Traction update

RCN SOTN Traction Working Party

LEARNING OUTCOMES
On completion of the article, the reader should be able to:
• Understand the historical development of traction application
• Apply the principles of traction to practice
• Set up and maintain skin extensions

NMC* CATEGORIES
*From April 1st 2002 the United Kingdom Central Council (UKCC) for nurses, midwives and health visitors was replaced by the new Nursing and Midwifery Council (NMC) although PREP categories have remained the same.
This article will enable the reader to address PREP categories:
• Care enhancement
• Practice development
• Education development
• Reducing risk

Examples of how this may be achieved and possible evidence for the reader’s professional profile are given throughout the article. Other ways to demonstrate your continuing professional development may be to:
• Review the skills of traction application on your unit.
• Keep a copy of this article together with the notes you make as evidence of completing the reflection items in the text.

THE HISTORY OF TRACTION

Overview
The use of manual traction to reduce dislocations has been recorded from the earliest days. The Aztecs and Egyptians both wrote about the practice of manual traction and the using of splints made from bark or branches. ‘On Fractures’ and ‘On Articulations’, sections of The Hippocratic Corpus, are Greek texts written between 4th century BC and the 1st century AD. These hold the earliest medical treatise which is considered to be of any true scientific worth. It is a system of medicine and surgery that includes well-edited reference to all previous work.

Hippocrates, who was born around 460 BC on the Island of Cos, was a prominent Greek physician. His tests contain discussions on diagnosis and treatment of fractures including carefully prescribed methods of traction for fractures of the long bones. He is said to have used his heels, ladders, poles and a form of rack called the Scamnum of Hippocrates, but many of these and other early methods were to administer a short sharp pull rather than prolonged traction.

Lower limb traction
The Italian surgeon Guglelmo de Saliceto (1210–1277) described the use of weights and pulleys for reduction of fractures, and it is this description which is considered to be the earliest record of the use of sustained traction. Guy de Chauliac (1298–1368), professor at the University of Montpellier, also recorded that sustained traction using a system of weights and pulleys could be used for the reduction of femoral fractures.

The use of continuous traction for fractures to the femur was not recorded again for four centuries until the 18th century when Chesser (1750–1831) described using a double inclined plane for the support of femoral fractures. In 1839 John Haddy James of Essex explained the use of weights suspended over a pulley to give continuous traction. He describes bandaging the leg to a wooden splint resting on rollers, with a string
from the splint passing over a pulley to a weight. The bed was not tipped to provide counter-traction, but the patient was fixed to the head of the bed with a harness to prevent him from being dragged out of the bed. Two years before this Josse of Amiens is said to have tied a patient’s foot to the end of the bed and produced traction by raising the foot of the bed. It was 26 years before the amalgamation of the two ideas was recorded.

Orthopaedic surgeons Petit (Pouflour du Petit) (1664–1741), Fabrig (Fabry) (1560–1634), Pare (1510–1590) and others began to develop and use apparatus which produced traction and counter-traction utilising inclined planes as they recognised the use of gravity in maintaining alignment.

Percival Pott (1714–1788) designed a splint with an angle at the level of the knee joint and Dupuytren (1777–1835) also described traction with flexion in 1893. Smith (1867) described suspension of the patient, and Philips (1869) described using a pull both in the direction of the axis of the limb and in the direction of the axis of the neck of femur.

Holland strapping, which consisted of thick linen strips impregnated with glue with wick extensions sewn onto the ends, was used to adhere to the skin to provide skin traction. Samuel David Gross (1805–1885), Professor of Surgery at Jefferson Medical College, first recorded the use of adhesive tape being used to apply skin traction.

In 1857 HG Davis of New York suggested using an elastic material in prolonged traction to reduce fractures. Following this, in 1860 Gurda Buck, working in New York, developed a traction system employing either the elastic material developed by Davis or the adhesive tape developed by Gross. This simple form of traction, Bucks extension, was described in 1861 and was used in the American Civil War.

In 1880 Bryant introduced Bryant’s or Gallows traction for fractures of the shaft of femur in children, using adhesive extensions attached to the overhead bars.

Huw Owen Thomas (1834–1891) known as the ‘father of British orthopaedics’ was the eldest of five sons of a bone setter working in Liverpool. He developed many splints and appliances, including the Thomas Splint, first recorded in 1890 as a treatment for tuberculosis of the knee joint. Its use was described as ‘an external skeleton for the lower limb and in weight bearing to transmit weight bearing from the ischial tuberosity to ground’. One of the most important elements of Thomas’s teaching was the use of uninterrupted immobilisation.

In 1851 Antonius Mathijisen (Mathysen), a Flemish army surgeon, introduced the use of plaster of Paris bandages which were to replace many splints and braces by acting as external support for fractures. Sir William Arbuthnot Lane (1856–1938) started to use silver wire and screws and, later, steel pins, to internally fix fractures.

In 1903 the Balkan War saw the introduction of overhead wooden beams, and the Balkan Beam was developed by a Dutch ambulance unit. These allowed the suspension of splints and the fixing of traction apparatus.

With the development of anaesthesia, surgeons were able to manipulate fractures and the availability of X-rays meant that poor position was no longer an acceptable outcome. As aseptic techniques improved, the use of skeletal pins to give a direct pull on bone increased. Skeletal traction had not been used before as the infections risks were considered to be so high, but there is an early record of Malgaine (1845–1850) using ice tongs to hold a fractured patella in place. This had been suggested first by NS Ransahoff of Cincinnati.

It was in 1909 that Martin Kirschner records the use of wires above and below a fracture with a distraction device used to reduce the overlapping bone ends. He was followed by Fritz Steinmann, who introduced thicker pins and a stirrup in 1911, and then by Denham who, in 1972, introduced a threaded pin. The pins were put through the femoral condyles, tibial tubercle or calcaneus. Bohler, working in Vienna after World War 1, used a Steinmann pin through the tibial tuberosity with the lower leg supported on a Braun frame, which provided the pulleys for the traction. Later, in 1931, he published a paper describing the use of a Bohler–Braun frame using pins through the calcaneus.

Robert Hamilton Russell (1860–1933) developed the idea of using traction to reduce muscle spasm by using below-knee strapping, weights and pulleys and a sling under the knee. In 1924 a modified version of the traction was introduced using extensions, cords and pulleys but no splint.

A lighter splint version of the Thomas Splint was developed and widely used for transporting casualties in World Ward 1, reducing the death rate following fractures of the femur from 80 per cent to 20 per cent.

During World War 2 the 8th Army ‘Desert Rats’ developed a method of using a full length plaster of Paris cast over skin extensions. The plaster of Paris cast, which enclosed a Thomas splint to which the extension was tied, was then split and bandaged to the splint. This was known as a Tobruk Splint. This method was invaluable for its intended use, which was to provide up to 48 h of immobilisation with traction during long distance transportation by sea from Tobruk.

In 1946 Obeltz developed a form of traction called 90/90 (ninety/ninety) traction which was first used in battles in North Africa during World War 2. It uses skeletal traction to suspend the leg.
with the hip and knee flexed at 90° when there is a wound on the posterior aspect of the leg.

In 1944 Fisk describes using a modified Thomas Splint with a hinged lower half, which allowed the patient to begin assisted movements of the lower limb to reduce knee stiffness. The Pearson Knee Piece was an addition to a Thomas Splint, which also allowed flexion of the knee joint.

Perkins (1970) describes the use of skeletal traction without any external splintage. He also advocates early active movement of the injured limb to reduce stiffness. To aid this, he first described the use of a split bed in 1958. Tulloch Brown of Glasgow introduced a type of sliding traction, which uses a Steinmann pin through the tibial tuberosity attached to a light ‘u’ loop that is fitted over the ends of the pin (Nangle 1951). KI Nissen (1971), working at Stanmore, designed a support for the foot and a stirrup, which enabled the leg to be suspended but prevented external rotation.

Upper limb traction

Dunlop (1939) described upper limb traction for the management of supracondylar and transcondylar fractures of the humerus in children. Skeletal traction through the olecranon, described by Ormandy (1974), can be used for the management of supracondylar and comminuted fractures of the lower end of the humerus and unstable fractures of the shaft of the humerus.

Spinal traction

Hippocrates describes the use of prolonged supination with traction to the head, trunk and lower extremities with pressure over the gibbous (hump). Spinal traction as such has only become widely used in modern times. In the 17th century, Glisson (1597–1677), and the 18th century, Erasmus Darwin, tried to apply traction for neurological conditions, but lacked the anatomical knowledge and equipment to provide effective treatment. Glisson suspended patients by their feet or by their armpits.

Corsets were widely used and Jean-Andre Vel

nel described a suspension bed using traction for scoliosis in 1789. Combining traction and corsets became popular in the mid-19th century. Hawley, Watson-Jones, Albee, Edgar and Oppenheimer are among the many who developed the traction bed first described by the Renaissance medical men and used it to maintain traction while applying plaster of Paris splints or corsets.

Skeletal traction for spines only became popular at the end of the 19th century when asepsis and antiseptics were introduced. Prior to that head halters such as Sayres’ halter were used, but there was a high risk of skin necrosis from the webbing. In 1933 Crutchfield and, slightly later in 1937, Barton (Cone and Turner) described skeletal traction using metal prongs which could be inserted into the skull attached to a hinged loop. This method was widely used in World War 2. Hoen also describes a similar apparatus in 1936.

The halo splint which consists of an oval metal band, which arches up posteriorly to clear the occiput, enables the patient to rest their head comfortably. The band is fixed into the outer table of the skull by a number of fixing pins. A halo-body orthosis, halo traction was first used by Perry and Nickel in 1959 for the management of paralytic deformities of the cervical and thoracic spines. An adjustable skull frame is incorporated into a plaster of Paris jacket, which extends from the shoulders to the iliac crests. This orthosis applies fixed traction to the cervical spine. Further developments of this orthosis took place giving a light, less cumbersome splint (Stewart and Hallett 1983).

Halo-pelvic traction uses the halo splint connected by four vertical spring-loaded distraction rods to a steel pelvic hoop fixed to the pelvis by two rods, which pass through the wings of the ilium.

PRINCIPLES OF TRACTION

Medical definition of traction

- ‘Two strong men will suffice by making extension and counter-extension’. (Hippocrates 350 BC).

To pull (or apply traction) effectively, there must be something to pull against, something which is endeavouring to pull or thrust in the opposite direction. These two forces are called traction and counter-traction, respectively.

Essentially, the pulling force overcomes muscle spasm and shortening, and, in some traction arrangements, the effects of gravity are also overcome.

By controlling movement of the injured part, traction enables bone and soft tissue to heal, and can be used in a variety of conditions as a method of treatment. Traction is based on simple mechanical principles, but human tissue is very vulnerable and traction on limbs must be practised with caution and discretion.

Mechanisms of traction

There are two mechanisms of traction:

1. Fixed, e.g., Thomas Splint. This is a pull between to fixed points.
2. Balanced or Sliding, e.g., Pugh’s, Hamilton Russell traction. Pull is balanced between weights and the patient’s body weight.
**Application of traction**

There are two main ways to apply traction:

1. Skin.
2. Skeletal.

**Types of traction**

There are several ways in which the two basic forms of traction may be applied:

- Fixed skin traction
- Sliding skin traction
- Fixed skeletal traction
- Sliding skeletal traction
- Combined fixed and balanced traction
- Modified skeletal traction.

**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 fractures and dislocations
- To help restore blood flow and nerve function
- 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
- As well as acting on the limbs, traction can be applied to the pelvis and to the spine.

**Essential principles**

- The grip or hold on the body must be adequate and secure
- Provision for counter-traction must be made
- There must be minimal friction in 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:
  (i) the traction set-up is functioning as planned.
  (ii) 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 and may retard rehabilitation. It is important, therefore, that those responsible for setting up and maintaining traction are familiar with the principles of traction, so that the mechanics of each type of traction set-up are well understood.

**CARE OF THE TRACTION APPARATUS**

- The traction system should be thoroughly checked at least once every shift (8 h) and always after any procedure has been performed, as the system may have been inadvertently altered. The checking should always be carried out by a trained Health Care Professional (HCP).
- The traction apparatus should be kept clean and dust free.
- The traction structure, for example, the Balkan beam 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 the correct strength and circumference to use with the pulleys and other traction equipment.
- The cords must be attached securely by standard non-slip knots, e.g., a clove hitch or two half hitches knot.
- The ends of the cords should be short (5 cm), single length and continuous, not short cords which have been joined together.
- The line of pull of the traction cords should be correct and checked at least every 8 h. 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 to run through each single pulley track, as this reduces friction and the possibility of the cord fraying.
- The amount of weight must be prescribed and should also be documented in the nursing records. 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 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 and staff.
The patient should be nursed on an appropriate mattress to give full support and comfort and allow efficient traction to be maintained. Bed attachments should be considered to help the patient to move as their condition allows. Ensure counter-traction is 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.

APPLICATION OF NON-ADHESIVE SKIN EXTENSIONS

Equipment
- One non-adhesive traction kit
- Crepe bandages, if not included in the kit
- Padding material, if not integral to the kit
- Tape for securing the bandages
- Scissors (see Table 1).

Advantages of non-adhesive skin extensions
1. Less risk of skin reaction than with adhesive skin extensions.
2. Easy to apply.
4. No anaesthetic required.

Disadvantages of non-adhesive skin extensions
1. Can only take a maximum weight of 4.5 kg (10 lb) (Stewart and Hallett 1983).
2. Needs reapplying at least every 24 h.

APPLICATION OF ADHESIVE SKIN EXTENSIONS

Equipment
Follow local policy for hair removal. Clippers or depilatory creams are the preferred method. If using creams a patch test should be carried out first.
- One adhesive skin extension kit. NB Patient may be allergic to adhesive. Hypoallergenic kits are available. A patch test should be done first.
- Crepe bandages, if bandages not supplied with the kit.
- Scissors.
- Tape for securing bandages (see Table 2).

Advantages of skin extensions
1. Can take up to a maximum of 6.5 kg (15 lb) (Stewart and Hallett 1983).
2. Easy to apply.
4. No anaesthetic required.

<table>
<thead>
<tr>
<th>Table 1 Application of non-adhesive skin extensions</th>
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<tbody>
<tr>
<td><strong>Action</strong></td>
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<tr>
<td>Two HCPs are needed for this procedure</td>
</tr>
<tr>
<td>One HCP to hold the limb and exert gentle traction in the prescribed line of pull</td>
</tr>
<tr>
<td>Non-adhesive strips are placed in position, see specific traction</td>
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<tr>
<td>Excessive lengths may be folded back and incorporated into the bandaging</td>
</tr>
<tr>
<td>Ensure the foam padding is placed over the bony prominences</td>
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<tr>
<td>Bandage the skin extensions onto the limb, using a figure of eight or a spiral technique, in internal rotation (Draper and Scott 1996)</td>
</tr>
<tr>
<td>Avoid bandaging over vulnerable soft tissue areas, e.g. behind the knee and in front of the elbow and wrist</td>
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<tr>
<td>Secure bandages with short lengths of tape, not completely encircling the limb</td>
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</table>
Disadvantages of adhesive skin extensions

1. May cause skin reactions, even when using hypoallergenic equipment.
2. Can only take a maximum weight of 6.5 kg (15 lb).
3. Bandages need reapplying at least every 24 h.
4. Cannot be used on fragile or oedematous skin or skin with poor vascular status.
5. Cannot be used where wounds, sores, abrasions or rashes will come into contact with the extensions (Taylor 1987).
6. May cause sores over bony prominences and/or under bandages.
7. May cause damage to nerves, especially around bony prominences.
8. More difficult to control rotation of the limb (Stewart and Hallett 1983).
9. Can only be used for a short term, unless light weights prescribed (Taylor 1987).

REFERENCES


FURTHER READING

Bick E (1937) Sourcebook of Orthopaedics. Williams & Wilkins, Baltimore/London
Bick E (1948) Sourcebook of Orthopaedics. Williams & Wilkins, Baltimore/London
Owen R (1972) Indications and contra-indications for limb traction. Physiotherapy(58)

Table 2 Application of adhesive skin extensions

<table>
<thead>
<tr>
<th>Action</th>
<th>Rationale</th>
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<tr>
<td>One HCP to support the limb, exerting gentle traction in the line of pull</td>
<td>To provide patient comfort</td>
</tr>
<tr>
<td>The second HCP prepares the area to be covered by the adhesive strips, referring to local policy on removal of hair</td>
<td>To prepare the skin for the extensions</td>
</tr>
<tr>
<td>Unroll and stretch the extensions prior to removing the backing paper (Taylor 1987)</td>
<td>To unkink the extensions and make them easier to handle against the limb</td>
</tr>
<tr>
<td>Nicks can be made in the length of the adhesive strips; the extensions are cut to length and rounded at the top edges</td>
<td>To improve the conformation of the extensions to the contours of the skin and to prevent the corners peeling (Taylor 1987)</td>
</tr>
<tr>
<td>The adhesive strips to be placed in position, refer to the traction prescribed, the integral protective foam must cover the bony prominences i.e. the malleoli or the head of ulna and styloid process of radius, if applicable</td>
<td>To prevent pressure sores occurring over the bony prominences. To avoid compressing the nerve</td>
</tr>
<tr>
<td>Avoid bandaging over soft tissue compartments e.g. behind the knee, in front of the elbow and at the wrist</td>
<td>To prevent constriction of the vital tissues in these areas, e.g. the neuro-vascular system</td>
</tr>
<tr>
<td>Bandages to be applied to cover the adhesive strips, using a figure of eight or spiral technique</td>
<td>To keep the extensions in place and to transfer the traction forces to the skin and underlying tissues</td>
</tr>
<tr>
<td>Secure bandages with short lengths of tape, not completely encircling the limb</td>
<td>To secure the bandages, and avoid a tourniquet effect</td>
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