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Proximal Sural Artery Flap for Knee Defects

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Abstract
Proximal sural artery flap is one of the dependable options standing first on the list to reconstruct the knee defects. In our series of 9 cases which were done in between 2017-2020, for various knee defects proximal sural artery flap was used to resurface knee. All the cases were performed without tourniquet under spinal anesthesia . Hand held Doppler was not used to locate perforators in any case. Results were quite satisfactory with near normal skin, thickness, color, and sensation. Execution of the procedure is relatively easy even in fatty individuals in comparison to other regional flaps. Post operative complications were negligible, with no total flap loss in any case. Donor site is well hidden.

Key Words: *proximal sural artery flap, knee defects, knee debridement*

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I. Introduction

Defects in and around the knee are certainly challenging to a reconstructive surgeon, because of its location over highly mobile joint, which often demands a stable, pliable tissue with sensation. Meeting these demands, proximal sural artery flap appears to be one of the best choices. It has thin skin when compared with thigh skin flaps, color is near normal to knee skin, sensation is quite satisfactory due to sural nerve, dimensions are quite enough to cover entire anterior surface of knee, apart from it is having reliable blood supply based on the sural arteries. Even donor site morbidity is minimal in comparison to the options.

II. Material And Methods

All the 9 cases were done between 2017 – 2020 in Department of Plastic Surgery, GGH, Vijayawada and Sri Ramadevi SuperSpeciality Hospital, Remedy Hospital, Tirupati. The causes for the knee defects were following road traffic accidents, tumor excision and exposure of plate screws. The age group was range from 20 years to 50 years. Males were 8 and females were 1 in this group. Five cases were presented with skin loss on the accidental site itself, one case was a planned tumor excision and rest of the three were following delayed skin necrosis after trauma, for which debridement was done before providing flap cover on table. All the defects were in and around the patella on anterior surface. They were all non smokers and non alcoholics. One man was having Diabetes, which is under control. The average size of the defect was 6 X9 Cm^2.

Surgical technique

Cases were done under spinal anesthesia. Patients were kept in prone or lateral position. No tourniquet was used in any case. To begin with a central reference line was marked from the center of posterior knee crease line to lateral malleolus. Pivot point was fixed 2 cm distal to this central mark on the reference line. Based on this pivot point, a defect based island flap (in some cases with skin tail extension as 'sperm shaped') marked on the junction of the middle and distal third of the leg, keeping the reference line in the center, which is indicative of Neuro vascular pedicle by doing 'planning in reverse' . Identification of perforators with hand held Doppler was not done in any case assuming that they were there as described. Then distal incision was made first to identify the sural nerve and short saphenous vein, which was clamped with hemostats ligated and divided. Then the dissection continued all along the markings, raising dermal flaps over the bridge segment on either side keeping subcutaneous pedicle with its neuro vascularity. The average width of the pedicle was maintained at 4cm, on either side of the neuro vascular structures. Flap harvestation continued till the pivot point securing heamostasis, simultaneously assessing the reach of the flap to the defect. Then sub cutaneous tunnel created from the pivot point to the defect to bring the flap to the defect. In cases where, flap was raised with skin tail

extension, the bridge segment was incised undermined on either side to accommodate the pedicle to avoid tension and compression. Flap inset was given adequately without any tension over suture line after keeping drain. Donor site reduced and bridge segment closed primarily. Left over raw area was cover with split thickness skin graft taken from the thigh and tie over dressing applied. Posterior slab was given with good padding over pedicle and pivot point to avoid compression. Post operatively limb was elevated by keeping pillow over leg avoiding pressure over posterior aspect of knee for 10 days on an average. Suture removal was done 2 weeks later followed by knee, mobilization after 3 weeks depending on other associated etiology.

Fig 1 schematic picture showing pre op defect, planning, flap harvestation, results after two weeks

III. Results

All the flaps were viable. No total loss of flap noted in any case. However, the common complication observed was epidermal necrosis either at the distal end or at the margins of the flap. This was managed conservatively without any debridement to heal by secondary intention. Similarly in one case with distal necrosis, which was managed conservatively with regular dressings - no skin grafting was done. Donor site graft take was also satisfactory and healed primarily. The color thickness pliability was well matched on par with the surrounding skin. Over all patient satisfaction was good.

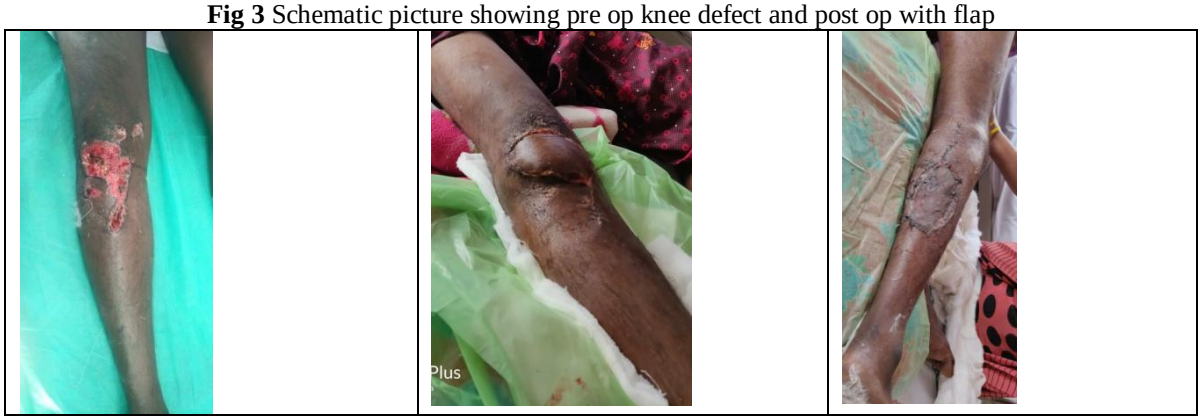
Table1: Schematic representation of out come.

S.No.	Age (years)	Presentation of Defect	Defect Dimensions (Cm)	Risk factor	Flap dimension (Cm)	Complications
1	19	With loss of tissue	4X4		5X5	Superficial epidermal necrosis
2	50	Surgical debridement	15X12		15X12	Uneventful
3	26	With tissue loss	5X6		6X7	Uneventful
4	35	Following debridement	8X7		9X8	Uneventful
5	53	Tumor exicixion	8X7	Diabetes mellitus	9X8	Distal necrosis
6	25	With tissue loss	7X8		8X9	Uneventful

7	32	With tissue loss	4X12		5X12	Uneventful
8	41	Wound gap following plate and screws	4X10		5X12	Superficial Epidermal necrosis
9	22	With tissue loss	5X6		6X8	Uneventful

Fig 2 schematic picture showing delayed necrosis of skin following trauma, defect after wound debridement, flap after suture removal

Fig 3 Schematic picture showing pre op knee defect and post op with flap



IV. Disscussion

Proximal sural artery flaps appears to be one of the best choices among all the regional available options. Before selecting proximal sural artery flap as an option, we used to do medial and lateral gastrocnemius muscle and musculo-cutaneous flaps as first option for knee defects. However, we have noticed that, muscle based flaps are often too bulky and commonly reach up to lower half of the knee. Later we shifted our focus on distal based medial and lateral genicular artery flaps from thigh with retrograde blood supply as other alternative. In planning these flaps location of perforator is sublime and plays a key role. The flaps are too bulky. Hence rotation is often technically difficult unless perforator is totally skeletonised, taking the imminent risk of venous congestion. And in females technical difficulty is further enhanced due to cumulative fat on the thigh.

To overcome these odds, we started applying proximal sural artery flap for the knee defects since 2017 with quite satisfactory results with good patience compliance. Proximal sural artery flap is based on the sural artery (medial, median and lateral sural arteries), which are often direct branches of popliteal artery and in few cases from genicular arteries (medial or lateral). These arteries supply the skin of calf region especially upper two third of leg. The sural arteries are so consistent that, no need to use Doppler to locate the perforators. These arteries accompany the sural nerve throughout its course and joins with the perforators of peroneal artery distally, which is the basis for 'reverse sural artery flap'. It is a fascio cutaneous flap. The exact flap dimensions

are not clearly defined. However in our series, we have found that, side to side- from lateral midline to medial midline, proximo distally- from knee crease line to junction of middle and distal third of leg can be harvested safely without compromising circulation to the flap. Flap planning and size is depending on the defect dimensions. Flap can be harvested as an island flap with sub cutaneous pedicle, or as a pedicle flap. Apart from these two, there is another variation, that is an island with extension of tail like a 'sperm shaped', to tuck at the bridge segment between the pivot point and the defect. This is to avoid pressure over pedicle, which is often possible with sub-cutaneous tunnelling. In cases of 'island' type, flaps are passed subcutaneously through a tunnel by creating adequate pocket. In both variations flaps behaved well without compromising circulation. Sural artery is accompanied by two venae commitantes with antegrade blood flow. In addition to having short saphenous vein, venous congestion is rarely observed in these flaps. The sural nerve in the flap provides reasonable sensation. The marginal epidermal necrosis of the flap is probably due to shearing force between the skin and fascia, which was overcome by meticulous dissection with fixation in our later cases. Donor site complications like minimal graft loss due to pressure from plaster slab or might be due to depending position of the graft site- are negligible. Sensation of the flap is also quite satisfactory in compare to flaps of other options due to intact sural nerve.

Overall the merits of the flap, optimum size to replace the knee defects, ease of dissection (even without tourniquet), consistent perforators (no need of Doppler), antegrade blood supply, reasonable sensation, thin skin- made superior among other regional peer flaps. Hence we strongly recommend considering proximal sural artery flap for knee defects before thinking of any other choices.

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