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Versatility of Tensor Fascia Lata Musculocutaneous Flap in the Management of Grade III & IV Trochanteric Pressure Ulcer

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Abstract: Background: Trochanteric pressure sore is the 2'" most common type of pressure sores and different surgical techniques and modifications of tensor fascia lata musculocutaneous flap had been developed. **Objective**: This is a prospective study that had been designed to evaluate using different surgical techniques of tensor fascia lata musculocutaneous flap in closure of grade III & IV trochanteric sore and the risk of complications. **Methods**: This is a prospective study which enrolled 15 patients with trochanteric pressure sore. The sample of this study had been selected from those patients admitted to Ibn Al-Kuff Hospital for Spinal Cord Injury during the period between March 2008 and September 2009. **Results**: Ten patients had been treated surgically with classical rotation tensor fascia lata flap, four patients had been treated by using V-Y advancement technique and only one patient had been treated with island approach. The vertical diameter of the trochanteric pressure sores which had been treated surgically using the classical rotation advancement tensor fascia lata flap was 8.5 cm while the vertical diameter of those ulcers treated by V-Y advancement was 3.97cm. Donor site had been closed directly in all of the 4 patients with V-Y advancement technique, and skin grafting was applied to all of the 10 patients treated with classical rotation technique and to the patient that was treated with island flap. All of the 10 patients, who had been treated with the classical rotation tensor fascia lata flap, had trochanteric pressure sore of 5 cm or more vertical diameter. On the other hand, all of trochanteric sore that had been treated with V-Y advancement had a vertical diameter of less than 5 cm. Five of the 10 patients with classical rotation advancement tensor fascia lata flap had no complications during the period of post-operative care. Only 1 patient treated with V-Y advancement tensor fascia lata flap developed post-operative complication (dehiscence). Dog ear deformity had been found in 4 patients treated with classical rotation technique, while none of those treated with the V-Y advancement technique had developed such a deformity. **Conclusion**: V-Y advancement tensor fascia lata flap is more applicable for smaller sized ulcers; its use makes the reconstructive surgeon able to directly close the donor site without using a skin graft, it is associated with less complications and dog ear deformity is eliminated by the usage of this technique. In addition, Classical rotation flap can be applied for any size of trochanteric ulcer despite the need for donor site closure by skin graft and the possibility of having more complications and the development of dog ear deformity which particularly appears with small sized flap.

Keywords: Tensor fascia lata, V-Y advancement, classical rotation, Trochanteric pressure sore.

INTRODUCTION

Pressure sores are localized areas of tissue necrosis that tend to develop when soft tissue is compressed between a bony prominence and an external surface for a prolonged period of time. The consequences of pressure-induced skin injury range from non-blanchable erythema of intact skin to deep ulcers extending down to the bone. (The National Pressure Ulcer Advisory Panel, 1989)

The development of a pressure sore is a complex process that requires the application of external forces to the skin(Reuler, J. B. *et al*., 1981).However, external forces alone are not sufficient to cause an ulcer; their interaction with host-specific factors culminates in tissue damage(Reuler, J. B. *et al*., 1981).

External factors that lead to the development of pressure sores include pressure, shearing forces, friction, and moisture(Reuler, J. B. *et al*., 1981).

Pressure applied to the skin in excess of the arteriolar pressure (32 mmHg) prevents the delivery of oxygen and nutrients to tissues, resulting in the accumulation of metabolic waste products (Kosiak, M, 1961). Shearing forces result in stretching and angulation of local blood vessels and lymphatics. Shear forces alone may not cause ulceration, but appear to have an additive effect so that in the presence of pressure, more severe tissue damage will occur (Bennett, L. *et al*., 1988).

Friction occurs when patients are dragged across an external surface. This results in an abrasion with damage to the most superficial layer of skin(Bennett, L. *et al*., 1988). Exposure to moisture in the form of perspiration, feces, or urine may lead to skin maceration and predispose to superficial ulceration (Cooney, L. M, 1997). A number of host factors may contribute to pressure sore development including immobility, incontinence, nutritional status, circulatory factors, and neurologic disease (Shea, J. D, 1998). Immobility is one of the most important host factors that contributes to pressure sore development. Immobility may be permanent (e.g., due to spinal cord injury) or transient (e.g., during

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an acute medical illness or from the use of sedatives) (Exton-Smith, A. N. *et al*., 1961). Urinary incontinence is frequently cited as a predisposing factor for pressure sores. Some studies suggest that incontinent patients have up to a five-fold higher risk for pressure sore development (Lowthian, P. T, 1976).

The role of nutritional status in the development of pressure sores is uncertain. (Berlowitz, D. R. *et al*., 2001)

The role of skin perfusion in the development of pressure sores has been increasingly recognized Contributing factors to the development of tissue ischemia have been postulated to include hypotension, dehydration, vasomotor failure, and vasoconstriction secondary to shock, heart failure, or medications. When vital organs such as the kidneys and gastrointestinal tract are not receiving adequate perfusion, it is likely that blood flow to the skin will also be decreased, which increases the risk for the development of pressure sores (Bliss, M. *et al*., 1999).

Neurologic diseases such as dementia, delirium, spinal cord injury, and neuropathy are important contributors to pressure sore development. This may in large part be related to immobility, spasticity, and contractures that are common in these conditions. Sensory loss is also common, suggesting that patients may not perceive pain or discomfort arising from prolonged pressure (Shea, J. D, 1998).

Pressure sores are usually easy to identify by their appearance and location overlying a bony prominence. The exception may be stage 1 ulcers, which can be difficult to recognize, particularly in patients with darkly pigmented skin. They also may be confused with other conditions that cause erythema such as cellulitis (Shea, J. D, 1998). Eschar often covers deep ulcers, making it difficult to determine whether lesions are stage 3 or 4. In addition, the extent of stage 4 ulcers is often underestimated due to undermining and fistula formation; a relatively small superficial skin defect may mask extensive deep tissue necrosis (Shea, J. D, 1998).

Pressure sores may be associated with both medical and psychosocial complications. The medical complications can be life threatening and are more common with stage 3 and 4 ulcers (11).

Schessel (Schessel, E. S, 2001) managed ulcers in elderly, debilitated patients, who were unable to walk, by constant tension approximation of the wound edges (Schessel, E. S, 2001).

Historically, John Staige Davis(13)in 1938 described the substitution of thin unstable scar from an ulcer with whole-thickness skin and subcutaneous fat. It was not until the 1970s, however, that a revolution in pressure sore coverage occurred with the development of the new popular musculocutaneous flap, when the TFL flap started to be used (Gusenoff, J. A. *et al*., 2002).

To prevent dog-ear deformity, several variations of the TFL flap preparation have been developed: Paletta, (1989) advocates advancement of the TFL flap according to the V–Y method in the late 1980s; Erco¨nen (1998) uses a V–Y TFL island flap; Demirseren,(2003) prepares a hatchet-shaped TFL flap, but he closes the donor site via Z-plasty.

The tensor fascia lata is a short flat muscle of the lateral thigh measures 12-15 cm in length. It is invested by 2 layers of the iliotibial tract that is continuous with the tensor fascia lata. The muscle serves as accessory flexor and medial rotator of the thigh. It originates from anterior aspect of the outer lip of the iliac crest, the lateral surface of the anterior superior iliac spine and the deep surface of the fascia lata. At the origin the tensor fascia lata lies between the gluteus medius and Sartorius muscle, superficial to the vastus lateralis and lateral to the origin of the Sartorius. The muscle blends with and inserts into the fascia lata in the middle third of the thigh. The blood supply of the muscles is from the transverse branch of the lateral femoral circumflex artery which arises from the deep femoral artery. Although, it may originate from the common femoral artery. The artery enters the muscle on its deep surface 6-8 cm from the anterior superior iliac spine. The vessel is 2-3 mm in diameter, on entering the tensor fascia lata the artery branches into vessels that run parallel to the muscle fibers and sends perforator to the skin. The descending artery continues beyond the muscle to supply the skin of the anterolateral midthigh and part of the lower thigh. Venous drainage is accomplished by vena comitantes measuring 1.8-2.5 mm associated with a major artery. The skin territory of the tensor fascia lata is supplied by 2 sensory nerves, the lateral cutaneous branch of the 12th thoracic nerve and the lateral cutaneous nerve of the thigh which is a branch of the 2nd and 3rd lumber nerves. The motor nerve supply is an inferior branch of the superior gluteal nerve (L4 and L5)(Stevenson, T. R. *et al*., 2008).

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PATIENTS & METHODS

This study had enrolled 15 patients with trochanteric pressure sore and These patients were selected from those attended or were admitted to Ibn Al-Kuff Hospital for spinal cord injuries during the period between March 2008 and September 2 All of the patients included in our sample were suffering from spinal cord injury, and were paraplegic or quadriplegic with sensory loss below the level of injury.

All of the patients were male and their age ranged from 16-42 year-old with a mean age of 27.3 years. Eight patients were in their twenties (i.e. 20-29 year-old) (54% of the sample).

The cause of spinal cord injury and trochanteric pressure sore was bullet injury in 11 patients (73.3% of the sample).

Regarding the type of the tensor fascia lata flap, 10 patients had been treated surgically with classical rotation tensor fascia lata flap, four patients had been treated by using V-Y advancement technique and only one patient had been treated with island approach.

Pre-Operative Preparation:

For all spastic patients, therapy with baclofen tablets is started and to be continued for 40 days in a starting dose of 5 mg three times a day and to be increased gradually toward the end of the 40 days according to the degree of spasticity.

The operative procedure had been done under sedation and an anesthetist was in constant attendance to monitor the patient vital signs and general conditions and to administer intravenous fluid and blood as required. The operative table is padded to prevent ulceration over a dependent prominence and the patient should be in the lateral decubitus position on the operative table . Operative Technique:

The anterior border of the tensor fascia lata musculocutaneous flap is designed by a line that extends from the anterior superior iliac spine down to the lateral tibial condyle. The posterior border of the tensor fascia lata musculocutaneous flap extends from the greater trochanter down to the lateral tibial condyle. The pedicle that supplies the tensor fascia lata musculocutaneous flap is located by a drawing a line which descends 8-10 cm below the anterior superior iliac spine(fig no. II A,B).

Installation of the methylene blue to identify the boundaries of the ulcers bursa. The ulcer and its bursa are excised. The prominence of the greater trochanter is shaved with an osteotome and rasping of the sharp edges of the bone. Any soft tissue calcifications and ossifications that might be present is removed. Hemostasis is done and the vertical and horizontal diameters of the ulcer are measured.

In general, when planning for tensor fascia lata musculocutaneous flap whether a V-Y technique or a classical rotation technique, maximum skin territory supplied by the descending branch of the lateral circumflex femoral artery was included in the design of the flap which is 8 cm above the lateral tibial condyle, the choice of the technique was made on an intraoperative judgment and was limited by the ulcer size (vertical diameter) and skin elasticity which is patient dependent.

The flap is raised by incision to the skin subcutaneous tissue and fascia lata at the distal skin border. Temporary suture are placed between the skin and the fascia lata to prevent dislodging the skin. The dissection is carried from the distal end of the flap proximally in a plane deep to the fascia lata overlying the vastus lateralis muscle. The flap is rotated or advanced over the excised ulcer and closure is done in layers and the final suture line should always be in a position where it will be not over a bony prominence and will not interfere with the usage with another flap that might be required to close another ulcer.

Closed suction drainage is applied under the flap and around the shaved bone and dressing is applied. Sutures are removed after 14days and the closed suction drain remains for 14 days and then removed and weight bearing at the side of the flap inset is avoided for 3 to 4 weeks, followed by a program of gradual weight bearing on the pressure sore area. Antibiotics therapy is continued for 7 to 10 days post-operatively or longer if needed.

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Figure 1: Anatomical landmarks of Tensor Fascia Lata.

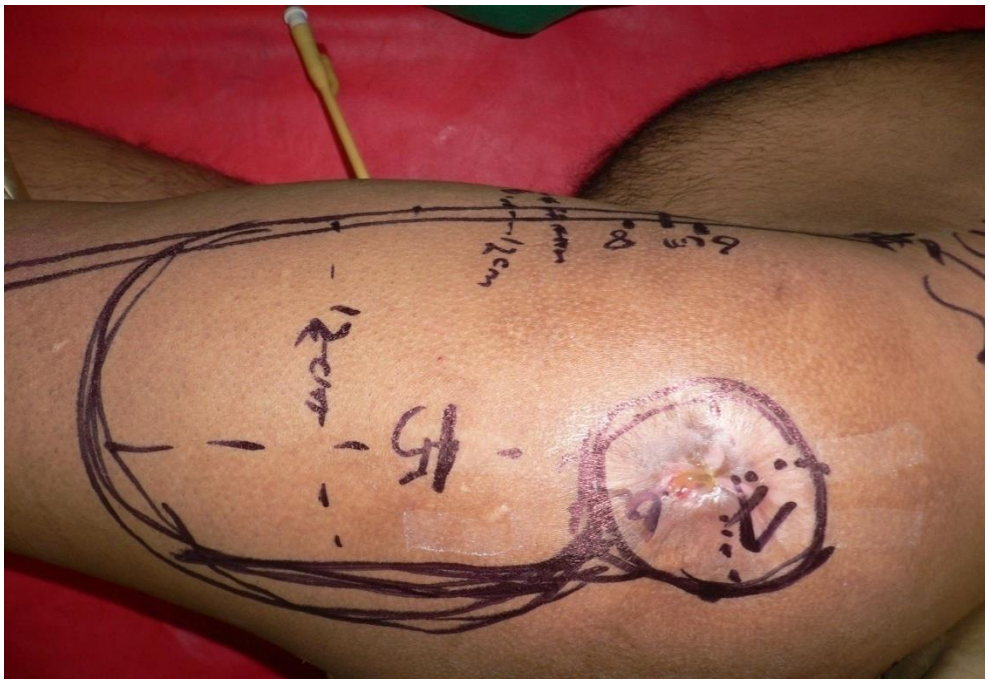

Figure 2: Pre-operative planning.

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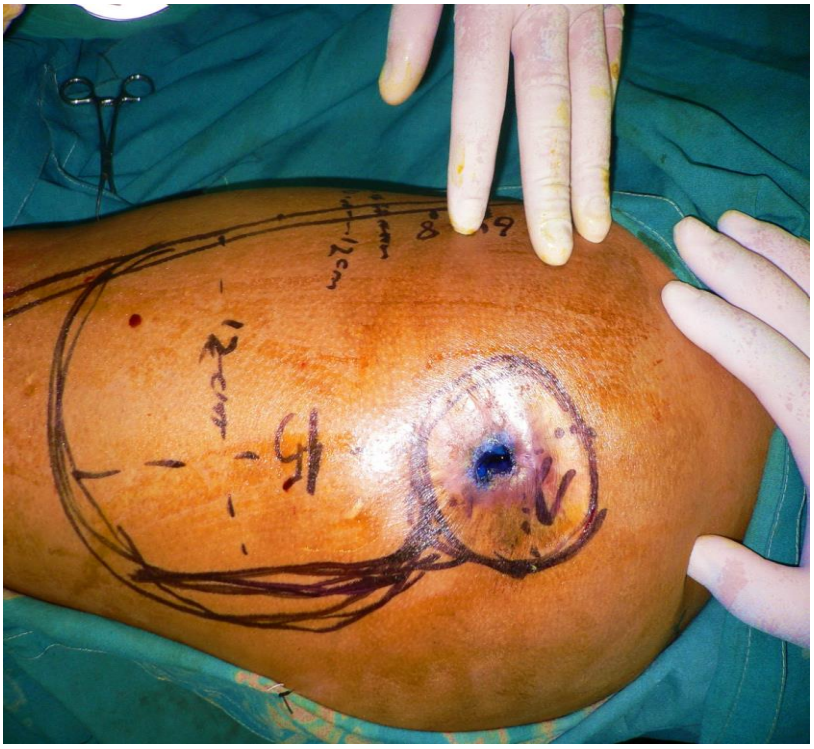

Figure 3: Installation of Methylene Blue.

Figure 4: Excision of the ulcer & its containing bursa.

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Figure 5: Flap elevation.

Figure 6: Flap Inset.

RESULTS

The vertical diameter of the trochanteric pressure sores which had been treated surgically using the classical rotation advancement tensor fascia lata flap was 8.5 cm after excision while the vertical diameter of those ulcers treated by V-Y advancement was 3.97 cm. Statistical analysis revealed that there was a statistically significant difference between the 2 means and the use of classical rotation advancement is associated with larger vertical diameter.

Ulcer surface area was 60.7 cm2 and 19.2 cm2 for those ulcers treated with classical rotation advancement and V-Y advancement tensor fascia lata flaps, respectively. Statistical analysis indicated that there was a statistically significant difference between the 2 means of ulcer surface area (P value = 0.001).

Donor site had been closed directly in all of the 4 patients with V-Y advancement technique, and skin grafting to all of the 10 patients treated with classical rotation technique and skin grafting was also applied to the patient that was treated with island flap.

All of the 10 patients, who had been treated with the classical rotation tensor fascia lata flap, had trochanteric pressure sore of 5 cm or more vertical and horizontal diameters. On the other hand, all of trochanteric sore that had been treated with V-Y advancement had a vertical diameter of less than 5 cm. Table 1 shows patients distribution according to their ulcer diameters and surface area.

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Table 1: Patients distribution according to their ulcer diameters and surface area

		Tensor Fascia Lata Flap					
		Classical rotation		island		V-Y advancement	
		No.	%	No.	%	No.	%
Vertical Diameter	< 5 cm	0	.0%	0	.0%	4	100.0%
	≥ 5 cm	10	100.0%	1	100.0%	0	.0%
	Mean Range	8.5 cm (6.5-9.5 cm)		5 cm		3.97 cm (3.1-4.5 cm)	
Horizontal Diameter	< 5 cm	0	.0%	1	100.0%	2	50%
	≥ 5 cm	10	100.0%	0	.0%	2	50%
	Mean Range	7.1 cm (6-9 cm)		3 cm		4.87 cm (3.5-6.0 cm)	
Ulcer surface area	< 20 cm	0	.0%	1	100.0%	3	75.0%
	20-29 cm	0	.0%	0	.0%	1	25.0%
	30-39 cm	1	10.0%	0	.0%	0	.0%
	≥ 40 cm	9	90.0%	0	.0%	0	.0%
	Mean Range	60.7 cm2 (39.0- 74.4 cm2)		15 cm2		19.2 cm2 (14.4-27.0)	

Regarding the frequency of post-operative complications, five of the 10 patients with classical rotation advancement tensor fascia lata flap had no complications during the period of post-operative care. The remaining 5 patients (50%) had developed different complications. In contrast, only 1 patient (25%) treated with V-Y advancement tensor fascia lata flap developed complications post-operatively which was dehiscence that had been corrected by re-advancement of the V-Y flap. Those 5 patients with post-operative complications were managed by frequent dressing, broad spectrum antibiotics and avoidance of pressure bearing.

These complicated cases showed healing within 4 weeks. Table 2 show patients distribution according to the frequency of the development of complications.

Table 2: Patients' distribution according to the frequency of complications

	Tensor Fascia Lata Flap					
	Classical rotation advancement		island		V-Y advancement	
	No.	***%***	***No.***	***%***	***No.***	***%***
Dehiscence	1	10.0%	0	0%	1	25%
Hematoma	1	10.0%	0	0%	0	0%
Seroma	1	20.0%	0	0%	0	0%
Wound infection	2	10.0%	0	0%	0	0%
No Complications	5	30.0%	0	0%	3	75%
Total	10	100.0%	1	100.0%	4	100.0%

Dog ear deformity had been found in 4 patients treated with classical rotation technique, while none of those treated with the V-Y advancement technique had developed such a deformity. It had been found that when we have designed a classical rotation flap with a large diameter, the dog ear deformity was eliminated.

DISCUSSION

Pressure sores in all of their variable anatomical distribution and types have a significant burden not only on the patient, but the entire health care system. In addition, these lesions are an important source of suffering for their families and other caregivers (Reddy, M. *et al*., 2008). Since the middle of the eighteenth century several revolutionary steps had been accomplished, this long way aimed to reach the point of well understand about the problem of the pressure sores and the best way to manage them (Reddy, M. *et al*., 2008). Regarding trochanteric pressure sore several important advances had appeared since the late 1980s, with the introduction of the V-Y advancement tensor fascia lata flap to the field of reconstructive surgery in treating trochanteric pressure sore at 1989 by Paletta who advocates advancement of the tensor fascia lata flap

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according to the V-Y method (Erkönen, A. R. *et al*., 1998).

Ten out of the 15 patients included in this study, their trochanteric ulcers were treated by the classical rotation technique while 4 of them were treated by V-Y advancement. Intra-operatively we have noticed that V-Y technique was applicable or easier to be used with smaller ulcers, while the classical method was applicable for any ulcer size particularly those ulcers with a vertical diameter exceeding 5 cm. This study revealed that the average vertical diameter of those ulcers treated with classical rotation method was 8.5 cm, and comparing this mean with the mean of the vertical diameter observed in the group treated with V-Y technique (3.97 cm), it had been found that there was a statistically significant difference between the 2 means depending on the technique used. It is well established fact that the V-Y modification of the tensor fascia lata flap provides more proximal and better vascularized tissue than in the classic tensor fascia lata design as well as more muscular portion of the flap to fill the area of debrided pressure sore. Perhaps more important, readvancement or rotation when necessary, is easier to and can be done reliably more than once.(Foster, R. D, 2006)

Regarding the postoperative complications, this study revealed that the classical rotation method is associated with more frequent complications than the V-Y technique. Five out of the 10 patients treated with the classical rotation method (50%) had different types of complications. In contrast, patients treated with V-Y advancement showed better post-operative period with only 1 patient developed dehiscence as a post-operative complication. This better outcome for patients with V-Y advancement technique is consistent with the finding of Josvay *et al* study which used modified tensor fascia lata musculocutaneous flap for the coverage of 8 trochanteric pressure sores (Josvay, J. *et al*., 2006). Out of these 8 cases, they observed complications in only 1 patient who had partial dehiscence (Josvay, J. *et al*., 2006). In addition to the post-operative complications, none of those treated with V-Y advancement developed dog ear deformity while this deformity had been noted in 4 patients treated with the classical rotation technique. The main objective of founding and developing the V-Y advancement tensor fascia lata flap by palette, (1989), Erconen, (1998) and Demirseren, (2003) was to prevent dog ear deformity development. One of the most important advantage of the V-Y advancement is that in comparison with the standard tensor fascia lata flap(Classical rotation technique), the rotation point and the dog ear are eliminated and it also places the thickest and best vascularized portion of the flap over the bone defect (Foster, R. D, 2006). Another important factor that might have a role in the reduction of the frequency of the post-operative complications in patients treated with V-Y advancement technique is that the plastic surgeon is able to use direct suturing as a method for donor site closure and there is no need for skin graft in contrast to the fact that in the classical rotation method, it is required to use skin graft.

Unfortunately, during the period of study, we did only one case of island tensor fascia lata flap, so we cannot get a clear points for discussion and comparison with other 2 types of tensor fascia lata flaps.

CONCLUSIONS & RECOMMENDATIONS

1. Spinal cord injuries due to bullets are the most frequent cause of trochanteric pressure sore, and it is the main cause of higher frequency of trochanteric pressure sore among young males included in the study.
2. V-Y advancement tensor fascia lata flap is more applicable for smaller sized ulcers; its use makes the reconstructive surgeon able to directly close the donor site without using a skin graft, it is associated with less complications and dog ear deformity was eliminated by the usage of this technique.
3. Classical rotation flap can be applied for any size of trochanteric ulcer and the larger the flap the lesser the chance of developing a dog ear deformity.

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