

## FLAP LACERATIONS WITH DISTAL BASE

### (A Study of Coal Mining Injuries)

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Flap Lacerations are the result of trauma in which varying amount of tissues are avulsed from their bed with a pedicle of variable size. The healing is invariably compromised because of crushing and shearing nature of trauma and impaired vascularity of tissues more so with the pedicle based distally in a limb. Lacerated wounds of leg tend to heal slowly when sutured under tension but quite satisfactorily when left alone (Leading article, 1978). Literature is replete with reports of treatment of leg lacerations mostly sustained at home where the most common cause is fall against sharp objects like ladder, chair, stakes etc., which is comparatively of less violent nature. (Woodyard, 1968, Tandon and Sutherland, 1973 and Crawford and Gipson 1977). The purpose of this communication is to report flap lacerations with a distal base sustained during coal mining.

#### Material and Methods

All the 55 patients are male workers of ages between 25 and 50 (Average being 34 yrs.) treated in the accident services of Singareni Collieries Main Hospital between May 1975 and April, 1980. Injuries were sustained over cylindrical parts of the limbs when a coal piece fell on the limb at an acute angle resulting in tearing of tissues. The usual type of wound is a triangular lacerated wound with skin raised in the form of a flap with a distal base, the edges being thin and ragged—the thickness of tissues increasing progressi-

vely from periphery to centre of the flap. Depending on the site and angle of contact between the sharp injuring edge of coal and the limb, various deeper soft tissues were also injured. The wound was found to be invariably contaminated with coal staining the tissues dark. Size of the flap varied from 8 to 25 cms-height of the triangle being measured.

All the patients had definitive treatment for the flaps initiated as soon as the general condition and other injuries permitted. Sedation or general anaesthesia were used as necessary. The wound is thoroughly cleaned, subcutaneous haematomas evacuated and all discoloured, stained tissues excised till capillary ooze was noted. The flap was either sutured back in position, or left to lie on its bed without sutures or placed on its bed with a single apical suture or excised primarily and grafted depending on the local conditions. Pressure bandage was applied over non-adhesive dressing and tulle-graz. The limb was elevated on pillows by about 15°. Analgesics and anti-inflammatory drug (oxyphenbutazone) was used routinely and antibiotics were prescribed only when other injuries justified their use. The patient was kept in bed either till the time of wound healing or the graft take resulting in closure of the wound completely. The patient was allowed ambulant with a supportive bandage till complete subsidence of gravitational oedema of the leg and foot, when he was declared fit for duty.

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The hospital being entirely meant for treatment of miners and their families, the chief aim was to return the workers to their work in as short a period as possible. The pressure for beds due to prolonged bed rest being considered a necessary handicap, all patients were treated as inpatients till final healing of the wounds was achieved.

### Observations

Of the total 55 cases, involvement of the thigh was noted in 6 cases, arm was involved in 3 instances and the remaining 46 had involvement of the leg both sides being involved equally (Table No. I).

### I. Thigh :

Of the 6 patients studied 2 had flaps involving only the skin and subcutaneous tissue on the anterior aspect of thigh, 2 had wounds involving vastus medialis muscle and the remaining 2 had flaps involving the knee joint through a tear in the quadriceps in the supra patellar region. All the wounds were thoroughly cleaned, devitalised and stained tissues excised till viable tissue was reached and primarily closed after meticulous haemostasis. Continuous suction was used after joint closure in both the cases with joint involvement. Postoperative plaster backshell was used till the time of suture removal which

**Table I**  
*Showing Summary of Results of Treatment*

S. No.	Part	No.	Wound healing (Days)		Fit for duty (Days)	
			Average	Range	Average	Range
I.	Thigh	6	12	10—14	30	12—46
II.	Arm	3	12	10—14	25	12—30
III.	Leg :—					
1.	Pre-tibial (Upper 2/3)					
	(a) Viable	8	18	12—28	45	30—53
	(b) Doubtful	7	17	14—26	53	30—60
	(c) Non-viable	3	23	16—52	58	28—98
	Total	18	185	12—52	50	28—98
2.	Overlying muscles	12	12	10—16	28	12—38
3.	Lower third :					
	(a) Skin only	8	16	10—26	27	15—55
	(b) Tendons	8	32	20—47	45	36—92
		16	25	10—47	37.3	15—92
	Total (Leg)	46	18.8	10—52	40	12—98

was usually 10 days. Isometric quadriceps exercises were started on the second post operative day and active knee bending exercises were started on the 10 day when joint or muscle were not involved but after 15 days when either of them was involved.

All the wounds healed primarily and full functional recovery was achieved on an average by 30 days (the range being 12-46 days).

## II. *Arm :*

Of the 3 cases with flaps on the arm 2 had flaps on the back and one on the front of the arm. Both the cases with lacerated flaps on the posterior aspect of the arm had triceps injury involving the muscle in its distal third, one opening into the elbow joint. The single case with wound on the front of arm had partial cut of biceps muscle. In all the cases the treatment was thorough cleaning, excision of dead stained tissues and primary closure of the wound. The healing in all the cases was primary and elbow function recovered fully within an average period of 25 days (range 12-30 days).

## III. *Leg :*

The injuries involving leg were grouped under three divisions.

1. Those involving shin or pre-tibial skin in upper two thirds of the leg.
2. Those involving muscular areas like calf, anterior or lateral compartments of the leg and
3. Those involving lower third of the leg where the deeper tissues are osseous or tendinous.

1. Pre-tibial skin was involved in a total number of 18 cases. In 8 cases the flap was definitely viable, the flap was of doubtful

viability in 7 and in 3 cases the flap was definitely non-viable.

In case of viable flaps the subcutaneous haematomata were evacuated, torn long saphenous vein ligated in two cases and edges of the flap were trimmed before returning it to its bed. In two cases the flap was maintained in position with a single suture at the tip to prevent wrinkling of the flap without any attempt at approximation of the wound edges. In the remaining 6 cases the flap was primarily sutured in two and left on its bed without sutures in 4 instances. On routine inspection of the wound the next day both primarily sutured cases required removal of sutures due to post operative oedema, impaired colour and vascular return of the margins. The single anchoring suture was removed on the fourth day in both the cases. The wound healing was complete by an average of 18 days (range 12-28 days) and return to work was noted by 45 days (30-53 days).

In flaps with doubtful viability the flap edges were cleaned and trimmed before replacing the flap on its bed without sutures. By the third post operative day variable extent of flap necrosis was noted in five cases which required excision and subsequent skin grafting. The remaining two cases maintained a viable flap with a raw area around the flap margins which healed by a subsequent epithelialization. An average of 17 days (range 14-26 days) were required for wound healing and 53 days (range 30-60 days) for return to work.

All the three definitely non-viable flaps had excision of the flap primarily followed by partial thickness skin grafting after 3 or 4 days.

The average period requiring for wound closure was twenty three days (range 16-52

days) and return to work was possible by 58 days (range 28-98 days).

2. Involvement of skin overlying the calf muscle was noted in 6 cases and all had variable lacerations of the underlying triceps surae muscle. The crushed necrotic muscle was excised and the muscle repaired. After achieving perfect haemostasis primary closure was done without tension in all the cases. All the wounds healed primarily. Injuries over the anterior and lateral muscular compartments were seen in 6 cases, one having an undisplaced fibular fracture and two having injury to the underlying muscles. The flaps were left to lie on their beds without sutures. 5 cases healed without any untoward event only one case requiring excision of necrotic flap and subsequent skin grafting. Return to work was possible by an average 28 days (ranging 12-28 days).

3. Wounds involving the lower third of the leg were encountered in 16 cases. Associated injuries of tendons were found in 8 cases (Tibialis anterior 2 cases, Extensor hallucis longus-one case, Peronei-2 cases and Tendo Achilles in 3 cases). The flap was treated as usual and primary suture of tendons was possible in 4 cases. Delayed tendon transplant was performed in 3 cases and one case had tendon exclusion. (The proximal and distal stumps of peroneus longus tendon after excision of lacerated and damaged tendon were sutured on to the peroneus brevis tendon). Wound healing in cases with tendon injury required on an average 32 days (range 20-47 days) but patients returned to work only by 45 days (36-92 days).

Exclusive involvement of the skin was noted in 8 cases. 6 were treated with cleaning, trimming and repositioning of the flap on its

bed and 2 were treated with excision of the necrotic flap and primary skin grafting. Of the 6 treated conservatively one required skin, grafting later. The average healing time was 16 days (range 10-16 days) but return to work was possible only by 27 days (range 15-55 days).

### Discussion

The blood vessels of limbs being oriented along the longitudinal axis, a distally based flap irrespective of the nature and extent of injury has a predetermined bias for poor healing. The average age in the present series is 34 years which is much less than other reported series, and this is a factor favourable to better wound healing. Flap lacerations in arm and thigh behave like extensive lacerations elsewhere without any predilection to delayed healing possibly because of the abundant blood supply to the skin, good vascularity of the deeper tissues and minimal effects of gravity.

Wounds involving the leg fare definitely worse as compared to their counterparts involving thigh and arm because of the adverse factors like increased effects of gravity, poor blood supply as determined by skin temperature studies (Rozner and Ashby, 1965) and increased sympatheticovenous tone of the limb vessels (Adson and Brown, 1929; Gaskell and Burton, 1953). Skin of the whole leg and more so that over the shin is firmly tethered to the deeper tissues. Consequently any traumatic oedema of tissues causes a rise in interstitial tissue pressure which is many times more (Felder, 1954). This disproportionate rise in tissue tension may be the sole determinant whether a primarily sutured flap will survive or end up in gangrene. Frequent and early inspection of wounds is essential if

a primarily sutured flap with borderline vascularity is to be saved from becoming fully avascular, as observed in two cases. Elevation of the limb by 10 to 15 degrees if not more is definitely helpful in reducing post-operative oedema more so in cases where the long veins like long saphenous were injured. Enforced bed rest seems to improve wound healing though the study does not have an ambulant counterpart. The reduced period of average healing of 18.8 days as compared to 27 and 53 days for immediate and delayed wounds in the report of Tandon and Sutherland (1973) can only be explained by the enforced bed rest in the present series even though the wounds in the present study are of much greater severity.

Even the single anchoring suture at the tip of the flap may distribute the tissue tension around it and lead to compromise vascularity. So even the innocuous tip suture may have to be desirably replaced by STERISTRIP.

Wounds over the lower third are prone to poor healing because of the inherent poor local vascularity and poor quality of underlying tissues which are osseous, ligamentous or tendinous (Brown, 1965). Associated injuries to underlying tendons or bones result in an invariable increase in healing time.

#### Summary and Conclusions :

1. A total number of 55 cases of distally based flap lacerations in coal miners are reported.
2. Flap lacerations in thigh and arm behave in a way similar to extensive lacerations elsewhere in the body.
3. Flap lacerations overlying the tibia, more so in the distal 1/3rd are predestined to poor healing compared to their counterparts over the calf.
4. Primary suture of flap lacerations is to be avoided and delayed primary suturing is preferable.
5. Steristrip application may be justified in these cases to prevent wrinkling of the flap.
6. Enforced bed rest, Elevation of the limb, early regular inspection of the wound and compression/supportive bandages form an essential part of the treatment.

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