Clinical and experimental wound closure using a skin stretching device
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Chapter 3

The Sure-Closure skin-stretching system
INTRODUCTION

The Sure-Closure™ 75 mm skin-stretching system (Life Medical Sciences, Princeton, NJ. USA) is a device that functions as an aid in closing wounds where the presence of a skin deficit excludes safe and effective use of primary closure techniques. As a wound-closing aid, the Sure-Closure skin-stretching system is designed to join skin margins of wounds so that they may be safely sutured. By applying controlled tension with the device evenly along the wound margins, the viscoelastic properties of skin cause the skin to rapidly stretch which is known as "mechanical creep". The force of the tension applied by the device is controlled by the surgeon. As the skin is expanding and tension is reduced, additional tension can be applied incrementally in repeated cycles until the skin margins are brought into close apposition for suturing. The device is then removed.

OPERATIVE TECHNIQUE

Two straight needles (length, 8 cm) of the skin-stretching device are passed through the dermis opposite each other at 0.5 cm distance from the wound margins (Fig. 1). Then the locking mechanism of the device is unlocked allowing the release of two U-shaped arms from the threaded tension bar, exposing 2 curved tissue hooks attached to each of the U-arms (Fig. 2). Each of the U-arms is then placed above and perpendicular to one of the intradermal needles. The skin on both sides of the wound is punctured with the hooks and the hooks are inserted in the tissue behind the intradermal needles. This allows the 2 U-arms, when engaged, to pull the intradermal needles towards each other. Then, the 2 U-arms on the tension rod are manually approximated until significant tissue resistance is encountered. The system is then locked to approximate the wound edges (Fig. 3). The tension gauge on the device is not engaged when less than 1 kg of tension is applied to the skin. As the skin stretches over time, tension on the bar reduces, which is reflected by the reference tension indicator moving backwards to a value of “1” or less (Fig. 4). Tension can then be increased. The Sure-Closure device has a safety clutch which disengages the tension should the force applied to the wound become too high (more than 2.5 kg). Tension is re-engaged as the skin expands and the device tension is reduced. The procedure is repeated until the wound margins are
approximated, or until progress in expansion of the skin becomes too slow. Most wounds can be closed within 30 minutes but some skin deficits cannot depending on skin properties and width of the wound or may require longer periods of stretching. When the wound margins have been brought into approximation, the

Figure 1.
Insertion of the needles of the skin-stretching device intradermally opposite each other along the margins of the wound.

Figure 2.
Unlocking the device to release the U-arms on the treated tension bar.
Figure 3.
After the device is placed into position and locked, the needles are pulled together.

Figure 4.
Stress relaxation is visualized by the reference tension indicator moving backwards.
wound can be sutured between, and on both sides, of the U-arms of the device (Figure 5). The locking device is unlocked and the U-arms are disengaged. The device can also be removed before suturing the wound. When suturing is completed, the intradermal needles can be pulled out.

**INDICATIONS AND CONTRA-INDICATIONS**

The Sure-Closure™ 75 mm skin-stretching system is indicated for wounds that can be spanned by the device. Wounds wider than 7 cm can be stretched with the device, although this is the maximum distance between the hooks of the device. This is done by first manually bringing together the 2 U-arms which are inserted in the skin before they are placed on the threaded tension bar of the device. When the center of the wound is too wide, skin stretching with the device can be initiated on a more narrow part of the wound. More than one device may be used simultaneously for wound closure, especially when the wound is larger than 12 cm in length.
The device is an aid in closure of large wounds by approximation and skin stretching. Such wounds include wounds resulting from excision of tumors at various locations,\textsuperscript{2-6} scar revisions,\textsuperscript{7} traumatic injuries involving skin loss,\textsuperscript{8,9} open fasciotomies,\textsuperscript{10} amputations\textsuperscript{11} and harvesting of free-flaps.\textsuperscript{12,13}

The skin-stretching device is contra-indicated by the manufacturer when active infection is evident at the wound site. The infection must be treated before closure of the wound. Skin stretching with the device is also contra-indicated when the patient has received local radiation treatment at the wound site or is receiving chemotherapy because of disturbed wound-healing. Another contra-indication is the presence of “non-viable” or atrophic tissue present at or near the wound margins. Finally, the device should not be used when it is not possible to maintain at least 7 mm distance between the device and underlying vital structures because the skin hooks may damage these structures when skin margins approximate.

\textbf{LIMITATIONS AND ADVERSE EFFECTS}

The amount of skin gain is contingent to skin mobility, which in turn is dependent on location of the wound and the condition of surrounding skin.\textsuperscript{2} It is important that enough surrounding skin is present to allow skin stretching. When surrounding skin is healthy, a short time span of 20 to 40 minutes of skin stretching is usually adequate to gain sufficient extra skin for wound closure. However, the time required for skin stretching in chronic wounds or delayed primary closure is prolonged as a result of edema and fibrosis along the skin margins. It is difficult to predict whether stretching of surrounding skin with the device will be sufficient for closure of that particular skin defect, or whether the application of another technique is necessary. It is a matter of experience, whether skin that is available on either side of the wound is sufficient for closure and whether mobility of the skin will allow the skin edges to be brought together.\textsuperscript{2}

Potential adverse effects or complications that are described in the literature\textsuperscript{2-13} as a result from using this device are skin necrosis, hypertrophic scarring, local infection, wound dehiscence and incomplete closure of the wound. However, complications are rare, if the indications are well-considered and the operation is well-performed, which seems to be the case in the clinical studies mentioned above.
REFERENCES