Royal College of Nursing

NURSING PRACTICE ACADEMY

Traction Principles and Application

Third edition

NURSING PRACTICE ACADEMY

Acknowledgements

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Introduction

In its purest sense, traction is the action of pulling or drawing. In a core text by Clarke and Drozd, (2023:96) traction is defined as **'the application of a pulling force to a part or parts of the body for the treatment of bone and muscle disorders or injuries**. Similarly, Nadaph et al (2023:1) define traction as **'the application of pulling force to the trunk or extremities for immobilization, fracture reduction and deformity correction'**. The two main methods of traction have been identified as 'skin' and 'skeletal' (Biz er al., 2019). For skin or skeletal traction, the limb is connected to a cord linked to a variable weight, which exerts the pulling force.

Skin traction allows a pulling force to be exerted on the affected limb via the soft tissues, using a weight. A cord is then attached to weights and linked to the plate. Skin traction 'kits' have been developed using adhesive and non-adhesive materials, made up of two skin tapes, which are attached to a padded spreader plate. This kind of traction is contraindicated in patients with varicose veins, neurovascular disorders, fragile skin and diabetes (Duperouzel et al., 2018).

In skeletal traction, the traction is transferred by means of a transosseous pin passing either through the supracondylar region of the femur or the tibial tuberosity using dedicated instrumentation (Biz er al., 2019). As surgical techniques have improved, skeletal traction has transitioned from a definitive treatment modality to a temporary stabilization method. This is supported by Cline et al (2021) who suggests the use of skeletal traction to have decreased over the years and used more for temporary fracture stabilisation. Due to the shift within practice and advancements in technology fractures are now being treated operatively with intramedullary nails, or plates and screws - so traction is used less frequently as a treatment modality than in the past. That said, traction can still be used as a temporary measure to provide pain relief while definitive treatment is planned.

Children and young people continue to be treated with traction in hospital and on some occasions at home to avoid lengthy inpatient stays. An example in relation to the earlier part of the life course, is reported by Dietzel et al., (2022) whose main finding suggests vertical skin traction (gallows) for femoral shaft fractures in young children (n=36) below the age of four years is an easy, non-invasive, and safe treatment option with satisfactory results and no significant complications. A Thomas splint may also be applied for the early reduction and immobilisation of a mid-shaft femoral fracture. A recent publication, *Skin Traction in Orthopaedic Care: efficacy, management and clinical practices across the life course*, presents a summary of four pertinent primary studies which support an increase in empirical research on the selection and effectiveness of traction across the life course (Clarke et al., 2025).

Although less routinely used in modern day practice, the evidence base suggests the choice of traction selected, correct application using a patient centred approach (NMC 2018) can impact upon the patient's experience and outcome. A key example is found within the common occurrence of hip fractures in older people who often encounter delays and await surgery. A recent prospective randomized controlled trial (RCT) by Kheiri et al., (2023) randomised 154 patients into group A or B. Skin traction was applied for group A, while only a soft pillow was placed below the patients' knees in group B. The study

reported the application of pre-operative skin traction to not affect the patients' self-reporting of pain, nor the mean morphine dosage taken per day in patients with isolated intertrochanteric fractures. In summary, Kheiri et al., (2023) did not support the routine application of pre-operative skin traction in patients with intertrochanteric fractures. Another study by Alsaraireh et al., also in 2023 aimed to assess the elements of the quality of pain management and identify factors that significantly predict higher quality pain management in patients with skin traction also reported the quality of pain management for fracture patients with skin traction to be not optimal. In relation to midshaft femoral fractures were pain and haemorrhage are common traction splints such as Thomas splint (TS) which immobilise the limb, can reduce pain and haemorrhage. A systematic review by Philipsen et al., (2022), which aimed to analyse and discuss the potential role of TS in the prehospital and emergency department (ED) setting found 1,248 articles to match the search strategy, 24 articles were assessed for eligibility based on their abstracts, resulting in 20 articles being included in the synthesis. Ten articles reviewed the effects of TSs on pain, while five reported that the use of a TS was appropriate. All five articles that reviewed blood loss found benefits from the use of a TS. The review concluded the use of TS to be associated with a decreased need for blood transfusions and fewer pulmonary complications. That said, no favourable effects were found in terms of pain relief. The authors did recommend the use of a TS in situations where one is likely to encounter a femoral fracture as well as when the time to definitive treatment is long. Further well-designed studies are required to validate these recommendations.

The RCN's Trauma and Orthopaedic Nursing (TON) Forum formally known as the Society of Orthopaedic and Trauma Nursing (SOTN) Expert Reference Group (ERG) undertook the work for the original document in 2002 with revisions in 2015, 2021 and then by TON in 2025.

This publication reflects the variation in the application of traction across the UK.

This revised edition has been updated with latest evidence from literature. It provides information on applying traction and caring for patients safely whilst traction remains in place. The publication does not specify which conditions or fractures may be treated with traction.

The guidance document is presented in three sections; **Section 1** provides the background and basic principles of traction. The adult and child/young person templates for care in **Section 2** are designed for practitioner advice. Care for specific types of traction described in **Section 3** can be used in conjunction with the templates in **Section 2**.

1. Traction background and principles

Historical background

The use of apparatus to apply traction to injured limbs has played an important role in the treatment of patients with fractures since the time of the Ancient Greek physician, Hippocrates. The texts he gathered contained discussions on diagnosis and treatment of fractures, including carefully prescribed methods of traction for fractures of the long bones. Through the following centuries, physicians recorded a variety of techniques and refinements to the way traction was used to deal with lower limb fractures and manage spinal conditions.

In the modern day, the development of aseptic techniques, antibiotics and surgical techniques have all combined so that surgical treatment is now the preferred method of treatment. However, traction is still used in some cases and orthopaedic and fracture trauma nurses still need to understand the principles of traction and not only have the ability to safely apply it but safely manage and provide the associated ongoing care for the patient across the life course, when required.

Principles of traction

In summary, there are many definitions of traction, but put simply, traction is the application of a pulling force for medical purposes, to treat muscle or skeletal disorders – for example, to reduce a fracture, stabilise and maintain bone alignment, relieve pain, or prevent spinal injury.

Traction is usually applied to the arms, legs, spine, or the pelvis. It is used to treat fractures, dislocations, and long-duration muscle spasms, and to prevent or correct deformities.

Traction can be used either short term, for example at an accident scene, or in ED as pain relief or as part of an interim care plan before surgery. It can also be used long term, as part of a non-operative treatment plan.

Traction is based on simple mechanical principles and is a well-established treatment in orthopaedic settings. To pull (or apply) traction effectively, there must be something to pull against, which is endeavouring to pull or thrust in the opposite direction. These two forces are called traction and counter traction respectively.

Counter traction is the force acting in the opposite direction to the applied traction. It is usually achieved by a patient's body weight and bed adjustment, sometimes with the use of additional weights.

The pulling force overcomes muscle spasm and shortening. It can also, in some circumstances, control movement of the injured part so enabling bone and soft tissue to heal.

Human tissue is very vulnerable, however, and traction on limbs must be practised with caution and discretion.

Uses of traction

- To relieve pain due to muscle spasm, maintaining the limb in a position of comfort and rest.
- To restore and maintain alignment of bone following fracture and dislocation.
- To allow treatment and dressing of soft tissues.
- To rest injured or inflamed joints and maintain them in a functional position.
- To allow movement of joints during fracture healing.
- To gradually correct deformities due to contraction of soft tissues, caused by disease or injury.
- To allow the patient to be moved with ease.

Essential principles

- The grip or hold on the patient's body must be adequate and secure.
- Provision for counter traction must be made.
- There must be minimal friction on the cords and pulleys.
- The line and magnitude of the pull, once correctly established, must be maintained.
- There must be frequent checks of the apparatus and of the patient to ensure that:
- The traction set-up is functioning as planned.
- The patient is not suffering any injury as a result of the traction treatment. The grip or hold on the body is achieved:
  - manually
  - via the skin
  - via the bone.

Poorly applied traction can cause considerable discomfort to the patient, cause injury e.g. pressure and may delay rehabilitation. It is important, therefore, that staff responsible for setting up and maintaining traction are thoroughly familiar with the principles of traction, so that the mechanics of each type of traction set-up are well understood.

Care of traction apparatus

- The traction system should be thoroughly checked at least once during each shift, and always after any intervention because the system may have inadvertently been altered. Checks should always be carried out by a health care professional with the required knowledge and skills.
- The traction apparatus should be kept clean and dust free.
- The traction structure, for example, Balkan beam and hinged clamps, should be tight and the traction cord should be running over the pulley and gliding smoothly.
- Only traction cord should be used for traction as it is designed not to stretch. It should be of correct strength and circumference to use the pulleys and other traction equipment.
- Standard non-slip knots should attach the cords securely, for example, a clove hitch or two half hitches knot (see figures 1-3).

- The ends of the cords should be short (5cm), single length and continuous, not short knots which have been joined together.
- The line of pull of the traction cords should be correct and checked at least once during each working shift. This ensures the appropriate pulling force is applied for optimal therapeutic effect at all times.
- Pulleys should be free running: the cord must rest comfortably in the pulley track. Only one cord should run through each single pulley track, as this reduces friction and the possibility of the cord fraying.
- The amount of weight should be prescribed and documented in the patient's nursing records/medical notes. The prescribed weights should be maintained at all times.
- The weights must hang freely and not be obstructed, otherwise the efficiency of the system cannot be maintained.
- Caution should be taken when choosing traction equipment to ensure that it is compatible with the bed or cot being used.
- Weights should not be hung directly over the patient unless an extra safety cord is used and checked regularly.
- The pointed ends of pins or wires used in the traction system (in skeletal traction) should be covered to prevent potential injury to the patient or health care professional.
- The patient should be managed on an appropriate mattress to give full support and comfort, plus allow sufficient traction to be maintained.
- Attachments should be considered to help the patient to move as their condition allows.
- Counter traction must be maintained at all times in any traction system. If counter traction is not present, the patient tends to be pulled in the direction of the traction force.

Knots

Although practitioners may develop their own knot, a 'round turn and two half hitches' is the only knot that is needed to secure traction cord. This knot is easy to learn and is a secure knot which will not come undone on its own.

It is never advisable to join short lengths of cord and always safer to use a continuous length of cord. You must never re-use traction cord. Re-use risks not only infection but injury, because unseen damage and wear can occur in the core of the cord. Cord ends should be trimmed and taped for neatness. Over time, the traction cord may start to stretch, and you may need to make adjustments in order to keep the system running freely. If the cord starts to show significant wear or snagging it should be replaced.

Completing a ‘round turn and two half hitches’

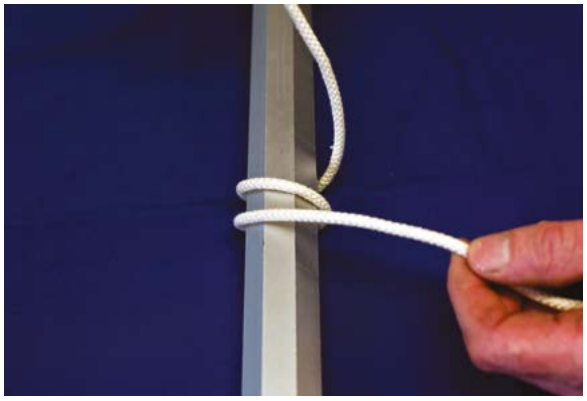


Figure 1: Stage 1

Pass the end of the cord twice around the item to be secured, leaving plenty of cord to enable you to complete the knot. You can always trim the excess cord later.

Figure 2: Stage 2

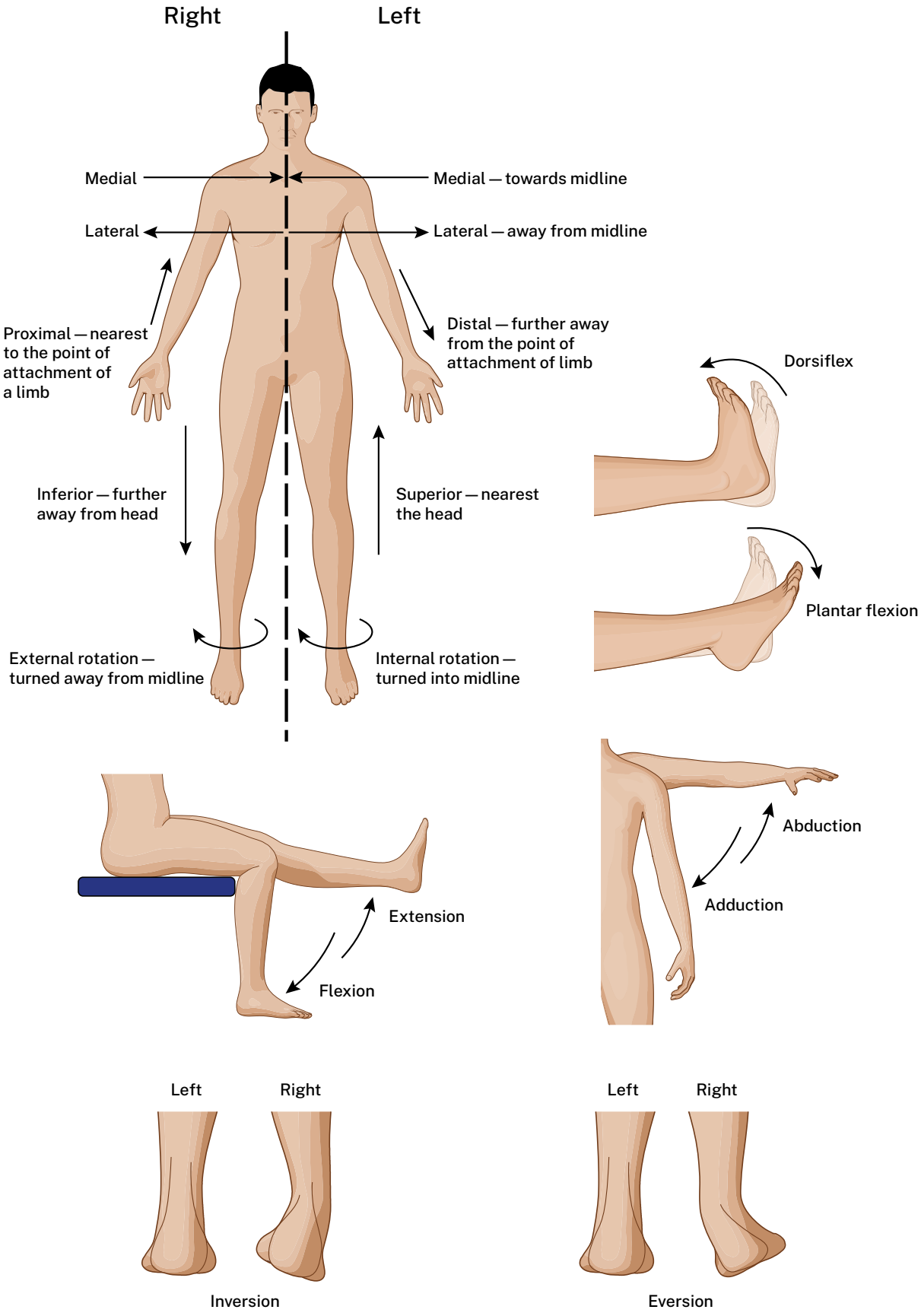
Pass the end of the cord around the length of cord creating a loop and bring the cord up in the inside. The loop can now be pulled in tight.

Stage 3: Figure 3

Repeat the action again creating a second loop in the same direction as the first loop and pull tight. The knot should now be secure. It is best not to trim the excess cord until you have completed all the traction set up as you may wish to make some adjustments.

Anatomical terms

Figure 4



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2. Suggested template for care of nursing of adults and children/ young people

Adult template for care of patients undergoing skin traction

1. Ensure the patient has agreed (consented) to care and treatment.
2. The patient is assumed to have capacity unless there are reasons to doubt this.
3. If capacity is in doubt, you should complete a TWO STAGE TEST (Mental Capacity Act, 2005).
4. If the patient lacks capacity, follow this by completing the BEST INTERESTS checklist.
5. Use this information to help personalise and individualise the patient's care.

Nursing care action	Rationale
Explain the procedure to the patient.	If traction is to be effective it is essential that the patient understands the need for traction.
Observe and record neurovascular observations, to include: • pain • warmth • sensation • movement • colour • capillary refill. Frequency of observation, as hospital per policy.	To detect abnormalities and prevent any neurovascular complications from occurring. To observe for development of compartment syndrome.
Give analgesia as prescribed.	To provide pain relief and aid compliance with traction.
Check the traction apparatus to ensure that pressure is not being caused.	To reduce the risk of pressure ulcer formation.
	Additional pressure relieving aids may be required.
Use an appropriate pressure ulcer risk assessment tool. Example: Braden Scale (Braden and Bergstrom, 1988)	To score and document your assessment.

Nursing care action	Rationale
Remove the bandages once a day to wash the limb and observe the skin.	
Apply counter traction to the limb during this procedure.	Counter traction avoids muscle spasm and alleviates discomfort.
Assess and document assessment of patient's pressure areas to include sacrum, spine, heels, elbows and malleoli	To reduce the risk of pressure ulcer formation.
Encourage the patient to lift himself/herself using the appliance provided by the occupational therapist or physiotherapist. Apply padding to any bony areas.	As above.
Encourage the patient to perform plantar/dorsi-flexion exercises to both feet to encourage venous return (see figure 4).	To reduce risk of deep vein thrombosis (DVT) developing.
Apply anti embolism stockings if prescribed and administer prescribed anti coagulation therapy.	As above.
Encourage the patient to do deep breathing exercises.	To reduce the risk of developing a chest infection.
Encourage the patient to drink oral fluids.	To maintain hydration and prevent urinary stasis. To prevent constipation.
Monitor urine output.	To detect urinary retention or acute kidney injury.
Encourage the patient to eat a high-fibre diet. Give aperients as prescribed.	To prevent constipation.
Check the traction each shift: • ensure that weights are not resting on the floor • ensure that knots are not jammed in the pulleys • ensure that skin traction has not slipped down the leg • ensure that weights are not rested on the bed during any procedures • elevate the foot of the bed to provide counter traction (this would be the head of the bed in cervical traction).	To ensure that traction is effective at all times.
Maintain oxygen and intravenous infusion therapy if prescribed.	To reduce the risk of developing fat embolism.
Observe vital signs and report change in National Early Warning Score (NEWS2) (RCP, 2017) to medical staff.	To provide early recognition of patient's condition deteriorating.

Child/young person model for care

Trust logo here

Template for care for children/young people undergoing skin traction

Before you complete this care plan the child/young person and parents/carers must be asked for their agreement (consent/assent) to care and treatment.

Date and time commenced:	Print name:	Signature:

Nursing care action	**Rationale**
Explain the procedure to the child/young person and family.	If traction is to be effective it is essential that the child/ young person and family understand the need for traction.
Observe and record neurovascular observations to include: • **pain** • warmth • sensation • movement • colour • capillary refill. Frequency of observation, as hospital per policy.	To detect abnormalities and prevent any neurovascular complications from occurring. Pain out of proportion to the injury may suggest the presence or development of acute compartment syndrome.
Give age and weight appropriate analgesia as prescribed.	To provide pain relief and aid compliance with traction.
Check the traction apparatus to ensure that pressure is not being caused.	To reduce the risk of pressure ulcer formation.
Assess the child/young person's skin for evidence of pressure sores and document. Consider need for pressure relieving aids dependent on child/young person's weight and immobility status.	Additional pressure relieving aids may be required.
Remove the bandages once a day to wash the limb and observe the skin. Apply manual traction to the limb during this procedure if required (dependent on diagnosis and reason for traction).	To check for signs of irritation and allergic reaction if adhesive skin traction is being used. Manual traction avoids muscle spasm and alleviates discomfort.
Check pressure areas, to include sacrum, spine, heels, elbows and malleoli, occiput (if on Gallows traction).	To avoid pressure ulcers developing.

Nursing care action	Rationale
If able and appropriate (ie, not for a child/young person in Gallows). Encourage the child/young person to relieve pressure on the sacrum using the appliance provided by occupational therapist or physiotherapist. Apply padding to bony areas if required.	As above.
Encourage the child/young person to perform plantar/dorsi-flexion exercises to both feet to encourage venous return (dependent on age/ weight of child/young person). (Not required for a child/ young person in Gallows traction). Older children/young people should be assessed and managed for risk of DVT as per local policy.	To reduce risk of deep vein thrombosis (DVT) developing.
Encourage the child/young person to move around the bed within confines of skin traction and if age appropriate, to do deep breathing exercises.	To reduce the risk of developing a chest infection.
Encourage the child/young person to drink a normal and regular amount of fluid, to maintain hydration levels.	To maintain hydration and prevent urinary stasis. To prevent constipation.
Monitor urine output.	To detect urinary retention or acute kidney injury.
Encourage the child/young person to eat a high-fibre diet. Give aperients as prescribed.	To prevent constipation.
Check the traction each shift: • ensure that weights are not resting on the floor • ensure that knots are not jammed in the pulleys • ensure that skin traction has not slipped down the leg • ensure that weights are not rested on the bed during any procedures • elevate the foot of the bed to provide counter traction.	To ensure that traction is effective at all times.
Maintain oxygen and intravenous infusion therapy if prescribed.	To reduce the risk of developing fat embolism.
Observe vital signs and report any change in Paediatric Early Warning Score (PEWS) (NHS, 2023) to medical staff.	To provide early recognition of patient's condition deteriorating.

3. Traction types, applications and care plans

To ensure effective application and care for all types of traction covered in this section, please refer first to:

- **Section 1** on care of the traction apparatus and knots
- **Section 2**, adult core care plan and child/young person core care plan.

Skin traction (formally Pugh's Traction)

The principles of skin traction are the basis for both Gallows traction and Thomas splint traction. When using basic skin traction, traction tapes are applied to the lateral and medial aspects of the skin on the lower limb, and with the attached weight hung freely over the bed a generating pulling force is achieved. It is used to create a traction force over a large area of skin which is then transmitted via the soft tissues to the bone.

Skin traction is often described as either 'adhesive' or 'non-adhesive'. Adhesive skin traction is used infrequently and only in exceptional circumstances.

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.

The application of skin traction should be carried out by at least two health care practitioners (HCPs) who are trained in the procedure.

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.

If you are using counter traction, you will need:

- traction cord
- weights and carriers
- balkan beam
- cross bars
- two pulleys
- spreader plate (if not in traction kit).

Application instructions	
Action	**Rationale**
Explain the fitting of the traction to the patient and family.	To gain informed consent and enable the patient to have full understanding of the need for the splint and traction.
Check for allergies (do a patch test if necessary) – hypoallergenic kits are available if the patient has skin sensitivities.	To ensure patient is not allergic to the adhesive and can tolerate adhesive skin traction (if used).
Ensure patient has received prescribed analgesia. Consider requesting a femoral nerve block from medical staff and/or use of inhalation analgesia (Entonox) if the patient has no contraindications, eg, head injury or chest injury, and depending on the reason for traction. Skin traction is used post-operatively as well as for fracture reduction.	To prevent unnecessary discomfort.
Ensure bed is assembled for traction, before patient arrives.	Bed is ready for transfer of patient from the emergency department trolley.
One HCP supports the limb in a neutral position.	To keep the limb in alignment.
Prepare the skin (for adhesive traction only). The second HCP prepares the skin as per local policy. If hair needs to be removed (adults only) clippers or depilatory creams are preferred methods. If creams are to be used, a patch test may be necessary first.	To ensure the adhesive lengths stick to the skin well.
Adhesive/non-adhesive extension set can be cut to required length and ends rounded.	Correct length to fit patient's leg. Rounded corners help to prevent the edges peeling down.
Before application of traction, perform a neurovascular assessment of the affected limb.	Record baseline observation.
Check skin for cuts/abrasions/rashes/skin conditions/ fragile broken skin, etc.	Will effect choice of skin traction and document condition of skin prior to application.
Apply and maintain manual traction to the limb, keeping the leg in alignment. Maintain check on Dorsalis pedis pulse. Check neurovascular status of limb. 	To straighten limb, reduce the fracture and prevent/overcome muscle spasm. To allow for application of skin extension. To ensure foot pulse is not lost when fracture is reduced.

Action	Rationale
Apply skin extension, making sure that tape is placed to medial and lateral aspects of the limb. Ensure the skin extension tapes are free from creases and the foam padding is over the malleoli. Leave sufficient room between the patient's foot and the end of the skin extension. 	Protects bony prominences against incidence of pressure sores. Prevention of potential blister formation. Allows for plantar flexion of the foot, maintaining normal ankle range of movement.
Bandage the skin extension to the patient's lower leg, using crêpe bandages. Avoid tight bandaging over the fibula head. Avoid bandaging over the malleoli and the Achilles' tendon. (In children/young people the bandages may go to the top of the leg). Secure the ends with tape. Leave knee area exposed.  The position of the extensions both laterally and medially can be used to control rotation of the limb, ie, by placing the lateral extension superiorly and the medial extension inferiorly, external rotation will be corrected. 	To prevent the extension from slipping and allows traction force to be transferred to the limb. This could cause peroneal nerve compression, resulting in foot drop. Reduce potential for pressure sores. Prevents children/young people disturbing the traction tapes. To prevent the bandages coming undone. To allow for vision of the leg alignment. To place the limb in neutral alignment.

Action	Rationale
Suspending the limb:	
different methods exist to suspend the limb in the extensions. Choice depends on the type of bed and the traction equipment available in the hospital	Facilitates the patient's mobility in the bed. Reduces the potential for the development of pressure sores.
weight may be applied using a separate length of traction cord as per patient's notes	To ensure limb is maintained in alignment.
elevate the foot of the bed.	To provide counter traction.

Practitioners should:

- remove and check bandages every 24 hours and whenever necessary
- not remove the extensions unless there are clinical indications
- examine the skin integrity of the patient, and report any signs of skin damage to a nurse or doctor
- check the extensions for wrinkles and adhesion and change only if necessary
- check the patient's limb for any neurovascular change or calf pain and report this to the nurse or doctor.

If using counter traction, practitioners should:

- always ensure the weights are connected securely and the traction cord and weights are checked at least daily, but usually as often as the patient is checked
- assess that the weight on the traction given is suitable. If the patient is moving either up or down the bed constantly, then either the weight is wrong or the amount of elevation. Inform the senior nurse and doctor about this and record the information in the patient's notes
- lower the bed for the patient to use a bedpan or urinal (bottle) and then put the counter traction straight back on.

Specific care for children/young people

The care for children/young people is the same as shown in the plan above, but with some specific, further considerations.

- Non-adhesive skin traction should always be the first choice, except if applying Thomas splint traction for the treatment of a femoral fracture, then use adhesive extension set.
- If the child/young person is to have surgery, then adhesive extensions should not go over the proposed surgical site.
- The knee should have a pad behind it to keep the knee in 15 degrees of flexion.
- Practitioners need to take extra care with what they give younger children to eat and drink as there is a risk of choking – extra pillows will help.
- Fluids need to be encouraged as they are at risk of renal calculi.
- Effective analgesia is essential, so the child/young person is not frightened to use a bed pan/urinal.

Thomas splint traction

The Thomas splint is used in conjunction with skin traction or skeletal traction to immobilise and position fractures of the femur (see figures 5 and 6). 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 Drozd, 2023). Application of a Thomas splint can be upsetting for the patient but most often reduces pain.

These guidelines can be used to apply Thomas splint traction to all age groups. Variation in the way this modality is applied may exist in clinical practice.

The application of Thomas splint traction should be carried out by at least two health care practitioners who are trained in the procedure.

Aim

To safely apply Thomas splint traction.

Equipment:

- Thomas splint: traditional splint with complete ring or adjustable splint with correct ring size and length (Figure 6).
- velcro (Figure 5) or calico slings
- adhesive skin extension set
- two crêpe bandages
- tape
- measuring tape
- gamgee
- windlass
- scissors.

Figure 5

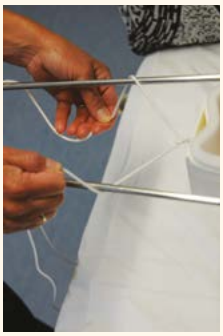
Figure 6

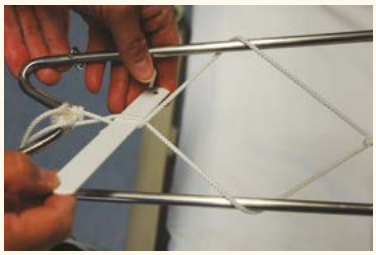
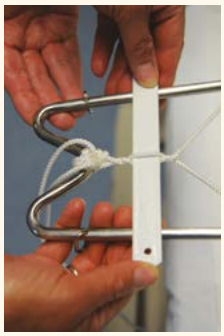
Application instructions

Action	Rationale
Explain the fitting of the traction to the patient and family.	To gain informed consent and enable the patient to have full understanding of the need for the splint and traction.
Ensure patient has received prescribed analgesia. Consider requesting a femoral nerve block from medical staff and/or use of inhalation analgesia (Entonox) if the patient has no contraindications, eg, head injury or chest injury.	To prevent unnecessary discomfort.
Ensure bed is assembled for traction, before patient arrives.	Bed is ready for transfer of patient from the emergency department trolley following application of splint.
Measure uninjured limb. Splint measurements: *Length* Measure the inside of the unaffected leg down to the heel and add 15-20cm. *Ring* Measure the circumference of the unaffected thigh at the groin, (obliquely circle top of leg) and add 5cm. 	Minimise pain of moving affected limb. To ensure correct fit for splint, allowing space for foot/ankle movement and swelling of the proximal femur due to fracture.
Prepare the splint: Select the ring and splint that corresponds to the measurements. If using an adjustable splint, assemble it as per manufacturer's instructions, select correct ring size and secure it out to correct length.  NB, Avoid closed ring splints.	Can compromise circulation to limb when excessive swelling present.

Action	Rationale
Position and secure the slings along the splint. 	To support the limb and accommodate the natural shape of the leg. The heel should not be resting on a sling as this would cause a pressure sore.
Slings should 'sag' slightly and the distal sling should end before heel. Layer gamgee (soft cotton padding) on top of the slings (two layers). 	For comfort.
Place an extra pad under the knee.	To allow for a five degree knee flexion to maintain natural alignment of limb.
Check if the patient has a known allergy to tape.	To prevent an allergic reaction.
Adhesive/non-adhesive extension set can be cut to required length and ends rounded. (Non-adhesive can only be used with Thomas splint if it is balanced traction and not fixed to splint.) Adhesive extension tapes are more commonly used in children to prevent slippage, reapplication and undue stress.	Correct length to fit patient's leg. Rounded corners help to prevent the edges peeling down.
Before application of traction, perform a neurovascular assessment of the affected limb. Check skin for cuts/abrasions/rashes/skin conditions/fragile broken skin, etc.	Record baseline observation. Will effect choice of skin traction and document condition of skin prior to application.
Apply and maintain manual traction to the limb, keeping the leg in alignment. Maintain check on Dorsalis pedis pulse. Check neurovascular status of limb.	To straighten limb, reduce the fracture prevent/overcome muscle spasm. To allow for application of skin extension. To ensure foot pulse is not lost when fracture is reduced.

Action	Rationale
Apply skin extension, making sure that tape is placed to medial and lateral aspects of the limb. Ensure the skin extension tapes are free from creases and the foam padding is over the malleoli. 	Protects bony prominences against incidence of pressure sores. Prevention of potential blister formation.
Leave sufficient room between the patient's foot and the end of the skin extension. 	Allows for plantar flexion of the foot, maintaining normal ankle range of movement.
Bandage the skin extension to the patient's lower leg, using crêpe bandages.	To prevent the extension from slipping and allows traction force to be transferred to the limb.
Avoid tight bandaging over the fibula head.	This could cause peroneal nerve compression, resulting in foot drop.
Avoid bandaging over the malleoli and the Achilles' tendon.	Reduce potential for pressure sores.
In children/young people, the bandages may go to the top of the leg.	Prevents children/young people disturbing the traction tapes.
Secure the ends with tape.	To prevent the bandages coming undone.
Leave knee area exposed. 	To allow for vision of the leg alignment.
The position of the extensions both laterally and medially can be used to control rotation of the limb, ie, placing the lateral extension superiorly and the medial extension inferiorly, external rotation will be corrected.	To place the limb in neutral alignment.

Action	Rationale
Place the leg on the splint, while still maintaining manual traction and limb support.  A small piece of gamgee is placed behind the knee.  The ring should fit snugly into the groin and up against the ischial tuberosity.	To maintain the traction pull. To allow slight flexion of the knee. To allow for fixed traction to be applied.
Secure the traction cords from the skin extension 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.  Apply a windlass (the use of two spatulas is not best practice). 	To allow application of fixed traction to the limb. To prevent external rotation of the limb. Takes up the slack in the tied ends and exerts an increased traction force to the limb.

Action	Rationale
  Reassess the patient's neurovascular status. If a child/young person, crêpe bandages can be applied over the top of the splint. Place gamgee over thigh to help further reduce fracture along with soft tissues and muscles.  If a child/young person, crêpe bandages can be applied over the top of the splint. 	Prevents the child/young person from disturbing the underlying extension set and bandages.

Action	Rationale
Ensure the patient has an AP and lateral X-ray of the limb.	To check the position of the fracture, confirming its reduction. Allow for further adjustments to be made if required.
Patient's fracture is immobilised and patient can be safely transferred to the ward.  Complete neurovascular observations on the affected limb and document.	Adult and child/young person's care on **page 11** and **page 13**.
Suspending the splint (see Figures 7 and 8): Different methods exist to suspend the limb in the splint, depending on the type of bed and the traction equipment available in the hospital. Weight may be applied using a separate length of traction cord. Elevate the foot of the bed.	Facilitates the patient's mobility in the bed. Reduces the potential for the development of pressure sores. To reduce pressure in the groin from the ring. To provide counter traction.

Figure 7: Suspended Thomas splint

Figure 8: Suspended Thomas splint

Practitioners should:

- monitor the patient's neurovascular status regularly (as per local policy), using an appropriate tool and document
- ensure the skin under the hoop/ring is kept clean and dry to prevent the formation of pressure sores
- observe for pressure around the back of the hoop/ring. Increasing elevation of the foot of the bed may relieve this. Padding is contraindicated as it increases pressure on the skin under the hoop/ring
- observe for pressure in the groin region. This can be relieved by good skin care, repositioning of the patient and, if practical, abduction of the limb
- observe for increased swelling of the limb. Adjust the hoop attachment as necessary. If a whole ring, consider changing the splint to a larger ring size. This would require medical confirmation, appropriate analgesia and a post-procedural check X-ray
- observe for damage to the integrity of the skin. This may be caused by pressure +/- over tight bandages. Take action to relieve the symptoms and dress any skin breaks immediately. It is important to document your findings and take nursing action
- observe for loss of fracture position. This may occur at any time during the healing process. Padding applied to the fracture site may assist in maintaining the fracture in alignment, but you must report and record any sagging or deformity
- prevent soiling of the hoop/ring when the patient is using the bedpan
- provide a monkey pole to enable easier mobility in the bed for the patient
- provide distraction for young children through play and activities
- observe for and encourage the patient to report splint movement. When the fixed traction is suspended, the traction cords slipping off the pulleys may cause splint movement
- ensure traction is not hindered by bed clothes, with traction pull in correct alignment
- maintain abduction, as requested by the medical staff, by moving the mechanics of the traction as necessary. Maintain the line of pull along the long axis of the leg. The patient should be aligned to the midline at all times
- carry out lateral tilting of the patient to prevent pressure sores. Align the patient to the midline and control the hip abduction and rotation by the mechanics of the pulley system
- document procedure and care in the patient's notes.

Hamilton-Russell traction

Hamilton Russell is less commonly used in current practice. It is a balanced traction system using vectors to affect a pull along the long axis of the femur. It is used to maintain the joint space at the hip, manage fractures of the acetabulum and support fractures of the shaft of the femur. Traction can be applied using below-knee skin traction or a skeletal pin (Clarke and Drozd, 2023).

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

The application of Hamilton-Russell traction should be carried out by at least two health care practitioners who are trained in the procedure.

Aim

To safely apply Hamilton-Russell traction via the skin.

Equipment:

- adhesive/non-adhesive traction kit
- two crêpe bandages (if not included in the kit)
- cotton wool padding with non-woven cover
- tape
- traction cord
- weights and carrier
- 15cm wide sling
- pillow(s)
- Balkan beam with a cross bar above the knee, and two extension bars with crossbars at the foot end of the bed
- three pulleys
- scissors
- spreader plate with pulley attached.

Figure 9: The application of Hamilton-Russell traction using one sling

Application instructions	
Action	**Rationale**
Explain the fitting of the traction to the patient and family/carers.	To gain informed consent and enable the patient to have full understanding of the need for the traction.
Two health care practitioners are required for this procedure.	For one health care practitioner to support the limb and exert gentle traction.
Ensure patient has received prescribed analgesia.	To prevent unnecessary discomfort.
Apply skin extensions – either adhesive or non-adhesive. A patch test should be performed if adhesive extensions are used.	To allow traction to be applied. To check for allergic reaction to the adhesive.
Ensure padding is placed over both malleoli.	To prevent pressure ulcer development over bony prominences.
If using non-adhesive skin extensions, consider padding the bony prominences of the tibial crest and the head of the fibula (this may not be effective, as these areas can still be subject to pressure or even increased pressure by doing this). Regular skin checks should take place.	To prevent underlying nerves becoming trapped against the sling at the site of the fibular head. Padding may cause irritate the skin, and the child to be itchy - should be assessed on an individual basis.
Allow a distance of 15cm allowed between the sole of the foot and the spreader plate.	To facilitate plantar flexion of the foot.
Apply below-knee extension slightly above the axis of the limb on the lateral aspect of the leg, and slightly below the axis on the medial aspect.	To help prevent external rotation of the limb.
Apply the bandage from the outer aspect of the limb, bringing the bandage over the limb to the midline (outside in).	To help prevent external rotation of the limb.
Secure the end of the bandage.	To prevent the bandage coming undone.
Place a padded sling behind the knee.	To provide attachment for the traction. The sling behind the knee must have a vertical pull in line with the patella to the pulley above (Nicoll, 1973) or a line of pull slightly distal to the patella (Taylor, 1987).
Support the knee and lower leg on a pillow with heel clear of the bed.	To help prevent pressure ulcers to the heel.
Attach the traction cord to the loops of the sling and pass it through the pulleys.	To apply the traction.
Attach the weights as specified by medical staff (approximately 3.5kg for adults; Stewart and Hallett, 1983). 0.5 kg per per year of age in children (Brousil J and Hunter J, 2013).	To apply appropriate traction.
Elevate the foot of the bed.	To provide counter traction.

Skeletal Hamilton-Russell traction

Aim

To safely apply Hamilton-Russell traction via a skeletal pin through the upper tibia.

Equipment:

- skeletal pin
- pin covers
- stirrup
- U loop with pulley attached
- bandage
- large bulldog clips or safety pins
- traction cord
- weights
- pillow(s)
- Balkan beam with a cross bar above the knee, and two extension bars with crossbars at the foot end of the bed
- three pulleys.

Application instructions	
Action	**Rationale**
Explain the fitting of the traction to the patient and family/carers.	To gain informed consent and enable the patient to have full understanding of the need for the traction.
Two health care practitioners are required for this procedure.	For one health care practitioner to support the limb and exert gentle traction.
Ensure patient has received prescribed analgesia.	To prevent unnecessary discomfort.
Apply the bandage to the 'U' loop and secure with bulldog clips or safety pins.	To prepare the 'U' loop to support the lower limb.
Line with padding.	To provide patient comfort.
Ease the lower leg onto the prepared 'U' loop and support under the knee with one hand while holding the end of the 'U' loop with the other hand.	To provide patient comfort and reduce bone movement.
Pass the 'U' loop and stirrup over the pin.	To prepare for the traction. The stirrup must have a vertical pull in line with the patella to the pulley above or a line of pull slightly distal to the patella.
Attach the traction cord to the stirrup and pass it through the pulleys.	To apply the traction.
Attach weights as specified by medical staff.	To apply appropriate traction.
Elevate the foot of the bed.	To provide counter traction.
Place a padded sling behind the knee.	To provide attachment for the traction. The sling behind the knee must have a vertical pull in line with the patella to the pulley above (Nicoll, 1973) or a line of pull slightly distal to the patella (Taylor, 1987).
Support the knee and lower leg on a pillow with heel clear of the bed.	To help prevent pressure ulcers to the heel.
Attach the traction cord to the loops of the sling and pass it through the pulleys.	To apply the traction.
Attach the weights as specified by medical staff (approximately 3.5kg for adults; Stewart and Hallett, 1983).	To apply appropriate traction.
Elevate the foot of the bed.	To provide counter traction.

Practitioners should:

- maintain the lower leg parallel to the bed frame
- maintain the degree of abduction prescribed by the medical staff. This is controlled by the position of the pulleys on the crossbars at the foot of the bed
- maintain the amount of flexion at the hip joint prescribed by the medical staff. This may have to be compromised by other clinical considerations. A fractured shaft of femur normally requires 20-degree flexion (Larson and Gould, 1978)
- the patient may be tilted laterally, but should still be aligned to the mid-line and the hip abduction and rotation controlled by the mechanics of the pulley system
- document procedure and care in the patient's notes.

Halo traction

Halo traction is the application of skeletal traction to the head by means of a halo device.

A 'halo vest' provides traction and support which allows for proper healing of the damaged or diseased spinal region. A halo vest includes a 'halo ring' that is secured to the skull with skull pins and a rigid, fleece-lined vest. The vest is attached to the halo ring with adjustable metal rods or struts. Together the apparatus provides stability to the cervical column while allowing the patient to be mobile.

Halo traction is applied to the patient in theatre or the emergency department by a trained team and radiographers.

Some halo rings and vests are MRI compatible. Check with the MRI department if an MRI test is required.

Patient selection

Halo traction is indicated in adults for definitive treatment of cervical spine trauma including:

- occipital condyle fractures
- occiptio-cervical dislocation
- stable type II Atlas fracture (stable Jefferson Fracture)
- type II odontoid fractures in young patients
- type II and IIA hangman's fractures
- adjunctive post-operative stabilisation following cervical spine surgery.

Halo traction is indicated in children/young people for:

- atlanto-occipital disassociation
- Jefferson fractures (burst fracture of C1)
- atlas fractures
- unstable odontoid fractures
- persistent atlanto-axial rotatory subluxation
- C1-C2 disassociations
- sub axial cervical spine trauma
- preoperative reduction in patients with spinal deformity.

Contra-indications:

- cranial fractures
- infection
- severe soft-tissue injury
- especially near proposed pin sites
- polytrauma
- severe chest trauma
- barrel-shaped chest
- obesity
- advanced age
- poor mental capacity.

Aim

To apply halo vest to immobilise the spine by restricting head, neck and upper body movement to promote healing of the damaged or diseased spinal region.

Autonomic dysreflexia

When spinal cord lesions prevent messages of painful stimuli (most commonly, distended bladder or constipation) from reaching the brain, an autonomic nervous system reaction is initiated in the body. This is most common in spinal injuries above T6 and presents as episodes of high blood pressure, throbbing headaches, profuse sweating, flushing of the skin (above the level of the spinal lesion), and nasal stuffiness (Clarke and Drozd, 2023).

This is a medical emergency, so recognising and treating the earliest signs and symptoms efficiently is crucial.

Application instructions	
Action	**Rationale**
Provide and explain information to patient for daily care of halo vest.	The patient understands the equipment and reason for application.
Pins should be checked and tightened regularly by the doctor, daily for the first three days and then every three days for two weeks. This should continue at follow-up visits post-application. Loosening is often reported by patients as noticing a 'clicking' sound. If the patient falls ensure the patient is seen by the doctor to assess for any migration or dislodgement.	To prevent slippage, mal-alignment and loss of traction.
Pin site care: Pin sites need to be assessed a minimum of once per shift for: • signs and symptoms of infection • pain or discomfort. Pin Site cleaning – refer to recent systematic review by Shields et al., (2022) and employer's local policy	To prevent infection. To prevent or treat at the earliest occurrence.
Vest care: Halo vest, straps/buckles and bolt integrity will be assessed once each shift and PRN.	
Loose bolts or worn straps should be reported to medical staff. Buckles should not be released except for skin care or vest maintenance.	To prevent reduction in traction and alignment and fracture instability.
The sheepskin should be kept dry at all times. If soiled or wet, notify the practitioner who is trained in halo vest application, to have the sheepskin changed.	To prevent skin irritation or pressure sores.
If edges are only slightly damp, expose to air and reassess.	
Do not add any padding under the vest for comfort. If the vest does not fit properly, notify the practitioner for assessment and adjustment as required	To avoid mal-alignment and pressure sores.
Do not use any supports under the head.	To prevent choking, aspiration.
Assess patient's swallowing. If a patient is having difficulties swallowing, a swallowing evaluation should be completed by a speech-language specialist.	To ensure adequate fluid and diet intake.
A halo spanner should be attached at all times (ie, to a rod or front vest plate).	To enable vest to be removed in an emergency.
Weight change (loss or gain) may affect vest fit. The team should be notified if vest fit changes so they can assess and refit if needed. If there are concerns regarding nutritional intake, consult a dietician and monitor weight changes more closely.	To prevent reduction in traction and alignment and fracture instability.

Action	Rationale
Skin and vest care:	
Patients wearing a halo vest are at increased risk for skin breakdown and should be assessed for pressure areas once every shift at a minimum, with special attention to bony prominences.	To prevent skin damage and pressure sores.
Patients with neurological deficits may not be aware of pressure areas and require increased visual inspections.	To minimise the risk of pressure sores.
If patient is non-compliant, at least two staff must be present to perform vest/skin care. One person supports the patient while the other performs care.	Poorly fitting halo vest or pressure damage may trigger autonomic dysreflexia.
Position patient flat on their side in good alignment. PATIENT MUST NOT MOVE.	To maintain spinal alignment and fracture stability.
Undo one side strap of the vest (one side should always be securely buckled).	
If the buckle position on the straps has not been marked, mark them before they are undone.	
Inspect skin integrity.	
Place an incontinence pad/towel against the sheepskin to prevent the sheepskin from getting wet then, with a damp washcloth, wash the torso.	
Dry the skin thoroughly.	
Do not apply lotions or powders under the vest.	To minimise collection or lumps that may cause irritation or skin damage.
Reconnect the strap to the proper notch, then turn patient to the other side and repeat the procedure.	
If it is very difficult to pass a towel between the vest and skin, the trained practitioner should be notified to reassess fit.	
Avoid scratching under the vest.	
Repositioning and mobilising:	
Never use the metal halo ring or struts/rods to lift, turn, or reposition a patient.	To prevent slippage or mal-alignment.
Turn and reposition the immobile patient every two hours.	To provide pressure relief and prevent pressure damage.
Patients must be assisted the first time they are mobile and until they are safe to move independently. If the patient also has altered sensation they may require ongoing assistance.	The vest will alter balance perception and postural hypotension may occur.
Logroll patient onto their side and place hands under the vest so the buckles do not catch on the bedding. Assist patient as needed to sitting position. Allow patient time to adjust to altered balance before standing. Initially, a walking frame is often helpful for balance even if not needed for leg weakness.	To avoid falling/fainting.
If a patient requires a mechanical lift, ensure the vest does not get caught on the sling or on the chair/bed when lifting or lowering.	
Consult with the physiotherapy team as needed.	

Action	Rationale
Choking and cardiac arrest: If effective abdominal/chest compressions cannot be achieved with the vest intact, lay the patient flat on a hard surface. (They will be lying on the back portion of the vest.) Release the straps on each side of the front portion of the vest. Loosen the bolts on the horizontal rods on the front vest plate. Raise the front vest plate up (swivelling on the rod) to expose the chest. Utilise the jaw thrust method to open the airway. The halo spanner for the bolts should be found attached to the vest. The patient should be kept flat and still until the halo vest is re-attached.	To achieve emergency rescue.

Gallows traction

Gallows traction is used in very young children (usually <18 months) to treat a fractured shaft of femur or may be used to stretch the soft tissues pre-operatively in the treatment of developmental dysplasia of the hip (DDH). Gallows traction is used in children under 2 years of age up to 12kg.

Compartment syndrome is considered a low-risk complication, neurovascular monitoring should take place according to local guidelines.

Aim

To safely apply and care for the child in Gallows traction.

Rationale

Positioning and treatment of a fractured femur in an infant

Stretching the blood supply and soft tissues prior to DDH surgery to prevent potential for subsequent avascular necrosis of the femoral head.

Equipment:

- cot
- two overhead beams
- four clamps to secure beams
- two infant size adhesive extension sets
- two crêpe bandages
- tape
- two pulleys required if traction cord not tied to overhead beams
- weights required if traction cord not tied to overhead beams.

Figure 10 and 11: Child in Gallows traction

Application instructions	
Action	**Rationale**
Give a full explanation to the parents. Use visual aids such as pictures or DVD. Allow time to answer questions. Gain verbal consent for the procedure.	To ensure parents are fully informed, that they understand the reason for the traction and consent to the procedure.
Check the child does not have a known allergy to adhesive traction. Consider applying a patch test if there is sufficient time and the child is otherwise comfortable (for example, if child has a fractured femur, this may not be appropriate). Assess skin for abrasions, bruising.	To assess for any skin problems. To reduce the possibility of a skin reaction.
Apply adhesive skin extension sets to both legs: • ensure foam padding is placed over the lateral and medial malleoli • leave a gap between the child's foot and the end of the extension set • bandage over the skin extension set using a spiral format • secure the ends of the bandage with tape.	 Prevent pressure sores developing over bony prominences. Allow normal range of plantar flexion of the foot. To prevent the extension set slipping and to allow traction force to be transferred to the limb. To prevent bandage coming undone.
Place the child in the supine position and flex the child's hips to 90 degrees.	
Attach the cords to the beams at the top of the cot and secure. If weights are used, pulleys need to be secured to the top beams. Amount of weight needs to be prescribed (a rule of thumb is approximately 450g per year of child's age).	To allow traction force to be applied.
Ensure knots are securely tied and check that the cord does not fray.	Maintain traction.
The child's buttocks should be raised so that they are just off the mattress, allowing a flat hand to pass underneath them.	To allow the child's body weight to provide counter traction. If treatment is for a fractured femur, the child will only move themselves as pain allows.
Perform half hourly neurovascular observations for the first two hours.	Observe the child's toes for circulatory problems.
Place short socks over the child's feet.	Maintain warmth and comfort.

Action	Rationale
Re-apply the bandages daily.	To prevent bandages wrinkling and causing potential tightness, which would cause skin problems and potentially vascular compromise.
Check the area of skin that is visible for soreness.	To examine the skin without disturbing the adhesive traction.
Continue to monitor the circulation two-hourly, for the first 48 hours.	Check for neurovascular deficit.
Check that pressure is not applied over the fibula head and that the child is moving their toes and feet.	To avoid pressure on the common peronealnerve (also known as the lateral popliteal nerve), to prevent the development of foot drop.
Provide age-appropriate toys to entertain the child in conjunction with the play staff.	To encourage the child's mental, physical and social development.
Encourage the parents to participate in their child's care eg, feeding, bathing, nappy changing, traction and bandage checks.	To involve them in the care of their child.
When the skin extensions need to be removed, they should be soaked off in a bath. The use of plaster- dissolving solution is also useful.	To reduce the risk of skin irritation.

Slings and springs suspension

‘Slings and springs’ are not true traction, as the aim is to hold the leg in suspension with no true counter traction. There is no empirical evidence to support its use.

A recent core text by Bruce et al., (2023) includes the use of slings and springs. Their application continues to be used as a good method for restoring range of motion gradually to an irritable hip, by abducting the effected leg, and secondly to rest the hip joint in a flexed position whilst allowing active movement in a child presenting with Perthes disease. Slings and springs are also used to allow joint mobilisation while a patient is non-weight bearing following femoral and tibial osteotomy.

Equipment:

- bed
- Balkan frame with one overhead beam with two clamps to secure beam
- two pulleys
- two springs
- two slings
- padding (gamgee)
- traction cord.

Aim

To safely apply and care for the child/young person under slings and springs suspension, to rest or restore optimal range of movement of the hip joint.

Application instructions	
Action	**Rationale**
Give a full explanation to the parents and child/ young person. Use visual aids such as pictures and DVD. Allow time to answer questions. Gain verbal consent for the procedure.	To ensure the parents are fully informed, that they understand the reason for the traction and consent to the procedure.
Overhead beam to be in position above either right or left hip (a degree of abduction may be ordered by orthopaedic consultant). With child/young person positioned on bed, attach a pulley above the child's affected thigh and calf.	To attach slings and springs, provide comfort and encourage range of movement.
Thread traction cord singular through each pulley which is attached to spring and then sling.  Spring and sling then drops vertically from overhead beam and may need to be adjusted to suit each child/ young person.	To suspend the leg at a comfortable height.
Ensure knots are securely tied and check that the cord does not fray.	Safety.
Insert padding into each sling. Be mindful of pressure points.	Prevents edges digging in skin and causing damage.
Place child/young person's affected leg in slings, with one sling under thigh and second under calf.	Promotes suspension.
Check for comfort and level of suspension.	To prevent distress and promote rest, comfort and the desired effect.
Provide age-appropriate toys/games to entertain the child in conjunction with the play staff.	To encourage the child's mental, physical and social development.
Encourage the parents to participate in the child/ young person's care, eg, feeding.	To involve them in the care of the child/young person.

Figure 12: Slings and springs suspension

Practitioners should:

- take measures to avoid the child/young person becoming bored and non-compliant
- provide shorts rather than trousers/skirts for the child/young person to wear.

Kendrick Traction Device

A Kendrick Traction Device (KTD) can be applied to all age groups and is light weight, compact (stored in a pouch), and quick and easy to apply. Variation in the way this modality is applied may exist in clinical practice; however, it is unlikely to cause additional pressure or pain. It can be used to immobilise a suspected fracture of the mid shaft of the femur plus eliminates the need to roll the patient or raise the leg during application. The KTD will be in situ on the patient and will not need to be applied on the ward. The KTD will then be removed in theatre prior to surgery.

The application of Kendrick Traction Device should be carried out by at least two health care practitioners who are trained in the procedure.

Aim

To safely apply a Kendrick Traction Device.

Equipment:

- ankle hitch
- upper thigh system
- traction pole
- knee elastic strap
- thigh elastic strap
- ankle elastic strap.

Figure 13: Kendrick traction device

Figure 14: Kendrick Traction Device applied to mannequin

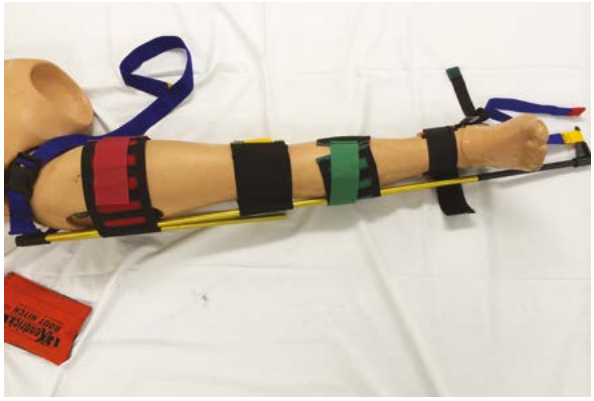
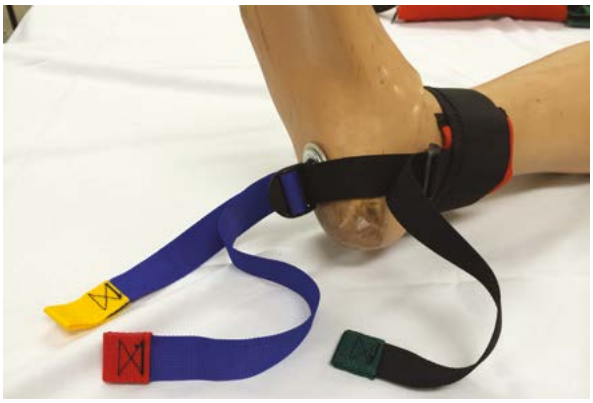


Figure 15: Ankle hitch equipment



Care of the patient while in a Kendrick Traction Device	
Action	**Rationale**
Explain to the patient and relatives what has happened and what the equipment is for.	To ensure the patient and relatives understand and to reduce their level of anxiety.
Ensure adequate analgesia.	To prevent pain and allow the patient to use a bed pan or bottle without fear.
Check cuffs on the traction at least daily.	To ensure no slippage or loosening.
Check patient's neurovascular status 4-hourly and report any changes to the senior nurse or doctor. Document in the patient's notes.	To ensure no neurovascular damage.

Carers should note:

- the splint is only designed for temporary use. Instructions on how long the splint can be left on for must be agreed with each patient
- most patients should receive surgery within 24 hours, with the splint being left undisturbed until the patient is in theatre so that there is minimal pain and further trauma.

Traction at home: Thomas splint

Conservative management of femoral shaft fractures with Thomas splint traction in children/young people is a treatment option, but the treatment time is six to eight weeks. This length of hospital stay makes this type of treatment as an inpatient unacceptable to families, and to hospital trusts experiencing pressure for beds. Home traction makes conservative management a good treatment option for some children/young people.

Patient selection

A child/young person is suitable for home treatment if:

- the orthopaedic consultant is happy that the fracture is satisfactorily reduced in the Thomas splint
- the child/young person has no open wounds on the affected limb
- there is no suspicion that the injury may have occurred non-accidentally
- the family has been given full information about the pathway of care, are prepared to nurse the child/young person at home on bed rest and will receive adequate support.

Preparation for caring for a child/young person in traction at home

Figure 16: Child with fixed traction at home

1. Traction maintained when child/young person at home (see Figure 16) until early callus formation is seen on X-ray. Weights used to reduce groin pressure and end of bed elevated.
2. Parents/carers trained by nursing staff in all care needs of the child in traction. They need to demonstrate to staff both competence and confidence in care before transfer home.
3. Skin must be intact on transfer home.
4. Liaise with the occupational therapist in discharge planning.
5. Parents organise a bed downstairs ready for the child's transfer home. Bedpan and urinal for home organised as appropriate. Parents arrange leave from work and, where needed, other help to ensure the child/young person has someone to provide care 24-hours a day.
6. Home tuition requested for home.
7. Ambulance transport booked for transfer home and for return to hospital for rehabilitation.

Preparation of traction for care at home

1. Slings, padding and all traction bandages checked/ changed as required before final X-ray. Windlass secured with tape (see Figure 17 below).
2. X-ray carried out and reviewed to ensure early callus formation is seen.
3. Weights removed. Bed put in flat position. Plaster cast applied over bandages (thin layer only so it is easily removed in the home with plaster shears) to stop child removing bandages and padding.
4. Child stays in hospital for a further 24 hours to ensure that ring does not cause groin pressure following weight removal. If skin pressure does occur, turns on windlass need to be reduced and if there is a significant change in traction then a further X-ray check may be required. If child reports increased pain in this period, it indicates fracture not stable, so child is not ready for transfer home.

Figure 17: Securing the windlass

Calculation of expected times for treatment

Parents and carers need this information to plan care at home. The times are estimates and every child will have an individual response to treatment.

- The total fracture healing time in weeks is usually the age of the child plus two.
- Early callus formation one third of total healing time.
- Rehabilitation time two to four weeks (that is, time before child/young person is walking independently following removal of traction).
- For example, a four-year-old child will take six weeks to heal. The child's fracture will be stable enough for transfer home at two weeks. The child should be walking independently eight to ten weeks post-injury.

Care of the child/young person at home

Care is now provided by parents/carers. They should be provided with a telephone contact number which they can ring for advice at all times. At home, the child/young person should be kept on bed rest.

The child/young person may sit up for meals and for a short period afterwards. A child/young person who is allowed to sit up for too long will experience skin pressure problems, therefore for the majority of the time, they should not be made comfortable sitting up – most children/young people will sit themselves up, but if they aren't supported will lie down again. Lying prone with pillows is an alternative position which the child/young person may like for doing activities.

A nurse with orthopaedic experience should visit the child/ young person at least weekly to check the traction is being maintained, that the child/young person's skin integrity is acceptable and that the family are coping with all aspects of care. After four weeks in traction, wear and tear of the traction extension will start to occur, and the traction may require tightening and, in some cases, completely replacing. If a suitable nurse is not available to provide this care at home, the child/young person will need transporting back to hospital by ambulance.

Rehabilitation

Children of pre-school age generally do not require formal physiotherapy. Parents should be advised how to gradually encourage the child to regain mobility.

Older children will have much more apprehension about mobilising and will have been in traction longer and possibly become stiffer. Children of school age will benefit from formal physiotherapy/hydrotherapy, initially as an inpatient, then as an outpatient. The physiotherapist will advise parents when the child can safely return to school.

Glossary of terms

Abduction – movement of a limb from the midline of the body.

Adduction – movement of a limb closer to the midline of the body.

Anti-embolic – chemical or mechanical methods used to prevent blood clot formation.

Balkan beam – vertical poles at the head and foot of the bed joined by overhead horizontal poles. Both the upright and horizontal poles can have adjustable cross bars positioned as required for the attachment of pulleys.

Bohler stirrup – a 'U'-shaped stirrup with special ends which fits onto a Steinmann or Denham pin with a loop at one end for attachment of traction cord.

Capillary refill – assessment of circulation returns to small blood vessels.

Cast padding – used to protect bony prominences from pressure, to reduce risk of pressure ulcers from developing.

Common peroneal nerve (lateral popliteal nerve) – nerve which winds around the head of the fibular near the knee joint.

Compartment syndrome – a condition caused by increased pressure within a compartment of a limb which leads to reduced oxygenation of the tissues and eventually death of those tissues. Plantar flexion of the foot with inversion will increase pressure within the calf alone even without the application of a cast or traction.

Counter traction – a force acting in the opposite direction to the pull or line of traction on the limb or body.

Deep vein thrombosis (DVT) – a blood clot that forms in the veins called a thrombus. Clot can then break off to form an embolus e.g., pulmonary embolus, which can be fatal.

Denham pin – a rigid stainless-steel pin with a short-threaded area; usually 4-6mm in diameter and of varying lengths.

Distal – part furthest away from the centre of the body.

Dorsalis pedis – pulse palpable on the dorsum of the foot midway way between the malleoli.

Dorsiflexion – normally refers to the foot when ankle is flexed and big toe pulled towards the leg.

Drop foot – commonly caused by damage to the common peroneal nerve when the patient is unable to dorsiflex or evert their foot.

Embolus – foreign body, blood clot, fat or air in the bloodstream.

Extension – straightening of a joint or limb.

Flexion – bending a joint.

Halo – a ring which fits around the head attached by screws into the skull.

Homan's sign – dorsiflexion of the foot causes pain in the calf. One possible sign of deep vein thrombosis.

Hyperextension – excessive extension of a joint beyond normal limits. Can be a normal finding in some patients' knees.

Nissen stirrup – similar to the Bohler stirrup but has multiple positions to attach traction cord to give some control over rotation of the leg.

Non-union – no healing or very slow healing of a fracture.

Optimum – the best possible in any given set of circumstances.

Plantar flexion – relates to the sole of the foot, the plantar side, when the toes point downwards. The opposite of dorsiflexion.

Proximal – part nearer to the centre of the body.

Radial pulse – pulse palpable at the wrist joint just below the base of the thumb.

Recumbent – lying down flat on the back or sides.

Semi-recumbent – as recumbent, but with the trunk slightly raised.

Skin extensions – either adhesive or non-adhesive, available in pre-made packs; applied to inner and outer side of limbs to allow traction to be applied.

Slings for Thomas splint – non-stretchy material placed across the bars of the splint and anchored on the outer side within safety pins.

Spreaders – a device used to allow traction cord to slide without compression on the patient's limb.

Steinmann pin – a rigid stainless-steel pin, 4-6mm in diameter of varying lengths.

Thomas splint – two longitudinal bars, terminating in a w-shaped extension bow at the distal end. Proximally, a leather ring is set obliquely at an angle of 120 degrees to the metal bar. Rings can be full, split or half.

Thrombus – the formation, presence or development of a clot or thrombus in a vein.

Traction cord – strong cord which can be tied securely without slipping. Must only be used singly when passing over a pulley.

Vector force – a force which shows the magnitude and direction of the traction pull.

Volkmann's ischemic contracture – is a complication of a supra condylar fracture in children which is most common cause and a serious, persistent contracture of the forearm and hand caused by ischemia (lack of blood supply). Common causes include excessively tight bandages or plaster casts, or a crushing injury to the limb.

Weights – can be water, metal or sand. Must be allowed to hang freely at all times. Can use a tin filled with small stones if no other equipment is available.

Windlass – a narrow piece of metal placed between the cords at the distal end of a Thomas splint to facilitate application of traction to the limb.

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RCN quality assurance

Publication

This is an RCN practice guidance. Practice guidance are evidence-based consensus documents, used to guide decisions about appropriate care of an individual, family or population in a specific context.

Description

The use of apparatus to apply traction to injured limbs has played an important role in the treatment of patients with fractures for centuries. This updated guidance provides information on applying traction and caring for patients safely whilst traction remains in place. It also reflects the variation in the application of traction across the UK.

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