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Review Article

A Review on Traction in Orthopedics

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ABSTRACT

Traction in Orthopedic and trauma has been an age-long practice designed to provide a pulling force to achieve the desired purpose. We aim to write this article to describe indications, applications of various forms of traction, and their relevant complications. In areas with limited resources for advanced treatment options, traction is still used to fill its traditional roles some roles in orthopedic and trauma care. Several methods for placing skeletal traction have been described, and it is critical for orthopedic surgeons not only to be proficient in their application but also to understand the appropriate indications for use.

Keywords: Orthopedic, Trauma, Indications, Skeletal.

INTRODUCTION

Traction in Orthopedics

Traction is the application of a pulling force for medical purposes, to treat muscle or skeletal disorders, for example, to reduce a fracture, stabilize 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, dislocation, long-duration muscle spasms and to prevent or correct deformities[1].

Traction can be used for either short term, for example at an accident scene, or in A&E as pain relief or as part of an interim care plan before surgery. It can also be used for long, as a part of a non-operative treatment plan. It is based on simple mechanical principle and is a well-established treatment in orthopedic settings. To pull (or apply) traction effectively, there must be something to pull against, which is endeavoring 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[1].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 practiced with caution and discretion[1].

Tibial Skeletal Traction

Skeletal traction is a treatment method for broken bones. It is a system where a combination of pulleys, pins, and weights are used to promote the healing of fractured bones. These are usually in the lower body. In skeletal traction, a pin is placed inside your bone[2].

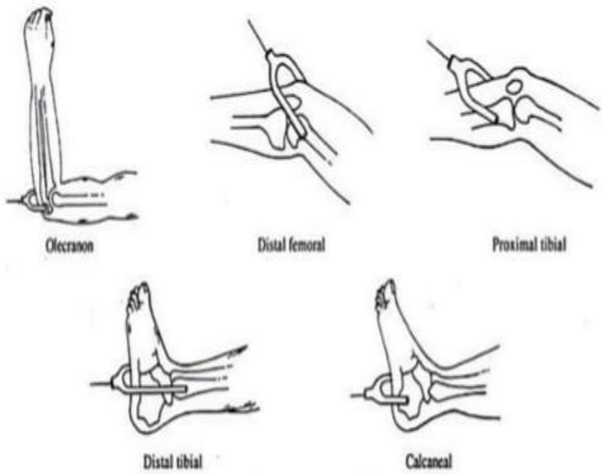

Figure 1: Sites of Skeletal Traction

PROCEDURE

Identify and demarcate the superficial landmarks around the proximal tibia. Make note of the medial and lateral knee joint lines and the four poles of the patella. The tibial tubercle and the fibular head should also be identified.

Identify the proper placement of the tibial traction pin[3]. This is generally approximately 2 fingerbreadths distal to the tibial tubercle and 2 fingerbreadths posterior and lateral on the tibia. Mark this trajectory on the lateral as well as the medial side where the pin will exit.

Use the prep solution to clean the leg on both the lateral and medial aspects[4].Start from the center and work circularly in an outward direction. Don sterile gloves and place sterile towels around the proximal tibia. Keep the knee joint in view in order to not block out any anatomical landmarks[5].

a. Apply local anesthesia around the marked trajectory of the pin on the lateral as well as the medial side where the pin would be expected to exit. Place the traction pin on the drill and then place the traction pin on the marked skin laterally. Generally, the tip of the traction pin is sharp enough to puncture through the skin. A small stab incision could also be made with a #11 blade scalpel.

b. In our practice it has been found that stab incisions with a scalpel can stretch over time especially with weighted traction, therefore it is not generally used[6]. After going through the skin, subcutaneous, and soft tissue, palpate for bone. The proximal tibia is close to the subcutaneous tissues.

c. Once on bone, walk the pin slightly anterior and slightly posterior in order to gauge that the pin is relatively central on the bone. While the more critical neurovascular structures are on the posterior aspect of the tibia, it is also important not to be too anterior on the tibia to ensure that the pin has adequate depth when weighted traction is applied. Confirm that the pin is parallel to the knee joint line. Once confirmed placement on the tibia, drill full speed and drive the pin through the bone and through the soft tissue and skin on the medial side[7]. Even out the amount of the pin that is outside the skin on both the medial and lateral sides. This will ensure that there is enough space on both the medial and lateral sides for the application of the traction bow and pin caps.

Place pin caps on the tip of either side of the pin to protect both the patient and staff. Alternatively, blood collecting test tubes can be utilized. Place Xeroform over the pin sites on the skin. Apply the traction bow and wrap the pin sites with Kerlix and continue to wrap the entire traction bow with Kerlix.

This acts as a cushion buffer in case the traction bow ever makes contact with the patient's skin. Cut traction rope and applies a traction knot. Apply rope to the traction bow with a hook and then attaches traction apparatus to the bed. Hang weights from the hook. Use 5-pound increments. Ensure that the traction bow is not resting on the patient distal to the traction pin site. A fully wrapped Kerlix can be placed directly on the skin at this level to ensure the traction bow does not come in contact with the patient's skin in order to avoid a pressure ulcer.

Obtain post-traction radiographs to determine if more or less weight is needed. While skeletal traction may be sound daunting at first, understanding anatomical considerations, being prepared with all necessary equipment, and following these clear and concise steps will lead to success[8].

BOHLER BRAUN SPLINT

Bohler-Braun is used in the conservative management of fractures of the lower limb. The splint is cumbersome making it difficult to work within situation where compactness of the splint is required. This work is a modification of the splint into a portable version[9].

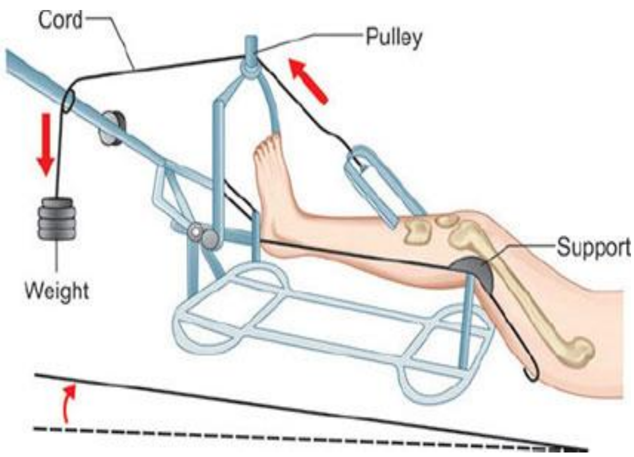

Figure 2: BOHLER BRAUN SPLINT

Structure

It consists of an iron frame with a set of 4 pulleys for application of mobile traction. It is modified from Braun splint which consists of only one pulley for distal tibia or calcaneal skeletal traction.

Bohlers Modification: addition of two more pulleys for proximal tibia and distal femur traction[10].

Uses of 4 pulleys

1st (Lowermost): Tibia and fibula injuries

2nd (Second from bottom): supracondylar fracture femur

3rd (directed away from patient): fracture shaft femur middle third

4th (topmost and directed towards the patient): prevents foot drop[11].

Uses With traction

For lower limb injuries with displacement / fragment overlap: The skeletal fraction is given via a K wire, Steinman pin, Bohler's pin, etc.

In leg fracture: pin through calcaneal tuberosity

In femur fracture: pin through tibial tuberosity in adults, just above condyles in children[12].

Without traction

Compound fracture with no overlap, for dressing and wound cafe and possible immobilization, soft tissue injury to leg, rest in case of cellulitis, gangrene, amputation, etc[12].

Advantages

Mobile traction is especially useful in cases where transportation is necessary as the traction unit I self-contained, limb in comfortable position, wound care possible, multipurpose application. Angle of traction can be changed by changing the pulleys [no change in arrangement required). Simultaneous traction through Calcaneal/distal tibia and proximal tibia/distal femur can be given[13].

Disadvantages & complications

Non ambulatory, Stiffness / contracture

Urination and defecation become difficult, common personal nerve compression

Other complications of recumbence like bed sore, hypostatic pneumonia etc[13].

Precautions or regular monitoring is needed for patients in traction

5 P's – Pulse/pins and needle; Pressure sores; Pintract infection; Physiotherapy; Portable radiographs

1. Pulse and pins and needles - Distal Neurovascular status sensation, distal pulsation, nailbed circulation, pain on passive dorsiflexion [sign of compartment syndrome]

2. Pressure sores – heel, ischium and other pressure areas

3. Pin tract Infection – detect early signs like pain, swelling, redness, discharge.

4. Physiotherapy – ankle mobilization to prevent equinus, anti-foot drop splint at nights. Knee and other joints mobilized if possible. Static quadriceps to be encouraged

5. Portable radiograph – biweekly or as and when required in first 2 weeks and then weekly. Accordingly arrange the weight and direction of traction[14].

Tips and Tricks

1. Pressure from slings, wrappings, etc. or from the leg lying against the side of the frame can cause peroneal nerve damage. Make sure leg is not externally rotated, and check the neurovascular status every two hours.

2. Make sure the proximal end of the frame does not press into the perineum. A large dressing or pieces of sheep skin can be used to pad this area and can be easily changed if soiled[15].

3. Make sure elastic bandages are not tighter at the proximal rather than the distal end of the femur or lower leg, otherwise swelling may occur [in skin traction].

4. Usually, the patient can turn towards the splint for backcare, linen changes, etc. It may be easier if the bed is made with two folded sheets, one at the head and another at the foot underneath the splint. Then, if only one part of the bed needs changing, the splint will not have to be moved[15].

5. If possible, apply an anti-embolism stocking to the unaffected leg.

6. Passive mobilization of Patella to prevent patella femoral adhesions.

7. Chest physiotherapy to prevent lung complications.

8. In cases of supracondylar fractures of femur, provide support/padding at the fracture site to prevent angulations and avoid padding at the knee joint which might contribute to angulation[15].

SKIN TRACTION

Skin traction is used when the **soft tissues, such as the muscles and tendons, need to be repaired.** Less force is applied during skin traction to avoid irritating or damaging the skin and other soft tissues[16].

1. General considerations

- Inadequate pain relief
- Loosening
- Constriction
- Friction with skin necrosis

Traction configurations

Straight skin traction is achieved with weight over the end of the bed.

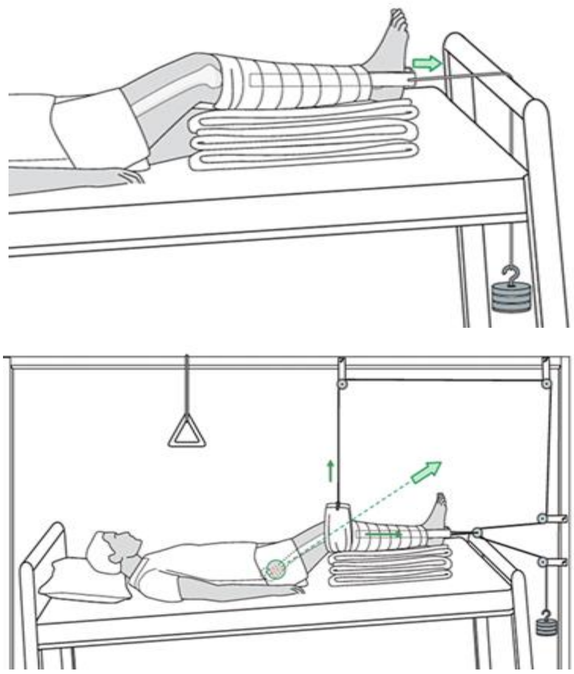

Figure 3: Straight Skin Traction

If skin traction is likely to be used for more than 24 hours, greater patient comfort and better control of the fracture can be achieved using balanced skin traction (Hamilton-Russell), which allows for a slightly flexed knee and hip and elevation of the extremity[17].This configuration of traction and leg support also can be adjusted to control femoral rotation by directing the upward support medially or laterally[17].

2. Application of skin-traction kit

This photograph shows a commercially available skin-traction kit.[18]

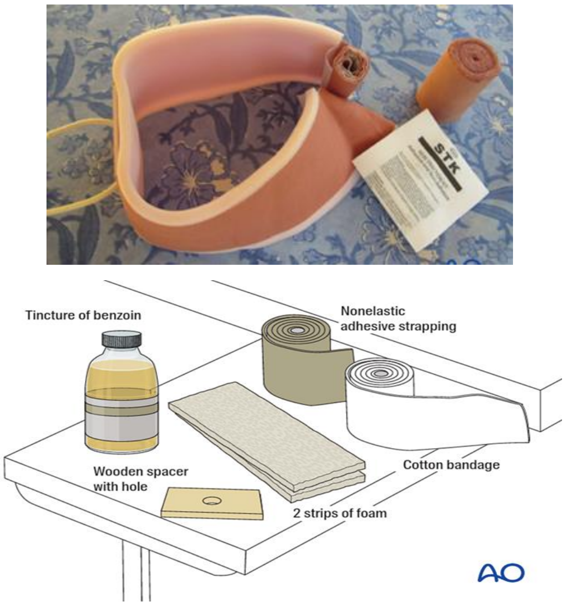

Figure 4: Skin Traction Kit

A simple skin-traction kit can be made easily with a roll of nonelastic adhesive strapping (approximately 3 inches, 8 cm, wide), Foam padding for the malleolar region and wooden spacer block (suitably drilled for cord attachment)

Before application of adhesive traction strip, the skin should be painted with friar's balsam (tincture of benzoin) or equivalent, then apply the strip to the lower leg from the level of the knee to the supramalleolar region. Apply the strapping to the inner side of the leg, then unroll it a little further to allow placement of the spacer and the foam, thereafter apply it to the outer side of the leg. It is important to ensure that the wooden spacer lies transversely, i.e., parallel to the sole of the foot[18].

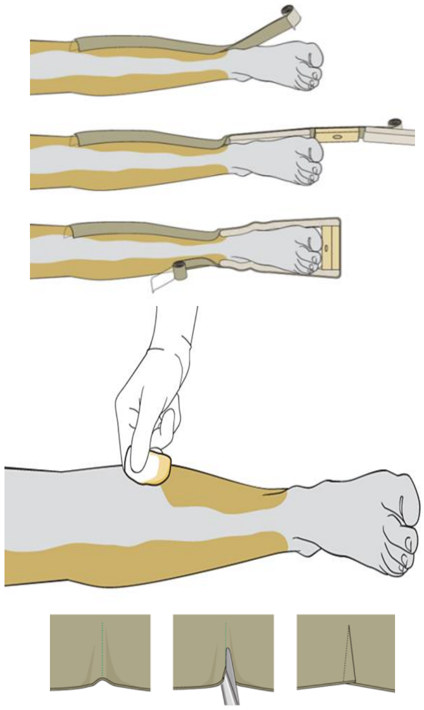

Figure 5: Applying procedure of skin traction

To prevent the development of blisters, the skin traction needs to be applied without folds or creases in the adhesive material, and the covering bandage should be nonelastic. Should a crease be inevitable due to the contour of the limb, the creased area should be lifted and partially slit transversally, and the edges overlapped.

Once the adhesive strip is satisfactorily in place, ensuring that the padded lower section overlies the malleoli, an inelastic bandage is carefully wrapped around the limb from just above the malleoli to the top of the strip[18]. Apply the overlying bandages spirally, overlapping by half.

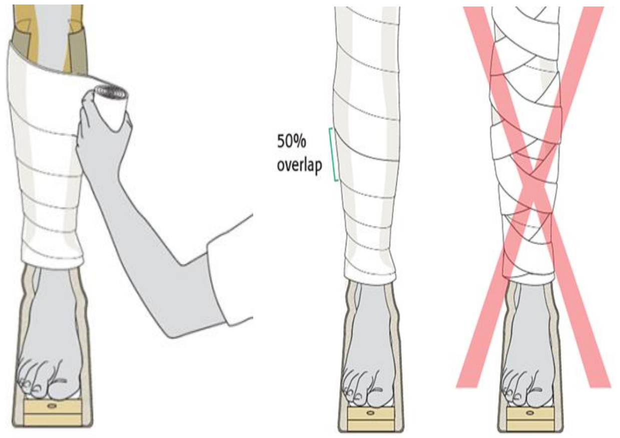

Figure 6: Applying procedure of bandage

3. Positioning of the lower extremity

As the proximal fragment position cannot be influenced, traction has been used to align the distal extremity to align the fracture. Typically, this requires mild flexion, abduction, and slight external rotation[19].

4. Straight skin traction

With straight skin traction, padding has been added under the patient's calf to keep the heel from pressing on the bed beneath it[20].

Note: With any longitudinal traction, the surface of the bed should be tilted, e.g., with blocks at the foot of the bed or in Trendelenburg, to counteract the tendency for the traction weights to pull the patient down the bed. With the tilted bed, the weight of the patient acts as countertraction[20].

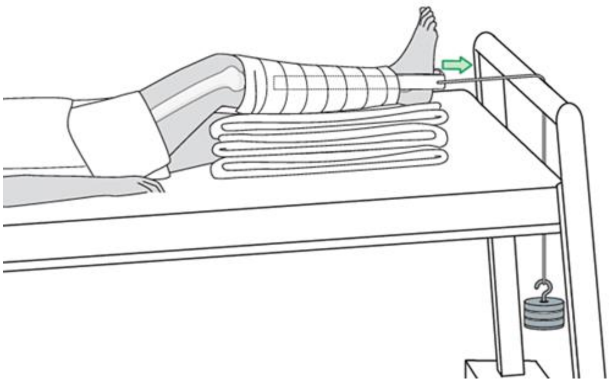

Figure 7: Straight skin traction

5. Balanced skin traction

To apply balanced skin traction, a dedicated orthopedic bed or a standard bed in combination with a mobile Balkan beam frame is needed[21]. A padded sling is placed behind the slightly flexed knee and applies skin traction to the lower leg. The principle of the parallelogram of forces determines that the upward pull of the sling and the longitudinal pull of the skin traction create a resulting force in the line of the femur, as illustrated.

This configuration of traction and leg support can also be adjusted to control femoral rotation by moving the overhead bar medially (internal rotation) or laterally (external rotation) [21].

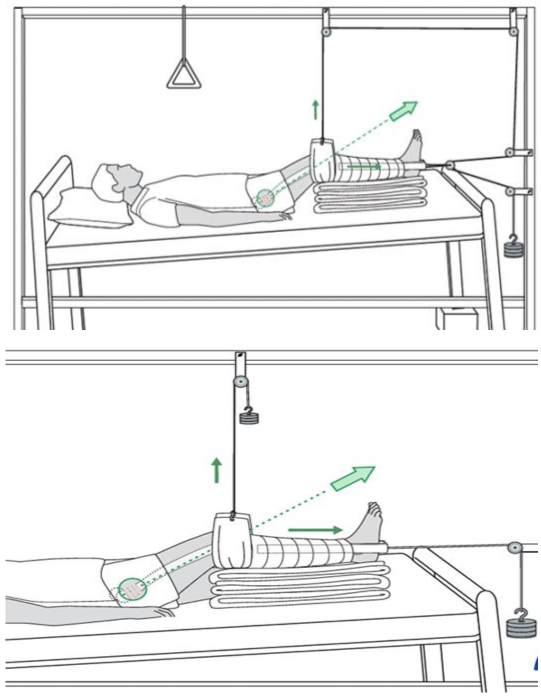

Figure 8: Balanced skin traction

A simpler alternative to this technique involves two separate systems:

- A sling suspended from the overhead frame or supported with a rope and pulley counterweight to provide an upward force, which lifts the leg off the bed
- Longitudinal (distal) traction applied with skin or skeletal technique[22].

The resulting vector force, as illustrated, is oblique (the vector sum of the upward and distal forces applied by the two weights).

6. Assessment of reduction

After traction has been set up, an x-ray is taken to check for acceptable fracture alignment. That is readjusted as necessary. The skin is assessed, especially bony prominences for breakdown, as well as neurovascular status, respiratory status, including rate and patter, breath and lung sounds, ability to cough and breathe deeply. Evaluate muscle strength and tone and mobility in affected and unaffected areas[23].

7. Mobilization in bed

Assisted active mobilization and chest physiotherapy should start from the first day. With the aid of a trapeze bar, as shown, patients can lift themselves, and the traction system allows mobilization of the knee. 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[24].

EXTERNAL FIXATION

External fixation is a surgical method of immobilizing bones to allow a fracture to heal properly. It is used to provide stability to bone and soft tissue after a serious break but can also be applied as a procedure to correct bone misalignment, restore limb length, or protect soft tissue after a serious burn or injury[25].

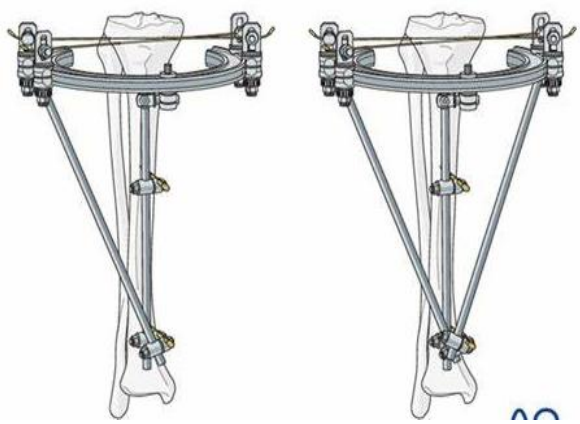

Figure 9: External Fixations to Repair Broken Bone

External fixation is accomplished by placing pins or screws into the bone on both sides of the fracture. The pins are secured together outside of the skin using a series of clamps and rods known as the external frame. External fixation is performed by an orthopedic surgeon and is usually done under a general anesthetic. The procedure itself typically follows the following steps:

1. Holes are drilled into the undamaged areas of bones around the fracture.

2. Special bolts are screwed into the holes.

3. Outside of the body, rods with ball-and-socket joints are joined with the bolts.

4. Adjustments can be made to the ball-and-socket joint to ensure the bone is aligned properly with as little, if any, shortening of a bone.

The areas of skin that have been pierced by the procedure need to be cleaned regularly to prevent infection. In some cases, a cast may need to be applied. The removal of the bolts and external frame can usually be done in a doctor's office with no anesthesia. Fractures have been known to occur at the drill sites and, as such, extended protection may be needed after removal of the device[26].

Advantages and Considerations of External Fixation

The main advantage of external fixation is that it is quickly and easily applied. The risk of infection at the site of the fracture is minimal, although there is a chance of infection where the rods have been inserted through the skin. External fixators are often used in severe traumatic injuries as they allow for rapid stabilization while allowing access to soft tissues that may also need treatment. This is particularly important when there is significant damage to skin, muscle, nerves, or blood vessels.

The external fixation also ensures the ideal compression, extension, or neutralization of bone placement while allowing for movement of the nearby joints. This not only aids in setting the bones correctly, but it can also help minimize muscle atrophy and edema (the buildup of excess fluid) caused by the total immobilization of a limb[27].

External fixation is contraindicated under the following circumstances:

- Bone-related disorders or deterioration that makes stabilization less assured.

- Persons who are not able or willing to properly care for the pins and wires.

- A person with severely compromised immune systems who are at higher risk of infection.

Other Uses of External Fixation

Beyond the immediate repair of severe or compound fractures, external fixation can be used to treat or repair other conditions. These include surgeries to correct bone malformations that result in the shortening of a limb. External fixation can also be used to retain the integrity of bone structures (such as the hand) after a serious burn or injury. Without fixation, the exposed or damaged tissue can contract from the accumulation of scar, causing long-term or even permanent restriction of movement[28].

Vacuum-assisted closure

Vacuum-assisted closure of a wound is a type of therapy to help wounds heal. It is also known as wound VAC. During the treatment, a device decreases air pressure on the wound. This can help the wound heal more quickly.

Figure 10: Vacuum-assisted closures

The gases in the air around us put pressure on the surface of our bodies. A wound vacuum device removes this pressure over the area of the wound. This can help a wound heal in several ways. It can gently pull fluid from the wound over time. This can reduce swelling, and may help clean the wound and remove bacteria. A wound VAC also helps pull the edges of the wound together. And it may stimulate the growth of new tissue that helps the wound close.

A wound vacuum system has several parts. A foam or gauze dressing is put directly on the wound. An adhesive film covers and seals the dressing and wound. A drainage tube leads from under the adhesive film and connects to a portable vacuum pump. This pump removes air pressure over the wound. It may do this either constantly. Or it may do it in cycles. The dressing is changed every 24 to 72 hours. During the therapy, you'll need to carry the portable pump everywhere you go.

It can gently pull fluid from the wound over time. This can **reduce swelling, and may help clean the wound and remove bacteria**. A wound VAC also helps pull the edges of the wound together. And it may stimulate the growth of new tissue that helps the wound close[29].

Why one might need vacuum-assisted closure of a wound?

One might need this therapy for a recent traumatic wound/or may need it for a chronic wound. This is a wound that is not healing properly over time. This can happen with wounds linked to diabetes. One may need a wound VAC for having a recent skin graft and for a large wound. Large wounds can take a longer time to heal[30].

A wound vacuum system may help wound heal more quickly by:

- Draining excess fluid from the wound
- Reducing swelling
- Reducing bacteria in the wound
- Keeping wound moist and warm
- Helping draw together wound edges
- Increasing blood flow to wound
- Decreasing redness and swelling (inflammation)

Wound VAC offers some other advantages over other types of wound care. It may decrease ones overall discomfort. The dressings usually need changing less often. And they may be easier to keep in place[31].

What are the risks of vacuum-assisted closure of a wound?

Wound VAC has some rare risks, such as:

- Bleeding (which may be severe)
- Wound infection
- An abnormal connection between the intestinal tract and the skin (enteric fistula) [32].

Proper training in dressing changes can help reduce the risk of these problems. Certain problems can increase risk of complications, such as:

- Exposed organs or blood vessels
- High risk of bleeding from another health problem
- Wound infection
- Nearby bone infection
- Dead wound tissue
- Cancer tissue
- Fragile skin, such as from aging or longtime use of topical steroids
- Allergy to adhesive
- Very poor blood flow to wound
- Wounds close to joints may reopen due to movement[33].

CONCLUSION

Traction still has some role in current practice particularly in resource-challenged regions as well as in the developed world especially as temporary treatment, pre, intra, and postoperative periods in orthopedics and trauma. We hope this provides an aid for the practitioner when the need arises, to guide them in application, planning and decision-making processes when traction is considered.

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