Maintenance of balanced traction care chart to minimise traction related complications of femoral fracture in children

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DOI: https://doi.org/10.22271/ortho.2018.v4.i1m.121

Abstract
Femoral shaft fractures are among the most common diaphyseal fractures in children. In fracture femur, traction is a method of initial stabilisation before definite treatment. Birmingham Children's Hospital in the United Kingdom uses a balanced traction care chart which was introduced locally to monitor traction care and traction related complications. The aim of this study is to retrospectively assess and review whether or not this balanced traction care chart reduces traction related complications. A total of 10 patients were included in the study and data was taken in terms of average duration of traction, traction daily check documentation, neurovascular status and pressure areas check, incidence and treatment of pressure sores, documentation of pain score, documentation of type of stool, regular check of skin traction and suspension, Check x-ray and action needed depending on score. The average duration of traction was 10.7 days. There is significant improvement in categories such as traction daily check documentation, neurovascular status and pressure areas check, as all the above categories were checked in all cases (100%) in comparison with the previous data. Moreover, current data showed that 40% of children developed pressure sore which was 62% previously and the severity of the pressure sore has decreased after introduction of the traction care chart. Of those pressure sores, two were blisters, one was slight redness and one patient had breakage of skin. Lack of adjustment was the reason for all pressure sores and pressure sores were treated with dressing and re adjustment of the Thomas splint. Introduction of the balanced traction daily care chart improves the outcome of patients with traction and minimises the risk of traction related complications. Birmingham Children’s Hospital in UK has introduced this chart and it has been received well on the wards by staff. As this report shows that this balanced traction care chart minimises traction related complications; it could be introduced to other Paediatric Hospitals as well.

Keywords: Balanced traction care chart, Fracture femur, incidence of pressure sores, Paediatric Orthopaedics, minimise traction related complications

Introduction
Femoral shaft fractures are among the most common diaphyseal fractures in children with an estimated annual incidence of 25 per 100,000 per year for children 0 – 14 years old in the United Kingdom (36 / 100,000 for boys and 21 / 100,000 for girls) [1]. In children, fractured femoral shafts are treated by various methods such as traction, traction then hip spica, hip spica without traction, elastic nails and plates. Traction is an old method of treating fracture femur. Once it was the definite method of treatment, now however it is a method of initial stabilisation before definite treatment. With more surgical options available and less use of traction as a definite method of treatment, there is less emphasis on training nursing staff and doctors on how to set it up and what to look for from day to day. This lack of practice can lead to less favourable outcomes and more complications. Birmingham Children's Hospital in the United Kingdom follows balanced traction guidelines and uses a balanced traction care chart which was introduced locally to monitor daily balanced traction care and traction related complications.
Balanced traction guidelines for femoral fracture in children \(^{2,3,4}\)

**Pre-Application check**

**Patients**

1. Age > 18 months
2. Weight > 12 kg
3. Skin condition intact and no skin breaks
4. Other injuries (Pelvis/same limb) may need traction cast or skeletal traction

**Equipments:** (Figure 1.1, 1.2)

1. Skin traction kit and bed with Zimmer Frame and cotton wool padding with non-woven cover.
2. Thomas Splint Size (Circumference/length)
3. 3 x weight holders
4. 5x pulleys
5. Ropes
6. Adhesive tape (to secure knots)
7. Pillows.
8. Scissors.

**Weights**

1. Weight A= Body weight/10 (Maximum 3.2 kg)
2. Weight B=C=A/2

**Assistance**

1. At least 2 x persons

**Pain Killers**

Administer strong pain killers +/- femoral block shortly before application of traction.

**Application**

**Skin traction:** (Figure 1.3, 1.5, 1.6)

2.1.1. Up to the level of the fracture (for maximum traction).
2.1.2. An index line from Great trochanter to lateral malleolus
a) Lateral strapping just posterior to index line.
b) Medial strapping just anterior to index line.
c) Loop projecting 5 cm distal to the foot (free ankle foot movement)
d) Bandage from just proximal to malleoli.
e) Well padding of malleoli and head of fibula and avoid wrinkles.

**Thomas Splint:** \(^{[5]}\) (Fig 1.2)

**Proximal circumference**

a) Corresponding to the obliquity of the splint.
b) Add 5 cm to the circumference of the contra-lateral (normal) side.

**Length**

a. Measure from Crotch to heel and add 15-20 cm (for the inner bar).

**Padding:** (Figure 1.4, 1.7)

a. Fashion slings between the rods of the limb to rest.
b. Proximally include the posterior part of the ring with the lateral bar.
c. Distally the slings end 6 cm proximal to the heel to avoid tendo achilles pressure.
d. Fashion one large pad from Gamgee/Cotton wool (10x 15 cm) which should be about 2 cm thick when compressed to place transversely under the lower part of the thigh (maintain normal anterior bowing of the femoral shaft).

**Traction cord:** (Figure 1.8)

a) Inner cord passed under its respective bar.
b) Outer cord passed over its respective bar.
c) Cords are tied over the end of Thomas splint.

**Suspension:** (Figure 1.9)

**Thomas splint traction suspension**

a) Tie another rope to the end of the skin traction cords (after tightening over the Thomas splint).
b) Pass the rope through a pulley at the end of the bed.
c) Attach weight A to the rope.

**Proximal Thomas Splint suspension**

a) Fashion a loop around the proximal end of Thomas splint.
b) Tie another rope to the middle of the above loop.
c) Pass the rope through a pulley above and then proximally through another pulley at the head of the bed.
d) Attach weight C to the end.

**Distal Thomas Splint Suspension**

a) Fashion a loop around the distal end of the Thomas splint.
b) Tie another rope to the middle of the above loop.
c) Pass the rope through a pulley above and then distally through another pulley at the end of the bed.
d) Attach weight B to the end.

**Final checks after applying the weight**

a) Make sure all knots are clear from the pulley (at least 15-20 cm clearance).
b) Secure all knots with adhesive tape.
c) Raise the foot of the bed by 2.5 cm for each 1 kg weight on suspension
d) Weights should be hanging freely with at least a 30 cm clearance from the floor.
e) The Leg should be aligned in 30 degree of valgus and 30 degree flexion.

**Post application check**

Check x-ray post application and every 5-7 days thereafter.

**Daily Traction check sheet**

Readjust/Realign traction and suspension as needed.

Any complication should be dealt with immediately and reported to seniors.

**Apply Hip Spica**

Once there is callus on X-ray and fracture is in good alignment with no/minimal shortening.
Fig 1.1: Equipments for skin traction

Fig 1.2: Thomas splint

Fig 1.3: Position and secure slings along the splint

Fig 1.4: Padding

Fig 1.5: Apply skin traction

Fig 1.6: Leave sufficient room between foot and skin extension

Fig 1.7: A small piece of Gamgee is placed behind the knee
Aims and Objectives
The primary aim of the study was to assess the maintenance of the daily traction care chart in the ward for management of fracture femur in children. A secondary aim was to look at traction associated complications, especially pressure sores and compare it with the previous data to find out whether or not this traction care chart reduces pressure sores.

Materials and Methods
Patients who had a fracture of the femoral shaft and underwent application of surface traction (Balanced traction and Gallows traction) for initial management were included in the study. A total of 20 patients over 8 months between February to September 2016 in Birmingham Children’s Hospital were audited retrospectively in terms of average duration of traction, traction daily check documentation, neurovascular status and pressure area check, incidence and treatment of pressure sores, documentation of pain score, documentation of type of stool, regular check of skin traction and suspension, x-ray check and action needed depending on score. Data was collected from clinical notes and the daily balanced traction care charts.
Results

In our data, all children were between 1 and 14 years of age. The average duration of traction was 10.7 days and average duration of traction in hip spica was 12.6 days (Table 1). The data shows that there is a significant improvement in most of the categories such as traction daily check documentation, neurovascular status check, pressure area check, daily patient position check, as all the above categories were checked in all cases (100%) in comparison with the previous data (Table 2).

100% compliance is also seen in categories such as daily documentation of pain score, daily documentation of type of stool, skin traction bandage, foot clearance and traction cords tension check, suspensions-knots and weights check. Moreover, 80% of patients had check x-ray done in less than 3 days which is also an improvement in comparison with the previous data (Table 2).

Table 1: A tabular presentation of data from balanced daily traction care chart.

| Categories                        | Frequency |
|-----------------------------------|-----------|
| Age                               | 1 to 14 years |
| Average duration of traction      | 10.7 days  |
| Average duration of traction in hip spica | 12.6 days |
| Traction daily check documentation | 10        |
| Neuro-vascular status check       | 10        |
| Pressure area check documentation | 10        |
| Incidence of pressure sore        | 04        |
| Any treatment for pressure sore   | 03        |
| Traction check list used          | 10        |
| Position of patients checked daily| 10        |
| Daily Documentation of pain score | 10        |
| Documentation of type of stool    | 10        |
| Skin traction bandage, foot clearance and traction cords tension checked regularly | 10 |
| Suspensions-knots and weights checked regularly | 10 |
| Check x-ray done < 3 days         | 08        |
| Action needed depending on score  | 04        |

Table 2: Comparison with the previous data taken before the introduction of the balanced traction care chart

| Categories                        | Previous | current |
|-----------------------------------|----------|---------|
| Skin traction and suspension check daily | 1/13(08%) | 10/10(100%) |
| Neurovascular status checked daily | 09/13(70%) | 10/10(100%) |
| Pressure areas checked daily      | 09/13(70%) | 10/10(100%) |
| Evidence of pressure sore         | 08/13(62%) | 4/10(40%) |
| Action needed depending on score  | 5/8(62%)  | 4/4(100%) |

In this study, 40% of the cases had pressure sores which was 62% previously (Table 2) and the severity of the pressure sores has decreased after introduction of the traction care chart (Table 2). Of those one was a pressure sore, two were blisters, one was slight redness and one case had breakage of skin. Lack of adjustment was the reason for all pressure sores and pressure sores were treated with dressing and re adjustment of the splint (Table 3).

Table 3: Nature of pressure sore and action needed depending on severity of pressure sore.

| Nature of pressure sore | Possible cause of pressure sore | Treatment Given                  |
|------------------------|--------------------------------|----------------------------------|
| Skin breaking/posterior gluteal | Lack of adjustment of the Thomas splint in traction | Minor adjustment done to relieve pressure, duoderm applied. |
| Blisters/posterior gluteal | Lack of adjustment of the Thomas splint in traction | Minor adjustment done to relieve pressure, duoderm applied. |
| slight redness/post gluteal | Lack of adjustment of the Thomas splint in traction | Minor adjustment done to relieve pressure, duoderm applied. |
| Blister/left lateral thigh | Lack of adjustment of the Thomas splint in traction | Minor adjustment done to relieve pressure, dermal wash, dressing. |

Discussion

Femoral shaft fractures are among the most common fractures of long bones in children. The definitive management of paediatric femoral shaft fractures remains controversial [1]. The treatment of paediatric femoral shaft fractures primarily depends on the child’s age however, the bone age and size of a child may influence the treatment choice [6]. The principle of femoral fracture treatment in children is the restoration of the normal level of activity and function with minimum physical and psychological stress. Dameron et al. [7] outlined 6 key principles for the treatment of paediatric diaphyseal fractures:

1. The simplest treatment is the best treatment.
2. The initial treatment should be definitive whenever possible.
3. Anatomic reduction was not required for perfect function.
4. Alignment must be restored, especially rotational alignment.
5. The more growth that remained, the more remodelling was available.
6. The limb should be immobilised in a splint until definitive treatment had been instituted [7].

Treatment for femoral shaft fracture varies with age. For infants, the treatment options are pelvic harnesses and early spica cast. For children less than 5 years the ideal
management option is skin or skeletal traction followed by spica cast. For children over 5 years, the management options include traction followed by spica cast, flexible intramedullary nails, submuscular plate, external fixation [8]. There is a core care plan for a child/young person undergoing skin traction in the Royal College of Nursing’s guidance- Traction: Principles and application [3]. There are clear instructions regarding the application and care plan for skin traction in the guidance. However, there is an increasing incidence of traction related complications in the hospital. The reason could be partly because of not maintaining the care plan on the ward or because of not having a traction care plan chart to monitor traction care. Moreover, lack of training for the staff who are responsible for looking after those patients on the ward could be another possible reason [9].

In 2015, a survey was conducted by the Orthopaedic Surgeons in Birmingham Children’s Hospital to look into different practice patterns in the UK regarding traction for fracture femur in the young age group; 2-5 years old. A telephone interview was conducted with Nurses, Senior House Officers and Speciality Registrar’s from 21 Hospitals in the UK: 16 Major Trauma centres in UK (12 Adults & Children, 4 Children only), 5 local district general hospitals between 1st of September 2015 and 31st November 2015. After the survey they recommended a simple, easy and quick guideline for application of traction in fracture femur in children as well as daily care with emphasis on possible complications as well as suboptimal application. (Figure 2).

After the introduction of the balanced daily traction care chart, Nursing staff and all doctors were trained to maintain this chart on the ward effectively and a further study was done which showed a significant improvement in traction related complication especially pressure sores.

Conclusions
Introduction of the balanced traction daily care chart improves the outcome of patients with traction and minimizes the risk of traction related complications. However improvements still need to be made to reduce the development of pressure sores. Balanced traction care charts can be used in other Paediatric hospitals to minimize traction related complications.

Acknowledgements
I want to express my deep gratitude to Mr Hari Prem, Consultant Paediatric Trauma and Orthopaedics, Birmingham Children’s Hospital, Mr R. Vadivelu, Consultant Paediatric Trauma and Orthopaedics, Birmingham Children’s Hospital and Mr Basil Budair, Speciality Registrar, Trauma and Orthopaedics, Birmingham Children’s Hospital for their generous support, valuable suggestions and help in performing the audit. Finally I am thankful to Orthopaedic Surgeons of Birmingham Children’s Hospital who have introduced balanced traction care guideline and daily traction care chart.

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