Femur Fractures and Traction Splints

by Douglas Haviland

EMT Objectives

After reading this article, the EMT will be able to:

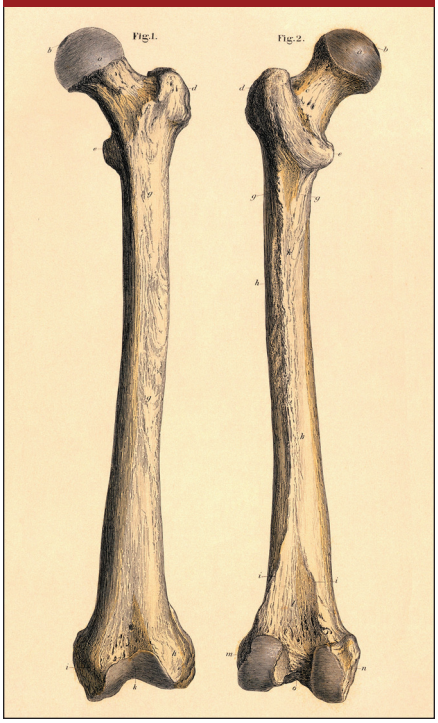
- Recognize the extreme traumatic forces involved in the fracture of a patient's femur.
- Understand the basic principles of bipolar and non-bipolar traction splints.
- Display a working knowledge of how the Hare and Sager traction splints are applied.
- Express the contraindications of use for both types of splints.
- Indicate alternative methods of loading and transporting a patient with a traction splint applied.

Introduction

The femur is the largest long bone in the human body *(see Figure 1)*. For most of us it is also the strongest, able to withstand forces from all manner of trauma that would easily break other bones. The femur is also surrounded by some of the biggest muscle masses in the body. These muscles are held at bay by the strength of the femur. Think of tremendous rubber bands strung and stretched over a large wooden rod - if the rod is broken, the bands collapse. In the human, this collapse would result in severe muscle spasms. For this reason it is important to realize the tremendous forces required to break a femur in most people. Not surprisingly, car crashes are the number one cause of femur fractures.

Figure 1:

Femur Bones - Illus. 1879



To treat prehospital femur fractures *(see Figure 2)*, traction splints were developed and have been around since at least 1875 when Hugh Owen Thomas developed the eponymous "Thomas Half Ring." The half ring device would go on to be the splint of choice for these injuries for a hundred years.

In the latter half of the 20th century a splint based on the half ring principle was developed by Glen Hare. Hare's splint streamlined the application process and eliminated much of the improvised nature of it. Since the 1980s the Hare (as I will simply refer to it), became the standard in EMS and a staple in EMT training programs.

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Figure 2:

Mid-Shaft Femur Fracture

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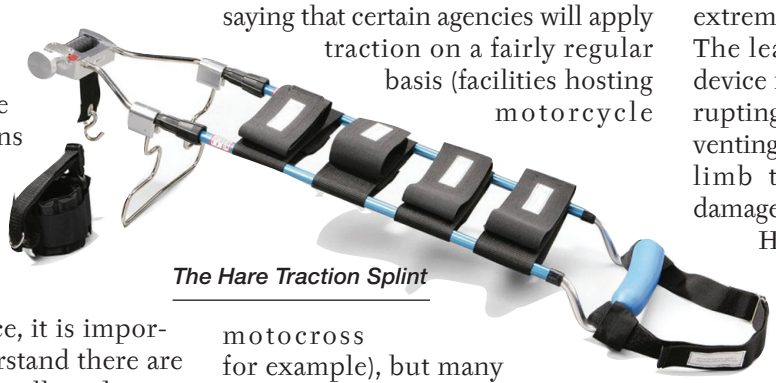
In the last 25 years another device, developed by Joseph Sager, was introduced and has garnered a following. Sager's splint uses different principles than the Hare and is considered by many to be simpler to apply and – according to the manufacturer – has other key benefits.

While many agencies have adopted the Sager, the Hare style bipolar splint remains the dominate traction splint in use at this time. While I will freely refer to the Hare device throughout this piece, it is important that EMTs understand there are other manufacturers selling devices that are, for the sake of brevity, essentially clones of the Hare. I will refer to these as brand "X" bipolar devices. These lower-cost traction splints will, by and large, duplicate nearly every aspect of the Hare. However, be aware that there will be one or two significant points of difference that may require attention. Among these may be the locking collets, the kickstand and the ratchet.



The Hare Traction Splint

While many agencies have adopted the Sager (unipolar), the Hare style (bipolar) remains the dominant traction splint in use at this time.

Other non-bipolar competitors have also introduced traction splints, including the Kendrick KTD (yes, the same Kendrick of KED fame) and the Faretec CT-6. In this review we will focus on the Hare and more closely examine the fine points of the Sager. We will not cover the Kendrick or the Faretec.

As noted, Hare devices are also referred to as ***bipolar*** splints while the Sager is known as a ***unipolar*** splint. Do not confuse the term *bipolar* with *bilateral* (as in both femurs broken). Information in this article was developed from various sources, including first-hand experience and manufacturers' instructions. What this article does ***not*** do is take the place of hands-on practice with **your** equipment!

Most of the controversies surrounding traction splinting concern how rarely most EMS agencies are tasked to apply it. It goes without saying that certain agencies will apply traction on a fairly regular basis (facilities hosting motorcycle motocross for example), but many (if not most) EMTs have never applied one in an actual emergency setting. With this lack of practice come rusty skills. Many EMTs are all but clueless when faced with their first mid-shaft femur fracture, especially if they've been out of EMT basic training for some time. Because of these issues some EMS experts are questioning the value of continuing to teach Hare and to continue carrying them on ambulances. Additionally, there are many misconceptions and old wives' tales associated with it.

Indications To Apply And Benefits of Traction

Traction splints are applied to isolated "mid-shaft" femur fractures *(see note below on Sager type splint)*. Typical femur fractures will present in distinct ways. The limb will be shortened and rotated outward *(see Photo 1)*. There will be a bulge at the point of the break pointing to its location (i.e., mid-shaft, proximal or distal). Femurs do break in both the distal and proximal locations, although the latter (proximal) are more typically identified as "hip fractures."

Photo 1:

Limb Rotated Outward

The patient will experience extreme pain with any femur break. The leading benefit of the traction device is reducing that pain by interrupting the muscle spasms and preventing any further movement of the limb that will cause additional damage (and pain!).

Hare traction application typically involves two EMS providers trained in the skill who share various responsibilities. If a third EMT is available, he/she should tend to additional patient assessment, care and transport considerations, which may become complicated *(see below)*.

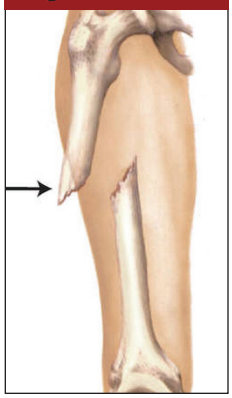
Contraindications Of Traction

Traction devices are contraindicated for the following conditions:

- **Any Threat To Life!** Patient unconscious (unable to protect airway), or having difficulty breathing or life-threatening bleeding.
- **Any Other Injury** on the affected limb, including the knee, ankle or foot.
- **An Open Femur** (bone ends exposed), sometimes referred to as a "compound fracture" *(see Figure 3)*.
- **Hip Fracture.** The presence of hip instability rules out the traction splint. An unstable hip would not provide a proper base to apply traction and is also indicative of possible life-threatening internal bleeding. Secure patient to a long board and transport to the closest trauma center.
- **Bilateral Femur Fractures**. This applies to the Hare type (bipolar) splint. If your ambulance carries a

Figure 3:

Open Femur



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bilateral Sager model it is possible to splint both legs.

- **Significant Multi System Trauma** affecting head, trunk, arms etc.

Contraindications for applying a traction splint include: any threat to life, another injury on the affected limb, an open or bilateral femur fractures, and significant multi-system trauma.

- **No Splint**, including a traction splint, should be considered unless the complete limb is exposed. In this case both limbs should be exposed to ensure there is no other injury to the opposed limb.

Given the intrusive nature of both the Hare and Sager splints - clothing below the waist should be removed, including boots, shoes, socks, pants and skirts. Underwear can be left in place. The patient's crotch can be covered for modesty with a sheet after the splint is applied. Since application of a traction splint is best done prior to moving the patient, responding EMTs will have to weigh patient modesty against the severity of injury in the public arena. As with many emergency medical procedures, EMTs may be forced to make tough choices. On occasion, modesty will have to take a back seat.

Caution: If helicopter air transport is considered, the Hare device when applied will present difficulty in ***most*** air medical situations due to space considerations.

Transport Considerations

Once the splint is applied to the patient the best patient movement option is to use a long backboard. However, in many situations the typical six-foot board will not be long enough to support the end of the Hare kickstand. It may be necessary to field-engineer a solution in order to make the board longer. Options include extending the board with a KED, short board or board splints.

Given the now-extended overall length of your patient, you may find that loading the cot as normal creates a problem: closing the rear doors of the ambulance! Rarely does patient care so directly come into conflict with the transport vehicle itself. You may find that since you extended the backboard and have several inches or more hanging off the end of the cot, that the rear loading doors will make contact with board, the splint and even the patient. This is a problem especially prevalent in van style, Type 1 ambulances. The easiest solution is simple: load the patient, on the backboard backwards on the cot! Placing the patient's head in proximity to the rear doors, the extended end with the splint now faces the front of the patient compartment, and usually overhangs the "captain's chair" (the seat typically at the patient's head).

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Ambulances usually have ample room toward the front and will allow for overhang of the now-extended backboard.

Always keep in mind you're treating the entire patient, not just an isolated femur break. While an injured femur can become a distracting experience both for the patient and the EMS crew, remember that the patient's A-B-Cs always take precedence over the break.

Traction Pull: On Hare type splints the traction pull is determined by the provider who is manually pulling the traction. The mechanical pull should equal the EMS provider pull. Only the provider pulling traction can determine this. It should be further noted that with Hare splints the mechanism to adjust traction (the ratchet), will – when the EMT pulling traction is properly positioned (one knee down, one knee up, patient's injured leg in-between) – end up placed squarely between the EMT's legs and within an inch or so of the EMT's crotch.

Traction splints should be checked to see not only that all straps and the ankle hitch are present in the bag, but that the entire splint is assembled and ready for use.

This is no time for EMS crew members to become overly concerned with personal modesty or harassment issues. If the skill is practiced regularly as proscribed, all crew members, male and female, will come to terms with the interpersonal work environment and the required professionalism to complete the task. While it is uncomfortable for many EMS personnel to have such close contact with one another, keep in mind your patient is in far more dire straits and is counting on you to do the right things. Also, training should be done as it is expected to be performed in the field. Saying: "I would do it differently if it was a real patient" doesn't cut it; practice as you would be expected to perform it!

Photo 2:

Adjustable Collets

Many EMTs will simply not be able to complete the tasks required in the position of pulling traction due to fitness or prior injury themselves. The position requires enough agility to be in the proper position on the ground, and enough strength to pull the required force for minutes at a time! If the person pulling manual traction releases, the broken bone ends will most likely collide. You can imagine the pain and suffering that will cause the patient! Always remember to ***Do No Harm!*** Pulling traction without completing the splint is tantamount to reinjuring the patient.

As a riding EMS crew, members should ensure that all equipment is checked at least daily. Traction splints should be checked to see not only that all straps and the ankle hitch are present in the bag, but that the entire splint is assembled and ready for use. (While riding with an organization to which I was new, I was doing a rig check and checking the various splints including the Hare. The splint had been checked for months – if not years – by riding EMS crew members as simply being "on the rig." That is, ambulance check sheets piled in the log book noted with a check mark that the splint was present. However, when I checked and opened the bag, I was aghast to find that while everything was in the bag and was indeed present, none of it was assembled! Each of the four Velcro cradles was neatly shrink-wrapped in its factory-shipped packaging. None of them were in place on the Hare frame. The ratcheting mechanism and the kickstand were firmly secure in their shipping positions. Obviously, if it had taken an emergency to discover this situation, patient care would have been delayed considerably while the crew tried to piece together the splint.

Furthermore, if the device had never been assembled, it most certainly had never been tested or drilled upon. Just because a medical device is new in the package doesn't guarantee it works. Remember the acronym for the meaning of the word "NEW" – ***Never, Ever, Worked!***

It is important for all providers to know how to make an ankle hitch from a common cravat.

Also, it is a very common occurrence for ankle hitches to go missing. (They are often discarded as trash by the hospital operating room staff.) For this reason it is important for all EMTs to know how to make an ankle hitch from a common cravat. In fact, from my years in the classroom and several thousand practice applications, I've noted the properly-applied cravat hitch is often more effective and comfortable than the commercial hitch *(See Sidebar, page 15)*.

Photo 3:

Securing The Ischial Strap

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Several cravats should be kept with the traction splint and their use should be practiced. One infamous incident involved a femur break on the boardwalk in a shore community. As noted above, the ambulance was not checked prior to the call and the ankle hitch was missing. Between the two responding EMTs and two paramedics on scene, no one remembered how to make a cravat hitch! As the story unfolds another responding police officer happened to be an EMT instructor. All the EMS responders were embarrassed to have a law enforcement officer show them up on-scene (and since it was on the boardwalk a crowd had gathered to witness the entire humiliating drama unfold)!

Note on ALS: An isolated femur break (i.e., with no associated trauma) should fall under the realm of BLS provider skills. As noted above, however, complicating factors can quickly change an isolated break into a much different scenario. Depending on local ALS protocols, the paramedics may have the option to provide morphine or another analgesic to the patient for pain management. Obviously this would be a paramedic directed option.

PMS (pulse, motor & sensory) should be checked before and after application of the splint. During extended transport the distal pulse should be rechecked. If the pulse was present before the splint was applied, but lost after application, this is not criteria to remove the splint! Instead note the change and continue to recheck. Also, it should be obvious that in order to check PMS properly, the foot must be completely exposed. There is no option to allow footwear, socks or hosiery to remain in place. The feet also need to be examined for associated injury. A foot or ankle injury, as noted above, would preclude traction splitting.

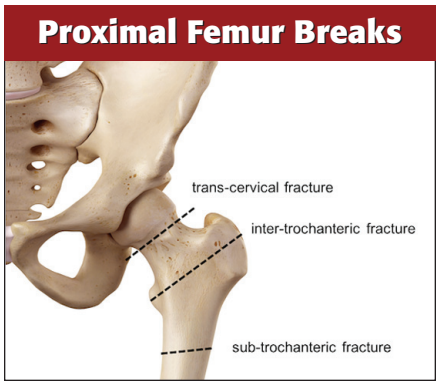
Hare Application: application of the Hare is taught differently depending on local protocols. Basics of the application include one responder providing stabilization to the affected limb (not traction, but simple firm stabilization). The second responder will measure the device on the unaffected leg (remember the legs will now be different lengths; we are trying to approximate the pre-injury length).

Any Hare style splint will have two adjustable "collets" that when spun either clockwise or counter-clockwise will loosen, allowing adjustment of the splint length *(see Photo 2, previous page)*. Splints will be stored fully collapsed in their bag. It's vitally important that the collets be checked frequently and that they were not "cranked down" overzealously when put away. I've personally seen collets so tight they required a large plier to break loose! Again this would spell near disaster in an actual application on-scene. Properly working collets will lock firmly with just a snug twist that doesn't require undue force.

After checking pulse, motor and sensory, and applying the ankle hitch, the second rescuer pulls traction.

After checking PMS *(see above)* and applying the ankle hitch, the second rescuer pulls traction. No traction should be pulled until **all** equipment is prepared, measured and ready for application. No manual traction is applied until **everything** is ready. When prepped correctly application should take no more than a few minutes (with practice).

Figure 4:



After placing the splint properly the first strap applied is **always** the uppermost ischial strap; this provides a secure anchor point for the entire splint *(see Photo 3, previous page)*. The ischial strap rides "high & tight" to the patient's body in the crease where the leg meets the trunk. The "rubber" bumper or stop at the most superior end of the Hare should be pressing firmly into the patient's ass cheek. Once again, this is a potentially uncomfortable manipulation on the part of the EMT and patient. However, it's critical that this rubber

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stopper be placed properly to prevent unintended shifting of the splint later on, shifting that will compromise traction. If the ischial strap is applied correctly it will tend to apply uncomfortable pressure on the femoral artery, for this reason padding should be provided and genitals should be adjusted as required.

The Sager Traction Splint

Next, mechanical traction is applied, up to the point that the EMT pulling traction indicates it has equaled his or her pull. As noted beyond the basics above, details may vary depending on local protocols.

Sager Splint Notes: It should be noted that Sager claims that their splint **can be used** on a proximal femur break *(see Figure 4, previous page)*, unlike the Hare. In fact, Sager claims that the splint can be used in up to 93% of all femur breaks! The manufacturer claims the splint is more effective than bipolar splints because the latter splints tend to apply traction in a unnatural angle. Many who have never seen a Sager splint applied are amazed at the relative ease of application *(see Figure 5)*.

For starters, the Sager can be applied by only one provider; common Hare splints require a minimum of two providers. Also, in a typical application the Sager will not "hang" that far off the end of the foot, eliminating the overall length issues noted above *(see Photo 4)*.

The Sager uses a weight-based scheme of traction with a scale in the splint. Sager recommends traction be applied up to 10% of patient body weight for single application. Bilateral application requires double the traction, or 20% of body weight. Sager splints incorporate a round or sliding scale (depending on model), similar to a fishing scale. The scales are calibrated in both pounds and kilograms.

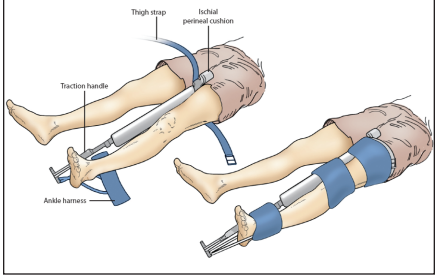
Sager recommends traction be applied up to 10% of patient body weight for single application, and 20% for double application.

Photo 4:

The Sager Traction Splint - Applied

Figure 5:

Applying The Sager Splint

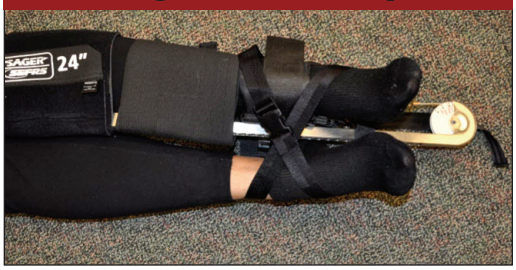


Sager claims one splint covers from four years old through adult. They also offer an "infant" model, although infant femur breaks are rare.

Another significant difference between the two types of splints (Sager vs. Hare) is that the Sager recommends wrapping the Velcro bands ***over*** the area of the break. In Hare application it is emphasized to never place the Velcro cradles directly over the area of the suspected break. In either splint the Velcro serves to prevent further movement and ease pain. The Sager also includes a "pinion" strap for the feet *(see Photo 5)*. The pinion serves to prevent rotation of the feet.

Photo 5:

Sager Pinion Strap



Blood Loss And Shock

Always remember a single femur break can account for up to a liter or more of blood loss (1000 ml - 1500 ml). Remember, this could be internal blood loss into the enclosed, confined space within the leg, so bleeding will **not** be obvious. Each break in a pelvis can lose as much as 500 ml (per

A single femur break can account for up to a liter or more of blood loss (1000 ml - 1500 ml).

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break), again not external. Combining those numbers you can see how a patient who has suffered significant lower extremity trauma can quickly deteriorate into a shock condition. Always be alert to the signs of impending shock, which could include a change in mental status, and/or increased heart and breath rates. Remember, cyanosis (blue cast to the skin) is always a **late** sign.

A rare, inherited condition – called osteogenesis imperfecta – can lead to making femurs, above all bones, susceptible to breaks.

A curious fact about femur breaks is that there is actually an inherited condition called *osteogenesis imperfecta*. This condition can lead to making femurs, above all bones, susceptible to breaks! The condition is rare; fewer than 20,000 cases are diagnosed in the US every year. One young female suffered seven femur breaks as a small child! Because a child suffering a femur break can lead to suspicion of abuse issues in the home, in this case the parents were held under a cloud of suspicion until it was determined she indeed did suffer from osteogenesis imperfecta.

Conclusion

Traction splinting provides definite benefits for patients who have experienced a femur fracture. To make the most of whichever device your squad carries, it's important that you understand its application rules and related details. Just because you don't use the splint frequently is no excuse; you never know what your next call will be. There is no substitute for regular hands-on drills with your splints.

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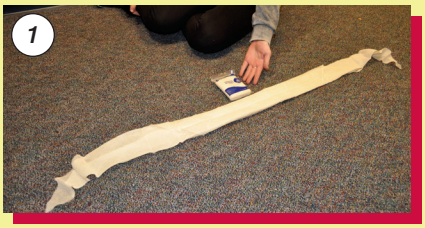
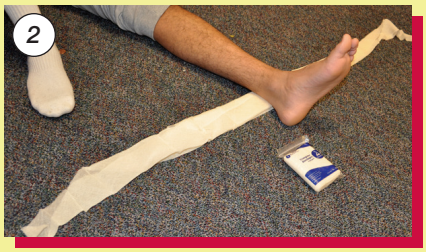
Making An Ankle Hitch From A Simple Cravat



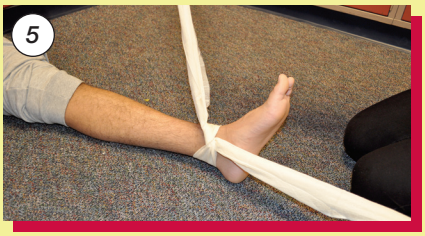
Start with a new cravat out of the package. Several folds will result in a long flat band. Lay it flat and smooth out the folds.



With the leg exposed, place the cravat under the hollow of the ankle. Cravat is proportioned with one-third left and two-thirds right. This is how you start your hitch.

Bring the longer right side portion up without pulling on the remainder.

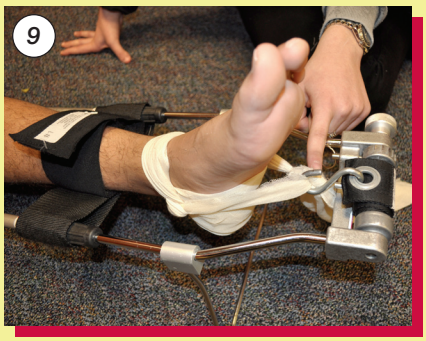
Flip your longer "moving" right portion over the top and bring the shorter left portion straight up; the moving portion is wrapped around forming a simple half hitch.



Bring the moving portion around the bottom of the arch of the foot and back to its origin. Tuck this portion under the original band and bring it back to the bottom, meeting the other tail. Using both hands – and with equal pull – remove all slack from the hitch.

The hitch is now complete. Finish it with a "square knot" (left over right, right over left). Under no circumstances use a bowknot; the knot is the only thing between a successful traction splint and failure. The only dependable knot to hold under actual field conditions is a square knot.

The rescuer's finger indicates the proper location for the Hare "S" hook to pass through, as shown in this photo and the next one.



Final hitch as attached to the Hare "S" hook.