

Regeneration of Pain, Touch, Cold, and Warmth, sensations in split thickness human skin grafts in adults (A clinical study)

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Abstract;

Back ground: Skin grafting is the most common form of reconstructive surgery, and regeneration of sensations in skin grafts is a complex process influenced by many factors such as , the thickness of the graft, the depth of the grafted bed, meshing of the graft, the condition of the bed and the surrounding area. So many studies performed on this subject, some of them clinically based on subjective type of sensation tests, and others histological to detect the presence of nerve fibers in the grafted skin

Objectives: To detect return of sensations to split thickness skin grafts by clinical methods.

Methods: From Oct. 1995 to Oct. 2010, a clinical prospective study performed in Al wasity Hospital for reconstructive surgery, Hilla teaching General Hospital, and Al kindy teaching General Hospital on recovery of sensations in human split thickness skin grafts on 200 patients, 400 grafts. There were 120

male, 80 female patients, there ages ranged from 20 -61 years with mean of 28 years. The regeneration of sensation of pain, touch, cold, and warmth, was studied with the usual clinical methods. We studied; different graft thicknesses, depth of graft beds, meshing of the grafts, grafts on early and late wound excisions

Results: in our study the regeneration of sensations occurred in the following order; pain, touch, cold , warmth, and has been found to extend over a period of 16days to 3 months, and sensations improve with time but never recover completely even after several years.

Conclusion: The recovery of sensation of grafted skin is a complex process that is influenced by many factors; some of them are related to the graft, to the recipient bed, to the patient as a whole, and occurs if the graft is applied on a sufficiently innervated bed.

Key words: skin graft, regeneration, split thickness skin graft, sensation, pain ,touch, cold, warmth.

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Introduction

Skin grafting is the most common form of reconstructive surgery. (1)

Skin is transplanted by completely detaching a portion of skin from its donor site and transferring it to a host bed where it acquires a new blood supply to ensure the viability of the transplanted cells.

Skin grafting was first performed in India, 2000 years ago, but wide spread interest did not develop until the 19th century. (2)

Skin graft can be:

1-split thickness skin graft; which includes the epidermis and variable fraction of the dermis, in an average of 0.012-0.018 inches

2-full thickness skin graft; which includes the entire skin epidermis and dermis.

An important decision in skin grafting is selecting the ideal graft from the optimal donor site.

Regeneration of sensations in grafted skin:-

In 1899 Stansky reported the early return of light touch sensibility in a full thickness graft but after 10 days the entire graft melted away.

Some authors regard this result of little value since it was based up on an insufficient amount of evidence.

Kredle and Evans (1933), Davis (1934), Davis and Kitlowski (1934), Meltzer and Fillinger (1936); performed great number of examinations with subjective methods for touch, pain, heat, and cold.

In Iraq, prophesor Khalid Naji had performed a study which was (Nervous regeneration in various skin grafts) in 1948 under supervision of L. S.Rogers and E.A. Mills, Bur biopsies taken and studied histologicaly and they found no nerve regeneration in the skin grafts. He believed that the skin grafts act as a conductor or transmitter to the stimuli to stimulate the nerves in the recipient bed. (Personal communication).

Fitzgerald et al had performed a study on pigs and found that the pattern of sensory innervations resemble that described for man, by weekly

histological examination, which revealed extension of regional cutaneous nerves into the graft and enter the neurolemmal sheaths of the graft plexus at 2 weeks.

Other found re innervations to commence usually within first month after grafting and sensation return to the graft edges and proceed to the centre.(3)

Some authors stated that even after healing is complete the degree of sensation in graft does not equal that of normal skin.(4)

Other estimated magnitude and threshold of touch, cold, and warmth, and found that it did not return to normal levels in burn survivors.(5)

Factors influencing pattern and extent of re innervations:

The pattern of innervations is primarily determined by the disposition of the neurolemmal cell pathways within the graft and the extent to which the skin graft is re innervated appears to be determined by the accessibility of these pathways to the probing nerve fibers, and assume the sensory pattern of the recipient bed. (6)

Some of the new fibers push ahead either naked fibers or along a scaffolding of Schwann cells projected from the central nerve ends of the recipient bed. (7)

While some of the fibers may find and establish connections with the end organs in the graft, others must end blindly or form new end organs. (8)

1-The depth of the recipient bed;

Ward R.S. has stated that the depth of burn injury appears to be the best predictor of altered sensations. (9)

Grafts applied on fat have given better functional sensory results than grafts on fascia and little or no innervations found if applied on bone (10, 11)

2-The type and condition of graft bed and surrounding skin;

Dense scarring of the grafted bed or neighboring area or nerve damage will impair innervations. (12),

Skin grafts over re innervated free muscle flaps can develop significantly better innervations than skin grafts over non innervated muscle flaps.(13)

3- Thickness of the skin graft;

Stated that the regeneration of sensation occurs earlier in thinner grafts, while Kredl and Evans (1933) are on the contrary. (9,10)

4-Chemotactic fibers;

Some authors suggest the presence of chemotactic factors that guide the nerve fibers to the suitable end organ.(14)

Methods

From Oct. 1995 to Oct. 2010 a clinical prospective study performed in Al Wasity Hospital for reconstruction, Hilla general teaching Hospital, and Al Kindy general teaching Hospital, on recovery of sensations in split thickness human skin grafts, on 200 patients, 400 skin grafts.

Sex; there were 120 males, 80 females.

Age; from 20-61 years with mean of 28 years.

Causes of graftings; operations on post burn contractures and scarring; 90 cases (45%).

Burn raw areas; 70 cases (35%).

Road traffic accidents; 30 cases (15%).

Blast injuries; 10 cases (5%).

Sites of grafting; upper limbs; 80 cases (40%).

Lower limbs; 60 cases (30%).

Head and neck; 40 cases (20%).

Trunk; 20 cases (10%).

Grafted beds;

Granulation tissues; 110 cases (55%).

Subcutaneous tissues; 50 cases (25%).

Muscle; 26 cases (13%).

Dermis; 10 cases (5%).

Bone; 4 cases (2%).

The regeneration of sensations of pain, touch, cold, and warmth, were studied with the usual clinical methods with the patient sitting on chair or lying comfortably in bed.

Thickness of grafts; All cases were split thickness skin grafts.

Results;

In our study the regeneration of pain, touch, cold, and warmth, has been found to extend over a period of 16 days to 3 months as shown in table 1.

Table 1; Showing the modality of sensation and range and mean of recovery in days.

Modality	Range(days)	Average (days)
Pain	16-90	41
Touch	16-75	43
Cold	18-90	47
Warmth	18-90	48

The recovery of sensation improves with time towards the values of the control sites but no complete recovery occurred even after 15 years post grafting.

Thickness of the graft and duration of recovery;

The relation between thickness of the graft and duration of recovery of sensation is directly proportional as shown in table 2.

The thicker the graft, the longer the duration of recovery.

Table 2; The relation between thickness of graft, and average time of recovery in (days).

Thickness of graft	touch	cold	Warmth	pain
Thin	39	43	44	37
Medium	43	47	48	42
Thick	45	48	50	45

The depth of recipient bed and recovery of sensation;

The deeper the bed the more late will be the recovery or no recovery. Grafts applied over muscle or bone will get very late, poor or no sensation even after 15 years as shown in table 3.

Table 3 the relationship between depth of recipient bed and the mean time of recovery of sensation; years(y), days (d), Negative (-ve).

The bed	Touch	Cold	Warmth	pain
Dermis	22d	23d	23d	21d
Subcutaneous	44d	49d	50d	42d
Muscle	15y -ve	15 y -ve	15y -ve	15y -ve
Bone	15y -ve	15y -ve	15y -ve	15y -ve

The effect of meshing on recovery of sensation;

Meshed grafts found to regain sensations faster than the non meshed grafts as shown in table 4.

Table 4 mean time of recovery of sensations in days of meshed and non meshed grafts.

Type of graft	Touch	Cold	Warmth	Pain
Unmeshed	46	50	51	43
Meshed	40	46	47	39

Early Excision and grafting of burn and recovery of sensation: In this study it has been shown that early excision and grafting of burns recovered sensations earlier than late grafting as shown in table 5.

Table 5: Showing the mean time in days of recovery of sensations of grafts in early and late excision of burns.

Excision	Touch	Cold	Warmth	Pain
Early	38	45	43	35.5
Late	44	52	51	49.1

Discussion;

In this study which is based on subjective type of sensation, individual variation expected to be an influencing factor.

The recovery of sensation was found to be in the following order; pain, touch, cold, and warmth.

This finding agrees with the results of Loyal Davis who stated that pin prick always recovered first (2).

Why pain first? No clear etiology can be demonstrated in our study or the previous studies, but it could be related to the availability of huge number of pain receptors every where in the body as small myelinated A fibers and un myelinated C fibers. (Dr. Sahib Al Musawy the head of department of physiology in Medical College in Baghdad University, personal communication.)

Thickness of the grafts;

Thin grafts regained sensation earlier than thick once, this result corresponds with the finding of Mc Carol 1938 and Barclay1955,and this could agree or supported by the theory which indicate that Unmyelinated neurons have the greater ability to traverse scar tissue and re innervate grafted skin following third degree burn injury (15).

The Depth of the wound ; We have found that the more deep the bed of grafts the more late recovery or no recovery will occur which corresponds with the findings of Ward-Rs. who stated that the depth of burn injury appears to be the best predictor of altered sensation. (16)

This could be explained by the un availability of cutaneous sensory nerves.

Effect of meshing; Meshed grafts found to recover sensation earlier than unmeshed grafts.

The interstices of the meshed graft found to recover sensation earlier than the strips of the graft by pin prick, this could be due to easy stimulation of sub epithelial nerve endings, or could be due to the phenomenon of hyperalgesia which accompanies the injury and inflammatory reaction to the grafted region.(Dr. Sahib Al Musawy, personal communication(1996).

Early Excision and skin grafting; Resulted in earlier recovery of sensation than late ,which could be explained by decreasing the lay down of fibrous tissues which if present in large amounts will impair nerve penetration to the graft,and may be due to more destruction of tissues including nerves and receptors with prolonged exposure before covering with skin grafts,this finding is supported by the study performed by Heimbach D.M.(17),but disagree with the finding of Hermanson and coworkers

who stated that there was no significant difference in sensibility between burn excised and grafted early or late.(18)

Conclusion;

The recovery of sensation of grafted skin is a complex process that is influenced by many factors; some of them are related to the graft, to the recipient bed, and to the patient as a whole.

Recovery of sensation occurs if the graft is applied on a sufficiently innervated bed and gains a patchy random distribution.

Recovery of sensations occurs with a clear individual variation.

Modality of sensation do not returned always simultaneously.

Pain retained first followed by touch, cold, and warmth, and improve with time but never recover completely even after several years.

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