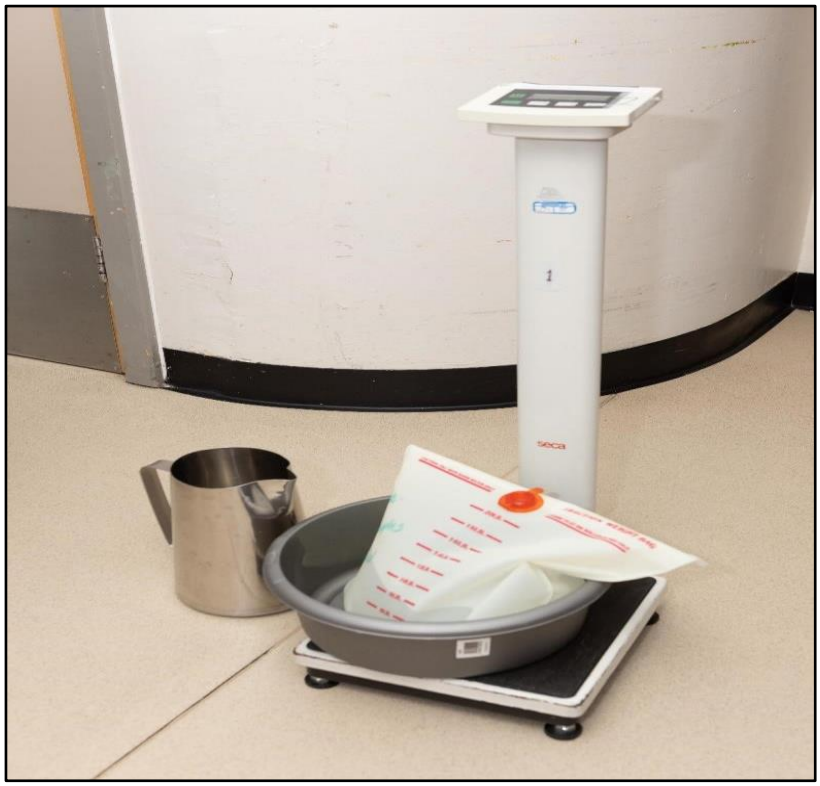
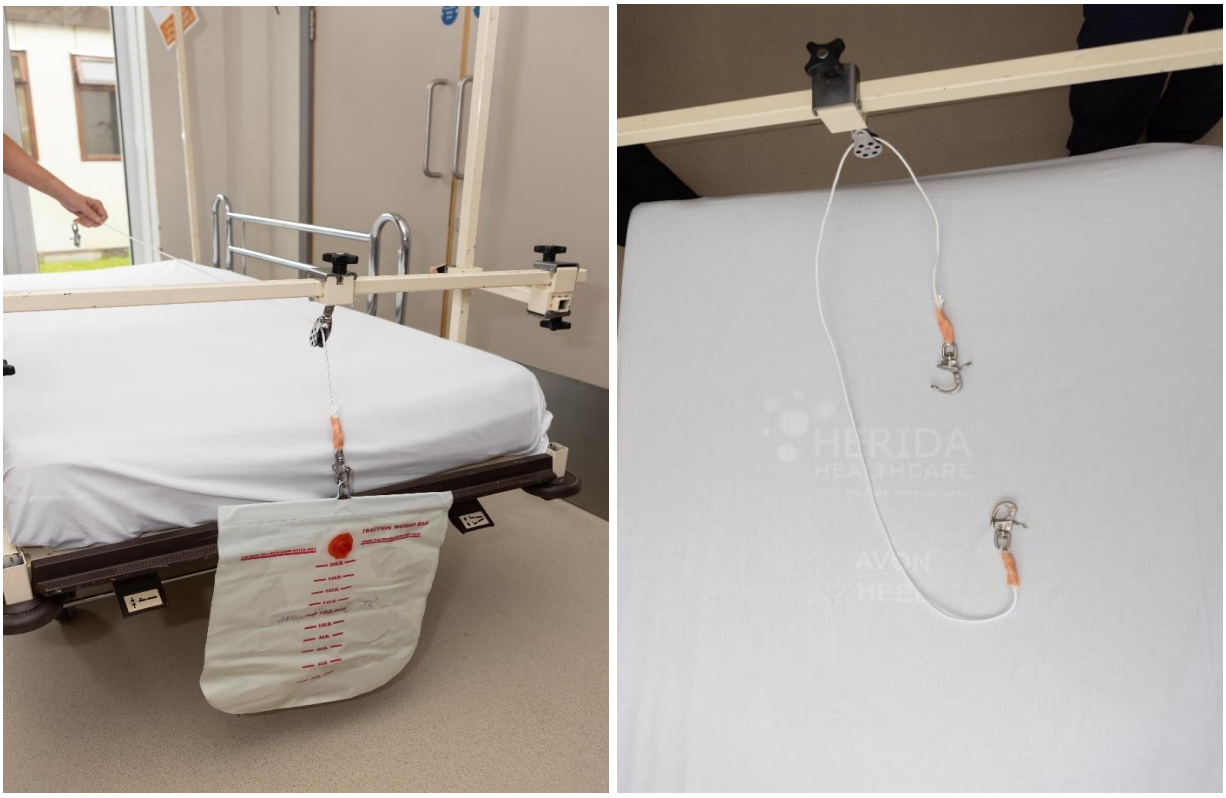


FIGURE 3: WATER BAG, PULLEY, TRACTION CORD, SLEEK TAPE

FIGURE 4: SHOWING KNOTS AND PULLEY

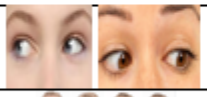
FIGURE 5: SHOWING KNOTS AND SLEEK TO SECURE

FIGURE 6: ATTACHED WATER BAG AND PULLEYS



APPENDIX 1: CRANIAL NERVES FUNCTION CLASSIFICATION

Cranial Nerves Function Classification

	Nerve	Classification	Major Functions	Assessment
1		Sensory	Smell	Have patient identify a familiar scent with eyes closed (usually deferred)
2		Sensory	Vision (acuity and field of vision): pupil reactivity to light and accommodation (afferent impulse)	Have patient read from a card or newspaper, one eye at a time. Test visual fields by having patient cover one eye, focus on your nose, and identify the number of fingers you are holding up in each of four visual quadrants.
3		Motor	Eyelid elevation: most EOM's: pupil size and reactivity (efferent impulse)	Check pupillary responses by shining a bright light on one pupil: both pupils should constrict. Do the same for other eye. To check accommodation, move your finger toward the patient's nose; the pupils should constrict and converge. Check EOM's by having patient look up, down, laterally and diagonally.
4		Motor	EOM (turns eye downward & laterally)	Have patient look down and in
5		Both	Chewing; facial & mouth sensation; corneal reflex (sensory)	Ask patient to hold the mouth open, while you try to close and to move jaw laterally against your hand. With patient's eyes closed, touch the face with cotton and have the patient identify the area touched. In comatose patients, brush the cornea with a wisp of cotton; the patient should blink
6		Motor	EOM (Turns eye laterally)	Have patient move the eyes from side to side
7		Both	Facial expressions; taste; corneal reflex (motor); eyelid & lip closure	Ask patient to smile, eyebrows and keep eyes and lips closed while you try to open them. Have patient identify salt or sugar place on the tongue (usually deferred)
8		Sensory	Hearing; equilibrium	To test hearing, use tuning fork or rub your fingers, place a tick watch, or whisper near each ear. Equilibrium testing is usually deferred.
9		Both	Gagging and swallowing (sensory); taste	Touch back of throat with sterile tongue depressor or cotton-tipped applicator. Have patient swallow.
10		Both	Gagging and swallowing (motor), speech (phonation)	Assess gag and swallowing with CN IX. Assess vocal quality.
11		Motor	Shoulder movement, head rotation	Have patient shrug shoulders and turn head from side to side (not routinely tested)
12		Motor	Tongue movement, speech (articulation)	Have patient stick tongue out and move it internally from cheek to cheek. Assess articulations.

APPENDIX 2: SPINAL NEUROVASCULAR OBSERVATION SHEET – WITH LEG RAISE *(UPPER LIMBS & LOWER LIMBS)*

Spinal_Neurovascular_Obs_Upper_and_Lower_Limbs.pdf (childrenshealthireland.ie)

Sláinte Leanaí Éireann
ag Cromghlinn
Children's Health Ireland
at Crumlin

Post Spinal Surgery Neurovascular Observations – Upper Limbs

Full Name:
Address: Addressograph
HCR

Movement of Upper Limbs																					
	Date																				
	Time																				
	Initials																				
		L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
Insert score 5-0 as per guide below																					
Elbow Flexion	C5																				
Elbow Extension	C7																				
Wrist Flexion or Extension	C6																				
Thumb Extension	C9																				
Finger Abduction	T1																				
Sensory Deficit of Upper Limbs	Intact																				
	Altered																				
	Absent																				
Comments																					

Guide

5= Normal Power
4= Active movement against gravity and moderate resistance
3= Active movement against gravity without resistance
2= Active movement and gravity eliminated
1= Flicker/trace of contraction that is palpable or visible
0= No contraction, complete paralysis

Adapted with kind permission from
Queens Medical Centre, Nottingham

1

Sláinte Leanaí Éireann
ag Cromghlinn
Children's Health Ireland
at Crumlin

Post Spinal Surgery Neurovascular Observations – Lower Limbs

Full Name: .....
Address: Addressograph
.....
HCR.....

Movement of Lower Limbs	Date																					
	Time																					
	Initials																					
		L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	
Insert score 5-0 as per guide below																						
Hip Abduction *(Scissors movement of legs while in supine position)*	C5																					
Straight Leg Raise *(while in supine position)*	L2 L3 L4																					
Knee Extension	C7																					
Great Toe Extension	C6																					
Plantar Flexion of Ankle	C9																					
Dorsiflexion of ankle	T1																					
Sensory Deficit of Upper Limbs	Intact																					
	Altered																					
	Absent																					
Catheter Sensation	S2-S5 Present/ Absent																					
Comments																						

Guide

5= Normal Power
4= Active movement against gravity and moderate resistance
3= Active movement against gravity without resistance
2= Active movement and gravity eliminated
1= Flicker/trace of contraction that is palpable or visible
0= No contraction, complete paralysis

Adapted with kind permission from
Queens Medical Centre, Nottingham

2

APPENDIX 3: FINAL CHECKS (TO BE ADDED TO BACK OF WATER WEIGHT CHECKS)

- Weight check of both water weights once per shift. Use the same scales each time.
- Is the weight appropriate for the child?
- Avoid NGT feeding at night.
- Check that the weights are hanging free from the floor and are not touching the bed.
- Check that the traction rope is taut, knots are secured, and line of traction is straight.
- Is the patient comfortable?
- Ensure the call bell is in reach and working.

APPENDIX 4: HALO TRACTION CHECKLIST

Halo_Traction_Checklist_CHI.pdf (childrenshealthireland.ie)

Sláinte Leanaí Éireann
Children's Health Ireland

Halo Traction Checklist

Full Name: .....
Address: Addressograph
.....
HCR.....
.....

Date							
Time							
Current Traction Weight							
Change in Weight							
Bed Weight	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*
Chair Weight	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*
Sp02 monitor at night	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*
Date pin site care due							
Traction cord checked	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*	*please tick*
Day Shift Signature							
Night Shift Signature							

Traction cord is checked daily for any signs of fraying. Checks done to ensure it is secured tightly and can move freely within the pulley