



## TY-RAPS - AN INNOVATIVE AND EASY-TO-USE METHOD FOR GRADUAL CLOSURE OF LARGE WOUNDS

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### ABSTRACT

**Background:** The aim of this study was to demonstrate an easy and safe technique that enables the gradual primary closure of large wound. We are sharing our experience of large wound closure by using simple principle of dermatotraction by Ty-Rap technique. **Material and methods:** In this study, a total of 10 patients were enrolled between the year 2022 – 2023 and having surgical wounds on different body parts that are unable to heal. The Ty-Rap system consists of a combination of two commercially available Ty-Raps. Ty-Raps are secured to the skin by four surgical staples and this is repeated every 2 cm of the wound. Tightening of Ty-Raps was done in every 3 days till complete approximation of wound. **Results:** At the end of this gradual closure, all the wounds were primarily closed within an average of 13.9 days. All the patients had complete and uncomplicated primary closure. **Conclusion:** This is a simple and novel way to close wounds gradually and deliberately. This is a useful addition to the surgical toolkit that is currently available.

**KEYWORDS :** Ty-Raps, Primary closure, Large wound

### INTRODUCTION

Large skin defects have been closed using a variety of procedures, including free flaps, skin grafts, local flaps, tissue expansion and stretching, and closure by secondary intention. The difficulty in healing from trauma is well understood. Formerly, the most popular methods for closing wounds have been delayed primary closure or the administration of a split skin graft. However, these secondary treatments are frequently linked to a lengthy hospital stay and another trip to the operating room. A variety of methods and devices, including the shoelace technique with vessel loops<sup>1,3</sup>, gradual approximation with Steri-Strips<sup>4</sup>, vacuum-assisted closure therapy system<sup>5</sup>, special stitch techniques<sup>6,7</sup> are recommended in a number of reports using the concept of dermatotraction. One of the main forces acting on the skin is tension, which, at the right amplitude and waveform, may help promote the skin's growth and expansion in order to promote early wound closure. Skin, blood vessels, and fascia are examples of extensible connective tissues. These tissues are impacted by mechanical stress because they have networks of fibrous collagen and elastin both inside the extracellular matrix and in an amorphous matrix<sup>8</sup>. Most of the collagen and elastin fibres that make up the skin's epidermal and dermal layers are embedded and float within a gel-like substrate<sup>9</sup>.

The reorientation of the skin's intricate network of elastin and mostly collagen fibres can cause the skin to stretch and expand. When skin is subjected to a continuous strain during the first few minutes, it stretches and develops creep. It is used to repair defects that first appear to be just too large for primary closure, which makes it clinically significant. The phenomena is believed to result from tissue fluid and ground substance being displaced from the dermis as well as dermal fibres realigning. Skin stretched to a consistent distance to seal a wound will show a drop in measured stress within a few minutes. As a result of skin stretching, wound closing tension decreases over time, allowing primary closure of relatively large defects.

Commercially built devices are typically costly and need preordering, which can present both a financial and logistical challenge. We saw the need for a new approach because of all these drawbacks with the existing wound closure approaches. It needed to be cheap, readily available, efficient, and simple

to use. The surgical application of Ty-Raps for the delayed closure of extremities wounds satisfies each of these requirements. The results of employing this unique technology are presented in this article, together with an assessment of its viability and mean time to wound closure.

### METHODS

This study was conducted at Sri Aurobindo Institute of Medical Sciences Indore, for a period of one year from 2022 to 2023 and a total of 10 patients were enrolled between this period with surgical wounds on different body parts. Every patient received pre-counselling and subsequently gave their informed consent for procedure.

The Ty-Rap system consists of a combination of two commercially available Ty-Raps. After taking all aseptic precaution two Ty-Raps were assembled and secured to the skin by two surgical staples on either side of wound and this is repeated every 2 cm of the wound. Staples were placed in proximity of the skin edges to avoid eversion or inversion of the skin edges after tightening.

The process of tightening the Ty-Raps until the skin starts to traction lightly was repeated every three days to allow for gradual, controlled stretching of the tissue until the skin margins were fully approximated. The Ty-Raps can be tightened and removed as an ambulatory or bedside treatment without the need for additional analgesic drugs, local anaesthetics, or an extended hospital stay.

### RESULTS

Total 10 patients were included in present study from 2022 to 2023 as shown in Table 1. Figures 1 to 4 depict the use of Ty-Raps and their results in diverse wounds. Three of the patients were female, and seven were male. 33.9 years was the mean age (range: 2–56 years). The size of the wounds varied from 6 to 38 cm in length and 4 to 8 cm in width. The amount of time it took to close a wound varied greatly based on its location and size. The average duration between applying Ty-Raps and the full closure of the wound was 13.9 days (interval: 6–18 days), and the average duration between applying Ty-Raps and removing them was 16.0 days (interval: 12–20 days). All patients tolerated the application and tightening of the Ty-Raps well, and no operation had to be stopped due to patient

pain. Furthermore, none of the patients experienced skin necrosis, and there were no Ty-Raps that required early removal. 100% of the wounds recovered without any issues.

## DISCUSSION

A Ty-Rap is a nylon tape cable tie that has a built-in gear rack and a ratchet on one end that is housed in a tiny, open box. The Ty-Rap's pointed tip cannot be pulled back once it has passed the ratchet and through the casing; the loop that results can only be drawn tighter. Almost wherever, they are easily accessible for clinical usage. Since then, Ty-Raps have been utilised therapeutically for the internal fixing of femur fractures<sup>10</sup> and even anal fistulas<sup>11</sup>. The first reports of this application date back to 1976<sup>12</sup>.

Stress relaxation and mechanical creep are the two primary viscoelastic biomechanical features of the skin that are taken into consideration during closure planning. Stretching brought on by a continuous strain on the skin results in stress relaxation<sup>13</sup>. When a brief, consistent force is applied to the skin, mechanical creep happens<sup>13</sup> as time goes on, the extension becomes more significant.

When stress is applied over time, the coiled collagen fibres in the dermal extracellular matrix realign and straighten in a more parallel orientation, releasing water molecules and enhancing skin elasticity.

Additionally in the extracellular matrix, the fragile elastic fibres break and lose their elasticity. Thus, the skin will eventually lose its propensity to recoil when the load is removed (stress relaxation) and extend (mechanical creep)<sup>13</sup>.

Preassembled Ty-Rap systems are long enough to prevent any chance of tensioning the wound's margins during the acute period, and they can be applied loosely. Because of this, after the nylon is tightened, its stiffness stops the wound edges from retraction again. Its strength also sets it apart from other approaches like the sewing method using monofilament sutures or the shoelace technique with vessel loops.

In our experience, the use of Ty-Raps for wound closure in surgical patients eliminates many drawback of previously documented techniques. Based on our findings, we found that using Ty-Raps is a better option for closure of large wounds.

## CONCLUSION

Ty-Raps wound closure prevents ischemia and necrosis while providing closure over high-tension wounds as an affordable, effectiveness and accessibility alternative to skin grafts, skin flaps, tissue expanders, and other invasive procedures. This method could aid in securing the closure of large wound with minimal scarring.

This is a simple and novel way to close wounds gradually and deliberately. This is a useful addition to the surgical toolkit that is currently available.

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## Declarations

**Funding:** No funding

**Conflict of interest:** None

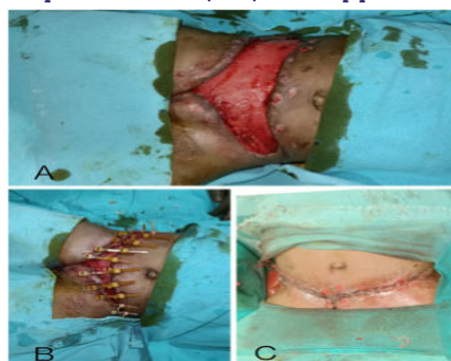
**Ethical approval:** This study was approved by the institutional ethical committee

**Table 1:**

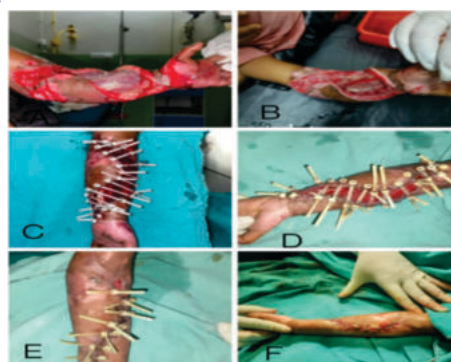
Serial no.	Age (Years)	Defect Size (Length×Width Cm)	Approximation of Ty-Raps in every 3 days in cm(average)	Duration (in days) From Ty-Rap Application to Final Closure	Ty-Raps Application To Ty-Raps Removal (Days)	Complication
1	2	13x5	1	15	17	Nil
2	35	26x7	1	17	19	Nil
3	40	25x6	1	18	20	Nil
4	56	38x8	1	15	17	Nil
5	19	10x4	1	11	13	Nil
6	26	15x4	1	12	14	Nil
7	43	10x4	1	14	16	Nil
8	55	8x3	1	13	15	Nil
9	21	12x 6	1	14	17	Nil
10	42	6x4	1	10	12	Nil



**Figure1. (A&B) 2 year male with scalp defect. (C) Debridement of wound and application of Ty-Raps.(D) Completely healed wound.(E&F) Follow up photos**



**Figure 2.(A) wound over lower abdomen.(B) Application and tightening of Ty-Raps. (C) Completely healed wound after Ty-Raps removal.**



**Figure 3. (A&B) Wound over left forearm post road traffic accident. (C,D&E) Application and tightening of Ty-Raps. (F) Completely healed wound after Ty-Raps removal.**



**Figure 4.(A) Wound over lateral aspect of right leg (B) Debridement of wound followed by application of Ty-Raps (C) Completely healed after Ty-Raps removal.**

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