



## AN EXPERIENCE OF EARLY DEBRIDEMENT AND ONE-STAGE FLAP RECONSTRUCTION OF DECUBITUS ULCERS IN A TERTIARY HOSPITAL.

**Pritha Rakshit**

Mch Plastic Surgery, Consultant, Department of Plastic Surgery, Apollo Gleneagles Hospital, Kolkata, India.

**Mainak Mallik\***

Mch Plastic Surgery, Junior Consultant, Department of Plastic Surgery, Apollo Gleneagles Hospital, Kolkata, India; \*Corresponding Author.

**Saptarshi  
Bhattacharya**

Mch Plastic Surgery, Consultant, Department of Plastic Surgery, Apollo Gleneagles Hospital, Kolkata, India.

### ABSTRACT

**Introduction:** Decubitus ulcers are difficult entities present in long term institutionalized patients due to various etiopathologies resulting in prolonged immobilization and non-ambulation. These require a multidisciplinary approach, proper nursing and care giving. Deeper ulcers entail proper surgical debridement and coverage of the defect areas with a vascular and pliable tissue cover often in stages. Early surgical intervention for such lesions promote rapid wound healing, lesser period of hospital stay and reduced costs but only in selected cases where the patients are expected to ambulate early. **Aims and objectives:** This retrospective descriptive non-randomized purposive study over six months at a Tertiary hospital in eastern India aimed at execution of one-stage reconstructive surgeries in Grades II, III and IV decubitus ulcers when the patients were expected to ambulate early, documenting the technical aspects of the surgical procedures, the post-operative events and complications and wound healing on follow up. **Methodology:** Patients were selected based on the defects to be reconstructed and expectation to ambulate early, the pre operative work up and anesthesia check up were done, general conditions optimised and operated. Planning in reverse was done and the true defects of pressure ulcers defined after complete excision (extended bursectomy with a pseudo tumor approach) and the flaps were harvested, inset given and donor sites managed accordingly. Post-operatively the flaps were monitored clinically, the complications and issues addressed, dressings changed on frequent intervals and results interpreted. After discharge, they were followed up at regular intervals. **Results:** Out of 10 flaps in 10 cases (5 sacral, 3 trochanteric and 2 ischial pressure sores), all flaps survived (with marginal necrosis in 2 flaps). The mean size of the defects was 5.5 x 3.3 x 2.1 cm (length, breadth and depth respectively). The mean operative time was 3 hours and mean post-operative hospital stay was 6 days. Sacral pressure sore defects were reconstructed with cutaneous single or double rotation flaps with or without intervening gluteal muscle transposition, trochanteric ones with myocutaneous Tensor fascia lata flaps transposed or advanced in V-Y fashion and ischial ones with cutaneous Dufourmental or rotation advancement flaps with or without muscle cover. The wounds healed at a mean post-operative period of 21 days, suture removal being done at a mean period of 12 days and 60% of the patients could ambulate with support early within 2 weeks post-operatively. There was no recurrence of pressure sores at a mean follow up period of 3 months. **Conclusion:** In cases of decubitus ulcers (in patients who are expected to ambulate early), presenting with deeper lesions not amenable to heal quickly conservatively, early debridement after optimising general conditions and one-stage reconstruction may be contemplated as a safe and definitive procedure.

**KEYWORDS :** Early one-stage flap reconstruction, decubitus ulcer, pressure injury.

### INTRODUCTION-

According to the National Pressure Ulcer Advisory Panel (NPUAP), a pressure ulcer is defined as a localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction. [1,2] As per the NPUAP, Stage I usually refers to a change in the skin without breakage. Stage II refers to a shallow ulcer with partial thickness skin loss. Stages III and IV are considered advanced ulcers with full thickness skin loss affecting tissues beneath the dermis. A new category was recently added to represent damage of underlying soft tissues while the skin remained intact. [1,2] As per the definitions issued by the NPUAP, the term "pressure ulcer" has been replaced with "pressure injury" in the staging system as it accurately describes involvement of both intact and ulcerated skins. [1,3] The causative factors for the development of pressure sores are many as per literature like shear, friction, denervation, poor nutrition, older age, dementia, depression and other psychiatric disorders like schizophrenia, moisture, abnormal movements etc. [4,5,6] Sacral, ischial and trochanteric pressure sores are reported to have the most common regional prevalence among other sores of the heel, occiput elbow and other regions with an incidence upto 62% of all other sores. [7] Incidence of pressure ulcers (injuries) as per studies is 7.7% [6], 3-10% [4], 10.5% [8] in long term institutionalized patients. Hence it is imperative to select the ideal candidates of surgery for these conditions. [6] No significant differences in debridement abilities were detected among nonsurgical debridement agents except hydrocolloid dressings and hydrogel or hydropolymer. [2]

The general consensus is to treat relatively superficial decubitus ulcers of Grades I and II conservatively. Patients with deeper decubitus ulcers as per literature (Grades III and IV and occasionally Grade II) which involves the whole thickness of the skin are candidates of surgical debridement and reconstruction. [4,5,8,9] Surgical treatment of

decubitus ulcers is expensive with a mean cost of 1000 £ to 2000 £ per year per case as per literature. [9] There is a lack of rigorous evidence regarding the pros and cons of reconstructive surgery of pressure sores as most studies in this regard have incorporated non-randomized case series and/or retrospective studies. [8] Also there is no randomized control trial evidence with respect to the surgical reconstructive techniques for resurfacing decubitus ulcers. [8] Authors reported the elective technique of muscle interposition as a separate intervening layer for resurfacing the defect craters where the semimembranosus, biceps femoris and gluteus maximus are the most commonly transposed muscles. [7,10]

The rationale for early surgical debridement and coverage applies for patients requiring tissue with high mechanical performance as conservatively healed tissue is fibrotic and of poor and insufficient quality. Larger wounds take long time to heal and early surgical intervention accentuates healing. Long standing ulcers also present with amyloidosis, malignant degeneration into Marjolin's ulcer, planocellular carcinoma and often harbor infection in the form of biofilms extending into the bone as chronic osteomyelitis. [9] Surgical debridement alone has not been included in the stages of surgery, taking it for granted and including it within the stages of reconstruction as has been published. [8] As per literature, brief hospitalization protocols have been formulated with outpatient care and one-stage reconstruction with the goals of lowering hospitalization time, post-operative dehiscence and wound complications and obtaining a stable cover with low recurrence. On follow up, wound complications were designated as dehiscence if within 30 post-operative days; otherwise they were referred to as recurrences in greater than 30 post-operative day period. [11] Outcome measures have been planned to be reported at the latest time point available for a study (assumed to be length of follow up if not specified) and the time point specified in the methods as being of primary interest, classifying short-term as 1-8 weeks,

medium-term as 8-18 weeks and long-term as more than 16 weeks. It has been reported that all surgical procedures may be single or multiple staged to increase the likelihood of the tissue surviving manipulation, reduce the overall surgical impact of the patients and ensure that all infected or aggravating factors are minimized. [8]

**METHODOLOGY-**

This is a retrospective, descriptive, purposive, institutional study conducted at the Department of Plastic Surgery, Apollo Gleneagles Hospital, Kolkata, India over 6 months (October 2019 to March 2020) aiming at execution of one-stage reconstructive surgeries in Grades II, III and IV decubitus ulcers when the patients were expected to ambulate early, documenting the technical aspects of the surgical procedures, the post-operative events and complications and wound healing on follow up. No randomization of the study patients was done. Convenience sampling was adopted for case selection. Patients were included between age group of 10 to 85 years presenting with decubitus ulcers. Selection was biased based on the possibility to ambulate early in future.

Informed consents were taken after explaining procedure details to patients and their attendants. Planning in reverse was done pre-operatively based on the apparent defects and the donor areas marked with defect templates. Routine blood investigations including the haemoglobin level (had to be optimized to >10 g/dl with blood transfusions pre-operatively), blood counts (if found TLC>11000 with systemic symptoms of fever had to be treated with IV antibiotics), fasting and post-prandial blood glucose (to note diabetes if controlled), serum urea and creatinine (to note kidney function), liver function enzymes (including serum albumin which had to be >3 g/dl preoperatively with whole blood and/or human albumin transfusion), urine routine examinations, X-ray local part (to note bony involvement, which on suspicion had to be resorted to MRI local part), use of Baclofen and benzodiazepines for abnormal movements of spasticity were pre-operatively advocated in all patients as per literature. [3,4,5,11]

The ulcers were excised with a surrounding margin of 0.5 cm all around (pseudo tumour approach) [4,7] and the bursa were removed by previously marking them with Triple dye (extended bursectomy has been advocated in other studies). [11] Haemostasis was done meticulously and the wounds washed with normal saline. In 3 cases, the cortex of the bones- coccyx, ischial tuberosity and greater trochanter was removed and sent for culture sensitivity to detect any osteomyelitis so that a prolonged intravenous antibiotic regime could be advocated. The defects were re-measured. The flap incisions committed, inset given and the wounds closed mostly over suction drains. Dressings were done and the patients with back ulcers positioned prone or laterally for the first 5 post-operative days and nursed in these positions. Flap monitoring was done clinically by inspecting the colour, temperature, turgor and capillary re-fill for the next 5 days with alternate day changes in dressings. Suction drain output were measured daily and the drains were removed after a mean period of 5 days post-operatively when their output was less than 20 ml per day and serous. The patients were followed up after discharge on OPD basis every 2 weekly until the first 2 months and monthly for the next 4 months thereafter.

**RESULTS-**

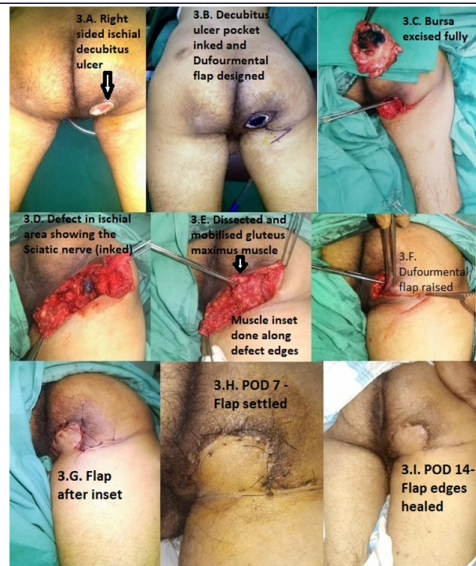
Out of the 10 decubitus ulcers operated in 10 patients, 5 were sacral, 3 trochanteric and 2 ischial ones. The mean age of the patients was 53.7 years (range 11 to 82 years). Male female ratio was 1.5:1.7 patients were paraplegic (2 of them due to trauma and 5 due to cerebrovascular accidents), 1 patient suffered from meningomyelocele and 2 patients underwent spinal surgeries before. The mean time of non-ambulation pre-operatively was approximately 60 days. Grade III decubitus ulcers were present in 4 patients, while 3 patients presented with Grade II and 3 other with Grade IV ulcers. Wound swab for culture sensitivity resulted in negative growth in 4 patients, while the other 6 patients had infected wounds (3 with Klebsiella, 2 with Methicillin resistant Staphylococcus aureus and 1 with Escherichia coli). The mean operative time was 3 hours for debridement and flap reconstruction. The mean post-operative hospital stay was 6 days. 7 patients had co-morbidities (diabetes, hypertension, COPD, coronary heart disease). In 6 patients early ambulation (within first 2 weeks) could be advocated, other 4 patients had to be managed with frequent changes in posture and air mattress. There was marginal necrosis of the flaps in 2 patients which

had to be debrided and re-sutured. Seroma developed on the undersurface of the flaps in 2 patients. Donor site primary closure suture line dehiscence was present in 1 patient where the wound had to be re-sutured. In 5 patients, there were no complications. 5 sacral pressure sores were reconstructed with double rotation flaps in 2 cases, lumbar artery perforator flap in 1 case, single rotation advancement flap in 1 case and Rhomboid (Limberg) flap in 1 case. [Fig.1] Gluteus maximus was rotated as a separate intervening layer into the edges of the crater of the defect in 3 of the 5 sacral pressure sores. In 3 trochanteric pressure sores Tensor fascia lata myocutaneous pedicled flap was done in all cases with transposition design in 2 cases [Fig.2] and V-Y closure in 1 case. In 2 ischial sores gluteus muscle was dissected and advanced to provide an intervening cover followed by skin closure with Dufourmental flap in 1 case [Fig.3] while a rotation advancement skin flap in another case. Split thickness skin grafting was done for the donor site in 1 case only. Mean defect size after debridement was 5.5cm length by 3.3 cm breadth by 2.1 cm depth. Unicortical bone (coccyx, greater trochanter, ischial tuberosity) was excised in 3 cases and sent for culture sensitivity (to decide on prolonged antibiotic therapy in case of osteomyelitis) out of which no samples revealed any growth of micro-organisms. Post-operatively suction drains were kept for a mean period of 5 days. Sutures were removed after a mean post-operative period of 12 days. The patients were followed up after discharge on OPD basis every 2 weekly until the first 2 months and monthly for the next 4 months thereafter. There was no recurrence of decubitus ulcer in any case. The patient details, co-morbidities, details of the decubitus ulcer, reconstruction and complications are given in Table.1.

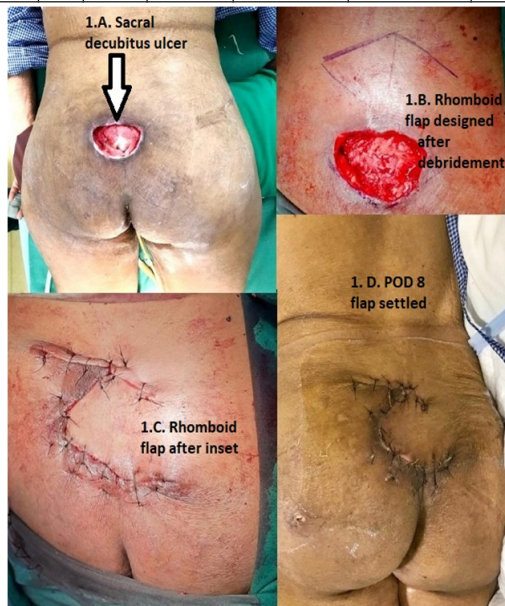
**Table- 1** – showing the details of the patients, pathology, method of immediate reconstruction used and complications. (CVA- cerebrovascular accidents, COPD- chronic obstructive pulmonary disease, MRSA- Methicillin resistant Staphylococcus aureus)

S.No	Age (years)	Gender	Comorbidities	Cause of ulcer	Decubitus ulcer characteristics	Reconstructive closure	Complications
1	42	M	Nil	Post-spinal surgery	Grade III 4 x 3 x 2 cm right trochanteric defect, culture negative.	Right sided Tensor fascia lata Myocutaneous pedicled flap with primary closure of the donor site.	Nil.
2	54	M	Diabetic, Hypertensive	Paraparesis due to CVA	Grade IV 7 x 4 x 3 cm midline sacral defect, culture positive to Klebsiella.	Double rotation skin flaps with underlying gluteus maximus midline advancement bilaterally.	Marginal necrosis of the medial ends of flaps- debrided and re-sutured.
3	82	F	Hypertensive, Coronary heart disease	Paraparesis due to CVA	Grade IV 8 x 5 x 3 cm midline sacral defect, culture positive to E. coli.	Double rotation skin flaps with underlying gluteus maximus midline advancement bilaterally.	Seroma under flap, drained.
4	78	F	Diabetic, Hypertensive	Paraparesis due to CVA	Grade II 6 x 3 x 1 cm right paramedian sacral defect, culture negative.	Laterally based Limberg's flap.	Nil.
5	66	F	Hypertensive, COPD	Paraparesis due to CVA	Grade III 5 x 3 x 2 cm left sided trochanteric defect, culture positive to MRSA.	Left sided Tensor fascia lata Myocutaneous pedicled flap with primary closure of the donor site.	Dehiscence of primarily closed donor area, debrided and resutured.
6	11	M	Nil	Meningomyelocele	Grade III 4 x 3 x 2.5 cm midline sacral defect, culture negative.	Rotation flap from one side without muscle cover.	Nil.

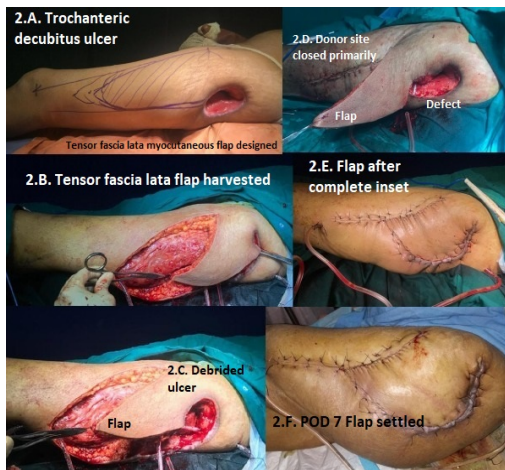
7	45	M	Nil	Traumatic Paraparesis	Grade IV 4 x 3 x 3 cm right sided ischial defect, culture negative.	Dufourmental skin flap over right sided advanced gluteus maximus.	Nil.
8	49	F	Hypertensive	Post-spinal surgery	Grade III 5 x 4 x 2 cm right trochanteric defect, culture positive to Klebsiella.	Right sided Tensor fascia lata Myocutaneous pedicled V-Y advancement islanded flap	Seroma under flap which was drained.
9	54	M	Diabetic	Traumatic Paraparesis	Grade II 7 x 5 x 1.5 cm left paramedian sacral defect, culture positive to Klebsiella.	Lumbar artery perforator islanded pedicled flap with donor area split skin grafted.	Nil.
10	56	M	Diabetic, Hypertensive	Paraparesis due to CVA	Grade II 5 x 3 x 1 cm left ischial defect, culture positive to MRSA.	Rotation advancement skin flap.	Marginal



**Fig 3 A-** Right sided ischial decubitus ulcer; **B-** Ulcer bursa inked with triple dye and Dufourmental flap being planned on the skin of the gluteal fold; **C-** Ulcer bursa excised with a pseudo tumour approach and removed in toto; **D-** the defect showing the sciatic nerve marked with ink; **E-** the gluteus maximus dissected and mobilised medially towards the crater of the defect and muscle inset given after haemostasis; **F-** The Dufourmental skin flap raised and undermined; **G-** after skin inset; **H-** follow up at POD7; **I-** after suture removal at POD 14.



**Fig. 1 A-** showing a sacral decubitus ulcer; **B-** after debridement and planning of Rhomboid flap; **C-** after closure of the defect; **D-** follow up at POD8.



**Fig. 2 A-** showing a trochanteric decubitus ulcer with Tensor fascia myocutaneous flap marked; **B-** the flap after harvesting; **C-** flap shown to be reaching the defect after debridement; **D-** the donor site being primarily closed; **E-** after complete inset of the flap; **F-** at POD7 follow up.

**DISCUSSION-**

This was a retrospective non-randomized descriptive purposive study of 10 patients with convenience sampling over 6 months in a tertiary care hospital where 50% were sacral ulcers followed by 30% trochanteric and 20% ischial. One study incorporated ischial sores as 46.8% cases of the total study patients. [11]The mean age of our study patients was 53.7 years (range 11 to 82 years). Age, as an independent predictor for wound healing with Odds ratio for elderly patients was 1.5 as per one study where the mean age of the study patients was 70.4 years [6] and 46.36 years [4] in another. As per our study male female ratio was 1.5:1. In one study of 819 pressure sore patients, 96.8% were males [6], in another cohort 80% of patients were males [11], in one more study 78% males [3] while male female ratio in other studies was 3.16:1 [4]. 70% of our patients presented with paraparesis (2 of them due to trauma and 5 due to cerebrovascular accidents), 10% lesions developed secondary to meningomyelocele and 20% due to post-spinal surgical procedures. Traumatic etiology from our study comprised of 20% of the cases as opposed to low spinal trauma >80% as per one study [4], 36% due to traumatic paraplegia and 18% due to traumatic quadriplegia, 12% due to encephalitis, 4% due to tumor compression [3]. As per our study the mean time of non-ambulation pre-operatively for the development of pressure sores was 60 days. Grade III decubitus ulcers were present in 40% of our patients, while 30% patients presented with Grade II and 30% others with Grade IV ulcers. As per other studies decubitus ulcers were included with 16, 32 and 52% [4] and 4%, 76% and 20% [3] respectively for Stages II, III and IV. Mean defect size after debridement was 5.5 cm length by 3.3 cm breadth by 2.1 cm depth for our study patients. Ulcer size is an independent predictor of wound healing with an Odds ratio of 5.2 for Stage II ulcers and 1.5 for Stage III ulcers. [6] Gradation on the basis of ulcer sizes (greatest dimension) has been proposed as per other studies with <5cm as small ulcers, 5-10 cm as medium ulcers and >10 cm as large ulcers. [3,4] As per studies, surgical intervention was done for small, medium and large decubitus ulcers respectively in the proportion of 24%, 28% and 48% [4] and 14%, 70% and 16% [3]. In our study wound swab for culture sensitivity pre-operatively resulted in positive growth in 60% cases with Klebsiella as the most commonly found microorganism in 30% of the total cases. As per other studies presence of infection was noted in 84% cases [4] and 90% cases [3]. Our mean operative time was 3 hours for debridement and single stage flap reconstruction and mean post-operative hospital stay 6 days as opposed to a 3.6 day (range 2-6 days) of median time of hospitalization as per one study. [11] 70% of our patients had comorbidities (diabetes, hypertension, COPD, coronary heart disease). 50% of our total cases were sacral pressure sores. The wounds

were managed with double rotation flaps in 20% cases, lumbar artery perforator flap in 10% cases, single rotation advancement flap in 10% cases and Rhomboid (Limberg) flap in 10% cases. Gluteus maximus was rotated as a separate intervening layer into the edges of the crater of the defect in 3 of the 5 sacral pressure sores. While another study adopted Limberg flap for resurfacing sacral pressure sores in 24% cases, propeller flap in 16% cases, single cutaneous rotation flaps in 12% cases and gluteus muscle was incorporated as myocutaneous flaps (either rotation or V-Y advancement in 18% cases). [4] In 3 trochanteric pressure sores (30% of the total cases of our study), Tensor fascia lata myocutaneous pedicled flap was done in all cases with transposition design in 2 cases and V-Y closure in 1 case. In 2 ischial sores (20% of the total cases of our study), gluteus muscle was dissected and advanced to provide an intervening cover followed by skin closure with Dufourmental flap in 1 case while a rotation advancement skin flap without muscle cover was executed in the other case. Apart from the Tensor Fascia lata myocutaneous flaps for resurfacing 30% trochanteric sores, in 40% of our total cases, gluteus muscle was separately transposed as a separate layer internally. As per one study of 94 patients with ischial and sacral sores, separately muscle transposition as an additional layer was advocated in 39.36% cases but there were no statistical differences in ulcer recurrences with muscle transposition. [10] Split skin grafting was done for the donor site in 1 case only (10% of our cases). Bone (coccyx, greater trochanter, ischial tuberosity) was excised unicortical in 30% of our cases and sent for culture sensitivity (to decide on prolonged antibiotic therapy in osteomyelitis) out of which no samples revealed any growth of micro-organisms. This is at par with other studies which also advocated the same technique. [7,11] In one study, bone samples revealed positive growth in 25% cases. [11] Post-operatively suction drains were kept for a mean period of 5 days. Keeping suction drains for a prolonged period upto 2 weeks duration or daily drainage less than 10 to 20 ml was advocated in one study. [9] Sutures were removed after a mean post-operative period of 12 days for our study patients. The mean wound healing time as per our study was 21 days. As per another study with 819 patients, 72%, 45.2% and 30.6% wounds respectively for Stages II, III and IV healed at 6 months with conservative managements. [6] In 60% of our patients, early ambulation (within first 2 weeks) could be advocated; 40% of the rest of the patients had to be managed with frequent changes in posture and air mattress. In the first 4 weeks post-operatively it is critical to change the posture of patients (dorsal to lateral and lying to seated) which should be done carefully with the aid of another person, preferably a family member. [11] We encountered marginal necrosis of the flaps in 20% patients which had to be debrided and re-sutured. Seroma developed on the undersurface of the flaps in 20% patients. Donor site primary closure suture line dehiscence was present in 10% patients where the wound had to be re-sutured. In 50% patients, there were no complications. As per one study there was 14% haematoma leading to wound infection, 14% wound dehiscence and 12% recurrence rates at 6 monthly follow up. [4] Another study revealed complications of haematoma in 3.7% cases, minor dehiscence in 11.1% cases. [11] While wound dehiscence, partial flap necrosis and recurrence were present in 8%, 6% and 4% cases respectively as per another study. [3] The patients in our study were followed up after discharge on OPD basis every 2 weekly until the first 2 months and monthly for the next 4 months thereafter. There was no recurrence of decubitus ulcer in any case at a 3 monthly mean follow up period in our study while studies revealed a 12% recurrence rates at 6 monthly mean follow up. [4] Another study had a mean follow up of 9.1 months (range of 2-28 months) where no recurrence was seen. [11]

## CONCLUSION-

In cases of decubitus ulcers (in patients who are expected to ambulate early), presenting with deeper lesions not amenable to heal quickly conservatively, early debridement after optimising general conditions and one-stage reconstruction may be contemplated as a safe and definitive procedure.

## REFERENCES-

1. Edsberg LE, Black JM, Goldberg M, McNichol L, Moore L, Sieggreen M. Revised National Pressure Ulcer Advisory Panel Pressure Injury Staging System: Revised Pressure Injury Staging System. *J Wound Ostomy Continence Nurs.* 2016;43(6):585-597. doi:10.1097/WON.0000000000000281
2. Medical Advisory Secretariat. Management of chronic pressure ulcers: an evidence-based analysis. *Ont Health Technol Assess Ser.* 2009;9(3):1-203.
3. Dr. Chintu George1, Dr. Devasenani V2\*, Dr. Balasubramanian3, Dr. Santharam4 Formation of reconstruction protocol for sacral pressure sore defects; Volume 4; Issue 8; August 2018; Page No. 18-24, International Journal of Medical and Health Research, ISSN: 2454-9142
4. Dr.T.Thirumalaisamy.—Formulation of Reconstruction Protocol for Sacral Pressure Sore Defects. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, vol. 16, no. 12, 2017, pp. 17-26; DOI: 10.9790/0853-1612011726

5. Bhattacharya S, Mishra RK. Pressure ulcers: Current understanding and newer modalities of treatment. *Indian J Plast Surg.* 2015;48(1):4-16. doi:10.4103/0970-0358.155260
6. Berlowitz DR, Brandeis GH, Anderson J, Brand HK. Predictors of pressure ulcer healing among long-term care residents. *J Am Geriatr Soc.* 1997;45(1):30-34. doi:10.1111/j.1532-5415.1997.tb00974.x
7. Marchi M, Battaglia S, Marchese S, Intagliata E, Spataro C, Vecchio R. Surgical reconstructive procedures for treatment of ischial, sacral and trochanteric pressure ulcers. *G Chir.* 2015;36(3):112-116.
8. Wong JK, Amin K, Dumville JC. Reconstructive surgery for treating pressure ulcers. *Cochrane Database Syst Rev.* 2016;12(12):CD012032. Published 2016 Dec 6. doi:10.1002/14651858.CD012032.pub2
9. Jens Lykke Sørensen, M.D., Ph.D., Bo Jørgensen, M.D., Finn Gottrup, M.D., D.M.Sc.; Surgical treatment of pressure ulcers; *The American Journal of Surgery* 188(Suppl to July 2004)42S-51S doi:10.1016/S0002-9610(03)00290-3
10. Thiessen FE, Andrades P, Blondeel PN, et al. Flap surgery for pressure sores: should the underlying muscle be transferred or not? *J Plast Reconstr Aesthet Surg.* 2011;64(1):84-90. doi:10.1016/j.bjps.2010.03.049
11. Milcheski Dimas André, Mendes Rogério Rafael da Silva, Freitas Fernando Ramos de, Zaninetti Guilherme, Moneiro Júnior Araldo Ayres, Gemperli Rolf. Brief hospitalization protocol for pressure ulcer surgical treatment: outpatient care and one-stage reconstruction. *Rev. Col. Bras. Cir. [Internet].* 2017 Dec 44( 6 ): 574-581. <https://doi.org/10.1590/0100-69912017006005>.