North West Children's Major Trauma Network
Always Children First

DOCUMENT CONTROL PAGE

Title:	North West Children's Major Trauma Operational Delivery Network (ODN) Femoral Fracture Initial Management Guidelines
Version:	1.1
Supersedes:	New document
Application:	North West Children's Major Trauma Operational Delivery Network (ODN)

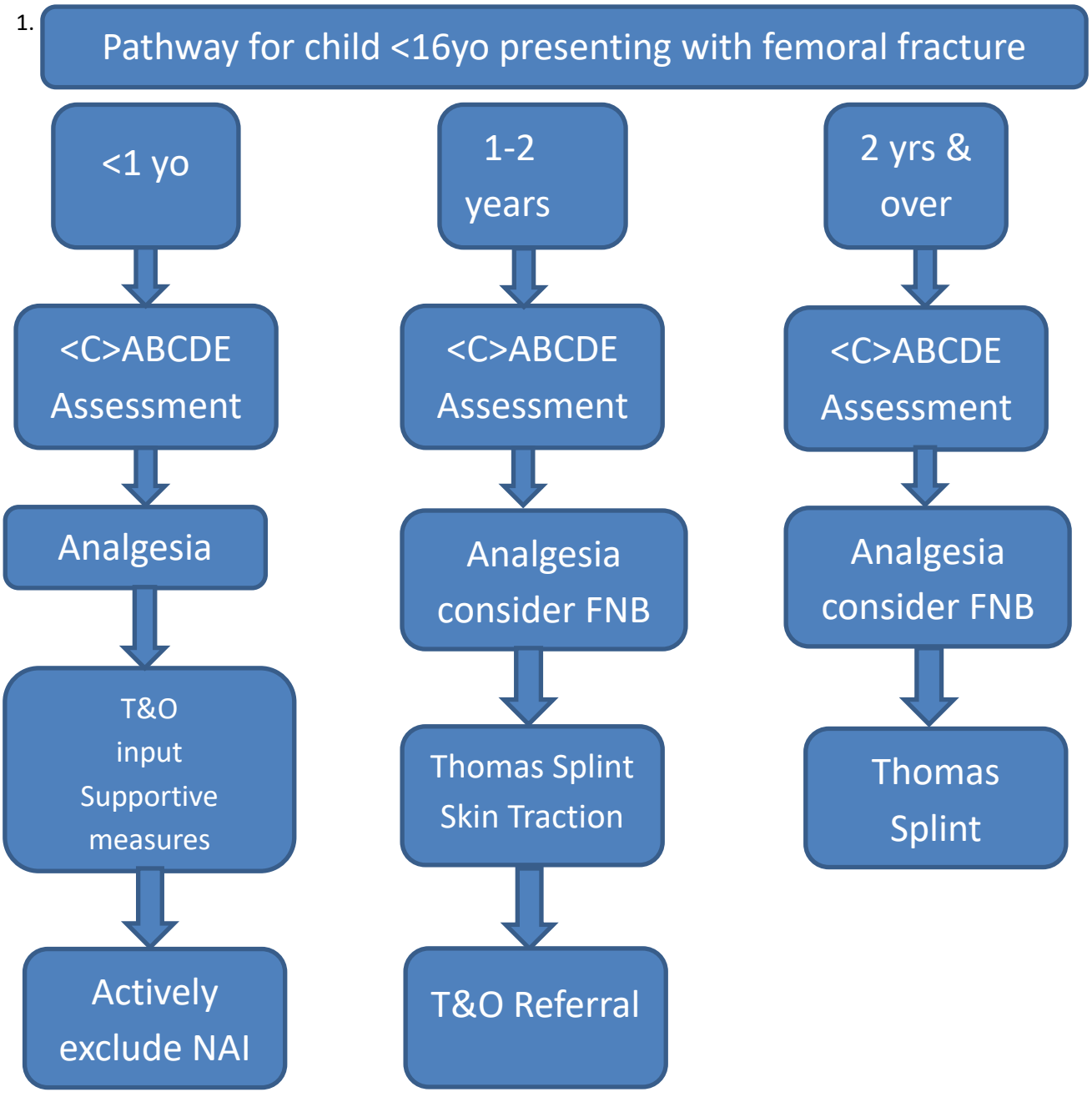
Originated / Modified By:	Colin Wong [1], Sanjay Desai[2], Jackie Miliken [3], Jason Cupitt [4], Kathleen Shields [4], Jo Tillett [5], Cath Pollitt [6], Tom Leckie [7], Anna Kirby-Bailey [8] In collaboration with North West Children's Major Trauma Operational Delivery Network
Amendment	P11 &12 Nitric Oxide changed to Entonox
Designation:	Trauma Consultant [1,,2,4,7,8], Trauma Nurse Leads [3,4,5,6,]
Ratified by:	North West Children's Major Trauma Operational Delivery Network (ODN) and RMCH Ratification Group
Date of Ratification:	14th February 2025

Issue / Circulation Date:	February 2025
Circulated by:	North West Children's Major Trauma Operational Delivery Network (ODN)
Dissemination and Implementation:	North West Children's Major Trauma Operational Delivery Network (ODN)
Date placed on the Website :	February 2025

Planned Review Date:	February 2028
Responsibility of:	Network Manager - North West Children's Major Trauma Operational Delivery Network (ODN)

EqIA Registration Number:	2024-86

1.



see page 4

see page 6

see page 8

GUIDELINE FOR MANAGEMENT OF FEMORAL FRACTURE IN PATIENTS UNDER 16 YEARS OF AGE IN NORTHWEST REGION

CONTENTS

2. PURPOSE AND SCOPE

This guideline has been developed to provide a framework for the assessment and initial management in the Emergency Department of a child under 16 years of age presenting to Emergency Departments throughout the Northwest Region with a femoral fracture.

This guideline has been written to help standardise the approach to pain management and appropriate management of femoral fractures in children according to their age.

The guideline is specifically for the clinical and nursing management of a fractured femur and does not replace guidance for management of polytrauma, major trauma, non-accidental injury or safeguarding assessment.

The guideline gives guidance on equipment procurement, management, analgesic options and will not cover every eventuality.

3. INTRODUCTION

Femoral Fractures are the most common reason for orthopaedic hospitalisation in children. They may result from either high or low energy transfer events.

- Prompt and effective management reduces pain, blood loss, anxiety and aids healing of these injuries.
- Non-Accidental Injury (NAI) must be considered if the child is < 3 years and especially if present in a patient before walking age
- Femur fractures are one of the most common fractures associated with NAI
- Transverse fractures more predictive of non-accidental trauma compared to spiral or oblique fractures
- Haemodynamic instability must raise suspicion for associated injuries
- Medical conditions and comorbidities
    - osteogenesis imperfecta
    - osteopenia secondary to neuromuscular disorders
    - benign or malignant bone tumours
- Analgesia: adequate pain relief is an important aspect of femoral fracture management and may require combinations of potent analgesics including strong opioids. Naloxone must be available in areas where strong opioids are administered. If the patient experiences low respiratory rate or increased sedation, then naloxone IV/IM 5micrograms/kg should be administered. A higher dose of 100micrograms/kg (max 2mg) can be given to completely reverse the drug if poisoning is suspected.

4. MANAGEMENT OF FEMORAL FRACTURES IN UNDER 1s

These children are non-mobile. After a rapid but thorough <C>A-E assessment and management, a detailed history must be taken to address safeguarding concerns.

ANY other associated injury in this age group should trigger a trauma call (or equivalent escalation if in a local emergency hospital) as infants can be very difficult to assess and it is easy to miss injuries.

a. Initial assessment

Has there been a high impact transfer of energy? do you need a major trauma call (or equivalent if in a local emergency hospital) /escalation of care?

-<C>	Catastrophic Haemorrhage	→ Apply pressure –Major Trauma call on 2222
		→ Major Haemorrhage Protocol Activation
-<C>	Potential Cervical Spine Injury	→ C-Spine Stabilisation & Major Trauma Call 2222
-Airway	Airway compromise	→ Major Trauma Call 2222
-Breathing	Oxygen Saturations, Respiratory Rate, Rule out Pneumothorax	
-Circulation	Heart Rate, i) Central CRT ii) Peripheral CRT iii) CRT distal to injury, Blood Pressure	
-Disability	Pupil Size, Blood Glucose, AVPU →if AVPU less than A or GCS 14 –Major Trauma Call	
-Expose	Temperature, Look for other injuries/NAI, Environmental management	
	Open Fracture/other injuries	→ Major Trauma Call 2222

b. AMPLE History from parents/carers

-Allergies

-Medications

-Past Medical History

-Last Feed/Meal

-Event itself

c. Analgesia **Weigh if possible or use estimated weight**

- Oral Ibuprofen

1-2 months	5mg/kg stat
3-11 months	50 mg stat
12-36 months	100 mg stat

- Oral Paracetamol

<4weeks	20mg/kg stat
1-5 months	60 mg stat
6-23 months	120 mg stat

- Consider ONE OFF IV Morphine with continuous oxygen saturation and heartrate monitoring

<1 month	50 micrograms/kg over 5mins once only
1 month -12 months	100 micrograms/kg over 5 mins once only

- Local Nerve Block Neonate -15 years see Femoral Nerve Block Section

d. Management of the femoral fracture

i) Rest the affected limb on a pillow or foam guttering if available. Under 1s will likely require Plaster of Paris for transfer to the tertiary centre.

ii) Ensure distal neurovascular status is intact.

iii) Ensure patient is comfortable.

iv) Plain film XRAY

v) Notify local Trauma and Orthopaedic Team for discussion with consultant and tertiary orthopaedic centre –Alder Hey Children's Hospital or Manchester Children's Hospital.

vi) safeguarding referral

vii) discussion with social services for child protection medical if suspicion of NAI

viii) keep parents/carers updated

5. MANAGEMENT OF FEMORAL FRACTURES IN OVER 12-24 MONTH OLDS

These children may be mobile. After a rapid but thorough <C>A-E assessment and management, a detailed history must be taken to address safeguarding concerns. An accidental injury is more likely in this age group if they are independently mobile. High suspicion of NAI if non-mobile.

ANY other associated injury in this age group should trigger a trauma call (or equivalent escalation if in a local emergency hospital) as toddlers can be very difficult to assess and it is easy to miss injuries.

a. Initial assessment

Has there been a high impact transfer of energy? do you need a major trauma call?

-Catastrophic Haemorrhage		→ Apply pressure –Major Trauma call on 2222
		→ Major Haemorrhage Protocol Activation
-(Potential) Cervical Spine Injury		→ C-Spine Stabilisation & Major Trauma Call 2222
-Airway	Airway compromise	→ Major Trauma Call 2222
-Breathing	Oxygen Saturations, Respiratory Rate, Rule out Pneumothorax	
-Circulation	Heart Rate, i) Central CRT ii) Peripheral CRT iii) CRT distal to injury, Blood Pressure	
-Disability	Pupil Size, Blood Glucose, AVPU →if AVPU less than A or GCS 14 –Major Trauma Call	
-Expose	Temperature, Look for other injuries/NAI, Environmental management	
	Open Fracture/other injuries	→ Major Trauma Call 2222

b. AMPLE History from parents/carers

-Allergies

-Medications

-Past Medical History

-Last Feed/Meal

-Event itself

c. Analgesia **Weigh if possible or use estimated weight**

- Oral Ibuprofen 12-36 months 100 mg stat

- Oral Paracetamol 6-23 months 120 mg stat

  2-3 years 180 mg stat

- Intranasal Fentanyl – follow local Trust Guideline for dosing, indications/contraindications. The table below reflects doses used in network major trauma centres for reference.

  (note intranasal fentanyl is a controlled drug and correct procedures must be followed)

Use fentanyl preparation 50 microgram/1ml for making up the below doses
(note this preparation does not need to be diluted)

Weight	Dose	Volume of Fentanyl = (dose in mls + 0.1ml added for residual volume of syringe/atomiser)
6kg	9 microgram	0.28ml = (0.18 + 0.1ml)
8kg	12 microgram	0.34ml = (0.24 + 0.1ml)
10kg	15 microgram	0.4ml = (0.3 + 0.1ml)
12kg	18 microgram	0.45ml = (0.36 + 0.1ml)
16kg	24 microgram	0.6ml = (0.48 + 0.1ml)

- Intranasal Diamporphine if not giving Intranasal Fentanyl– follow local Trust guideline for indications/contraindications. The table below reflects doses used in network major trauma centres for reference.
  (note intranasal diamorphine is a controlled drug and correct procedures must be followed)

Dilute 5 mg powder of diamorphine with specified volume of Normal Saline (V*) Spray 0.2mL of resultant solution up nose		
Weight	**Dose**	**Volume of Normal Saline (V*)**
12kg	1.2mg	0.8 mL
15kg	1.5mg	0.7 mL
20kg	2mg	0.5 mL

- Local Nerve Block Neonate -15 years see Femoral Nerve Block Section

d. Management of the femoral fracture in 1-2 year olds

i) Ensure patient is comfortable and analgesia given

ii) Ensure distal neurovascular status is intact

iii) X-Ray imaging if any doubt as to injury

iv) A Thomas splint is likely to be used in the ED in lieu of weight-based skin traction (Gallows Traction). The skin traction method is the same for Gallows and a transfer may be made from one to the other on the ward.

In the ED the simplest solution will be to stabilise using a Thomas Splint.

v) The local T&O should discuss these patients with the tertiary centre Orthopaedic team and may transfer with supportive measures or a plaster cast to support the injured limb in this age group. This should be discussed with parents.

vi) See Section 9. Application of the Thomas Splint

vii) X-Ray Plain film imaging

6. MANAGEMENT OF FEMORAL FRACTURES IN OVER 24 month olds

After a rapid but thorough <C>A-E assessment and management, a detailed history must be taken to address safeguarding concerns. Accidental fractures in mobile children are more common than NAI.

A Major Trauma Call (or equivalent escalation if in a local emergency hospital) should be made if any other significant injuries or fractures are present.

a. Initial assessment

Has there been a high impact transfer of energy? do you need a major trauma call (or equivalent escalation if in a local emergency hospital) ?

-Catastrophic Haemorrhage → Apply pressure –Major Trauma call on 2222

→ Major Haemorrhage Protocol Activation

-(Potential) Cervical Spine Injury → C-Spine Stabilisation & Major Trauma Call 2222

-Airway Airway compromise → Major Trauma Call 2222

-Breathing Oxygen Saturations, Respiratory Rate, Rule out Pneumothorax

-Circulation Heart Rate, i) Central CRT ii) Peripheral CRT iii) CRT distal to injury, Blood Pressure

-Disability Pupil Size, Blood Glucose, AVPU →if AVPU less than A or GCS 14 –Major Trauma Call

-Expose Temperature, Look for other injuries/NAI, Environmental management

Open Fracture/other injuries → Major Trauma Call 2222

b. AMPLE History from parents/carers

-Allergies

-Medications

-Past Medical History

-Last Feed/Meal

-Event itself

c. Analgesia	**Weigh if possible or use estimated weight**	
• Oral Ibuprofen	12-36 months	100 mg stat
	4-6 years	150mg stat
	7-9 years	200mg stat
	10-11 years	300mg stat
	12-17 years	300-600mg stat
• Oral Paracetamol	2-3 years	180 mg stat
	4-5 years	240mg stat
	6-7 years	250mg stat
	8-9 years	375mg stat
	10-11 years	500mg stat
	12-15 years	750mg stat
	16-17 years	1 gram

- Intranasal Fentanyl – follow local Trust Guideline for dosing, indications/contraindications. The table below reflects doses used in network major trauma centres for reference.
  (note intranasal fentanyl is a controlled drug and correct procedures must be followed)

Use fentanyl preparation 50 microgram/1ml for making up the below doses **(note this preparation does not need to be diluted** but once the total dose volume exceeds 1ml, the administered dose should be split evenly between each nostril**)**		
Weight	**Dose**	**Volume of Fentanyl = (dose in mls + 0.1ml added for residual volume of syringe/atomiser)**
20kg	30 microgram	0.7ml = (0.6 + 0.1ml)
24kg	36 microgram	0.8ml = (0.72 + 0.1ml)
28kg	42 microgram	0.95ml = (0.84 + 0.1ml)
32kg	48 microgram	1.05ml = (0.96 + 0.1ml)
36kg	54 microgram	1.2ml = (1.08 + 0.1ml)
40kg	60 microgram	1.3ml = (1.2 + 0.1ml)
45kg	67.5 microgram	1.45ml = (1.35 + 0.1ml)
50kg	75 microgram	1.6ml = (1.5 + 0.1ml)
55kg	82.5 microgram	1.75ml = (1.65 + 0.1ml)
60kg	90 microgram	1.9ml = (1.8 + 0.1ml)

- Intranasal Diamorphine if not giving Intranasal Fentanyl– follow local Trust guideline for indications/contraindications. The table below reflects doses used in network major trauma centres for reference. (note intranasal diamorphine is a controlled drug and correct procedures must be followed)

Dilute 5 mg powder of diamorphine with specified volume of Normal Saline (V*) Spray 0.2mL of resultant solution up nose		
Weight	**Dose**	**Volume of Normal Saline (V*)**
12kg	1.2mg	0.8 mL
15kg	1.5mg	0.7 mL
20kg	2mg	0.5 mL
25kg	2.5mg	0.4mL
30kg	3mg	0.35mL
35kg	3.5mg	0.3mL
40kg	4mg	0.25mL
50kg	5mg	0.2mL

- Local Nerve Block Neonate -15 years see Femoral Nerve Block Section
- Inhaled Entonox as per local guideline

d. Management of the femoral fracture in over 2s

i) Ensure patient is comfortable and analgesia given

ii) Ensure distal neurovascular status is intact

iii) Use distraction techniques and consider Entonox

iv) In the ED the simplest solution will be to stabilise using a Thomas Splint. Discuss with T&O

See Section 9. Application of the Thomas Splint

v) X-Ray Plain film imaging

vii) recheck neurovascular status

viii) Notify T&O if not already done so for further management

ix) Ensure regular analgesia and muscle relaxant prescribed

7. FEMORAL NERVE BLOCKS IN BABIES, INFANTS and CHILDREN

Key points

1. Paediatric femur fractures are associated with severe pain, which will be exacerbated during necessary transfers and investigations as well as during application of traction
2. Femoral nerve blocks allow effective, safe and medium duration analgesia
3. Ultrasound (US) guided blocks are more effective and safer and should be performed if equipment and expertise are available
4. This must be discussed with and explained to the family as it can look and feel like a very unpleasant distressing procedure.

Contraindications

1. Local anaesthetic allergy/anaphylaxis
2. Open wound or signs of infection at likely injection site

Potential Complications

1. Allergy/anaphylaxis
2. Direct neural trauma from needle/high pressure infiltration of local anaesthetic
3. Vascular injury eg formation of pseudoaneurysm
4. Intravenous/intra-arterial infiltration +/- haemodynamic collapse due to local anaesthetic toxicity

Equipment

1. Monitoring – continuous ECG and SpO_2
2. Ultrasound machine – high frequency linear probe (eg 10-15MHz)

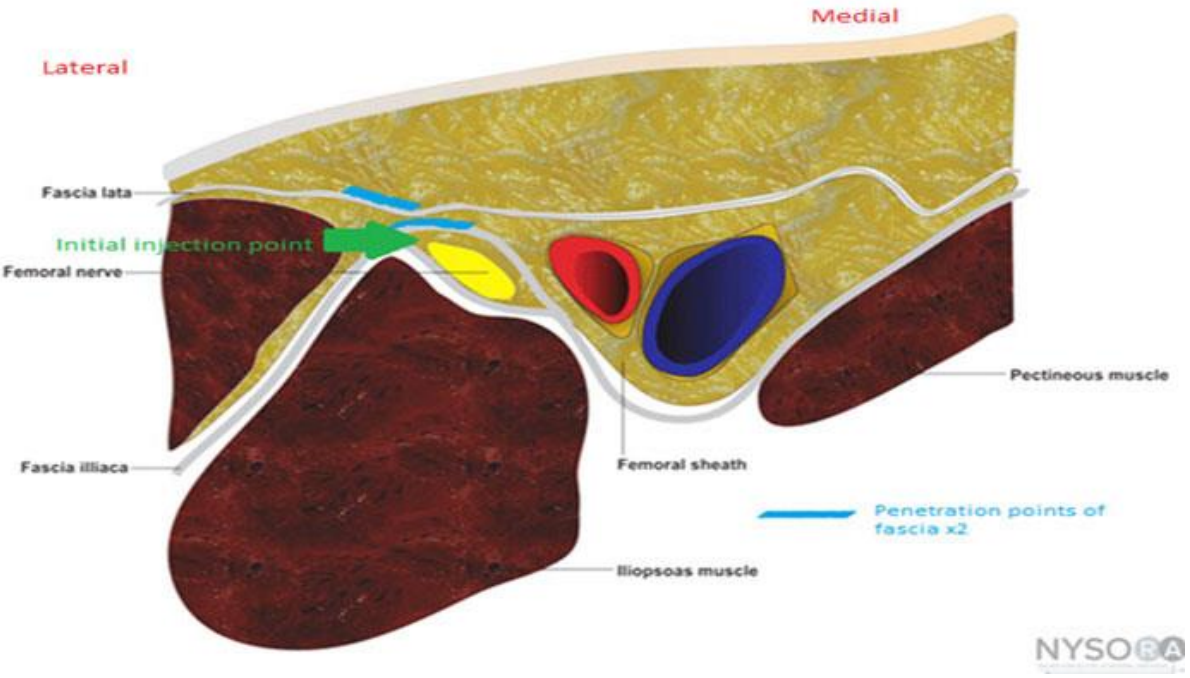
3. Sterile probe cover
4. Sterile gloves
5. Needle for injection -Specific nerve block needle if available
6. Low pressure extension tubing - optional but improves accuracy of infiltration

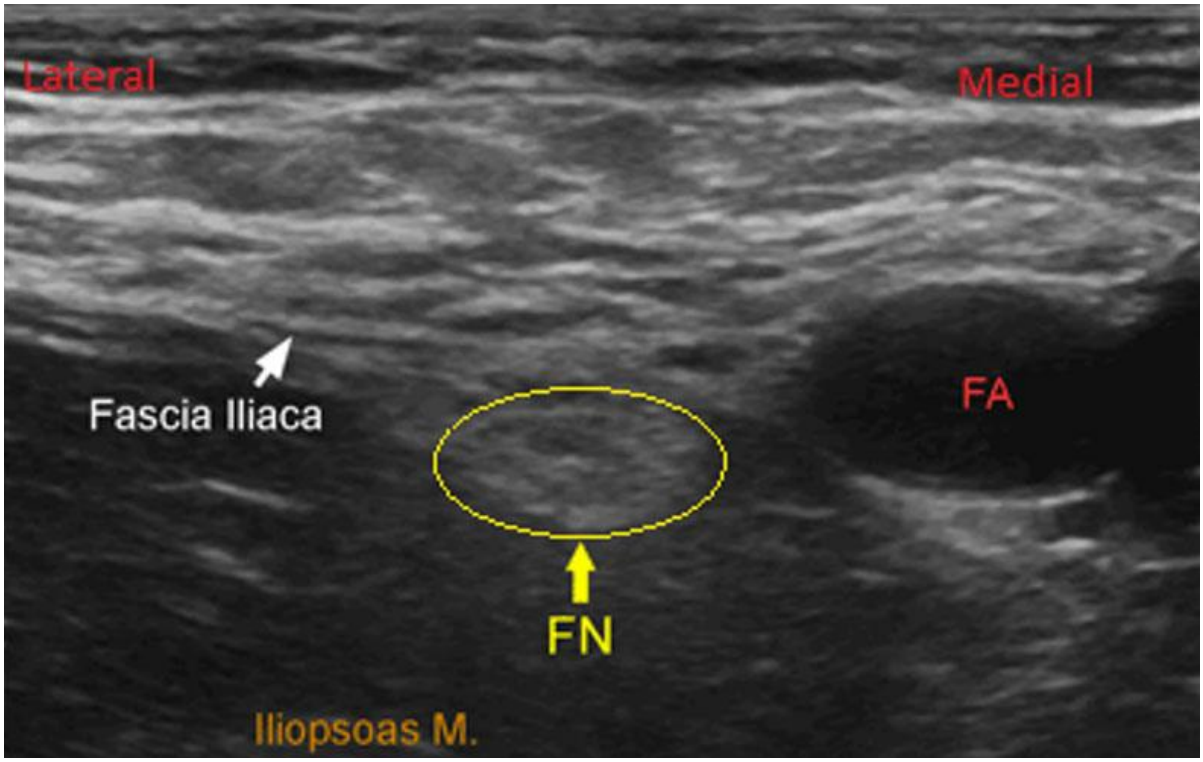
Analgesia, Anaesthesia, Sedation

1. 1% lignocaine for skin infiltration - 1-2 mL subcuticular injection
2. Local anaesthetic for block (any suitable, dilute both to double volume with normal saline)
    1. **Bupivacaine max 2 mg/kg (e.g. 0.4 mL/kg of 0.5%)** – *increased risk cardiotoxicity but longer duration of action*
    2. **Lignocaine max 4 mg/kg (e.g. 0.4 mL/kg of 1%)** or with adrenaline > 7 mg/kg – *short duration 2 hrs which may be sufficient e.g. transfer to theatre, safer for inexperienced user*
3. Consideration of supplementary analgesia for e.g., Entonox sedation or IN fentanyl if severe agitation or difficult positioning of lower limb is impairing block insertion

Anatomy

- Locate femoral crease: ASIS to pubic symphysis
- Lateral > Medial: Femoral nerve > artery > vein
- Palpate artery
- Needle insertion and superficial local anaesthetic injection site roughly 5cm lateral to artery towards ASIS in grown child, 1cm in baby
- On ultrasound view femoral nerve has *popcorn* or *honeycomb* appearance

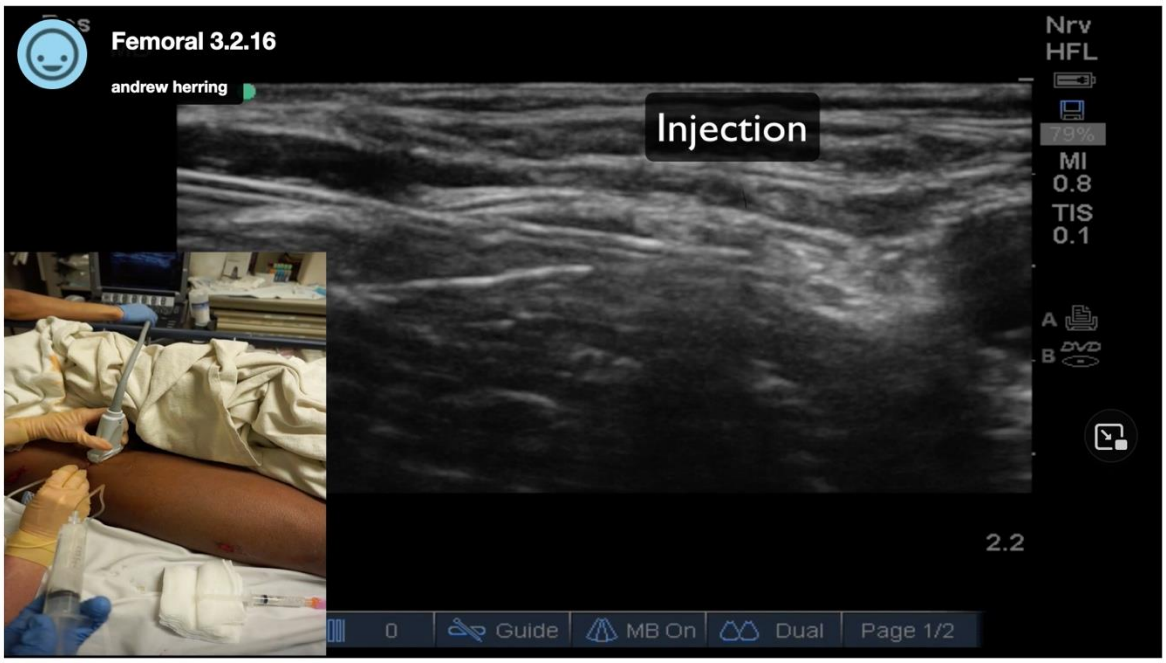




TECHNIQUE

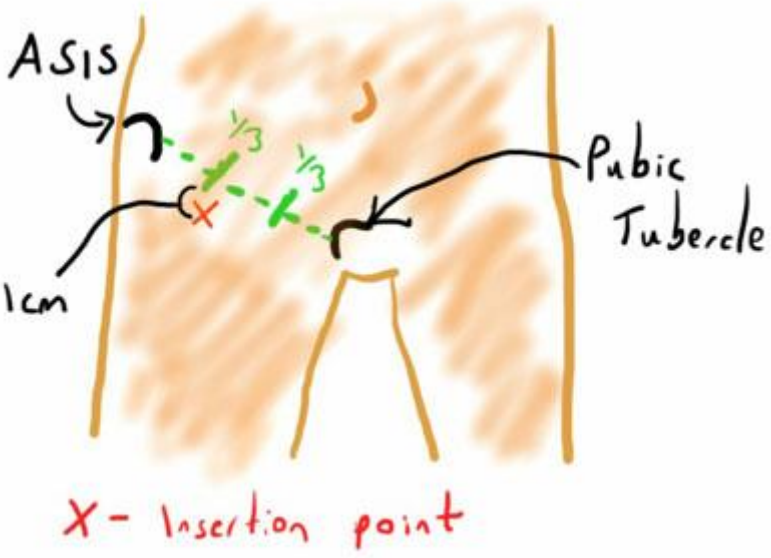
Ultrasound-guided (ideally performed with assistant)

1. Locate landmarks
2. Prepare ultrasound machine
    - Correct probe
    - Position opposite side of bed from block sign
    - Gel onto probe with cover/large tegaderm applied after
    - Prepare dressing pack with local anaesthetic, appropriate needle, low pressure tubing
3. Clean area and drape appropriately especially medially
4. "In-plane" ultrasound probe orientation with marker pointing to ASIS
5. Observe landmarks (Lateral > Medial)
6. Infiltrate 1-2 mL of 1-2% lignocaine superficially lateral to artery
7. Pierce skin with block needle through anaesthetised skin
8. Advance slowly ensuring tip of needle always visible
9. When lateral to nerve and between layers of fascia iliaca infiltrate small amount
    - **Prior to any injection aspirate without moving needle to ensure not within vessel**
10. Continue to infiltrate local anaesthetic gradually aiming to fully encircle the nerve



"Blind Technique" – Fascia-Iliaca Block:

1. Locate landmarks – ASIS to pubic tubercle divided into thirds
2. Needle insertion point is 1 cm distal to junction of lateral and middle thirds
3. Injection point is after second "pop" denoting passage through two fascial planes
4. Aspirate to ensure not in vessel
5. Gradually infiltrate local anaesthetic stopping every few mLs to aspirate again
6. If in correct space resistance to infiltration should be minimal, if significant resistance withdraw slightly and re-try



Post-procedure care

1. Simple dressing/band-aid for injection site
2. Review of injection site for formation of pseudoaneurysm – usually within 2 hrs of procedure
3. Monitoring can be stopped 5-10 minutes post procedure

Alternatives in case of block failure

1. Continue opiate analgesia
2. Immobilisation of lower limb

Post Procedure care

Continue monitoring the child carefully, looking particularly for signs of local anaesthetic toxicity for at least one hour.

These should include regular:

-Heart rate

-GCS

-Blood pressure

-Plus Lower limb neurovascular observations and Capillary refill

Document the block clearly the side and site of injection, needle used, volume and name of local anaesthetic and any associated problems.

8. APPLICATION OF THE THOMAS SPLINT

i) Thomas splint traction

The Thomas splint is used in conjunction with skin traction or skeletal traction to immobilise and position fractures of the femur. It can be used in all age groups and involves application of a long leg splint with a hoop or ring that extends beyond the foot which can then be fixed, for example, to the end of the bed or suspended in a balanced system using skeletal or skin traction (Clarke and Santy Tomlinson, 2014).

Application of a Thomas splint can be upsetting for the patient but most often reduces pain.

Equipment:

- Thomas splint –sized correctly
- velcro (Figure 5) or calico slings
- adhesive skin extension set
- two crêpe bandages
- tape
- measuring tape
- gamgee
- windlass
- scissors

1 Measure the **uninjured** leg

Measure the **uninjured** lower limb from inner groin to medial malleolus and add 15 cm.

Measure the circumference of the upper thigh of the uninjured lower limb and add 5cm.

These provide the measurements for your Thomas Splint.

2 Prepare the Thomas Splint

Clean the splint if reusable, ensure no sharp edges.

Avoid closed ring splints as swelling may occur

3 Apply the slings

Position and secure the slings along the splint. Slings should sag slightly and the distal sling should end before heel.

4 Pad the slings with Gamgee

Place an extra pad under the knee to give 5-10 degrees flexion

ii) Apply Skin traction (formally Pugh's Traction)

The principles of skin traction are the basis for both Gallows traction and Thomas splint traction.

This guidance can be used to apply skin traction to all age groups. Variation in the way this modality is applied may exist in clinical practice.

Aim

To safely apply skin traction.

Equipment:

- one adhesive or non-adhesive traction kit
- crêpe bandages (if not in the kit)
- padding (if not integral to the kit)
- tape
- scissors

1 Apply skin extension

Apply skin extension, making sure the tape is placed next to medial and lateral aspects of the limb. It is vital that the extension tapes are crease free to prevent pressure sores and the foam padding is over the malleoli.

There should be a loop of skin extension at the end.

2 Bandage the limb

Bandage round the skin extension to ensure it does not slip off.

Do not bandage around the malleoli/Achilles tendon.

Leave the knee exposed.

3 Leave the knee exposed

Bandage to the top of the leg and tape over the unsecured ends.

The position of the extension can be used to control rotation of the limb.

Place the limb in neutral alignment.

3) Place the limb into the splint

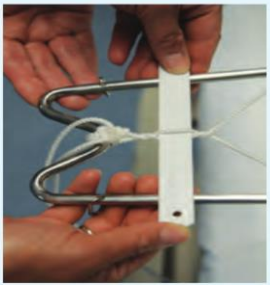
Ensure the knee is slightly flexed with pad under the knee.

4) Secure the traction cords

Secure the traction cords from the skin to the end of the splint, passing the OUTER cord OVER the lateral bar of the splint and the INNER cord UNDER the medial bar.

Tie off at the end of the bar in the notch.

5) Secure the windlass



This applies traction to the limb. Attempt to get the relative lengths of each limb equal.

Reassess neurovascular status of the distal limb.

6) Place Gamgee over the limb and bandage over this

Apply Gamgee over the limb to further reduce the fracture and wrap bandage over the splint and the limb.

7) XRAY the limb –AP and lateral

It should look like this.

XRay and re-check neurovascular status and analgesic state of the child.

The patient should be transferred for further care out of the Emergency Department with a full handover to the onward surgical and nursing teams.

Local Nursing fracture management guidelines should be adhered to from this point.

Onward Management

The Thomas Splint is usually used as a temporary device to stabilise a patient whilst waiting for definitive management although it can be used as definitive management. Associated problems arise with soiling and skin/tissue breakdown. Gallows or End of Bed Traction should be considered if traction is considered to be the definitve management.

- Analgesia, Lactulose and Diazepam for muscle spasm prescribed
- Hourly Vital signs for 12 hours then four hourly.
- Hourly neurovascular assessment for four hours, then 4 hourly checks. If skin traction needs reapplying or position of Thomas splint adjusted hourly neurovascular checks to be monitored for 4 hours.
- Regular pain assessment.
- Hourly neurovascular assessment.
- Regular palpation of dorsalis pedis
- Regular pressure area assessment / repositioning.
- Encourage fluids and deep breathing exercises

Definition of terms

- **Fracture:** Any type of break in a bone.
- **Traction:** Traction is the application of a pulling force to an injured part of the body or extremity.
- **Skin traction (bucks traction):** Skin traction is applied by strapping the patient's affected lower limb and attaching weights.
- **Counter traction:** Application of force in the opposite direction used to oppose/offset traction.
- **Neurovascular observations:** Are an assessment of circulation, oxygenation and nerve function of limbs within the body.
- **Compartment syndrome**: Increased pressure within one of the body's compartments which contain muscles and nerves, causing pain, muscle and nerve damage due to insufficient blood flow.

References

https://rcem.ac.uk/wp-content/uploads/2021/11/Nasal_Diamorphine_for_Children_Addenbrookes_Hospital_2009.pdf

https://www.orthobullets.com/pediatrics/4019/femoral-shaft-fractures--pediatric

https://journals.lww.com/co-pediatrics/Fulltext/2013/02000/Femoral_fractures_in_children.9.aspx

Paediatric Orthopaedic Guidelines for Children with femur Fractures – Nursing Guidelines V4–Jackie Milliken 2015

WHH Guideline Intranasal Fentanyl for Acute Severe Pain in Paediatric Emergency Department 2019

BNFC online 2023

RCN Traction Principles and Application July 2021 –Royal College of Nursing

Northwest Trauma Network Audit of Management of Femoral Fractures in Children 2021, Thompson, L.

https://www.rch.org.au/clinicalguide/guideline_index/Femoral_Nerve_Block/

Trust Guideline for the Management of: Closed Diaphyseal (Midshaft) Femoral fractures in Children from birth to 16 years –Jenny Lind NHS Trust Sanghrajka & Wormald 2022

Contributors

Sanjay Desai, Jackie Miliken, Jason Cupitt, Kathleen Shields, Jo Tillett, Cath Pollitt, Tom Leckie, Anna Kirby-Bailey