A Novel Technique for Applying Skeletal Traction to the Lower Extremity

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INTRODUCTION:

Skeletal traction is an important tool for temporary stabilization of long bone and pelvis fractures. Application in the emergency setting requires several specialized tools and bed components, which can be time-consuming to obtain and lead to delays in care. In this study we tested a novel "speed traction" setup on a Sawbones model. This setup requires only a Steinmann pin and nylon rope and can be utilized on any type of bed or stretcher. The purpose of the study was to determine the smallest pin diameter necessary to safely apply this setup.

METHODS:

A traction model was created by fastening a Sawbones femur to a plywood base. A 2.0mm smooth Steinmann pin was placed in the distal femur 4cm proximal to the intercondylar notch. A ruler was positioned onto the base directly below the pin. A segment of nylon rope with a loop on each end was placed around the pin at a standard distance from each end. Weight was then attached to the rope and allowed to hang freely from the end of the base, starting with 15 pounds and increasing by 5 pound increments up to 35 pounds. At each 5 pound increment the amount of pin deflection was measured to the nearest 1/10th millimeter by taking photographs of the pin from above. If pin deflection increased beyond a certain threshold then the weight overcame the frictional force created at the rope/pin interface and the setup failed. If this occurred then we moved on to the next available pin size until all pins had either failed or reached the 35 pound weight. These same steps were repeated using a Kirschner bow and Bohler pin holder for comparison. We then analyzed the data to find the smallest pin diameter able to withstand the maximum weight without failure.

RESULTS:

Using a thin wire (2.0mm) and a Kirschner bow, deflection was 10.5mm at 35 pounds. The overall trend showed that larger pin diameter resulted in smaller amounts of deflection. The 2.8mm smooth Steinmann pin was the smallest diameter pin that successfully withstood the maximum weight without failing, showing a deflection of 23.8mm at 35 pounds. However, at 20 pounds of weight, the 2.8mm pin deflection was only 12.5mm. The setup was left in place for 48 hours without further increase in deflection.

Smooth pins outperformed threaded pins of equal diameter for all pins and weights with the "speed traction" setup.

DISCUSSION AND CONCLUSION:

The 2.8mm smooth Steinmann pin demonstrated the ability to withstand 35 pounds of weight in this simulation of distal femoral traction using a novel "speed traction" setup. Also, when only 20 pounds was applied, the deflection was within 2mm of the Kirschner bow setup, a difference that was considered clinically equivalent. While larger diameter pins could also tolerate the application of traction weight without significant deflection, minimizing the size of the pin decreases the amount of soft tissue and bony disruption upon insertion. This novel design has several advantages for the on-call surgeon. It can be applied quickly and easily with limited tools in an austere environment. It does not require the use of a formal tensioning device such as Kirschner bow, though this may be applied later if desired. By eliminating the need for a tensioning device, traction can be applied and removed easily during transfer of the trauma patient and minimizes the risk of skin complications that could be caused by a Kirschner bow resting on the anterior tibia. It also eliminates the requirement for a traction frame or specialized bed setup, which cannot be applied to most stretchers and is often not available for several hours after arrival, thus decreasing potential delay and patient discomfort.

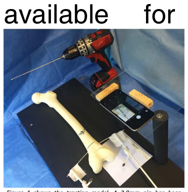


Figure 1 shows the traction model. A 2.8mm pin has been placed through the distal femur. This demonstration photograph shows silk tape in place to prevent the nylon cord from sliding.

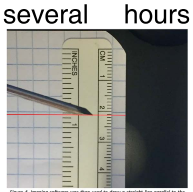


Figure 4. Imaging software was then used to draw a straight line parallel to the graph paper lines and through the tip of the pin. Deflection equals the distance measured on the ruler minus the reference distance with no weight applied.

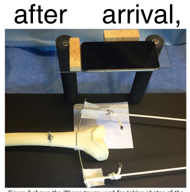
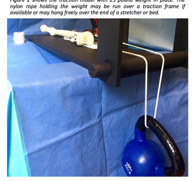
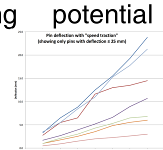


Figure 3 shows the iPhone tower used for taking photos of the pin and underlying ruler/graph paper at each 5 lb increment in weight.

Figure 2 shows the traction model with 25 pound weight in place. The nylon rope holding the weight may be run over a traction frame if available or may hang freely over the end of a stretcher or bed.





Pin deflection in millimeters with increasing weight using "speed traction" setup

	Weight (lb)						
	5 lb	10 lb	15 lb	20 lb	25 lb	30 lb	35 lb
2.0 Smooth	12.0						
2.0 Thread	16.0	31.5	51.0	71.0			
2.4 Smooth	8.8	14.0	23.0	28.0			
2.4 Thread	19.5	31.8	46.8	63.5	79.5		
2.8 Smooth	3.3	6.5	8.8	12.5	15.5	19.3	23.8
2.8 Thread	17.5	27.5	33.5	47.5	63.0	73.0	84.0
3.2 Smooth	2.8	5.5	6.5	11.6	13.0	13.5	14.5
3.2 Thread	6.0	11.5	16.5	25.8	29.5	33.5	40.7
3.6 Smooth	1.7	2.7	3.9	5.2	6.6	8.9	10.7
3.6 Thread	8.9	13.1	19.1	28.1	31.7	36.1	42.3
4.0 Smooth	1.0	1.8	2.6	3.6	4.9	5.6	6.0
4.0 Thread	3.5	5.5	8.4	11.0	15.3	17.8	21.3
4.8 Smooth	0.5	0.9	1.5	2.0	2.3	2.6	3.0
4.8 Thread	1.0	2.1	3.0	4.3	5.3	6.5	6.8