



Crumlin | Temple Street | Tallaght | Connolly

## NEUROVASCULAR GUIDELINE

<b>Area of use:</b>	All of organisation <input checked="" type="checkbox"/>	CHI at Connolly <input type="checkbox"/>	CHI at Crumlin <input type="checkbox"/>
	CHI at Herberton <input type="checkbox"/>	CHI at Tallaght <input type="checkbox"/>	CHI at Temple Street <input type="checkbox"/>
<b>Lead author &amp; title:</b>	Name: Susan Keane Title: Clinical Practice Facilitator		
<b>Approved by &amp; title:</b>	Name: Grainne Bauer Title: Chief Director of Nursing		
<b>Version:</b>	Version 1	<b>Approval date:</b>	December 2021
<b>Qpulse reference:</b>		<b>Revision due:</b>	December 2024
Version History			
Version:	Date approved:	Summary of changes:	Author:

### Contents

1.0	Guideline statement .....	3
2.0	Scope .....	3
2.1	Employee.....	3
2.2	Agents .....	3
3.0	Neurovascular Assessment.....	3
3.1	Skin Colour and Temperature Assessment .....	4
3.2	Sensation and Motor Function Assessment .....	4
3.3	Oedema.....	5
3.4	Pulse Assessment.....	5
3.5	Capillary Refill Time (CRT) Peripheral.....	6
3.6	Pain.....	6
3.7	Frequency of Observations .....	6
3.8	Documentation.....	6
4.0	Management .....	6
4.1	Potential Complications.....	7
4.2	Discharge and Parent Information.....	8

*This is a controlled document. While this document may be printed the electronic version posted on Qpulse is the controlled copy and can only be guaranteed for 24 hours after downloading.*

5.0 Monitoring, Audit & Evaluation.....8

6.0 Stakeholders.....8

7.0 References .....9

8.0 Appendices.....10

*Upper Limb Observation Chart*

*Lower Limb Observation Chart*

## 1.0 Guideline Statement

Neurovascular assessment skills are an integral part of acute patient care. They are essential for early recognition of neurovascular compromise which may lead to permanent deficits, loss of limb or even death (Schreiber, 2016). The purpose of this guideline is to provide an educational and evidence based practice resource for nursing staff involved in neurovascular assessment of paediatric patients. It outlines the required assessment process to promptly recognise clinical change. It supports decision making when interpreting assessment findings and implementing appropriate interventions. This guideline should be used in conjunction with the Upper and /or Lower Limb Observation charts (see Appendix 1 & 2).

## 2.0 Scope

This guideline applies to all nursing staff involved in neurovascular assessment.

### 2.1 Employees

All full-time, part-time and fixed term employees employed by Children's Health Ireland are covered by this policy.

### 2.2 Agents

Agents are considered to be people such as employees of suppliers, volunteers, students on placement or any other individuals associated with CHI at Temple Street. All such agents are covered by this policy.

## 3.0 Neurovascular Assessment

Neurovascular assessment is an essential part of clinical practice. Judicious observations, timely identification, reporting and appropriate intervention can minimise the long term complications associated with neurovascular compromise. Neurovascular assessment is used to evaluate sensory and motor (neuro) and peripheral circulation (vascular) of the extremities (Blair & Clarke, 2013). These observations include pulses, capillary refill time, skin colour, skin temperature, sensation and motor function. Assessment findings of the affected extremity must be compared to findings of the unaffected extremity. Subtle changes must be recognised as important and differences should be communicated to the medical /surgical team promptly (Daniels & Nicoll, 2012).

**Table 1 - Risks for Neurovascular Impairment (Johnston-Walker & Hardcastle, 2011)**

<p><b>Injuries</b></p> <ul style="list-style-type: none"> <li>• Musculoskeletal</li> <li>• Nerve</li> <li>• Vascular</li> </ul> <p><b>Signs of Limb Infections</b></p> <ul style="list-style-type: none"> <li>• Tissue Oedema</li> <li>• Circumferential Burns</li> <li>• Crush Injuries</li> <li>• Coagulopathies</li> <li>• Tourniquet - prolonged use</li> </ul>	<ul style="list-style-type: none"> <li>• Orthopaedic &amp; Spinal surgery</li> <li>• Plastic surgery on extremities or phalanges</li> <li>• Fractures</li> <li>• Internal &amp; external fixations</li> <li>• Plaster Casts</li> <li>• Post application of traction</li> <li>• Tight Bandages</li> <li>• Post Cardiac Catheterisation</li> </ul>
---	--

### 3.1 Skin Colour and Temperature Assessment

Skin colour and temperature of the affected extremity must be compared to the alternate side. Temperature changes can be detected more easily by using the back (dorsum) of the hand (Johnston-Walker & Hardcastle, 2011). Coolness and pallor of the skin can occur due to diminished arterial blood flow. Warmth and cyanotic discoloration can be caused by venous insufficiency (Zsiro & Wollan, 2014).




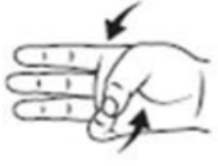

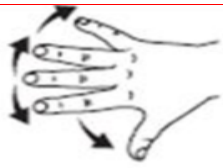
Changes in skin colour can be attributed to many causes, therefore, this assessment must be considered in the context of the patient’s usual skin tone and any current skin conditions. Indications of cyanosis can manifest as a bluish colour for patients with light skin tone, as a greyish-green colour with yellow skin tones and as a pale, greyish colour with darker skin tones (Sommers, 2011). Skin that is shiny and pale indicates pressure is increasing around the affected area. This requires immediate intervention to avoid vascular compromise that can lead to muscle and nerve ischaemia. Depending on the severity of trauma to the area, bruising may also be noted (Johnston-Walker & Hardcastle, 2011).

### 3.2 Sensation and Motor Function Assessment





Patient complaints of tingling, pins and needles or numbness in an extremity should be investigated immediately (Wiseman & Curtis, 2011). Assessment should be proximal and distal to the site of injury or surgery if not precluded by a device, such as a splint or cast. Abnormal findings during assessment of the patient’s sensory function may be related to nerve involvement or compromised blood flow to the extremity. Altered sensation may also be a result of a nerve block or epidural, this should be documented in the patient’s neurovascular assessment sheet as an additional comment.

Trauma, unrelieved pressure and ischaemia may result in permanent damage to muscles, nerves and vessels. The patient’s ability to perform specific movements is a key indicator of motor function of specific nerves. Loss of motor function is often a late sign of neurovascular compromise; therefore, frequent assessment is vital with careful attention given to even subtle changes (Johnston-Walker & Hardcastle, 2012).

**Table 2 - Key Sensation and Motor Assessment Points for Upper Limbs** (RCH Melbourne, 2019)

MOTOR SENSATION			
<p><b>Radial Nerve</b> Palpate webbing space between thumb and index finger, including dorsal surface of hand</p>		<p><b>Radial Nerve</b> The ability to extend wrist and fingers at the knuckle joint. If cast on hand only assess extension of fingers</p>	
<p><b>Median Nerve</b> Palpate webbing space between thumb and index finger, including palmer surface of hand</p>		<p><b>Median Nerve</b> The ability to bring thumb and little finger together so they are touching</p>	
<p><b>Ulnar nerve</b> Palpate between little finger and distal ring finger on palmer and dorsal surface of hand</p>		<p><b>Ulnar nerve</b> The ability to abduct or spread all fingers</p>	

**Table 3 - Key Sensation and Motor Assessment Points for Lower Limbs** (RCH Melbourne, 2019)

SENSATION	MOTOR FUNCTION
<p><b>Peroneal Nerve</b> Palpate dorsal surface of the foot</p>	<p><b>Peroneal Nerve</b> The ability to dorsiflex ankle and toes</p>
	
<p><b>Tibial Nerve</b> Palpate plantar surface of foot</p>	<p><b>Tibial Nerve</b> The ability to plantar flex ankle and toes</p>
	

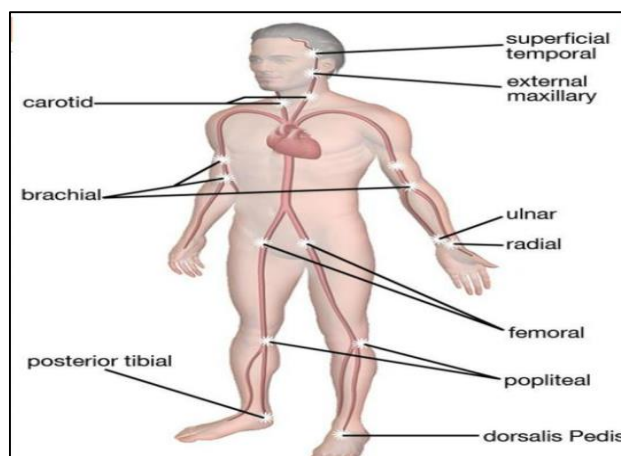
### 3.3 Oedema

Musculoskeletal injury often results in oedema at the site of injury. This can also contribute to vascular compromise and can lead to muscle and nerve tissue damage. On-going assessment is warranted to monitor the extent of the oedema and its effects (Johnston-Walker & Hardcastle, 2011).

### 3.4 Pulse Assessment

Pulse assessments should be completed bilaterally on the affected and unaffected limb and should be comparable. The major peripheral pulse points include brachial, radial and ulnar arteries in the upper extremities; and femoral, popliteal, posterior tibial and dorsalis pedis in the lower limbs (Daniels & Nicoll, 2012). When palpating the pulse of each extremity, assess the most distal pulses that are accessible. Assess if pulses are strong, weak or absent. If unable to palpate a pulse, consider the use of manual Doppler scan which may assist in identifying a weak or thread pulse. Inequality at assessment points is an abnormal finding and indicates poor perfusion to the limb. Identifying the pulse palpation site with an indelible marker can assist nurses to consistently locate pulse points (Johnston-Walker & Hardcastle, 2011).

**Figure 1. Major Pulse Points**



Source: <https://slideplayer.com/slide/11855766/>

*This is a controlled document. While this document may be printed the electronic version posted on Qpulse is the controlled copy and can only be guaranteed for 24 hours after downloading.*

### 3.5 Capillary Refill Time (CRT) - Peripheral

Capillary refill time (CRT) is the rate at which blood returns to the capillary bed after the nail bed or skin of the affected extremity has been compressed for 5 seconds. The assessor counts, in seconds, how long it takes for the skin to return to its normal colour. The skin generally perfuses within 2-3 seconds (Royal College of Nursing, 2017).

### 3.6 Pain

The most important indicator of neurovascular compromise is pain disproportionate to the injury. Pain associated with compartment syndrome is generally constant however worse with passive movement to extension and is not relieved with opioid analgesia. Indication of pain in non-verbal patients includes restlessness, grimacing, guarding, tachycardia, hypotension, tachypnoea or diaphoresis. If pain is disproportionate to injury notify medical team (RCH, Melbourne 2019)

### 3.7 Frequency of Observations

- 1 hourly for the first 24 hours post injury, surgery or application of cast or as indicated by medical/surgical team.
- Then 4 hourly for a further 48 hours or as specified by the treating medical team.
- More frequently if any deviations from baseline observations.

#### For cardiac catheter patients:

- Neurovascular observations, should be conducted on the affected limb / limbs with routine post anaesthetic observations and then with every set of observations.
- Sensation and motor function should be assessed appropriately according to the affected limb.
- With each set of neurovascular observations, the puncture site should be assessed for bleeding or ooze, colour, warmth and signs of infection.

(RCH, Melbourne, 2019).

### 3.8 Documentation

- A baseline neurovascular assessment of both limbs is essential in recognising neurovascular compromise and should be documented on admission.
- On-going neurovascular observations for upper and lower limbs can be documented on the appropriate neurovascular assessment chart.
- Alterations in neurovascular status should be documented and the patient's medical /surgical should be notified immediately.

## 4.0 Management

Ensure affected limb is elevated to minimise the risk of compartment syndrome. Lower extremities can be elevated with pillows or using bed mechanics; upper extremities can be elevated on a pillow, sling or box sling.

#### Management of Neurovascular Compromise

- Elevate limb, no higher than heart level.
- Notify treating team
- Split plaster casts or cut/remove bandage as advised
- Maintain limb alignment.

*This is a controlled document. While this document may be printed the electronic version posted on Qpulse is the controlled copy and can only be guaranteed for 24 hours after downloading.*

If neurovascular status improves keep affected limb elevated and continue to monitor closely.

If neurovascular status does not improve or continues to deteriorate, the patient may need to attend theatre for pressure monitoring and/or fasciotomy.

#### **For cardiac catheter patients:**

If any changes to neurovascular observations (i.e. decrease in pulse pressure, change in limb colour or coolness of limb), escalate by notifying the treating team. Consider need for an ultrasound conducted to confirm or rule out a thrombus (RCH, Melbourne 2019).

## **4.1 Potential Complications**

### **Compartment Syndrome**

Compartment Syndrome is a serious complication of musculoskeletal injury. Compartment Syndrome results from an increase in pressure inside a compartment which comprises of muscles and nerves and is enclosed by fascia. Fascia is inelastic and does not expand to increased volume or pressure. When the compartment pressure increases, nerves and then muscles become compressed resulting in decreased blood flow and tissue perfusion, muscle ischemia and loss or altered sensation. Compartment Syndrome is a surgical emergency to relieve the pressure or reduce volume within the compartment, which will preserve blood supply, tissue perfusion and function. Early recognition of neurovascular deterioration is crucial in limb salvage or survival.

The medical team should be contacted immediately as soon as compartment syndrome is suspected. Early treatment includes removal of constricting bandages or cast. The limb should be laid flat or slightly raised to a maximum of 10% above the patient's heart. Higher levels are not recommended as the arteriovenous pressure difference decreases, which can further impair the circulation to the affected area. Surgical fasciotomy is considered the most effective treatment (Lutter, Schoffl, Hotfiel, Simon, & Maffulli, 2019).

#### **Indications of compartment syndrome include:**

- **Pain:** The first and most reliable sign of compartment syndrome. Pain out of proportion to injury, extreme pain on passive movement and pain unrelieved with opioid analgesia.
- **Paralysis:** Is generally a late sign of compartment syndrome and results from prolonged nerve compression or muscle damage. Paralysis presents with inability to actively move the limb and increased pain on passive movement that is not relieved in extension.
- **Paresthesia:** Results from nerve compression and generally is indicated by pins and needles, tingling or numbness.
- **Pallor:** Indicates arterial insufficiencies below the level of injury, below the level of injury will appear cold and pale.
- **Temperature:** Coolness of the limb distal to injury indicates decreased arterial supply.
- **Capillary refill:** Indicates limb perfusion, capillary refill more than 3 seconds indicates inadequate limb perfusion.
- **Pulselessness:** Absent pulse is a late sign and indicates tissue death.
- **Swelling and Increased Pressure:** Is a result increased inter-compartment pressure, skin presents tight and shiny.

## 4.2 Discharge and Parent Information

For patients at risk of neurovascular compromise, education on neurovascular assessment is crucial. Age appropriate education should be provided to the patient, including encouragement for the patient to move their digits regularly.

Educate parents on the importance of performing neurovascular assessment and why it is necessary to disturb the patient when sleeping while in hospital.

Many patients who are at risk of neurovascular compromise, leave hospital before the risk of compartment syndrome is over. Parents should be educated regarding the signs and symptoms of neurovascular compromise and when to return to their GP or discharging hospital if they are concerned.

### Cardiac Catheter patients

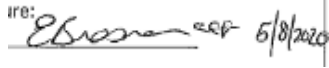

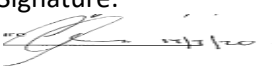

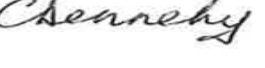
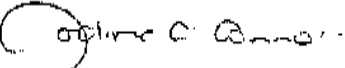
Advise parents/carers to limit their child's activity for the first 24 hours at home and avoid any strenuous lifting (RCH, Melbourne 2019).

## 5.0 Monitoring, Audit and Evaluation

This policy/procedure/protocol/guideline shall be **Reviewed** and updated at least every three years by the Author/and or Owner, or earlier if required, in order to determine its effectiveness and appropriateness. In addition, the Author/and or Owner will **Audit** compliance of key practice principles with this policy/procedure/protocol/guideline on an annual basis.

## 6.0 Key Stakeholders

The following Key Stakeholders were consulted in the development/review of this document:

Emer Brosnan, CNEF, CHI Temple St.	Signature:  5/8/2020
Louise Barrett, CNEF, CHI Crumlin.	Signature: Louise Barrett approved by email Date: 23.05.2020
Rachel Bolger, CNM 2, Orthopaedic OPD, CHI Temple St.	Signature:  8/2/2020
Conor Green, Consultant Orthopaedic Surgeon, CHI Temple St.	Signature: 
Fionnuala O'Neill, Nurse Practice Development Coordinator, CHI Crumlin	Signature:  Date 16.06.2020
Caitriona Dennehy, Nurse Practice Development Coordinator, CHI Tallaght	Signature:  Date 25.06.2020
Caroline O'Connor, Nurse Quality, Practice & Research Coordinator, CHI Temple St.	Signature:  Date 16.06.2020



## 7.0 References

- Blair, V. & Clarke, S. (2013). Neurovascular assessment post femoral nerve block: Nursing (RN) implications on fall prevention. *International Journal of Orthopaedic and Trauma Nursing*, 17, 99-105.
- Daniels, R. & Nicoll, L. (2012). Assessment of musculoskeletal functions. *Contemporary Medical-Nursing nursing*, 2<sup>nd</sup> edn. 1621-1641. Clifton Park, New York.
- Johnston-Walker, E. & Hardcastle, J. (2011). Neurovascular assessment in the critically ill patient. *Nursing in Critical Care*, 16(4), 177.
- Lutter, C., Schoffl, V., Hotfiel, T., Simon, M. & Maffulli, N. (2019). Compartment Syndrome of the Foot: An Evidence-Based Review. *The Journal of Foot & Ankle Surgery*, 58, 632-640.
- Sreiber, M.L. (2016). Neurovascular Assessment: An Essential Nursing Focus. *MEDSURG Nursing*, 25(1), 55-57.
- Royal Children's Hospital (2019). Clinical Guidelines for Neurovascular Observations. Accessed [https://www.rch.org.au/rchcpg/hospital\\_clinical\\_guideline\\_index/Neurovascular\\_observations/](https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Neurovascular_observations/) October 23<sup>rd</sup> 2019.
- Royal College of Nursing (2017). *Standards for Assessing, Measuring and Monitoring Vital Signs in Infants, Children and Young People*. RCN. London.
- Wiseman, T. & Curtis, K. (2011). Gunshot wounds to the leg causing neurovascular compromise- a case study. *Australasian Emergency Nursing Journal*, 14, 264-269.
- Zsiro, D. & Wollan, M. (2014). Nursing management: Musculoskeletal trauma and orthopaedic surgery. *Medical-Surgical Nursing: Assessment and management of clinical problems*. Elsevier, St Louis.

## Appendix 1 – Upper Limb Observation Chart

[https://media.childrenshealthireland.ie/documents/Neurovascular\\_Assessment\\_Upper.pdf](https://media.childrenshealthireland.ie/documents/Neurovascular_Assessment_Upper.pdf)

## Appendix 2 – Lower Limb Observation Chart

[https://media.childrenshealthireland.ie/documents/Neurovascular\\_Assessment\\_Lower.pdf](https://media.childrenshealthireland.ie/documents/Neurovascular_Assessment_Lower.pdf)