

## **Perioperative Management of the Facial Wounds with Insight of Scar Prevention**

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### **ABSTRACT**

Human face is the front side of a head which functions most of all for individual identity. Global culture agrees that scarring on the face reduces attractiveness to the opposite sex; and it drives everyone with a wound or a proposed wound on his/her face to ask for a favorable scar. Clinical management of incisional scars begins with a thorough discussion of surgical pre-measures. The main modifiable factor of scar formation is the design of the skin incision that bears the least tension in the healing period. During surgical procedures, doctors must pay attention to skin tension lines and vascularization to the wound edge tissues. After the surgical procedure, sutures with non-absorbable materials must be taken off, and skin tape must be applied perpendicularly to the wound axis to reduce tensions during the remodeling phase of healing. The patients' active participation in wound management, even long after the wound appears to heal, support good outcomes. Post-surgical evaluation visits must be conducted and focus on the prevention, early detection, and proper management of the healing wound, especially ones with hypertrophic potential. Hypertrophic scars which do not improve after six months is no longer considered hypertrophic scars but it is considered keloids which require proactive and more intensive management.

**KEYWORDS:** facial wounds, hypertrophic scars, keloids

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### **INTRODUCTION**

Recent developments in cellular and molecular biology provide many insights into the mechanism of wound healing. Significant findings in basic science research have been translated into clinical applications; notable examples are biologic acellular matrices, negative pressure wound therapy, and bioabsorbable polymer products. However, for most doctors and patients, clinical management of wound continues to lag behind the progression of decades old researches. Floods of medically ineffective wound care products with strong commercial promotion often confuse and mislead patients, while abundance of scientific papers of the latest science in wound healing often end up being an indigestible intellectual burden for busy clinicians who do not have much time to read. Textbooks of general surgery in clinicians' bookshelf often lags 20 years in average behind the current developments. Even the latest and most up-to-date edition of textbook still lags 3 to 5 years behind current

developments.

Human face is the front side of a head, which functions primarily for individual identity –other function includes a medium for the expression of human thought and emotional content. Although in some cultures scarring on the man considered to be attractive to the opposite sex, global culture agrees that scarring on the face reduces attractiveness to the opposite sex; and it drives everyone with a wound or a proposed wound on his/her face to ask for a favorable scar.<sup>1</sup> This article tries to review relevant aspects of wound healing management and to elucidate the most up-to-date rational related to it. We review the wound healing processes and reiterate how these processes go on –especially in the remodeling phase of wound healing—in relation to prevention and management of unfavorable post-surgical scarring on the facial area.

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### REVIEWING SCAR FORMATION

#### Wound healing

Wound healing process can be divided into three main phases: inflammation, proliferation, and remodeling. Inflammation begins with disruptions in capillary blood vessels and induction of hemostatic cascade. The leaked intravascular contents form fibrin clots, which are composed of woven fibrin fibers and platelets. This provisional extracellular matrix (ECM) in the wound paves the way for migration of various proinflammatory cells that participate in the cleansing of the wound bed. The dominant cells in this phase, in order of appearance, are platelets for hemostasis, polymorphonuclear (PMN) leukocytes to fight pathogenic mechanisms and macrophages that work at the end of this phase.

The second phase in wound healing is the proliferation phase, which begins around the 4th or 5th day with the migration of fibroblasts into the wound matrix. By 2 to 4 weeks, the fibroblasts are maximally up-regulated to replace fibrin networks with a stronger matrix of collagen. In the mature wounds, the initial elastic fiber networks are no longer found and this explains the firmness and non-elasticity of scars.<sup>2</sup> Another important aspect of the proliferative phase is the formation of new blood vessels to deliver oxygen and nutrients to the newly formed tissue and the inward epithelialization of keratinocytes from the wound edges into the wound tissue. Wound contraction begins around the 10th to the 12th day, but the timeline may vary depending on the wound severity and the patient's general condition.<sup>3</sup> The dominant cells in this phase, in order of appearance, are fibroblasts that form the collagen matrix, endothelial cells for neovascularization, and keratinocytes involved in epithelialization; macrophages from the previous phase are still found early in this phase.

The third and final stage in wound healing is the remodeling phase, which usually begins at the 3rd week after tissue injury. Microscopic findings of this stage include decreases in fibroblast count, occlusion of blood vessels, and hardening of collagen fibers. Continuous collagen production and degradation to achieve harmonization of the composition of the mature wound matrix last for at least 6 months after injury. At this point, production and degradation balance each other, and no significant changes in the amount of collagen are observed. The remodeling phase is the most responsible for intra- and interpersonal variations in scar qualities. A healing incisional wound can become an unfavorable scar during this period.

By understanding these three main phases, wound healing process can be optimized. Modifiable factors to achieve ideal incisional scar include the design of the incision, atraumatic handling of soft tissue, good hemostasis, proper aseptic techniques, and tension reducing approximation between wound edges.<sup>4</sup>

The wound healing phases go on simultaneously and do not act as separate phases. The proliferation phase begins even

before the inflammatory phase not yet complete (macrophages are still active at the beginning of the proliferation phase) and the proliferation continues even when the remodeling phase begins by degrading the excess collagen structure. The remodeling phase itself still continues long after the sutures have been removed; because of this, the care of an incisional wound should be considered as a continual process, and minimizing scar formation should be the ultimate goal of this long-term process. These are important aspects of wound management that must be understood not only by the surgeons but also by general practitioners who work at an emergency clinic to reassure patients agreement in their planned surgical procedures.<sup>5,6</sup>

#### Attention to skin tension and incision design

The external shape of the human body is determined by the underlying skeletal framework, which is covered by muscle and skin. Adjusting to this complex and dynamic shape, the skin should be both vicious to the underlying tissue and elastic to change shape and return to the original state. God creates skin tissue to be both durable and elastic mechanically.

The tension vectors across the skin are specific to the volume and movement of the structure of the tissue beneath it. It has been long known excessive skin tension is responsible to the formation of scar. Unfortunately, quantitative measurement of skin tension is neither reliable nor practical in clinical settings. Instead, skin lines have been used as surrogate indicators of tension vectors. While a multitude of skin lines have been introduced over time, Langer lines and relaxed skin tension line (RSTL) are the most widely known.<sup>7</sup>

#### Langer lines

If we make punch excisions—which are round/circular in actual shape—on the skin, they immediately deform into ellipse defects on the skin. Connecting the major axes of those ellipse defects results in what is considered Langer's lines (see fig. 1). These projection skin lines run parallel to the main collagen bundles in the dermis layer.<sup>8,9</sup>

#### Relaxed skin tension line

When pinching a point on an area of human skin, there is a virtual pinch line that makes the skin easily extensible with no tension from the surrounding and the pinched skin soon return to its original position. There are also virtual lines that is difficult to be pinched due to local tension, and there are also virtual lines which cannot be pinched. Relaxed skin tension line (RSTL) is a groove created when the skin is pinched and relaxed without local tension (see fig.1).<sup>10,11</sup> Clinically, the skin is maximally extensible perpendicular to RSTL, and this implies that the tension is minimized when incisions are created along RSTLs. While the Langer's lines and RSTLs run in the same direction over many areas of the body, they are significantly different in mechanically complex areas such as mouth angle, lateral canthal, and temple

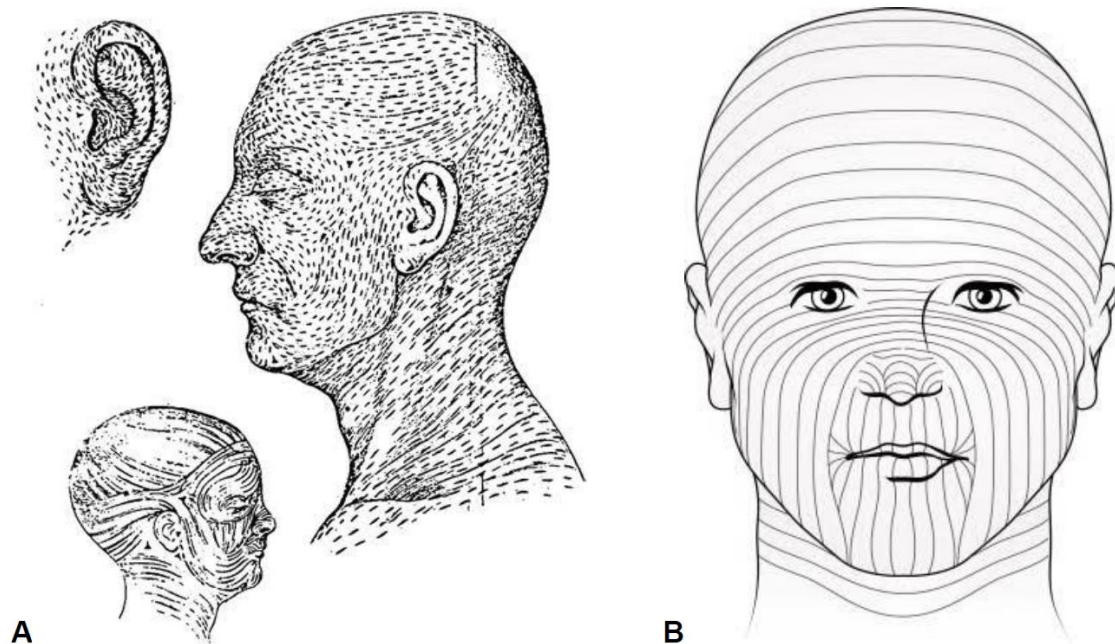


Figure 1. Langer lines (A) and relaxed skin tension lines (B) on human face.

A good understanding of skin tension vectors is critical to incision design. All plastic surgeons agree that improper incision designs are the number one reason for potentially hypertrophic scarring. Great tension across an incised wound risks separating the skin edges during healing process; in response, the wound will hold itself together more tightly by increasing collagen production and deposition. Macroscopically, wound scarring will appear to be hypertrophy.

In certain areas of extreme skin tension, hypertrophic responses are unavoidable regardless of the direction of incision (i.e. shoulders and knee). For this reason, traditional incisions almost always avoid the skin directly over the extensor joints such as shoulders and knees.

#### Other factors of scarring response

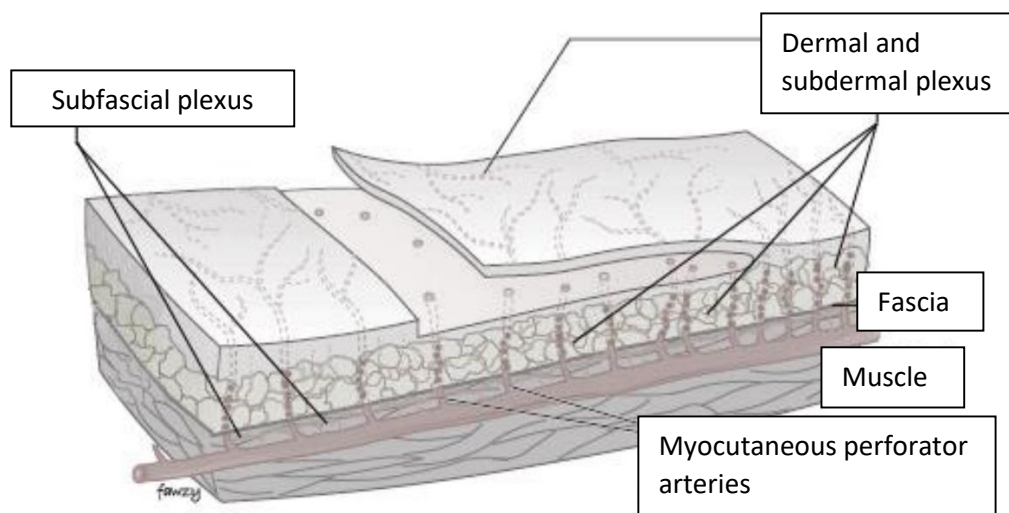
##### Blood supply

Blood supply is an important factor in wound healing process because cellular activities in wound healing requires a supply of oxygen, nutrients and energy. Area of the skin with rich supply of vasculature is proven to heal with finer and smoother scars; the face is a prime example.

From the major arteries, the blood flows through

septocutaneous and musculocutaneous perforating arteries, then supplies the fascial, subcutaneous, and dermal plexuses. Eventually, the blood exchanges oxygen and nutrients for carbon dioxide and other unwanted wastes during the transit through dermal capillaries. The epidermal layer has no vascular components, and nutrients are delivered from the dermis to the epidermal cells through a diffusion process.

Regarding this vascularization concept, a viable wound margin must receive its blood supply through one of the two routes: vertically (bottom-to-up) from perforating arteries in the surrounding area of wound bed, or horizontally from the dermal plexus network supplied by a distant perforator artery.<sup>12-14</sup> Often, the perforator arteries in the operative field are damaged and cannot be preserved, especially during extensive undermining. In these situations, it is of utmost importance that the operator cautiously handle the dermal plexus. In other circumstances, a skin flap created next to an old incision line should be considered as an island flap – because the dermal plexus of the flap is assumed to be discontinued in the area of the old incision; therefore it is very important for the operator to carefully handle the perforator artery responsible for the skin flap's blood supply. (see fig. 2)



**Figure 2. The concept of skin vascularization.**

In flap surgeries, if the operator's maneuver injures several perforator arteries under the flap during dissection, the created flap is nothing but a full-thickness composite tissue without any vascular supply and is very susceptible to risk of flap compromise and necrosis.

### **Age**

Aging skin tends to have less skin tension and sebaceous gland activity, and as such, hypertrophic scars rarely occur in the elderly. This is in contrast to incisional scars in children; improper management of such wounds leads to potentially-hypertrophic scars because of their increased cellular activity, prolonged scar maturation, and rapid physical growth during childhood.<sup>15</sup>

### **Skin colour and ethnicity**

In addition, ethnic skin characteristics and their association to post-surgical scar response have been well documented. People of Caucasian descendant are more likely to form finer and smoother scars,<sup>16</sup> while people with darker skin like ones of African, Asian or Hispanic descendant appear genetically predisposed to hypertrophic scars and keloids.<sup>17,18</sup>

### **Previous History**

Previous history of poor wound healing, hypertrophic scarring, and keloids overrides all other patient factors. Such information determines a characteristic of how the individual responds to the wound in term of his/her tissue response and his/her behavior in managing the wound. For example, patients with keloids in the earlobe may be very likely to develop keloids again several months after the incision healed. Although demographic factors such as age, ethnicity and skin color are just as important as respecting skin tension and blood supply, none of these is physiologically modifiable. Therefore, knowledge of those related factors these patient factors is important and becomes a responsibility for the operator to explain to the patients as a part of an informed consent.

## **PERIOPERATIVE MANAGEMENT**

### **Surgical technique**

The operator's experience and techniques are the factors that determine the final result of the scar appearance; increased experience is associated with improved aesthetic outcomes.<sup>19</sup> The experienced operators always incorporate the right incision designs, as well as surgical techniques described as the 5 A's - aseptic, absence of tension, accurate approximation, avoidance of raw surface, and atraumatic tissue handling.

Smaller and delicate surgical instruments restrict operators to use as little strength and crushing force as possible when in contact with wound tissue. For the similar reason, an operator should consider using the suturing material as smallest size as possible in fixing and suturing wound with minimal tension in all levels of approximation: intermuscular, interfascial, subcutaneous, and intradermal sutures.

Sutures with non-absorbable materials, such as nylon or polypropylene, must be taken off as soon as the wound has the strength to maintain the wound has gained the strength to hold itself together. In every wound closure procedure, the operator must remember that the role of the suture is simply to provide "fixation to approximation without tension", not to hold the wound tissue together (it is the role of fibroblasts and collagen fibers) nor to close the wound (it is the role of the epithelium cells). Based on this understanding, basic surgical skills training always teaches how to suture 'layer by layer' in such a way that even a disruption of one or several skin sutures does not immediately cause a wound dehiscence.

### **Dressing the wound**

The ideal wound dressing method and material must: a) provide and maintain a moist environment for the wound, b) facilitate angiogenesis and synthesis of connective tissue, c) increase epidermal migration for epithelialization, d) maintain proper tissue temperature to increase blood flow to wound site and support epidermal migration, e) allow gas

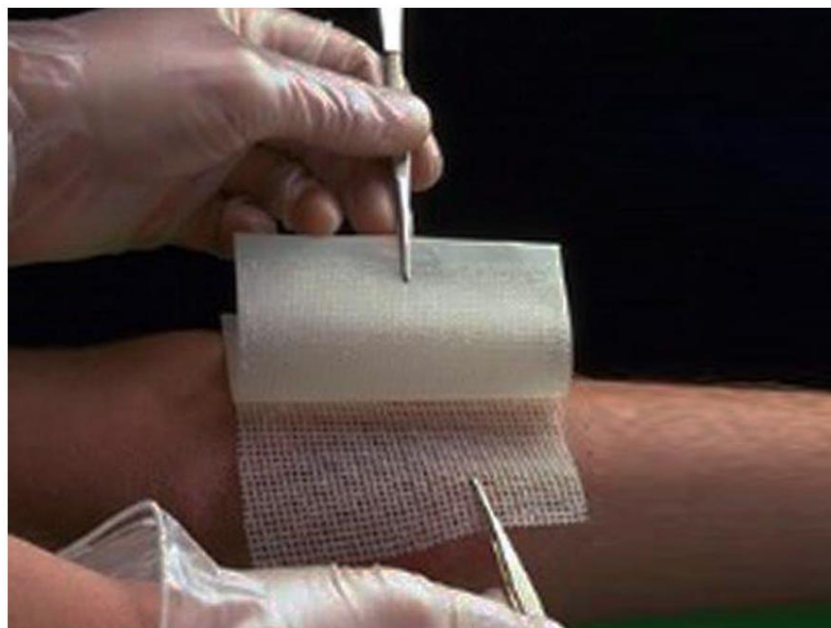


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exchange (aeration) between the wound and the environment, f) provide protection against bacterial infections, g) facilitate wound cleaning in terms of supporting leukocyte migration and enzyme accumulation, i) be sterile, not toxic to cells and tissues, not trigger allergies, and i) be non-adherent to the wound and easily removed during wound care.<sup>20</sup> Dressing materials are known to influence postoperative surgical wound healing and scar formation.<sup>21,22</sup> After wound closure, sterility, moisture and hydration of the wound must be maintained properly. There are now many modern wound dressing materials such as dressing foam that can secure all of those conditions; foam dressing is replaced daily during wound care.

Traditional wound dressing utilizes sterile gauze, skin tapes, and elastic bandages (if needed) are still widely used to cover, facilitate wound healing and protect it from contamination.<sup>23</sup>

Sterile gauze made of woven cotton, rayon or polyester fibers provides protection against bacterial infections. Due to its fiber composition, sterile gauze pad is applied to absorb exudates and fluid from wound environment, and will be shortly saturated by exudates. Traditional gauze pad needs to be replaced frequently to avoid maceration of healthy tissue; therefore from the economic aspects, this dressing method becomes less efficient. Another disadvantage is, this kind of dressing tends to stick to the wound when there is a lot of drainage –so it is uncomfortable and even painful for the patient during dressing removal. The use of a paraffin tulle dressing whether it is containing topical antibiotics or simply for moisturizing is suitable for superficial clean wounds. In daily practice, the paraffin tulle is positioned between the wound and absorbent gauze, and intended to prevent adhesions between the wound and the gauze on it. (see fig. 3)



**Figure 3. Paraffin tulle dressing.**

Traditional wound dressings are still relevant only for wounds with minimal exudate. To provide an ideal condition for the wound as mentioned above,<sup>20</sup> modern dressing materials are now commonly applied –even by health care centers in remote areas.

For post-surgical wounds near the facial orifices (periorbital, nostril, perioral), many plastic surgeons –including authors— recommend open wound care. Facial orifices characteristically produce secretions. A mixture of wound exudation and orificial secretions may attract secondary infection that is difficult to observe under dressing coverage. For wounds near the facial orifices, it is sufficient to put on paraffin tulle after cleaning the wound, then apply topical preparation for moisturizing environment. Author usually applies a 1% chloramphenicol eye ointment (because it is thinner than the skin ointment) or pure honey (in its original substance and as the ointment).<sup>24</sup>

### **Treatment in the first few days after surgery**

Excluding the skin-grafted wounds, all wound dressings are removed and the wounds are cleaned on daily basis. Doctors or nurses clean the wounds either with sterile saline solution (NaCl 0.9%) or simply with running water that was previously boiled and warmed –the principle known as dilution is the solution for pollution. Doctors should avoid cleaning the wound using alcohol or iodide preparations – both are originally projected to be cytotoxic to pathogens but unfortunately impact active cells in wound healing in similar way. Those 'old school' antiseptic preparations should no longer be used regularly to clean physiologically healed wounds, unless there are clear signs of local infection.

### **Treatment in the first week after surgery**

Sutures with non-absorbable materials must be taken off, and skin tape must be applied perpendicularly to the wound axis to reduce tensions. Within a week after the surgical

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procedure, the tensile strength in wound tissue is only 3%; it is increased to 20% in the third week when the remodeling phase begins and reaches 80% in the 3rd month of remodeling phase. Therefore, the retaining skin tape must be applied for at least three months.<sup>25</sup> This retaining skin tape works best on a flat or convex skin surface. It is not required to be applied on a flexor crease—for example on the eyelids.

### Treatment in the first three months after surgery

This is the time in which the phase of remodeling is at its peak of its activities during the normal wound healing process. While most thoughtfully-designed and carefully executed surgical incisions have the potential to heal ideally without significant protest, incisions without ideal planning and management risk developing a hypertrophic response during this period. Therefore, regular clinical evaluation of the scar—for example: monthly evaluation—is rational and recommended. Patients must be motivated to continue applying their wounds with retaining skin tapes. In addition to the timeline of regular evaluative visits, all patients are advised to visit the doctor if their scars start to appear 'widened' or 'elevated'. During this 3-month post-surgical period, scars can develop hypertrophic response or even keloid, as discussed in the next subsection of this writing.

### Anticipating hypertrophic scarring and keloids

Hypertrophic scars and keloids are the suboptimal end results of healing wounds, and are believed to be a characteristic of human skin. Both of these clinical entities

belong to a spectrum of fibroproliferative disorders, and are difficult to differentiate histologically if not accompanied by relevant and detailed clinical information.<sup>26</sup>

### Hypertrophic scarring

The synthesis and degradation of collagen fibers regulates the remodeling phase. As the wound reaches maturity, extracellular cytokines change to stop further collagen synthesis and degradation. However, a number of genetic and environmental factors can interfere with this 'stop' signal; consequently the absence of inhibitory feedback leads to continual production of collagen fibers in the wound which clinically forms hypertrophic scarring.

Clinically, hypertrophic scars show redness in color and grow within 3 to 6 months during the wound healing. (see fig. 4) Although the surface of hypertrophic scars elevates above normal skin surface—similar to keloids, the proliferation of its connective tissue is contained within the initial wound margin compared to a keloid which is more extensive than the original wound boundary. That is the characteristic clinical feature distinguishing hypertrophic scars and keloids. Most hypertrophic scars begin to lose redness and decrease in size in the 6th month of wound healing period, and this process continues for the next 2 years until the scar surface flattens.<sup>16</sup> Often, hypertrophic scars cause discomfort and severe itching. Administration of antihistamines will relieve such symptoms.



**Figure 4. Hypertrophic acne scars**

Silicone gel sheet or silicone oil-based cream has been proven effective in preventing and limiting hypertrophic scarring,<sup>27</sup> and believed to attenuate scar with its mechanism of increasing hydration and maintaining skin temperature under occlusive membrane.<sup>28,29</sup> Silicone gel sheets or silicone oil-based cream are applied as early as possible i.e. 2 weeks after the surgical procedure (1 week after removing stitches). The

sheet is cut slightly larger than the scar dimension it needs to cover, and is applied every two hours with a 30 minute rest interval in between. The application interval is gradually increased to four hours with a rest interval of 30 minutes. This continues for up to 6 months after the surgical procedure. Silicone oil-based cream is easier and more practical to use because it has the advantage in covering the area where

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application of silicone sheets is difficult to adhere.<sup>30</sup> Silicone oil-based cream is applied 3-4 times a day and massaged for 5 to 10 minutes with each application.

For scars with clinical signs of hypertrophic potential, intralesional steroid injection is as effective as for the keloids. Triamcinolone acetonide of 10 mg/mL to 40 mg/mL are injected directly into the fibrous part of scars with clinical signs of hypertrophic potential.<sup>31-33</sup> Steroids inhibit the expression of genes related to the collagen synthesis process, thereby reducing collagen production and conversely increasing its degradation. For facial areas, the injection dose ranges from 2.5 mg/mL to 20 mg/mL, for other body areas it varies from 20 mg/mL to 40 mg/mL. Injections are repeated every 3 to 4 weeks for 4 to 6 months. Important consideration is: the total dose of injected steroid in a single therapy session should not exceed 120 mg in adults and 80 mg in children. The depth of Injection route should also be alerted: steroid injected too deep into the subcutaneous fat under the normal skin around the scar will risk atrophy, depigmentation, and telangiectasia of the overlying skin. In such cases, the injection therapy session is terminated –the skin symptoms will improve slowly over time.

Pressure therapy prevents scars from overgrowing and should be started as soon as the wound heals.<sup>34</sup> Mechanical pressure induces local hypoxia leading to fibroblast regeneration, suppressing collagen production, and activating collagenase enzymes which accelerate the dismantling of collagen. The applied pressure must exceed 24 mmHg for more than 30 minutes daily for 3 to 12 months. Such physical pressure causes discomfort and significantly limits daily activities,

therefore doctors must anticipate patients' low compliance. In other words, the success of therapy is highly dependent on patient's motivation.

### Keloids

Although the keloid condition was already mentioned in ancient Egypt papyrus from 1700 BC, it was first introduced to the scientific world by a French dermatologist Baron Jean-Louis Albert in 1806 and was later named keloid in 1817; rooted from the ancient Greek word chele which means 'hoof'.<sup>35</sup> Keloids are often observed in wounds enduring high tensile forces. In addition to the mechanical problems, the predisposition keloids are known to be passed down as autosomal dominant traits and are more commonly found people of Asian, Hispanic or African descent who have darker skin tone than in whiter Caucasians.<sup>16</sup> Studies revealed that populations with darker skin tones like Asians, Hispanics and Africans have incidence rate of keloids as high as 4.5 to 16 percent.<sup>17</sup> Still no valid reference yet regarding the incidence rate of keloids representing Asian population, but one study in Taiwan reported a rate of 0.15% with a greater risk of developing keloids is found in women rather than in men.<sup>18</sup>

The distinguishing feature of keloids from hypertrophic scars is the overgrowth of fibrous tissue in keloids remains active during the later phase of remodeling process –between 6 to 18 months. Keloid scars grow beyond the original wound boundary, change from red to brown, and behave like benign tumors on the skin surface. (see fig. 5).

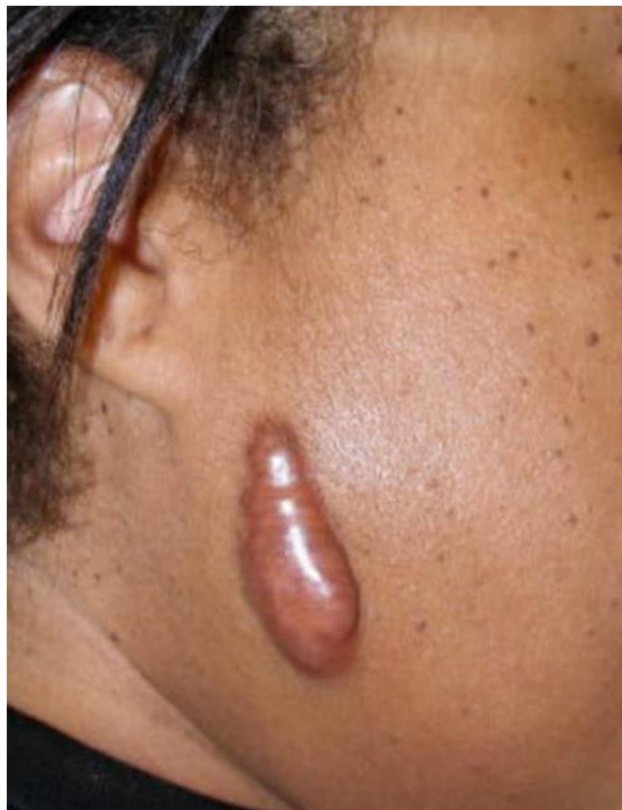


Figure 5. Acne keloid

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From the perspective of molecular biology, keloids are products of uninhibited deposition of collagen. Within a physiologically healing wound, proliferation of fibroblasts slows down until it stops and submits to apoptosis in peripheral margins. Such down regulation of fibroblasts and collagen deposition is also observed within hypertrophic scars in the late phase of remodeling.<sup>36,37</sup> In keloids, fibroblasts continue to multiply despite the fact that the existing dermal matrix is strong enough to compensate for the pulling force between the two opposite wound edges; the particular etiology behind that overactivity remains imprecise even after years of researches.<sup>38-40</sup>

Routine evaluation at the site of the post-surgical wound is useful to anticipate early onset of keloids, especially on wounds that are at the site of pull / strain such as the joints. Silicone gel sheets and silicone oil-based creams when applied clinically to wounds lead to keloids, the results are not as real when compared to hypertrophic scars. Effective therapy for keloid is an injection of intralesional steroids, which often result in improved appearance significantly after 3 to 4 times injection. In contrast to hypertrophic scars, keloid

can recur after cessation of steroid injections. Further intervention is often needed. Physical pressure therapy may help, but is generally ineffective.

### Management of hypertrophic scar and keloid complications

Besides of those therapeutic approaches to anticipate hypertrophic scarring or keloid formation, various forms of lasers, including Nd:YAG 1064, fractional laser, pulsed dye laser, IPL, Q-switched laser, have been reported effective to improve the scar appearance.<sup>41,42</sup>

When an unfavorable scar is unresponsive to all the aforementioned therapeutic modalities, the scar revision is done by using a variety of surgical methods –with the mathematical reasoning of altering the pulling force of the opposite wound edges. If the direction of the incision previously placed the scar on the skin tension line, excision with the z-plasty or w-plasty (see fig. 6) is designed to move the tension vector of the wound edges so the resulting new scar is expected to have better appearance.<sup>43,44</sup>

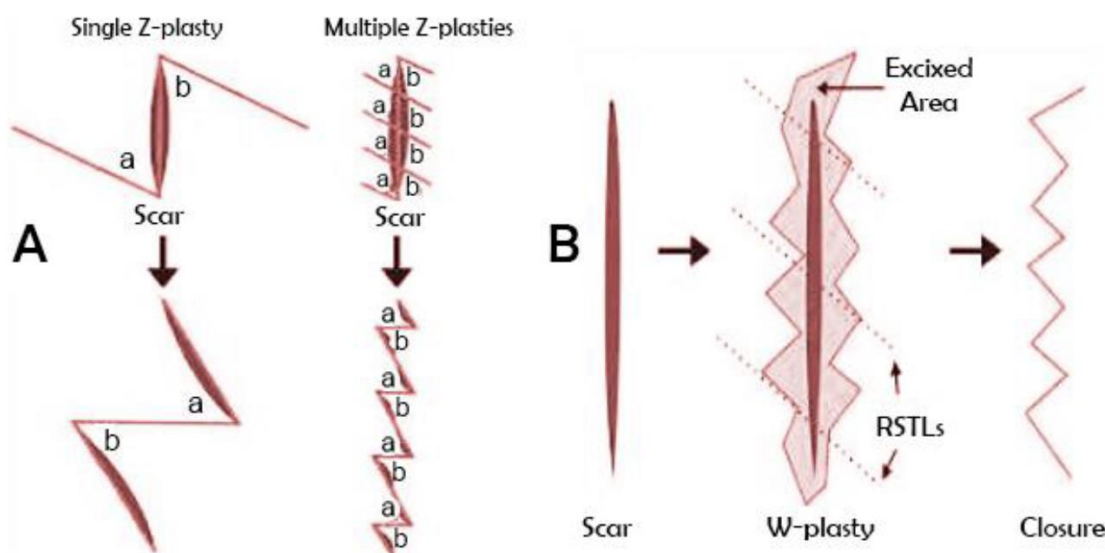


Figure 6. Z-plasty (A) and W-plasty (B)

For keloids, various surgical techniques have been used to remove keloids and improve the appearance of scars: from simple excisions that are closed primary with sutures to excisions that are covered by skin graft or skin flap methods. Radiotherapy is effective as an adjuvant treatment to surgical procedure; one study found that radiotherapy was able to reduce keloid dimensions by an average of 55% over a 30-month follow-up period.<sup>45</sup> However, the use of radiation must pay attention to the risk of cancer due to the effects of ionizing radiation –although reports of cancer cases after keloid radiation are rare.

While methods of intralesional steroid injection and radiotherapy have been reported to reduce the recurrence rate, there are still many patients who continue to experience

recurrence after trying all forms of therapeutic modalities. It is important for the doctors to inform the patients –especially ones with a history of significant keloid-- personally or in family counselling before the intervention therapy that there is the high likelihood of recurrence –ranging from 45 to 100%. Doctors have to emphasize the importance of patients' patience and perseverance for sustainable and successful scar management.

Other alternatives approaches to manage keloids have been described in medical literatures, such as chemotherapy agents of 5-fluorouracyl (5-FU) or bleomycin.<sup>46,47</sup> Newer keloid therapies such as molecular targets and mesenchymal stem cells still lack sufficient clinical evidence to be widely utilized in daily clinical practice.<sup>48-51</sup>



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### SUMMARY

Clinical management of incisional scar begins with a thorough preoperative discussion. Before all elective operation, a patient should be aware of personal predisposing factors for the risk of excessive scar formation. The largest modifiable factor of scar formation is the design of skin incision that bears the least amount of tension in the postoperative period. The operating doctor must pay meticulous attention to the lines of skin tension and the blood supply network of the wound margin. Non-absorbable sutures are taken off as early as the wound is able to hold itself together. Tension-holding skin tapes are used during the period of remodeling.

Doctors must motivate patients for their active participation in their wound management, even long after the skin appears to heal. Hypertrophic scars which do not improve after six months is no longer considered hypertrophic scars but it is considered keloids which require proactive and more intensive management.

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