The Hierarchy of Evidence

The Hierarchy of evidence is based on summaries from the National Health and Medical Research Council (2009), the Oxford Centre for Evidence-based Medicine Levels of Evidence (2011) and Melynyk and Fineout-Overholt (2011).

I Evidence obtained from a systematic review of all relevant randomised control trials.

II Evidence obtained from at least one well designed randomised control trial.

III Evidence obtained from well-designed controlled trials without randomisation.

IV Evidence obtained from well designed cohort studies, case control studies, interrupted time series with a control group, historically controlled studies, interrupted time series without a control group or with case- series

V Evidence obtained from systematic reviews of descriptive and qualitative studies

VI Evidence obtained from single descriptive and qualitative studies

VII Expert opinion from clinicians, authorities and/or reports of expert committees or based on physiology

Melynyk, B. & Fineout-Overholt, E. (2011). Evidence-based practice in nursing & healthcare: A guide to best practice (2nd ed.). Philadelphia: Wolters Kluwer, Lippincott Williams & Wilkins.

National Health and Medical Research Council (2009). NHMRC levels of evidence and grades for recommendations for developers of guidelines (2009). Australian Government: NHMRC. http://www.nhmrc.gov.au/_files_nhmrc/file/guidelines/evidence_statement_form.pdf

OCEBM Levels of Evidence Working Group Oxford (2011).The Oxford 2011 Levels of Evidence. Oxford Centre for Evidence-Based Medicine. http://www.cebm.net/index.aspx?o=1025

Databases searched:	✓ CINAHL (Ebsco)	✓ Medline (Ebsco)	✓ Pubmed (NLM)	☐ Nursing (Ovid)	☐ Emcare (Ovid)	Other List: _____
Keywords used:	‘Neurovascular observations’, ‘neurovascular assessment’, ‘compartment syndrome’, ‘5 Ps’, ‘neurovascular deterioration’, ‘neurovascular compromise’					
Search limits:	‘2016-2023’ ‘All child’					
Other search comments:						

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Reference (include title, author, journal title, year of publication, volume and issue, pages)	Evidence level (I-VII)	Key findings, outcomes or recommendations

Jerome, T. J. (2020). Acute upper limb compartment syndrome in children: Special focus on nerve recovery. *World Journal of Pediatric Surgery,* 3, 1-12. From CINAHL	VI	**Key findings:** • 24 children with Acute Compartment Syndrome (ACS) in the upper limb were analysed between 2009 and 2015 to assess the affects ACS has on nerve recovery. • ACS is an orthopaedic emergency and required immediate intervention to prevent irreversible nerve damage, muscle fibrosis, atrophy, contractures and deformities. • The presentation of children with ACS is unique in many ways, including the 5 Ps; pain, parenthesis, pallor, pulselessness and paralysis. • There are higher rates of ACS in patients who have tight bandages, high-energy mechanism of road-traffic accidents, crush injuries or falls. • Early detection and decompression of the affected limb through single-incision fasciotomy is the most effective way at decompressing all compartments and restoring adequate neurolysis. • There was a statistical significant associated between intervention <24 hours and >24 hours after injury of ACS and functional outcomes. • Complete recovery of the forearm nerves post fasciotomy occurred at a mean of 10 months after injury. **Outcomes:** This study proves that surgical decompression through a fasciotomy plays a vital role in the recirculation of blood supply to the ischemic nerves and muscles, thereby, prevention muscle fibrosis, atrophy, contractures and deformities. Full muscle and nerve recovery occurred between 6-12 months for 88% of children in this study. **Recommendations:** Recommendations for future studies include completing the above study as a large prospective study cohort to better explain and explore the relationship between ACS, early surgical intervention and neuromuscular recovery. **Strengths** • The results of this study was statistically significant. • Outcome and findings of the study were clear, concise and easy to interpret. **Limitations** • Small study group and retrospective design.

Mortensen, S. J., Orman, S., Testa, E. J., Nazarian, A., & von Keudell, A. G. (2020). Risk factors for developing acute compartment syndrome in the pediatric population: A systematic review and meta-analysis. *European Journal of Orthopaedic Surgery & Traumatology,* 30, 839-833. Retrieved from Medline.	III	**Key findings:** • ACS can be difficult to assess in children, therefore, identification of at-risk patients to facilitate prompt diagnosis is important. • A systematic review was conducted to identify risk factors for the development of ACS in the paediatric population. • 9 studies were reviewed, 380,411 patients were identified, 1,144 patients were diagnosed with traumatic ACS. • Multiple factors were explored that could contribute to ACS. Findings were as below. **Outcomes:** Open fractures, high-energy trauma, concurrent humerus and forearm fractures, and male gender significantly increase the risk of developing ACS in the paediatric population. **Recommendations:** Larger, high-quality studies are warranted to further assess the risk factors of ACS in children. **Strengths:** • Large patient cohort • Level III evidence **Limitations** • The quality of reports regarding paediatric ACS are limited, therefore, the quality and number of studies included in this systematic review were not of a high standard.

Lin, J. S., & Samora, J. B. (2020). Pediatric acute compartment syndrome: a systematic review and meta-analysis. *Journal of Pediatric Orthopaedics,* 29(1), 90-96. Retrieved from CINAHL.	IV	**Key findings:** • A systematic review was performed to identify the etiology of paediatric ACS, time of intervention, use of pressure monitoring, presentation, long-term outcomes, and complications of the injury. • 12 studies were reviewed, and 233 children were eligible to be a part of the study. • The most common cause of paediatric ACS were trauma related. • ACS occurred in all extremities, but was most common in lower leg and forearm. • Compartment pressures were measured in 68% of patients to aid diagnosis. • Pain was the most common presenting symptom followed by paraesthesia. • The mean time of injury to fasciotomy was 25.4 hours. • 85% of patients achieved full functional recovery. • Range of motion deficit was the most common complication. **Outcomes:** • There was no significant difference in time from injury to fasciotomy, age, sex, the presence of a facture, or anatomic location in those patients who achieved full functional recovery compared with patients who did not. Paediatrics ACS has better outcomes than adult ACS. Trauma was the major cause of ACS, and intracompartmental pressure measurements can aid diagnosis. **Recommendations:** • No recommendations were made for future studies. **Strengths:** • Methods, findings and discussion were clear and concise. • Large patient cohort. **Limitations:** • All studies included in systematic review were retrospective case series. • Some studies did not report individual patient data, whilst others did not report presenting symptoms, time of initial injury to the diagnosis of ACS, and onset of increased pressures, therefore, not giving a holistic understanding of paediatric ACS.

Schreiber,M.L (2016). Neurovascular Assessment: An Essential Nursing Focus. Medsurg Nursing, 25(1), 55-57 from PubMed	VII	**Key findings:** • Clear descriptions of assessment of pulses, capillary refill, temperature, colour, sensation and motor function • Examples of frequency of assessments Importance of communication of changes to neurovascular status • Importance of comparing affected and non-affected limbs **Outcomes:** • Nursing staff have the opportunity to identify neurovascular compromise and reduce complications and prevent poor outcomes • Ensure documentation of what is normal for the patient and what is abnormal **Recommendations:** • Defaulting to changes in frequency of assessment of neurovascular status depending on patient's individual status. **Strengths:** • Clear focus and points made • Writer is faculty member of technical collage and health care speaker-expert in field. • Easy to understand **Limitations:** • Level VII evidence • Simple information does not go into much depth

Patel, k., & McCann, P. A. (2012). The emergent assessment of supracondylar fractures of the paediatric humerus. Journal of Hand Surgery, 17(2), 161-165. From Medline	VII	**Key findings:** • Adequate documentation of neurovascular assessment includes capillary refill time, presence or absence of pulses, normal or abnormal motor and sensory function. • Fracture classification by Wilkins modification of the Gartland system • Outlines upper limb nerves and expected outcomes **Outcomes:** • The analysis concluded inadequate documentation of neurovascular assessment throughout the hospital. Some areas documentation was less than adequate more than 50% of the time • The analysis concluded inadequate documentation of neurovascular assessment throughout the hospital. Some areas documentation was less than adequate more than 50% of the time **Strengths:** • The article stated a clearly focused aim of the research and clearly stated the goal intended. • Method of the study was clearly stated • There is no bias in recruitment of participants because all participants suitable for inclusion were included in the study. • Documentation was taken in separate departments in the hospital allowing a larger scale on assessment • This study has 35 participants meaning it is a medium size scale study • This study is primarily focused on the paediatric population. Population clearly outlined **Limitations:** • The conclusion of the study did not match up with the aim of the study. The results ended up being more focused on the documentation rather than the assessment of the fracture. • Retrospective analysis leads to the reader's interpretation of documentation, possibility of author bias and may be selective in what is included in the results. • Study relies on documentation of other nurses, not all documentation is accurate • This retrospective analysis was only undertaken at one institution meaning they only assessed one small population geographically, cannot generalise to the whole population

Ferlic, P. W., Singer, G., Kraus, T., & Eberl. R. (2012). The acute compartment syndrome following fractures of the lower leg in children, International Jou	VI	**Key Findings:** • Retrospective case series of all patients treated with an acute compartment syndrome following a fracture of the lower leg between the years 1998- 2010. • Inclusion criteria includes less than eighteen years and complete documentation of the patients history • Exclusion criteria included compartment syndrome with absence of a fracture • 9 out of 31 participants were diagnosed solely on clinical symptoms • This study questions if the rates of compartment syndrome in the paediatric population may be lower, especially under the age of 12, this is out of the scope of this study **Outcomes:** • compartment syndrome can develop up to 65 hours post injury, early recognition of ACS can lead to positive outcomes and diagnosis is based on clinical symptoms • Recommendations: • for further research because there is limited research on paediatric population in relation to development of compartment syndrome. **Strengths:** • The study focused solely of the paediatric population which was clearly outlined to be below the ages of eighteen. The Median age is 14.6 years old, this is a strength because the results can be generalised to the paediatric population • There were 1038 fractures in the studies time period there were 31 participants who developed compartment syndrome. This is a large scale retrospective analysis • This retrospective case analysis helps identify the time between injury and presence of complication which was statistically significant **Limitations:** • study relies on documentation of other nurses and is done on the authors interpretation of notes • It is unclear but appears the study was taken from one hospital which limits generalisation only children included in this study were those with compartment syndrome as a result of a

		fracture, information on the development of compartment syndrome from other causes may be beneficial. • There is a high incidence of patients who had trauma from motor bike or skiing accidents, it is questionable that the rates of skiing accidents is high because of the popularity of the sport in Austria.

Johnston-Walker, E., & Hardcastle, J. (2011). Neurovascular assessment in the critically ill patient. Journal in Critical Care, 16(4), 170-177 from Medline	VII	**Key Findings:** • Compartment syndrome is a well-documented complication associated with musculoskeletal trauma • Outlines when neurovascular assessment is indicated Trauma can result in damage to blood vessels and nerves this can result in temporary or permanent deficit in function. Description and definition of acute compartment syndrome Patients that are at risk of compartment syndrome • Neurovascular assessment involves assessing changes in oxygenation, circulation and nerve function • Assessment of neurovascular status includes assessment of the 5P's pain, pallor (colour), peripheral pulses, paraesthesia (or sensation), and paralysis (or movement). And how to undertake these assessments **Outcomes:** • Staff should recognize the context of neurovascular assessment and should communicate clinical concerns to the appropriate treating team • Neurovascular status should be assessed every 1-2 hours for the initial 24 hours after surgery, trauma, or application of a cast. **Strengths:** • This article is a literature review of the current literature related to neurovascular assessment. It outlines the distinct assessment components and highlights the importance of its inclusion in nursing practice. This article introduces a clearly focused aim which is consistent with the conclusion and is a strength in this article **Limitations:** • This article has no information about the search strategy or where the articles were gathered from or how many No specific population group was mentioned in the study

Shields, C. J., Clarke, S. (2011). Neurovascular Observation and documentation for children within accident and emergency: A critical review. International Journal of Orthopaedic and Trauma Nursing, 15, 3-10	VII	**Key findings:** • Appropriate validated neurovascular charts should be utilized for simplicity Definition of Compartment syndrome and noted as the most common complication of neurovascular compromise • Assessment should be based on the 5 P's pain, pulse, pallor, paraesthesia and paralysis Bilateral comparison of limbs should be obtained and documented for the purpose of a baseline assessment. • Early detection of neurovascular deterioration is vital in avoiding long-term disability **Outcomes:** • pain is a reliable indicator for neurovascular deterioration • throughout literature the frequency of undertaking neurovascular assessment is inconclusive • Neurovascular assessment tools should be used due to their simplicity and are vital in determining neurovascular deterioration **Recommendations:** • lack of literature on paediatric neurovascular assessment and availability of paediatric assessment tools, more information is needed for evidence base practice. further studies should be conducted, particularly in providing more child friendly methods of assessment. **Strengths:** • four databases were used in the search including CINAHL, Medline, PUBMED and British Nursing Index, this could be assumed to be a large scale systematic review. • The aim of this study is clearly outlined and consistent with the conclusion • This was a well written literature review that maintained good direction • Primary author is a practicing paediatric nurse who is undertaking further study in orthopaedic and fracture trauma. Expert experience in the field. **Limitations:** • Few articles sourced are solely focused on paediatric nursing, broad population assessed

Johnston-Walker, E., & Hardcastle, J. (2011). Neurovascular assessment in the critically ill patient. Journal in Critical Care, 16(4), 170-177 from Medline	VII	**Key Findings:** • Compartment syndrome is a well-documented complication associated with musculoskeletal trauma • Outlines when neurovascular assessment is indicated • Trauma can result in damage to blood vessels and nerves this can result in temporary or permanent deficit in function. • Description and definition of acute compartment syndrome Patients that are at risk of compartment syndrome • Neurovascular assessment involves assessing changes in oxygenation, circulation and nerve function • Assessment of neurovascular status includes assessment of the 5P's pain, pallor (colour), peripheral pulses, paraesthesia (or sensation), and paralysis (or movement). And how to undertake these assessments **Outcomes:** • Staff should recognize the context of neurovascular assessment and should communicate clinical concerns to the appropriate treating team • Neurovascular status should be assessed every 1-2 hours for the initial 24 hours after surgery, trauma, or application of a cast **Strengths:** • This article is a literature review of the current literature related to neurovascular assessment. It outlines the distinct assessment components and highlights the importance of its inclusion in nursing practice. This article introduces a clearly focused aim which is consistent with the conclusion and is a strength in this article **Limitations:** • This article has no information about the search strategy or where the articles were gathered from or how many • No specific population group was mentioned in the study