

## Keypoints in Wound Contractures

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**W**ound contracture is a challenging problem to deal with. By understanding the phases of wound healing, attempts can be performed to prevent abnormal wound healing that can lead to scar contracture. This article will attempt to provide a simple summary of wound contracture and how to prevent it.

Although most wounds can be expected to heal uneventfully, infection, dehiscence, and delayed healing continue to be problems, associated with significant morbidity, mortality, and economic cost. Wound contracture is one of morbidities that caused by delayed healing and incorrect management of wound.<sup>1</sup>

### Clinical Definition of Contracture

It is important to differentiate contraction and contracture. Contraction is the active biologic process which decreases the dimension of the involved connective tissue. Contracture is the end result of the process of contraction.<sup>2</sup> The process of contraction may lead to severe functional and esthetically deforming contractures.

### Problem Which Comes With Contracture

Contracture comes with several problems. As an abnormal scarring, the hypertrophic scar appearance is not esthetically accepted by the patient. This problem leads to psychological stress to the patient. The most problematic effect from scar contracture is limitation in range of motion if the contracture occurs in extremities joints. This limitation result in low patient productivity.

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### Keypoints in Contracture Formation

#### Abnormal Wound Healing

The normal wound healing process occurs in three overlapping phases. Following the initial injury, there is the inflammatory phase, the purpose of which is to remove devitalized tissue and prevent invasive infection. Next, there is the proliferation phase, in which the balance between scar formation and tissue regeneration occurs. Finally the longest and least understood phase of wound healing occurs, the remodeling phase, the purpose of which is to maximize the strength and structural integrity of the wound. Disruption of any of these three phases can lead to abnormal wound healing that can cause wound contracture.

#### Massive myofibroblast activity and contraction of fibrotic tissue

A major advance in understanding wound contraction occurred with the discovery of specialized form of mesenchymal cell called the myofibroblast (Gabbiani, Ryan, and Majno, 1971).<sup>3,4</sup> This cell is a typical fibroblast with well developed endocyttoplasmic reticulum which also possesses many of the features of smooth muscle cell. Such features include massive bundles of intracytoplasmic microfilaments, positive immunofluorescent labeling with human anti-smooth muscle serum, nuclear indentation indicative of contraction, and cell-to-stroma connections which would be necessary for cellular contraction to be imparted to whole tissue. The excessive activities of myofibroblast lead to wound contracture.

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### Large skin defect which is not adequately closed by skin graft or flap

Wound which is not adequately closed or left to spontaneous healing will result in prolonged inflammatory phase until the wound is closed. Spontaneous wound closure depends on contraction and epithelialization. Epithelialization proceeds from wound margins towards center at 1mm/day.<sup>5</sup> The contraction process will result in wound contracture if not treated properly.

### Lack of elasticity of the new tissue cover

Scar that result from wound healing is lack of skin appendages, therefore the elasticity decrease significantly compared to normal skin. Due to this problem, movement ability of the joint under the scar will also be affected.

## **Strategy To Manage Wound Contractures**

Contracture can be released by several strategies. Simple linear contracture can be released by multiple z-plasties. Diffuse contracture can be released by scar excision and reconstruction with grafts or flaps according to the affected region (Figure 1,2).

The management as shown in the pictures is not affordable for many patients. In addition, there are limited doctor mastering the technique.

## **How To Prevent Contractures**

According to the understanding of the requiring time needed for wound healing to reach maturation phase, and the difficulty of management due to the cost and the limited doctors can be solved by the simple and cheap management as mentioned below.

### Understand the three phases of normal wound healing

Wound healing is a complex process, involving a daunting array of cell variants, cytokines, growth factors, and matrix elements. Although a simplification, the classic division of wound healing into inflammatory, proliferative,

and remodeling phases.<sup>1</sup>

In the process of wound healing, normal wound contraction performs a beneficial role by facilitating earlier wound closure by reducing the surface area of the original wound. Yet when the contraction continues beyond the point at which reepithelization occurs, it leads to scar contracture and, eventually, poor cosmetic results and functional loss.

There was a time when scar formation was taken for granted by patients and even surgeons, but since evidence was reported that the wound of a human fetus does not form a scar, there have been continual efforts to identify the mechanism of scar formation and to then stop this process. Though it is not definitely known yet, scar formation and scar contracture are thought to be the result of interaction of multiple factors, and at least at the molecular and cellular levels, the fibroblast and the myofibroblast are considered to have *the biggest role*.<sup>4</sup>

### Differentiate healed wound from dry wound

Wound closing in layman's term is known by dry wound. Dry wound marked by non-exudative, and has adequate tensile strength to allow suture removal.<sup>6</sup> Non-exudative wound can be achieved on the first week after trauma. Drying wounds do not literally healing wounds. Wounds are categorized as healed wounds after they pass the remodeling phase which can last 6 months or even 2 years following the trauma. Healed wounds can be recognized by these characteristics: less itch, has almost similar color with surrounding tissue (no redness), thinner and softer.<sup>6</sup> As long as the wound is not yet mature, possibility of contracture still persist. To promote wound maturation the following matters should be considered.

### Handling wound adequately

Several factors involved in achieving normal wound healing process. By managing the duration of surgery, proper aseptic and antiseptic procedures, gentle tissue handling and also minimizing dead space will help to reduce the possibility of abnormal wound healing.

**Immobilization**

At the time wound occurs, especially on joints area, special care are required to prevent the development of contracture. When wound sites lie adjacent to joints area, it may be necessary to splint the part in extension for at least 3 weeks in order to immobilize the joint. Night splinting should be followed until 6 months after the injury. Night splinting immobilization can be prolonged until 2 years after trauma if signs of contracture formation were found (Figure 3).

**Pressure Garment**

By using pressure garment, the risk of

developing contracture is reduced (Figure 4). Pressure garment can be detached at bath time, and should be applied until the wound is mature.

**Patient and family cooperation**

Patient and family cooperation is one of the most important factors in achieving good scar and preventing contracture. Patient must be aware on how to manage the wound by him/herself to prevent abnormal wound healing. By educating patients and their family, good cooperation can be built to prevent contracture. Simple thing but yet need patient's compliance can be done by patient to prevent wound contracture on the axilla (Figure 5).<sup>6</sup>



**Figure 1.** Patient suffered from right popliteal contracture (Left and Up-Right). Contracture was released and reconstructed with flap (Down-Right).



**Figure 2.** Patient diagnosed with neck and axillar contracture (Left). The axilla and neck contracture was released and reconstructed with flaps, the adjacent sites covered with skin grafts (Right).



**Figure 3.** Night splint for one year (to achieve maturation on extension position) especially for children.



**Figure 4.** Pressure garment can be used to prevent excessive scarring that leads to contracture



**Figure 5.** Axilla abduction to prevent contracture

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## REFERENCES

1. Janis JE, Kwon RK, Lalonde DH. A practical guide to wound healing. *Plast Reconstr Surg.* 2010;125:230e.
2. Peacock EE, Cohen IK. Wound healing. In: McCarthy JG eds. *Plastic Surgery: volume one, General Principles.* Philadelphia: WB Saunders; 1990:165-9.
3. Brody GS, Peng STJ, Landel RF. The etiology of Hypertrophic scar contracture: Another view. *Plast Reconstr Surg.* 1981;67:5.
4. Shin D, Minn KW. The Effect of Myofibroblast on Contracture of Hypertrophic Scar. *Plast Reconstr Surg.* 2004;113:2.
5. Lowenstein A, Song DH. *Essential for student.* USA: Plastic Surgery Educational Foundation; 2007: p 1-9
6. Sudjatmiko G. *Petunjuk Praktis Ilmu Bedah Plastik Rekonstruksi.* Jakarta: Yayasan Khazanah Kebajikan; 2007: p4-5.