

# Wound Closure by Intraoperative Skin Traction: Analysis of 23 Cases

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## ABSTRACT

*The study presents 23 cases submitted to a new and simple technique for closure of skin wounds through cycling and continuous traction of their borders in a short period of time. The technique allows for the primary closure of wounds, avoiding more invasive methods such as grafts or flaps.*

*The procedure utilizes low-cost material, such as Prolene 2<sup>TM</sup> suture and a slender catheter, in contrast to techniques with the same purpose, but that need specific devices (Sure-Closure<sup>TM</sup>) and cost much more.*

*In addition to its low cost and ease of use, the procedure may be done on an outpatient basis, with low rates of complications and morbidity and satisfactory clinical results.*

## INTRODUCTION

The concept of tissue expansion was initially put into practice by Neuman<sup>(1)</sup> in 1956, when he used a round inflatable expander in the retro auricular region. He

carried out an intermittent expansion during two months, enabling skin gain. Thereafter, Radovan<sup>(2)</sup> and other authors began to develop the gradual skin

expansion technique.

The process called immediate skin expansion was first described by Gibson<sup>(3)</sup>, and is explained by the mechanical creep phenomenon in which collagen fibers stretch parallel to the direction of the traction force and fundamental substance, made up of mucopolysaccharides and tissue fluids, and when moved leads to an increase in the surface area as the final result<sup>(4-7)</sup>.

The techniques aimed at gaining skin by intraoperative distension, described by Hirshowitz<sup>(8)</sup>, Stough<sup>(9)</sup>, Lam<sup>(10)</sup>, Bjarnesen<sup>(11)</sup> and others, need specialized equipment to be performed. These devices are not generally available in most hospitals, and are expensive.

We propose a simple wound closure technique by skin traction that allows for primary closure, thus avoiding more invasive procedures such as grafts and flaps.

It is a low cost, easy procedure with satisfactory practical results.

## METHODS

The study presents 20 patients with a total of 23 lesions in need of surgical healing and submitted to primary synthesis after one or multiple skin traction cycles. Ages ranged between 2 and 82 years, with a mean of 40 years. The mean for areas to be closed was 57.8 cm<sup>2</sup> and most were in the lower limbs. The number of cycles for each procedure ranged from 1 to 3, and most needed 3 cycles. Data are presented in better detail in Table I. Surgeries were performed in a surgical center using an aseptic technique. Local anesthesia was the most frequently used type of anesthesia. Very large lesions required local-regional block (1 case) or general anesthesia (1 case). The latter was also used in children (2 cases).

The technique consists of rectifying borders, followed

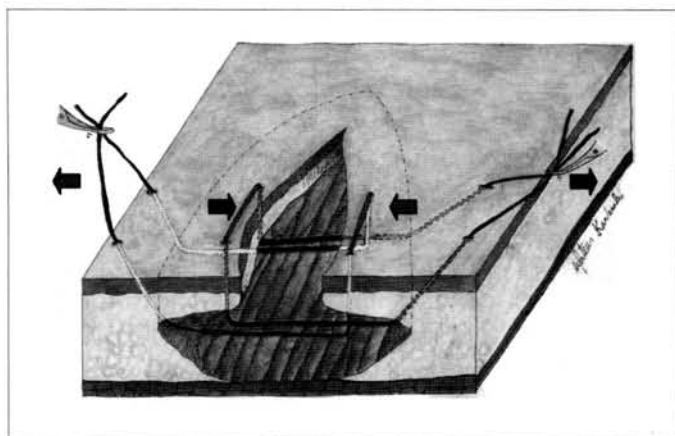


Fig. 1 – The drawing represents the positioning of sutures and direction of traction.

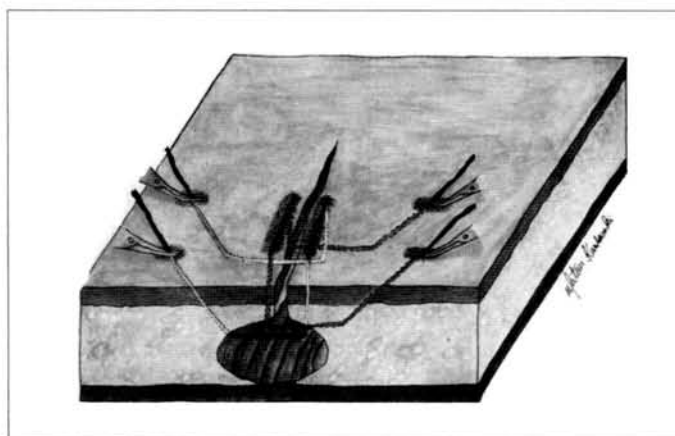


Fig. 2 – After maximum tension is reached, the exit of the suture is clamped close to the skin.



Fig. 3 – A: Immediate postoperative CBC resection at the left frontotemporal region; B: 9<sup>th</sup> postoperative month of wound closure utilizing skin traction.

by moderately detaching subcutaneous or fasciocutaneous, depending on the location or depth of the wound.

Similar to a "U" suture, the Prolene 2™ suture penetrates with a 7.5 cm needle (and not Prolene 2.0™) in the area posterior to the detachment, and comes out in the interior of the wound, in the direction of the opposite border, where the flap is transfixed at approximately 1 cm from the border; then the suture is covered by a catheter segment, using the needle; to return, the needle penetrates at the end of the detachment and comes out as distant as possible in a non-detached area in order to complete the "U", bilaterally. This step can be observed better in Fig. 1. The length of the catheter per suture, that is, the width of the suture, varies according to the size of the lesion, and is only necessary in the area of greatest tension. Various traction sutures can be associated according to needs, such as in large and/or irregular wounds.

By pulling both sutures on each side simultaneously, in opposite directions, the borders of the lesion are brought together up to a certain point of maximum tension. At this point, the assistant blocks the exits of the sutures close to the skin using four Kellys in order to maintain the tension (Fig. 2).

After 10 minutes, the Kellys are released, the tension is relaxed for 60 seconds and then traction is resumed. At this point, given the skin relaxes because of the previous cycle, the same force applied leads the lesion borders to approach each other more. The cycle (cyclic pressure) is repeated for 1 to 4 cycles (10 minutes each, at 1 minute intervals), until the borders approach each other, allowing suture.

The traction sutures can be used by the assistant to relax and approach the borders during sutures, making the surgeon's work easier. At the end of the procedure, the traction sutures are removed.

The material used for the skin traction costs US\$ 27.

The usual routine care for simple sutures was recommended in the postoperative period and sutures were removed between the seventh and twenty-first postoperative day, varying according to the region and local conditions.

The postoperative follow-up period ranged between 10 days and 4.5 years.

## RESULTS

Adequate coaptation of borders was possible in all cases with adequate results at the end of the treatment.

There was one case of total dehiscence that was treated with a skin graft. In another five cases there was partial dehiscence, the largest of which was 0.6 cm by 2.4 cm that healed by second intention, in a maximum period of 21 days.



Fig. 4 – A: Preoperative period of a patient with a congenital gluteus nevus; B: Intraoperative period, before detachment and skin traction; C: 21st postoperative day after suture removal.

There was widening of scars in the late postoperative period in three cases. There was one case of sustained alopecia of approximately 2.5 x 4.0 cm in the scalp in the late postoperative period (1 year), but without an esthetic sequela, and the patient was satisfied with the result. If necessary the condition may be treated by means of a simple resection of the scar area.

## DISCUSSION

Fast distension techniques, when created, took into account the viscoelastic properties of the skin, utilizing continuous and progressive traction. They represent a new concept in wound closure<sup>(12-17)</sup>.

They offer a simple solution for complex wounds in selected cases, and are an alternative to procedures with higher morbidity, such as skins grafts, tissue expanders, local or free flaps<sup>(18-21)</sup>.

The technique described in the present study shortens or prevents hospitalizations, decreasing treatment costs and allowing the patient to return to normal activities early.

Vascularization is the limiting factor to skin traction, and the viability of the tegument may be severely affected if the force is excessive. Thickness, tension of the skin in the detached graft, pale and painful skin are the indicators used by the surgeon to judge how much tension can be applied safely to the borders of the wound. This is where the surgeon's experience and sensitivity influence decisions.

Other techniques utilized with the same objective need devices that are not available in most hospitals, and that need to be requested in advance, ruling out their use in an unexpected situation.

In addition to the difficulties in the availability of traction devices, the mean cost per unit is US \$ 250, making the treatment more expensive and making its use unfeasible for lower-income patients. On the other hand, the technique proposed here has an average cost of US \$ 27, and the material necessary can be found in most hospitals.

Wound closure time using the proposed technique ranged between 10 and 30 minutes (22 cases). This time ranges between 25 minutes and 456 hours in the cases described in the literature with other equipment or devices<sup>(4, 10, 22)</sup>. The only exception was the first case performed with the technique proposed, an extensive thigh wound (130 cm<sup>2</sup>) that due to excessive care and technical inexperience, was sutured after 120 hours (5 days) of traction, applied once a day in an outpatient setting.

Hirshowitz and Stough do not recommend detaching wound borders because it would increase the risk of complications<sup>(9, 15)</sup>. Dehiscences, small skin necroses and infections are reported in spite of not detaching<sup>(4, 15, 23)</sup>, and may also occur in the tech-

Table I

Age (years)	Site of lesion	Size (cm)	Area (cm <sup>2</sup> )	Duration of traction
28	Thigh	13 x 10	130	5 days
61	Temporal	6 x 6	36	30 min.
26	Leg	5 x 4	20	30 min.
46	Thigh	5 x 3.5	16.5	20 min.
26	Thigh	9 x 4	36	10 min.
33	Arm	5 x 3.5	17.5	30 min.
33	Thigh	12 x 6	72	30 min.
40	Thigh	11 x 6	66	30 min.
40	Thigh	10 x 4.5	45	30 min.
82	Leg	12 x 8	96	30 min.
39	Knee	6.5 x 5	32.5	30 min.
02	Frontal	8 x 7	56	30 min.
23	Hand	5 x 3.5	17.5	20 min.
03	Frontal	8 x 3.5	28	30 min.
73	Sacral	10 x 10	100	20 min.
61	Trochanter	8 x 8	64	10 min.
62	Scalp	10 x 5	50	20 min.
46	Hand	4 x 4	16	20 min.
74	Trochanter	6 x 6	36	20 min.
34	Leg	10 x 5	50	20 min.
17	Gluteus	12 x 9	108	20 min.
09	Scalp	6 x 5	30	30 min.
52	Peritoniotomy	16 x 13	208	20 min.
Δ 40	-	-	57,8	-
Treated cases.				



nique proposed. In experimental studies, Lam and Melis reported that the combination of detachment and external skin traction devices work synergistically in order to attain greater reduction of closure tension, in comparison to each technique alone<sup>(10, 23)</sup>.

The technique proposed allows associating moderate detachment to continuous traction, with a lower risk of complications, because the cutaneous route for irrigating borders is practically intact and the flap is transfixed only in two points. Conversely, techniques that use devices need the introduction of needles or an intradermal Kirschner suture along the full extent of the wound margins connected externally by a traction device<sup>(9, 13, 14)</sup>, interrupting a substantial part of the skin irrigation route of borders, thus making it

indispensable to maintain the subcutaneous route.

The cases with scar widening were due to the positioning of the scar in relation to skin traction lines, as, for example, a vertical direction in two thigh cases and one leg case. The case that progressed with total dehiscence was a patient with a 10 x 5 cm leg wound that was sutured primarily after 20 minutes of traction. It was evolving well up to the 1st postoperative day, when unfortunately the patient began walking normally, and carrying out regular professional activities that demanded intense physical activity, ending in total dehiscence on the 3rd postoperative day.

Wound widening is described in techniques that use devices or other methods<sup>(5, 11, 14, 22)</sup>, although they are esthetically more acceptable than the scars that result

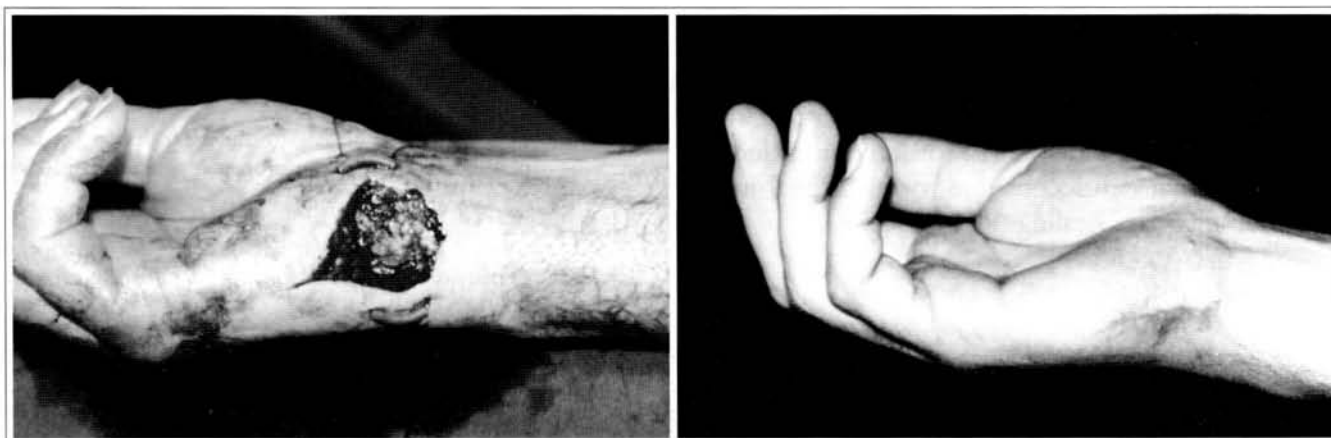


Fig. 5 – A: Traumatic right hand lesion, with substance loss (positioned traction sutures can be observed); B: 75<sup>th</sup> postoperative day, with adequate outcome.



Fig. 6 – A: Preoperative period of patient with a peritonistomy performed 2 months before, and closure required; B: Immediate postoperative period, without the need to maintain traction sutures, even for extensive lesions.

from grafts or flaps. Complication rates according to references and the technique proposed are low<sup>(6, 17, 22)</sup>.

The technique presented is versatile and easy to perform, enabling the surgeon to adjust the traction mechanism to the exact size he wishes, and not limit it to pre-established standards of manufacturers because it is performed with Prolene-2 sutures.

## CONCLUSION

This is another valuable alternative to be incorporated into the armamentarium of tactics and techniques that surgeons can offer for a simple and effective treatment of their patients. It is indicated in various scenarios: traumatic wounds with skin loss; open fasciotomies; peritoniotomies; tumor excisions; skin scar and congenital lesion revisions; closure of a flap harvesting area and others.

However, the technique is not indicated for elderly patients with deficient nutritional status and/or very delicate skin because of the risk of laceration due to traction or total dehiscence due to nutritional incapacity for adequate healing.

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