The Journal of Emergency Medicine, Vol. ■, No. ■, pp. 1–9, 2017
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0736-4679/$ - see front matter

https://doi.org/10.1016/j.jemermed.2017.12.002

Techniques and Procedures

HIP DISLOCATIONS IN THE EMERGENCY DEPARTMENT: A REVIEW OF REDUCTION TECHNIQUES

Michael Gottlieb, MD

Department of Emergency Medicine, Rush University Medical Center, Chicago, Illinois
Corresponding Address: Michael Gottlieb, MD, 1750 West Harrison Street, Suite 108 Kellogg, Chicago, IL 60612

☐ **Abstract—Background: Hip dislocations are a common presentation in the Emergency Department (ED) and require urgent reduction to reduce the risk of avascular necrosis. Over 90% of all dislocations can successfully be reduced in the ED and there is evidence that cases awaiting operative reduction result in significant delays. Discussion: While there is limited data comparing specific techniques, the individual success rates of most maneuvers range from 60-90%. Additionally, each technique has distinct advantages and limitations associated with its use. Conclusions: It is important for Emergency Physicians to be familiar with several different reduction techniques in case the initial reduction attempt is unsuccessful or patient characteristics limit the use of certain maneuvers. This article reviews a number of reduction techniques for hip dislocations, variations on these techniques, and advantages and disadvantages for each approach.** © **2017 Elsevier Inc. All rights reserved.**

☐ **Keywords—dislocation; hip; reduction; relocation**

INTRODUCTION

Hip dislocations are a common emergency department (ED) presentation, with studies suggesting an increasing incidence in North America (1–3). The hip joint is a ball-and-socket joint that is supported by multiple strong capsular ligaments (4–6). However, these ligaments may get disrupted when a strong force is applied to the femur, most commonly after motor vehicle collisions (4). In addition, reports have suggested that approximately 7% of all total hip replacements sustain a subsequent dislocation (7).

Reduction of a hip dislocation is often more challenging than dislocations of other locations, with most patients requiring procedural sedation to facilitate the reduction (8,9). Experts recommend up to 3 attempts at closed reduction before considering operative reduction (4). However, approximately 10% of all hip dislocations may be irreducible in the ED setting, requiring operative reduction under general anesthesia (10). Importantly, dislocated hips are at significant risk of avascular necrosis and operative delays may be substantial, with 1 study demonstrating a mean time delay of 10.9 hours among cases requiring general anesthesia (2,4,8,11). Therefore, it is essential for emergency physicians to be familiar with multiple techniques when performing reductions of hip dislocations, especially if the first technique is unsuccessful. This review is intended to describe several different reduction maneuvers, variations on these techniques, and advantages and disadvantages for each approach (Table 1).

DISCUSSION

Allis Technique

The Allis technique is a well-known approach that is still frequently performed in many EDs. This technique was

Reprints are not available from the authors.

Received: 20 September 2017; Final submission received: 3 November 2017;
Accepted: 1 December 2017

Table 1. Review of Techniques for Hip Dislocation

Name	Technique	Advantages	Disadvantages
Allis	Provider grasps affected leg with both knee and hip flexed to 90° applying traction toward the ceiling	Well-established	Risk of falls and lower back injury to the provider
Bigelow	Provider grasps affected leg with both knee and hip flexed to 90°, applying in-line traction while abducting, externally rotating, and extending the leg	This technique is no longer recommended	Risk of falls and lower back injury to the provider. Increased risk of femoral neck fractures
East Baltimore lift	Two providers place their arms underneath the affected knee with their knees bent and their hands on each other's shoulders. Providers slowly stand up while countertraction is applied to the patient's ankle	Strong, controlled upward force and ability to internally and externally rotate the hip	Multiple providers are needed
Tulsa/Rochester/Whistler	Provider places the arm underneath the affected knee with the provider's palm on the flexed, unaffected knee. Using the forearm as a fulcrum, the provider applies downward pressure on the ankle, while internally and externally rotating the hip	Requires only 1 provider	Less upward force is possible. Potential injury to the provider's forearm
Flexion adduction	One provider flexes and maximally adducts the affected hip, while the second provider applies manual pressure on the femoral head	Allows for a controlled, steady reduction attempt	Limited data on efficacy
Foot fulcrum	Provider places patient's foot against his or her inner ankle and places provider's outer foot against the patient's femoral head. Provider grasps patient's flexed knee and leans backward	Requires only 1 provider and allows for a controlled, steady reduction attempt	Potential injury to provider's back and patient's sciatic nerve if incorrectly performed. Risk of fall injury
Howard	Provider grasps affected leg with both knee and hip flexed to 90°, applying in-line traction, while a second provider applies lateral traction	Allows for a slow, controlled reduction attempt	Multiple providers are needed. Limited data on efficacy
Lateral traction	Provider grasps affected leg in extension and applies in-line traction, while a second provider applies lateral traction	Valuable technique when the patient is unable to flex the affected hip	Multiple providers are needed. Limited data on efficacy
Lefkowitz	Provider places his or her knee underneath the affected leg with both knee and hip flexed to 90°. Provider applies a downward force on the patient's lower leg, using the knee as a fulcrum	Requires only one provider and allows for a controlled, steady reduction attempt	Potential to injure patient's knee ligaments. Difficult to provide significant force for the reduction
Captain Morgan	Provider places his or her knee underneath the affected leg with both knee and hip flexed to 90°. Provider plantarflexes ankle to facilitate the reduction	Requires only 1 provider and allows for a controlled, steady reduction attempt	May be more difficult in patients with longer legs
PGI	Provider gradually flexes knee to 120° of flexion, then abducts to 45°, and finally externally rotates until the hip reduces	Allows for a controlled, steady reduction attempt and does not require significant force	Limited data, but appears promising
Piggyback/rocket launcher	Provider places patient's flexed knee over his or her shoulder and rises to a standing position	Requires only 1 provider and allows for a controlled, steady reduction attempt	Excess pressure on the lower leg can injure the knee ligaments

(*Continued*)

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Table 1. Continued

Name	Technique	Advantages	Disadvantages
Skoff	Patient is placed in left lateral decubitus with the leg in 100° of hip flexion, 45° of internal rotation, 45° of adduction, and the knee bent to 90°. In-line traction is applied to the leg, while another provider applies pressure to the greater tuberosity	Allows for a controlled, steady reduction attempt	Multiple providers are needed. May be difficulty to palpate the greater tuberosity. Limited data on efficacy
Stimson	Patient is placed prone with the affected leg 90° past the end of the gurney. Downward traction is applied by the provider using either the provider's arm or the provider's bent knee	Well-established. Uses gravity to facilitate the reduction	Multiple providers are needed. Difficulty to monitor the patient in the prone position. Potential for the patient to fall off the gurney
Traction–countertraction	Patient is placed in left lateral decubitus with the leg in 100° of hip flexion, 45° of internal rotation, and 45° of adduction. One provider applies posterior traction at the upper thigh, while a second provider applies anterior traction at the lower leg	Allows for a controlled, steady reduction attempt. The use of bed sheets for traction allows the provider freedom to use his or her hands to facilitate the reduction	Multiple providers are needed. Limited data on efficacy

first described in 1895 and is performed with the patient supine and the provider on top of the bed (12). The provider grasps the affected leg at the knee and flexes both the hip and the knee to 90° (Figure 1) (12). The provider then applies traction toward the ceiling until the hip is reduced (12). An assistant or bed sheet may be used to stabilize the patient to the bed during the reduction attempt. Alternatively, the patient may be strapped into a backboard to provide countertraction and support. While the original description involved no rotation at the hip joint, it is generally recommended to perform gentle internal and external rotation to facilitate the reduction attempt. This technique has been suggested to be effective in approximately 60% of reduction attempts (8,13).

Despite the relatively common use of this technique, there are several disadvantages with this approach. The use of primarily lower back muscles may not allow as much force to be used for the reduction attempt. In addition, the awkward position may place the provider at risk of lower back injury. Finally, if the provider performs the procedure while standing on the bed, there is also a significant risk of the provider falling off the bed. Alternatively, the procedure could be performed with the provider standing next to the bed, or by placing the patient on a backboard on the floor to reduce the risk of injury to the provider (Figure 2).

Figure 1. Traditional Allis technique.

Figure 2. Allis technique performed from a standing position at the bedside.

Bigelow Technique

This is the oldest technique still used for hip reductions, dating back to 1870 (14). The Bigelow technique is similar to the Allis technique, in that the provider begins on the patient's bed with both the knee and hip of the affected side flexed to 90° (14–16). The hip begins in an adducted and internally rotated position (14–16). The provider then applies in line traction to the femur, while gently abducting, externally rotating, and extending the lower leg (14–16). Similar to the Allis technique, an assistant or bed sheet is necessary to stabilize the patient to the bed. This technique carries similar risks as the Allis technique described above, particularly the potential for lower back injuries and falling from the bed. In addition, this maneuver has been suggested to result in higher rates of femoral neck fractures and, therefore, is not recommended at this time (17,18).

East Baltimore Lift Technique

This technique is performed on the supine patient and requires several providers or assistants to be involved. Two providers stand on each side of the patient's gurney with their knees slightly bent and place their arms beneath the patient's knee with their hands on each other's shoulders (19). Another assistant provides downward pressure on the patient's ankle while the first 2 providers provide an upward force by rising to a standing position (19). Internal and external rotation may be necessary to facilitate the reduction. This may be modified by having one of the providers apply downward traction on the ankle while using the contralateral arm to lift the patient's leg (Figure 3). The advantage of the East Baltimore technique is the ability to provide a strong upward force by using the stronger quadriceps and gluteal muscles of both providers. However, a distinct disadvantage of this maneuver is the need for several providers to be present.

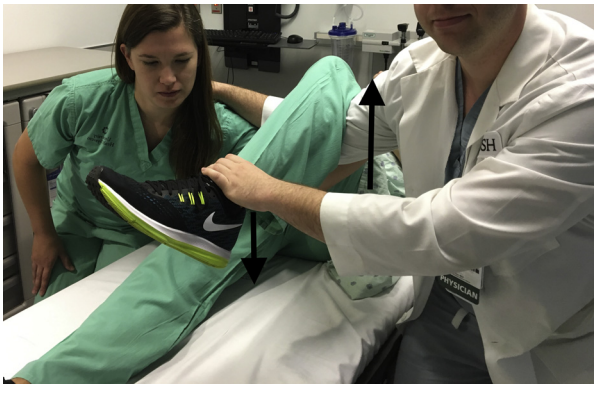

Figure 3. East Baltimore lift technique.

Tulsa/Rochester/Whistler Technique

A variation of the East Baltimore technique has been described in the literature simultaneously as the Tulsa technique, Rochester technique, and Whistler technique (13,20–22). With this technique, the patient flexes both hips and knees on the gurney. Then, the provider places his or her arm underneath the patient's affected knee and the provider's palm on the unaffected knee (Figure 4) (13,20–22). The physician places the other hand on the patient's affected ankle (13,20–22). Using the proximal forearm as a fulcrum, the provider applies downward traction on the ankle, while internally and externally rotating the hip (13,20–22). Nordt described successful reduction in 13 consecutive patients, while Walden and Hamer demonstrated similar effectiveness between the Whistler and Allis techniques (62.5% vs. 64.7%) with no significant complications in the treatment group (13,21). The primary advantage of this modified technique is the need for fewer providers to be present to perform the reduction attempt. However, the use of the provider's arm as a fulcrum puts significant force onto the relatively smaller bones of the forearm and carries some risk to the provider. In addition, this modification may not provide as much upward force as other techniques because the provider is relying on relatively weaker upper extremity muscles when compared with lower extremity muscles.

Flexion Adduction Technique

The patient begins in the supine position. One provider stands on the opposite side of the patient and lifts the contralateral, affected leg into flexion and maximal adduction, while proving inline traction with the femur (Figure 5) (18,23). The other provider stabilizes the pelvis, while applying manual pressure to the head of the femur (23).

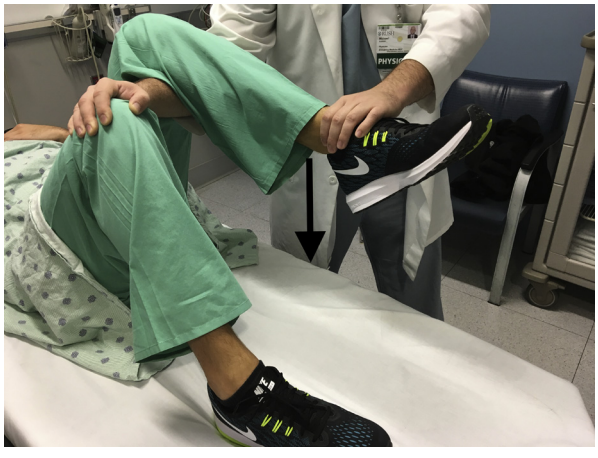

Figure 4. Tulsa/Rochester/Whistler technique.

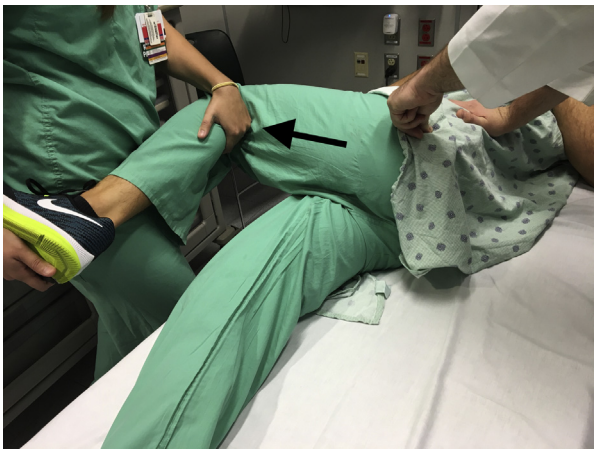

Figure 5. Flexion adduction technique.

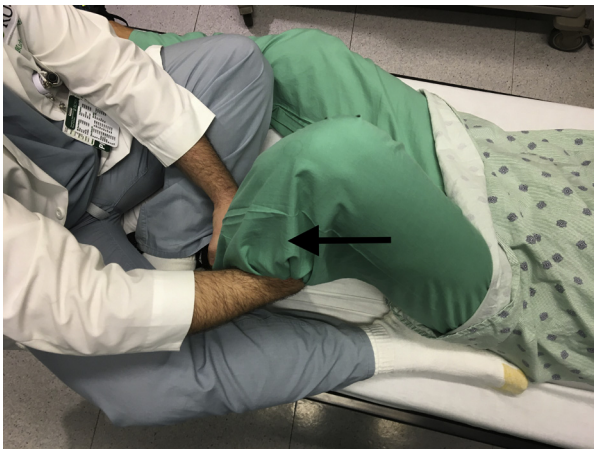

Figure 6. Foot fulcrum technique.

This technique allows for a controlled, steady reduction attempt, reducing the risk of injury to the patient or providers. Unfortunately, current data on the efficacy of this maneuver are limited to procedural descriptions (18,23).

Foot Fulcrum Technique

With this maneuver, the patient lies supine on the bed and the provider is seated on the bed at the patient's feet (24). Before the reduction, the provider gently flexes the patient's affected hip and knee as much as possible in order to shift the femoral head into a more posterior position (24). The provider places his or her inner foot against the anterior aspect of the patient's ankle and his or her outer foot on the posterolateral aspect of the patient's hip, palpating for the femoral head (24). The physician grasps the patient's flexed knee and leans backward, using the inner foot as a fulcrum, while using the outer foot to provide pressure against the femoral head (Figure 6) (24). This may be facilitated by applying internal and external rotation. The original authors were able to successfully reduce 15 of 19 dislocations using this technique (24).

This technique may be advantageous in locations with limited personnel, because only 1 provider is needed for this technique. However, this technique poses several risks to both the patient and provider. Similar to the Allis and Bigelow techniques, the provider may injure his or her back during the reduction and also has the potential to fall from the bed (12,14). In addition, if the outer foot pressure is not directed in the correct location, it is possible to cause significant damage to the patient's sciatic nerve.

Howard Technique

For this technique, the patient is supine on the gurney the affected knee and hip flexed to 90° (25). An assistant applies lateral traction to the affected thigh, while the other provider applies inline traction of the femur (Figure 7) (25). Often, the provider performing inline traction will also perform gentle internal and external rotation to facilitate the reduction (25). This technique may be facilitated by having the assistant use a bed sheet to apply the lateral traction. Unfortunately, there is minimal available evidence on the effectiveness of this technique.

Lateral Traction Technique

This technique shares similarities with the Howard maneuver in that the patient is supine and lateral traction is applied to the midthigh by an assistant. However, as opposed to the Howard technique, the provider applies a longitudinal force along the length of the femur with the leg extended at the knee (Figure 8) (21). Often, the provider will need to perform internal rotation to facilitate the reduction (21). One advantage of this technique

Figure 7. Howard technique.

Figure 8. Lateral traction technique.

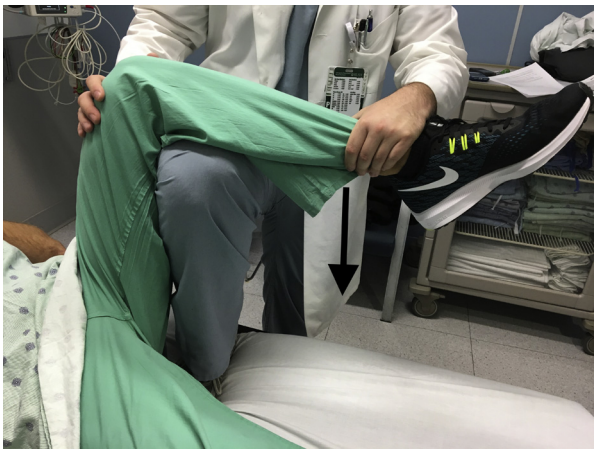

Figure 9. Lefkowitz technique.

is that it can be performed in patients who are unable to flex their hip—a limitation to most of the other described techniques. Unfortunately, there are limited data on the effectiveness of this technique.

Lefkowitz Technique

The Lefkowitz technique was first described in 1993 and is performed with the patient supine on the stretcher. The provider places his or her flexed knee under the patient's ipsilateral knee in the popliteal fossa (Figure 9) (26,27). The provider holds the patient's leg at the anterior thigh and ankle while an assistant stabilizes the patient (26,27). The provider applies a downward force on the patient's lower leg, using the knee as a fulcrum to elevate the hip (26,27). Internal and external rotation may be used to facilitate the reduction attempt. This technique is advantageous because it reduces the risk of back injury and does not require the provider to stand on the patient's bed. However, by using the knee as a fulcrum, the provider has the potential to damage the patient's knee ligaments during the reduction attempt.

Captain Morgan Technique

A modification of the Lefkowitz technique, referred to as the Captain Morgan maneuver, was described in 2011 (28). Differences with respect to this technique include the use of a backboard to stabilize the patient and a focus on elevating at the knee rather than applying downward pressure on the ankle. With this approach, the provider will plantarflex his or her ankle and lift upward with his or her hand to elevate the patient's leg and facilitate reduction (28). The original study by Hendey and Avila reported a 92% success rate with the isolated reduction failure requiring open reduction because of an intra-articular fracture fragment (28). Similar to the Lefkowitz technique, the Captain Morgan maneuver reduces the risk of back injury and does not require the provider to stand on the patient's bed. In addition, the Captain Morgan technique allows the provider to combine calf and upper extremity strength to facilitate the reduction, while reducing the traction forces on the patient's knee.

PGI Technique

The PGI technique, named after the Postgraduate Institute of Medical Education and Research, is one of the few reduction techniques that does not require traction on the femur (29). With this technique, the patient lies in a supine position with the knee bent to 90° (29). The provider begins by gradually flexing the knee to 120° of flexion (29). Next, the provider abducts the knee to approximately 45° of abduction (29). Finally, the provider performs gentle external rotation until the hip reduces (29). The authors do not recommend any traction be used in this technique (29). In their 15-patient sample, closed reduction was successful in 93% of patients with the isolated reduction failure necessitating operative reduction because of an intra-articular fracture fragment (29). This technique has significant promise because of the relative ease of reduction for the provider and decreased potential for iatrogenic injury.

Piggyback/Rocket Launcher Technique

For the piggyback technique, the patient is placed in the supine position near the end of the gurney. The patient's affected leg is flexed at the hip and the patient's knee is placed over the provider's shoulder (Figure 10) (5,30). Using the shoulder as a fulcrum, the provider applies a downward force on the patient's ankle until the hip is reduced. A modification of this approach, referred to as the rocket launcher technique, involves the provider

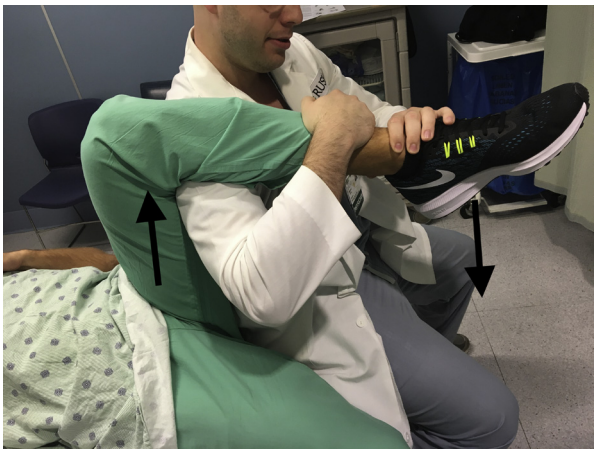

Figure 10. Piggyback/rocket launcher technique.

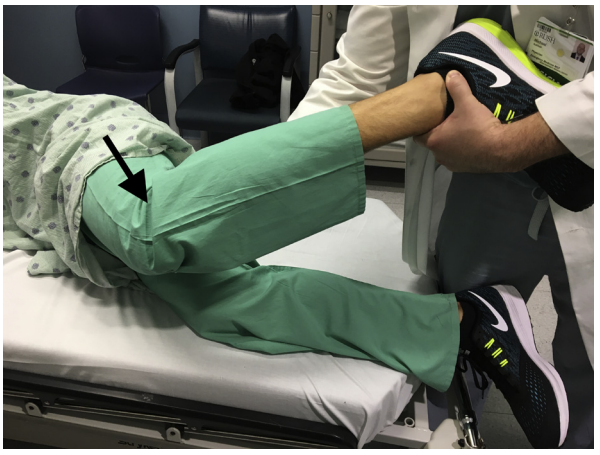

Figure 11. Skoff technique.

rising to a standing position while applying external rotation and abduction to the hip joint (31). This technique was able to successfully reduce 5 of 6 dislocations in a sample case series by Dan et al. (31).

This technique has the advantage of using the shoulder as a fulcrum, reducing the potential for provider injury when compared with the Whistler technique. In addition, the rocket launcher technique allows for a greater amount of force to be applied in a controlled setting by having the provider use the much stronger quadriceps and gluteal muscles.

Skoff Technique

For this technique, the patient is placed in the left lateral decubitus position with the affected leg facing upward (32). An assistant should position the leg in 100° of hip flexion, 45° of internal rotation, and 45° of adduction, with the knee bent to 90° (Figure 11) (32). The assistant will provide lateral traction in line with the femur, while the provider palpates for the deformity in the gluteal area and pushes on the greater trochanter to realign the femoral head with the acetabulum (32).

This maneuver is relatively simple to perform and offers the advantage of allowing gravity to assist the reduction. However, it may be challenging to palpate the greater tuberosity and defect among patients with a larger body habitus or by less experienced providers. Unfortunately, the current data on the effectiveness of this approach are limited to a case report.

Stimson Technique

This is one of the oldest described techniques for hip dislocation, dating back to 1883, when Lewis Stimson first described it (33,34). For this technique, the patient is placed prone on the gurney with the affected leg at 90° past the end of the gurney. The provider flexes both the hip and the knee to 90° while applying a downward force on the lower leg with one arm (33,34). The physician may use the other arm to internally and externally rotate the leg, while maintaining adduction until the hip reduces (Figure 12) (33,34). A modification of this technique has been described, wherein the provider places his or her knee behind the popliteal fossa and gently transfers the weight to the bent knee, thereby allowing both hands to be free with one stabilizing the patient and the other providing internal and external rotation of the hip (Figure 13) (35,36).

One advantage of this technique is the beneficial effect of gravity by allowing the weight of the leg itself to assist with the reduction effort. In addition, the provider uses downward force, resulting in a lower risk of falls or low back injury. A disadvantage of this technique is the requirement for prone positioning, which can make it more difficult to assess the airway during procedural

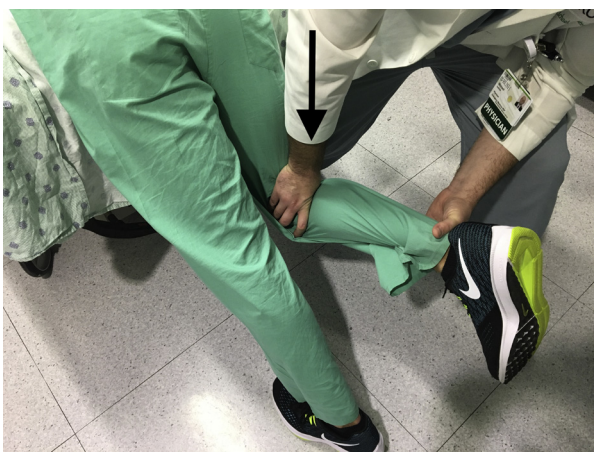

Figure 12. Stimson technique.

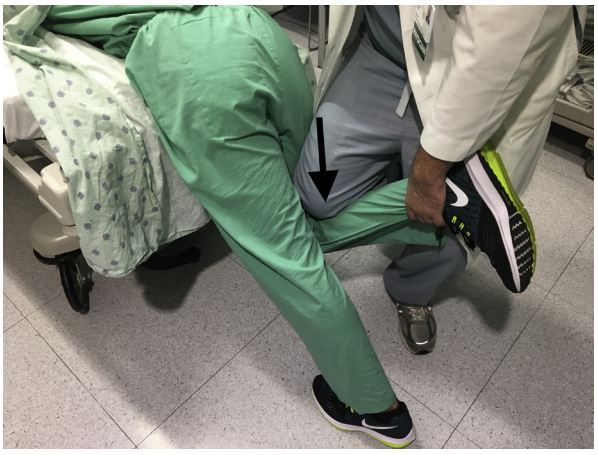

Figure 13. Modified Stimson technique.

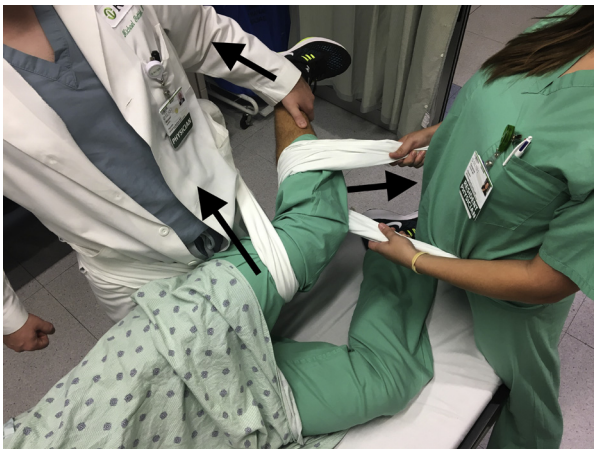

Figure 14. Traction–countertraction technique.

sedation. In addition, the patient positioning often requires a second provider to be present to help stabilize the patient from falling from the cart.

Traction–Countertraction Technique

The patient is placed in the left lateral decubitus position with the affect leg facing upward (37). An assistant positions the leg in 90° of hip flexion, 45° of internal rotation, and 45° of adduction, similar to the Skoff technique (32). Using bed sheets wrapped around the patient and providers, 1 provider applies anterior traction to the lower leg, while the other provider applies posterior traction to the upper thigh (Figure 14) (37). The closest provider will palpate for the deformity in the gluteal area and push on the greater trochanter to realign the femoral head with the acetabulum (37).

This technique offers similar advantages and disadvantages as the Skoff technique. In addition, the use of bed sheets to facilitate traction allows for freedom of the provider's hands to focus on more direct reduction and stabilization efforts. Unfortunately, there are limited data on the effectiveness of this technique beyond anecdotal experience.

CONCLUSION

While the above techniques have been used for hip dislocations, none has been demonstrated to have superior efficacy when compared with the others. Consequently, determining which technique should be used first often depends upon the patient and provider. For example, a patient that requires close airway monitoring should not be placed prone (e.g., Stimson), while a patient with contralateral extremity injury will not tolerate the lateral position (e.g., Skoff, traction–countertraction) or the use of the other extremity to facilitate the reduction (e.g., Whistler). As a result, one must tailor the attempt to the patient circumstances. Should the first attempt be unsuccessful, the provider is advised to attempt a different technique on the subsequent reduction attempt. Therefore, it is essential that emergency physicians be familiar with several reduction techniques to ensure the best likelihood of successful reduction.

Acknowledgments—The author would like to thank Kimbia Arno, MD, Christine Binkley, MD, MPH, and Chase Socha, MD, MPH for their assistance with the accompanying figures.

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