

## A Comparative Study on Split Thickness Skin Graft Take Up Rate after Tumescence and Non-tumescence Technique of Graft Harvesting in a Tertiary care hospital- Tirupathi

### Abstract

#### BACKGROUND

Ulcer or raw area formed due to multiple causes like trauma, burns, venous and arterial insufficiency, etc. To cover the raw area most commonly used surgical Technique is SPLIT THICKNESS SKIN graft

**AIM:** To compare the graft take up rate after harvesting with TT and NTT.

#### METHODS

Data was collected from patients presenting to outpatient Department of General Surgery and plastic surgery, SVRRGGH, Tirupati with the ulcers due to various etiology during the period of september 2018 to august 2019 were included in the study.

#### RESULTS

Most common age group involved is 41-50 years. Males to female ratio is 1.7:1. Most common area to be grafted is leg 59%. Most common cause of ulcer is diabetic foot ulcers. The Mean graft take-up rate at the recipient site after day 5 is 96.18 and 92.14 % in TT and NTT, respectively. The difference was found to be statistically highly significant ( $p = 0.000$ ). Percentage Healing of Donor site after day 10 is 98.50 and 95.50 % in TT, NTT respectively. Mean Graft uptake at recipient site on day 5 is more with burns in TT have 99.29% uptake, in NTT have 92.42%.

#### CONCLUSION

The harvesting graft with TT has reduced intra-operative blood loss compared to NTT. Take up rate and donor site healing is better in TT than NTT. The effect of both techniques at the end of 3 weeks was found to be the same. Take up rate is better in males than females. Outcome based on the cause of ulcer has better with burns and have poor results with chronic non-specific ulcer, hence TT is considered superior except for the challenges faced.

**Keywords:** TT tumescence technique, NTT non-tumescence technique

Date of Submission: 17-07-2021

Date of Acceptance: 02-08-2021

### I. Background

Grafting of skin originated in India approximately 3000 years ago<sup>1</sup>. Split thickness skin grafts are further classified into mesh skin grafts, stamp skin grafts, and chip skin grafts, based on their shape<sup>2,3</sup>. The amount of dermis included with the graft determines both the likelihood of survival and the level of contracture<sup>4</sup>. FTSG seems to tolerate ischemia for up to 3 days. STSG takes well even after four days of ischemia<sup>5</sup>. When taking a graft from a hair-bearing region, it is vital to take a thin graft because thicker split thickness grafts will contain undesired hair follicles and eventually lead to hair loss in the graft and hair loss at the donor site<sup>6,7</sup>. A meshed graft offers multiple areas of potential reepithelialization<sup>8</sup>. Adoption of the tumescence technique (TT) in STSG has been low due to inadequate information on the viability of the graft, especially after using adrenaline. Many surgeons still use electrocautery, tourniquet, and topical adrenaline gauze<sup>9,10</sup>. The tumescence technique is one of the most common liposuction techniques in which large volumes of dilute local anesthetic (wetting solution) are injected into the fat to facilitate anesthesia and decrease blood loss<sup>11</sup>. Tumescence Technique is the sub-dermal or sub-eschar injection of fluid containing a vasoconstrictor before surgery to reduce blood loss. The tumescence local anesthetic solution was prepared on the day of surgery in the operating room, immediately before surgery. It consisted of 0.05% (0.5 mg/ml) or 0.1% (1 mg/ml) lidocaine, 10mEq/l sodium bicarbonate in Ringer lactate solution with 1:1,00,000 epinephrine. The maximum dose of lidocaine was set at 7 mg/kg, corresponding to 7ml/kg for 0.1% dilution and 14 ml/kg for 0.05% dilution<sup>12</sup>. Tumescence local anesthesia solution has been reported to have antibacterial effects due to lidocaine's bacteriostatic properties, which are enhanced by the addition of sodium bicarbonate and the washout effect of a solution commonly used in TLA<sup>13</sup>. Bactericidal effects of lidocaine<sup>14,15,7</sup>-bacteriostatic in an acid solution, bactericidal in a neutral solution. TLA has been reported to produce analgesia for a duration of up to 18 hours. The maximum

safe dose for TLA of 55 mg/kg lidocaine<sup>16</sup>. A skin graft success or its take depends on nutrient uptake and vascular in- growth from the recipient bed. This occurs in three phases: inflammatory response / plasmatic imbibition, inosculation, angiogenesis. Reinnervation occurs lately after graft up-take. Proper skin graft dressing prevents graft mobility and seroma formation. Factors that affect the take rate include seroma/hematoma formation, poorly vascularized wound bed, contaminated bed, shearing of graft, and technical aspects. Apart from these co-morbid conditions, some medicines like steroids, smoking, and malnutrition affect the take-up rate.

Split thickness skin graft failures can be attributed to flaws. Tissues with limited blood supply such as bone, tendons, cartilage, or sites with necrotic tissue or infection do not accept skin grafts. Wounds must be free of pus and should have a healthy pink to beefy red appearance with a pH of 7.4 or above. Streptococcus should be eliminated as it can 'eat-up' the skin graft in twenty-four hours. Systemic diseases, nutritional disorders, and vascular disorders should be corrected before grafting.

### **Aim**

To compare the graft take up rate after harvesting with tumescent and non-tumescent technique.

### **Objectives**

1. To study the Percentage of graft take-up rate on day 5 for patients who had undergone graft harvesting by tumescent and non-tumescent Technique.
2. To study the percentage healing of donor sites on day 10 in both groups.
3. To study the outcome of non-healed donor and recipient sites after short term follow-up of three weeks.

## **II. Methods**

The study was conducted in 100 patients of the Department of general surgery and plastic surgery SVRRGGH, Tirupati of which includes both the males and females between the age group of 20 to 65 years.

### **Study Design:**

Comparative study

### **Inclusion Criteria**

1. Patients aged 20-65 years with Ulcer.
2. Patients with clean wounds prepared for grafting.
3. Patients with burns of small surface area.

### **Exclusion Criteria**

Pus swab is positive for beta-hemolytic streptococci

### **Data Collected Using**

1. Clinical examination
2. Laboratory investigations
3. Radiological investigations

A patient's preoperative workup includes detailed clinical history regarding Age, sex, duration, and cause of the ulcer, history of trauma, burns, and any unknown bite is noted. Detailed clinical examination is done to look for peripheral pulse palpations, tests for venous insufficiency, signs of ischemia, and infection signs. Blood investigations like complete blood picture, blood grouping, and typing, blood sugars, blood urea, serum proteins and albumin, a plain x-ray of the affected area to rule out osteomyelitis, culture swab for culture and sensitivity sent from the ulcer area to be grafted. Graft bed should be well prepared by wound debridement, by improving nutritional status, correction of anemia, control of blood sugars, and culture should be negative for beta-hemolytic streptococci .The procedure was commenced only after the swab was found to be negative. The sample population of 100 patients was allocated into two equal and comparable groups by use of computer generated random numbers. GROUP A of 50 patients has been treated with STSG under the TT. Anesthetic fitness was obtained. A test dose of Lignocaine and adrenaline is given. Infiltration was performed using a manual technique with a syringe and spinal needle. Spinal anesthesia was given to the patient as all the cases in the following study involve the lower limb. The surface area of the raw site to be grafted was traced using sterile gauze. The graft donor site was prepared. TLA was taken in a 10ml syringe connected to the spinal needle and injected intra-dermally and sub-dermally over the donor site. A raised surface was formed, and graft harvesting was commenced after 10 minutes. The graft was harvested from the donor site after lubricating with vaseline and stabilizing the leg using Humby's knife and downe blade. The meshing of the graft was done, and the recipient site was prepared. The graft was placed on the raw area and fixed with monocryl. Tight dressing of the donor site was done. The recipient site was analysed on day 5 for take rate and the donor site on day 10 for percentage healing. Harvesting graft from donor site following Non-tumescent Technique that is without any

subdermal infiltration of solution. The tumescent local solution was prepared on the day of surgery in the operating room, immediately before surgery, and consisted of 0.1% (1mg/ml) or 0.05% lidocaine and 10mEq/l sodium bicarbonate in 1000ml of warm normal saline with 1:1, 00, 000 epinephrine. The concentration was decided based on the surgical site: the wider the surgical site is, the lower the concentration is, and the larger the volume.

**Statistical Methods**

T-test paired and unpaired were done where ever applicable and p-value of <0.05 is considered as significant. The outcome is compared between two groups: the mean uptake of graft at the recipient site and the Percentage of healing on the donor site. The statistical software named SPSS software version 21.0 is used for the analysis of the data and Microsoft word and Excel sheet have been used to generate graphs, tables etc.

**III. Results**

**1. DISTRIBUTION OF STUDY PARTICIPANTS BY AGE AND GENDER**

<b>AGE</b>	<b>Tumescent Number (%)</b>	<b>Non Tumescent Number (%)</b>	<b>Total</b>
21 – 30 years	8 (16%)	10 (20%)	18 (18%)
31 – 40 years	6 (12%)	13 (26%)	19 (19%)
41 – 50 years	20 (40%)	17 (34%)	37 (37%)
51 – 65 years	16 (32%)	10 (20%)	26 (26%)
Total (n=)	50 (100%)	50 (100%)	100 (100%)
<b>Gender</b>	<b>Tumescent (TT) Number (%)</b>	<b>Non Tumescent (NTT) Number (%)</b>	<b>Total</b>
Male	33 (66%)	31 (62%)	64 (64%)
Female	17 (34%)	19 (38%)	36 (36%)
Total (n=)	50 (100%)	50 (100%)	100 (100%)

In the present study, 40% of subjects from the Tumescent group and 34% of subjects from the Non-Tumescent group belonged to 41 – 50 years

In the present study, 66% and 62% of males were present in both Tumescent and Non-Tumescent, respectively. 34% and 38% of females were present in both Tumescent and Non-Tumescent, respectively

**2. Distribution of study participants by cause of Ulcer and Area to be grafted**

<b>Cause of</b>	<b>Tumescent (TT) Number (%)</b>	<b>Non Tumescent (NTT) Number (%)</b>	<b>Total</b>
Diabetic foot ulcer	18 (36%)	12 (24%)	30 (30%)
Traumatic ulcer	11 (22%)	11 (22%)	22 (22%)
Burns	7 (14%)	7 (14%)	14 (14%)
Chronic non-specific ulcer	4 (8%)	7 (14%)	11 (11%)
Arterial ulcer	5 (10%)	5 (10%)	10 (10%)
Venous ulcer	4 (8%)	5 (10%)	9 (9%)
Marjolin ulcer	1 (2%)	3 (6%)	4 (4%)
Total (n=)	50 (100%)	50 (100%)	100 (100%)
<b>Area to be grafted</b>	<b>Tumescent Number (%)</b>	<b>Non Tumescent Number (%)</b>	<b>Total</b>
Leg	31 (62%)	28 (56%)	59 (59%)
Dorsum of foot	9 (18%)	8 (16%)	17 (17%)
Forearm	6 (12%)	5 (10%)	11 (11%)
Ankle and foot	2 (4%)	6 (12%)	8 (8%)
Thigh	1 (2%)	2 (4%)	3 (3%)
Posterior calf	1 (2%)	1 (2%)	2 (2%)
Total (n=)	50 (100%)	50 (100%)	100 (100%)
Posterior calf	1 (2%)	1 (2%)	2 (2%)
Total (n=)	50 (100%)	50 (100%)	100 (100%)

In the present study, the leg was the most common area grafted in 62% and 56%, followed by dorsum of foot in 18% and 16% of Tumescant and Non-Tumescant groups, respectively.



STSG UPTAKE ON DAY5 IN TT and NTT

### 3. Comparison of Surgical outcome on Day 5, Day 10, and week 3 in both groups

	Tumescant (N = 50)			Non-Tumescant (N = 50)		
	Mean	Standard Deviation	The standard error of the mean	Mean	Standard Deviation	The standard error of the mean
Skin graft take rate – TT-NTT Day 5	96.18	5.193	.734	92.14	3.031	.429
Percentage healing of Donor site – TT-NTT Day 10	98.50	2.720	.385	95.50	1.515	.214
Percentage healing of Donor site – TT-NTT Day 21 (week 3)	97.60	2.900	.410	96.90	2.837	.401

In the present study, the Mean graft take-up rate at the recipient site after day 5 is 96.18 and 92.14 percent in Group A Tumescant and Group B Non-tumescant, respectively. The difference was found to be statistically highly significant ( $p = 0.000$ ). In Group A, TT early and better graft uptake is because of less hematoma or seroma formation on grafted site. The bacteriostatic property of anesthetic agent lignocaine maintained an aseptic environment under the graft. In the present study, percentage Healing of Donor site after day 10 is 98.50 and 95.50 percent in Group A Tumescant and Group B Non-tumescant respectively. The difference was found to be statistically highly significant ( $p = 0.000$ ). In the present study donor site is followed up to 3 weeks, percentage Healing of Donor site at week 3 is 97.60 and 96.90 percent in Group A Tumescant and Non-tumescant Group B respectively. The difference was found to be not statistically significant ( $p = 0.225$ ).

In the present study, it is observed that the mean take-up rate at recipient site on Day 5 and Percentage healing at Donor site on Day 10 were more in males (96.64 & 98.94) when compared to females (95.29 & 97.65) in Tumescant group, may be because in female, anemia is present commonly.

### 4. SURGICAL OUTCOME BASED ON THE CAUSE OF ULCER

Cause of Ulcer	Day 5 Recipient site	Day 10 Donor site	Week 3 Donor site
<b>1. Diabetic ulcer</b>			
(TT) Mean $\pm$ SD	95.56 $\pm$ 5.393	98.61 $\pm$ 2.304	97.78 $\pm$ 2.557
(NTT) Mean $\pm$ SD	92.91 $\pm$ 2.57	95.41 $\pm$ 1.44	97.91 $\pm$ 2.57
P value	=0.0023	<0.0001	0.8001
<b>2. Traumatic Ulcer</b>			
TT	99.09 $\pm$ 2.023	100.00 $\pm$ 0.000	98.64 $\pm$ 2.335
NTT	92.27 $\pm$ 2.611	95.45 $\pm$ 1.507	96.818 $\pm$ 2.522
P value	<0.0001	<0.00001	<0.0003
<b>3. Burns</b>			
TT	99.29 $\pm$ 1.890	99.29 $\pm$ 1.890	97.14 $\pm$ 3.934
NTT	92.428 $\pm$ 2.507	95.0 $\pm$ 0.00	96.428 $\pm$ 2.439
P value	<0.0001	<0.0001	=0.2794

<b>4. Chronic ulcer</b>			
<b>TT</b>	87.50±2.887	96.25±4.787	95.00±4.082
<b>NTT</b>	92.142±2.672	96.428±2.439	98.571±2.439
<b>P value</b>	<0.0001	=0.8153	<0.0001
<b>5. Arterial ulcer</b>			
<b>TT</b>	92.00±5.701	97.00±4.472	97.00±2.739
<b>NTT</b>	92.0±2.738	95.0±.00	96.00±.00
<b>P value</b>	=1.00	=0.0021	0.0113
<b>6. Venous ulcer</b>			
<b>TT</b>	92.50±2.887	96.0±0.1	97.50±2.887
<b>NTT</b>	92.00±2.738	95.00±.0	94.00±2.23
<b>P value</b>	=0.3764	<0.0001	<0.0001
<b>7. Marjolin ulcer</b>			
<b>TT</b>	95.00±0	95±0	100±0
<b>NTT</b>	88.333±7.637	96.667±2.886	96.667±5.773
<b>P value</b>	<0.0001	<0.00011	<0.0001

In the present study, mean rate of Graft uptake at recipient site on day 5 is more with burns after good debridement i.e., in TT out of 50, 7(14%) with burns have 99.29% uptake, in NTT out of 50, 7(14%) with burns have 92.42% followed by traumatic ulcer with 99.09 and 92.27 in TT and NTT respectively, diabetic ulcer has 95.56 and 92.91 in TT and NTT respectively followed by arterial ulcer, venous ulcer, marjolin's ulcer and STSG over chronic non-specific ulcers has least take up rate of 87.50 in TT.

In the present study, Healing at donor site on day 10 were more in cases with Diabetic ulcer, Traumatic Ulcer and Burns when compared to Chronic ulcer, Arterial Ulcer, Venous ulcer and in both Tumescant and Non-Tumescant groups.

#### IV. Discussion

##### 1. AGE INCIDENCE:

In the present study, 100 subjects aged between 20-65 years are taken. Among 100 subjects, 37% were in the age group of 41-50 years. Between 21 to 30 years are 18%, 31 to 40 years are 19%, 51 to 65 years is 26%. The mean age is 43.24 years with a standard deviation of 11.320 years. 40% from the tumescant Technique (TT) and 34% from the non-tumescant Technique (NTT) are 41-50 years. Mean age deviation in the tumescant Technique (TT) is 45.42±11.894 and in NTT is 41.06±10.379.

In the study conducted by Vaishnavi et al., 100 patients aged between 18-65 years, majority of patients are aged between 36-45 years are 48%. Up to 35 years are 10%, between 46 to 55 years are 32%, and 56-65 years are 10%.

In the study conducted by Rajendran MK et al.<sup>17</sup> study, 80 patients aged between 18 -65 years are taken with 40 patients in each group.

In the study conducted by Koujalagi R et al.<sup>18</sup>. 90 subjects aged between 18 to 78 years with 45 patients in group TT with man age of 29.98±12.6 and 45 patients in group NTT with mean age of 45.36±10.23 years were included.

##### 2. SEX DISTRIBUTION

In the present study, out of 100 subjects, 64% are male, and 36% are females. Incidence of burns, cellulitis, traumatic ulcers is more common in men compared to females, as observed in several studies.

In Vaishnavi et al. study (2018), out of 100 subjects, 66% are males, and 34% are females.

In Koujalagi R et al. study, out of 90 subjects, 71.11% were men and 28.89% women.

##### 3. CAUSES OF ULCER

In the present study, Diabetic foot ulcer is the most common ulcer (30%), followed by 22% of Traumatic ulcers, 14% of Burns, 11% of Chronic ulcers, 10% of Arterial ulcer, 9% of Venous ulcer, and 4% of Marjolin's ulcers.

In Vaishnavi et al., study traumatic ulcer (37%) was the most common cause, followed by unknown bite (10%) and burns (3%).

In Koujalagi R et al. study, the chronic non-specific ulcer was the most common cause.

In Rajendran MK et al., study patients with <30% TBSA from thermal burns caused by open flames and scalds are included.

**Distribution of study participants by Cause of Ulcer**

Cause of ulcer	Present study	Vaishnavi et al	Koujalagi R et al	Rajendran MK et al
Diabetic foot ulcer	30	0	0	0
Traumatic ulcer	22	37	15	0
Burns	14	3	22	80
Chronic non-specific ulcer	11	0	26	0
Arterial ulcer	10	0	0	0
Venous ulcer	9	0	0	0
Marjolins ulcer	4	0	0	0
Unknown bite and cellulitis	0	10	10	0
Post burn contracture	0	0	17	0
<b>Total</b>	<b>100</b>	<b>50</b>	<b>90</b>	<b>80</b>

**4. AREA TO BE GRAFTED**

In the present study, Leg was the most common area grafted in 59% of the cases, followed by the Dorsum of the foot in 17% of the cases.

In Vaishnavi et al., study, the dorsum of the foot was the most common area to be grafted, followed by leg, ankle, and foot.

In Rajendran MK et al., study, lower limbs are the most common area to be grafted, followed by head and neck, and trunk.

In the present study ,in Group A, 50 patients were subjected to STSG under TT by sub-dermal administration of tumescant solution, which also has the action of local anesthesia and provides tissue had a smooth, firm, even, slightly swollen appearance.

In Group B, there is no administration of any solution. The graft is harvested under spinal anesthesia.

Harvesting of STSG with Humby’s knife was done and meshing 2:1 for all areas except for hands, distal forearms. Grafts were placed immediately after complete hemostasis on the ulcer bed and secured with staples or monocryl. Recipient site dressing was done with wet gauze pieces soaked in normal saline over lubricant layer applied over graft. Plaster of Paris is applied for immobilization or to prevent shearing forces in both groups, and the dressing was opened on post-operative day three and look for the colour of graft, and second dressing was opened on POD 5, look for the graft uptake at recipient site.

Donor site dressing was done with dry gauze pieces and opened on POD 10 to know healing percentage of donor site and followed at the end of the third week.

**M. K. Rajendran et.al study (2018)**<sup>17</sup> in this study, the tumescant solution was made by 1-milligram adrenaline 1:1000 added to 999 millilitres of warm saline (37°C). This diluted the adrenaline to 1:1,000,000. The recipient site was analyzed on day 5 for taking rate and the donor site on day 10 for percentage healing.

**Koujalagi R et al. study (2018)**<sup>18</sup>, in this study, with a modified tumescant solution as subcutaneous pre-harvest injection of 1 mg (1:1000) adrenaline added to 500 mL of saline is used. The donor site of patients in both the groups were monitored and inspected on 10th day postoperatively for percentage healing.

**5. COLOUR OF THE GRAFT**

The pink colour of graft denotes Incidence of uptake is more after day five or more chances of graft survival or viability. Pale colour denotes incidence of uptake is less after day 5, is due to delayed re-vascularisation due to infection, shearing forces, anemia, uncontrolled high blood sugar levels, etc

**6. MEAN GRAFT TAKE UP RATE AT RECIPIENT SITE ON DAY 5**

In the present study, in Group A, 50 patients were subjected to STSG under TT. In Group B, there is no administration of any solution. The Mean graft take-up rate at the recipient site after day 5 is 96.18 and 92.14 % in TT and NTT, respectively.

In Vaishnavi et al, study conducted on 50 patients and both Tumescant and Non -tumescant technique is conducted on same patient for STSG. By TT, mean graft uptake on recipient site is 97.10%, in NTT it is 94.40%.

In Rajendran MK et al study, the mean graft take rate was 2.5% higher in the tumescant group compared to the non-tumescant group (96.3% compared to 94%). This study showed tumescant Technique had a better outcome could be due to less hematoma/ seroma formation on the grafted site.

## **7. HEALING PERCENTAGE IN DONOR SITE ON DAY 10**

In the present study, Percentage Healing of Donor site after day10 is 98.50 and 95.50 % in TT and NTT respectively.

In Rajendran MK et al study, On day 10, there was no difference in percentage healing of donor a sites between the tumescent and non- tumescent groups,  $p=0.562$ . During follow up for assessing final outcome at three weeks all the patients had 100% healing. Patients in the tumescent group were significantly more likely to heal earlier with 7.5% healing between day 10 and week 3 compared to 25% of patients in the non-tumescent group who also healed during the same period (day 10 and final follow up,  $p=0.034$ ).

In koujalagi R et al study of 45 patients in each group, the donor site of patients in both the groups were monitored and inspected on 10th day postoperatively for percentage healing. Percentage of wound healing by epithelialization was calculated by wound tracing method. The healed epithelialized area was marked by marker and then the sheet was placed over calibrated paper to count the area of percentage of healing in both the groups. The number of donor areas that achieved complete epithelialization on the post-operative day 10 by tumescent Technique was seen in 15.56% of patients. Whereas in group B, complete epithelialization was observed only in 6.66% of patients. The difference in healing percentage between the groups was statistically significant ( $P= 0.0134$ ). Compared to the patients in group B, patients who underwent tumescent Technique (group A) had higher healing rate ( $>80\%$ ,  $p=0.0134$ ). Evidence of infection in the donor site was absent in both the groups. From this study, implementation of tumescent anesthesia in cutaneous surgery will not only aid in minimal bleeding and ease of graft harvesting but will also help in faster healing with no further complications in surgeries involving patients with burn, ulcer, and cellulitis.

## **8. HEALING PERCENTAGE IN DONOR SITE AFTER 3 WEEKS**

In the present study, donor site is followed up to 3 weeks, percentage Healing of Donor site at week 3 is 97.60 and 96.90 percent in Group A Tumescent and Non-tumescent Group B respectively. The difference was found to be not statistically significant ( $p = 0.225$ ).

In Vaishnavi et al, study, Healing % in donor site, By the end of 3 weeks healing % in donor site is 97.40 in both TT and NTT Groups.

## **V. Conclusion**

1. That harvesting graft with tumescent Technique reduced intra-operative blood loss compared to non-tumescent Technique.
2. Take up rate is better in TT than NTT.
3. Early and better donor site healing in tumescent Technique compared to non-tumescent Technique.
4. The effect of both techniques at the end of 3weeks was found to be the same.
5. Take up rate is better in males compared to females.
6. Surgical outcome based on the cause of ulcer has better results with burns and have poor results with chronic non-specific ulcer hence tumescent Technique is considered superior except for the challenges faced.

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