

Author Year Country Research Design Sample Size	Methods	Outcome
Velasco et al. 2015 Spain Cohort N=98	<p>Population: <i>Study group:</i> Mean age=46 yr; Gender: males=20, females=7; Level of injury: paraplegia; Pressure injury stage: III or IV. <i>Control group:</i> Mean age=46 yr; Gender: males=59, females=12; Pressure injury stage: III or IV.</p> <p>Intervention: <i>Study group</i> (n=27): In addition to standard care, received preclosure application of 2 mL of the fibrin sealant Tissucol Duo in combination with an antibiotic. <i>Control group</i> (n=71): Historical control received standard care, consisting of debridement plus closure with a local muscular flap.</p> <p>Outcomes: Hematoma-seroma rate; Days until drain removal; Drainage volume; Length of hospital stay; Days of antibiotic treatment; Surgical failure and relapse after 6 mo.</p>	<ol style="list-style-type: none"> Study group had significantly lower rates of hematoma-seroma ($p=0.005$), fewer mean days until drain removal ($p<0.05$), lower mean drainage volume ($p<0.05$), shorter mean lengths of stay ($p<0.05$), and fewer mean days of antibiotic treatment ($p<0.05$). 19.7% of the control group experienced surgical failure compared to 3.7% in the study group, though this was not statistically significant. 8.5% of the control group experienced relapse after 6mo compared to 3.7% in the study group, though this was not statistically significant.
Kuo et al. 2014 Taiwan Cohort N=99	<p>Population: Mean age=59.7 yr; Gender: males=54, females=45; Pressure injury stage: III or IV.</p> <p>Intervention: Patients received complete debridement, including bursectomy and partial ostectomy of the bony prominence where required, followed by immediate regional flap reconstruction. <i>Free-style perforator-based flap (Group A)</i> (n=35) vs. <i>Gluteal rotation fasciocutaneous flap (Group B)</i> (n=37) vs. <i>Musculocutaneous flap or combination of muscle and fasciocutaneous flaps (Group C)</i> (n=27).</p> <p>Outcomes: Complication rate; Flap necrosis rate.</p>	<ol style="list-style-type: none"> Group A had a mean follow-up of 24.2 mo, with a 22.9% complication rate and an 11.4% flap necrosis rate. Group B had a mean follow-up of 20.8 mo, with a 32.4% complication rate and a 13.5% flap necrosis rate. Group C had a mean follow-up of 19 mo, with a 22.2% complication rate and a 0% flap necrosis rate. Differences in complication rates and flap necrosis rates between groups were not statistically significant.
Ljung et al. 2017 Post Test Germany N _{initial} =51 N _{final} =34	<p>Population: Mean age= 43yrs; Gender: males=41, females=10; Level of injury: paraplegia=34, tetraplegia=17; ASIA classification: A=268, B/C=84; Number of pressure injuries: One=43, Two=7, Three=1; Pressure injury classification: IV=51; Ulcer location: Tuber ischia=45, Hip=8, Sacral=7; Type of flap: Gluteal=42, Biceps=12, Tensor=6.</p> <p>Intervention: Patients were examined 10 yrs after receiving pressure injury wound flap/excision surgery.</p> <p>Outcomes: Ulcer status(recurrent ulcers, new ulcers), Healing Results, Visual Analog Scale (VAS).</p>	<ol style="list-style-type: none"> After 10 yrs, 27% (n=9) patients had recurrent ulcers and 18% (n=6) had new ulcers. 36% (n=12) had PU that healed, 3 of which had been re-operated. Median VAS score was 70 at 10-year follow-up.
Singh et al. 2010 India Pre-post N=30	<p>Population: Mean age: 33.2 yr; Gender: male=23, female=7; Level of injury (ASIA): grade A=21, grade B=6, grade C=2, grade D=1, grade E=0; Wound Status: grade III or IV ulcer=30.</p> <p>Intervention: Various types of flap surgery were performed.</p>	<ol style="list-style-type: none"> There was a statistically significant increase in mean values of quality of life, hemoglobin and total serum proteins at 6-mo follow-up. Improvements in subjective well-being were reported in 76.7% of patients.

	<p>Outcome Measures: Improvement in health (hemoglobin, serum proteins, and general well-being), patient satisfaction and global quality of life scores according to the visual analog scale.</p>	<ol style="list-style-type: none"> 1. Satisfaction was reported in 83.3% of patients with the ultimate outcome of the surgery.
<p>He et al. 2012 China Post-test N=11</p>	<p>Population: Mean age=47 yr; Gender: males=9, females=2; Level of injury: paraplegic=11; Wound status: grade III or IV ischial ulcer=11. Intervention: Surgery using free partial lateral latissimus dorsi musculocutaneous flap. Outcome Measures: Recurrence and success rates of surgery.</p>	<ol style="list-style-type: none"> 1. All surgeries were successful. 2. No recurrence occurred during follow-up (mean 60 mo). 3. All patients experienced various degrees of back tightness, shoulder weakness and limited shoulder motion since surgery. 4. Within 9 mo adverse side effects had stopped in all but 3 patients.
<p>Unal et al. 2012 Japan Post-test N=11</p>	<p>Population: Mean age: 37.8 yr; Gender: males=9, females=2; Level of injury: paraplegic=11; Wound status: recurrent lesions or multiple ischial sores=11. Intervention: Use of inferior gluteal artery (IGA) and posterior thigh perforators in ischial pressure sore management. Outcome Measures: Perforator of flap, recurrences, complications and postoperative follow-up.</p>	<ol style="list-style-type: none"> 1. Nine IGA and five posterior thigh perforator flaps were used and in two patients a combination of both was done. 2. Six patients presented with recurrent lesions and five were operated for sacral and contralateral ischial pressure sores previously. 3. Two patients had suture detachments and their wounds were resutured (mean, follow-up 34.3 mo). 4. During follow-up, two patients had recurrences.
<p>Kim et al. 2010 Korea Post-test N=75</p>	<p>Population: Mean age=54 yr; Gender: males=43, females=32; Level of injury: paraplegia=34, tetraplegia=5, ambulatory=36. Intervention: Gluteus maximus perforator-based island flap for coverage of buttocks defects. Outcome Measures: Recurrence and complication rates of gluteus maximus perforator-based island flap surgery.</p>	<ol style="list-style-type: none"> 1. No recurrence at follow-up (mean, 15 mo). 2. 3 complications (distal flap necrosis, wound dehiscence, infected sacral sore). 1.
<p>Borgognone et al. 2010 Italy Post-test N=12</p>	<p>Population: Mean age=52 yr; Gender: males=10, females=2; Level of injury: paraplegic=12; Wound status: grade III ulcers or grade IV ulcers=12. Intervention: 'Criss-cross' surgical treatment of ischial pressure sores. Outcome Measures: Recurrence of ulcer.</p>	<ol style="list-style-type: none"> 1. Recurrence of ulcer occurred in one patient (mean follow-up 45 mo). 2. All flaps survived however two distal cutaneous partial necroses of the flaps occurred. 3. Suture dehiscence at the wound edge occurred in one patient. 4. A second procedure was necessary for one patient with a hematoma under the flap.
<p>Lin et al. 2010 China Post-test N=12</p>	<p>Population: Mean age=40 yr; Gender: males=9, females=3; Level of injury: paraplegic=10, tetraplegic=2; Wound status: grade IV ulcer=12. Intervention: Surgical reconstruction with a laterally based posterior-thigh fasciocutaneous flap. Outcome Measures: Flap survival, recurrence of pressure sore and primary wound healing.</p>	<ol style="list-style-type: none"> 1. In two patients pressure sores recurred (mean follow-up, 62 mo). 2. All the flaps survived. 3. Primary wound healing occurred in all patients.
<p>Srivastava et al. 2009 India Post-test N=25</p>	<p>Population: Mean age=27.6 yr; Gender: female=6, male=19; Level of injury: paraplegic=22, tetraplegic=3; Level of ulcer: stage III=13, stage IV=23, unknown=3.</p>	<ol style="list-style-type: none"> 1. Four participants had initial complications: wound dehiscence and delayed graft healing (mean follow-up, 15.4 mo). 2. Four participants had ulcer recurrence.

	<p>Intervention: Surgery (debridement, split skin grafting, flap mobilization and closure). Outcome Measures: Ulcer healing rate, postoperative complications, ulcer recurrence rate and neurologic (ASIA grade) and functional recovery (Barthel index).</p>	<p>3. The majority of participants (56.5%) significantly improved neurologically on ASIA grade and functional evaluation on Barthel Index.</p>
<p>Relander et al. 1988 Sweden Post-Test N=39</p>	<p>Population: Mean age=38 yr; Gender: males=24, females=15; Localization of primary pressure sores: sacral ulcers=21, ischial ulcers=29, trochanteric ulcers=16. Intervention: Patients underwent surgical treatment of primary pressure sores. Outcome Measures: Pressure injury recurrences, unhealed vs. healed sores and reasons for discontinuing surgical treatment.</p>	<ol style="list-style-type: none"> 1. Average time of hospitalization was 51 days. 2. The greatest amount of time was spent in the hospital for those with trochanteric ulcers staying for a mean of 79 days. 3. There was recurrence in 48% of sores during follow-up which lasted from 2 to 12 yr. 4. In 9 cases, 2 operations were performed. 5. Eighteen sores remained unhealed. 6. 91% of sacral sores healed, 62% of ischial sores and 69% of trochanteric sores. 7. Discontinuation of surgical treatment occurred in 10 patients with 4 of these patients demonstrating poor general health, 4 opposing the operation, in one case the surgeon opposed the operation and in the final case the patient had died.
<p>Tadiparthi et al. 2016 United Kingdom Case Series N=45</p>	<p>Population: Mean age=47 yr; Gender: males=23, females=22; Level of injury: paraplegia=35, tetraplegia=10; Number of pressure injuries=60. Intervention: Data was retrospectively analyzed for those with pressure sores managed under the new multidisciplinary protocol with joint management by plastic surgery and spinal injury teams. Outcomes: Treatment method; Complication rate; Recurrence rate; Patient readmission rate; Readmission length of stay.</p>	<ol style="list-style-type: none"> 1. 29% were treated with conservative methods (debridement and dressings alone or in combination with negative pressure wound therapy) and 71% underwent flap reconstruction surgery. 2. After a mean follow-up of 33 mo, the major complication rate was 9%, the minor complication rate was 22%, and the recurrence rate was 6%. 3. Comparison of the admission database before and after intervention using a 5 yr follow-up period showed a reduction in readmissions for complications from 14% to 5.5% and a reduction in average readmission length of stay from 65 d to 45 d.
<p>Wettstein et al. 2015 Switzerland Case Series N=119</p>	<p>Population: Mean age=51 yr; Gender: males=91, females=28; Level of injury: paraplegia=74, tetraplegia=27, other=18; Number of pressure injuries=170; Pressure injury stage: III=50, IV=116, V=4. Intervention: Data was retrospectively analyzed for those with their pressure sores managed under the new interdisciplinary treatment protocol with cooperation between conservative and surgical disciplines. Outcomes: Time from debridement to defect closure; Length of hospitalised bed rest after defect closure; Complication rate; Recurrence rate.</p>	<ol style="list-style-type: none"> 1. The mean time from debridement to defect closure was 40 d and the mean length of hospitalised bed rest after defect closure was 58 d. 2. 23 patients died during the study period. 3. The rate of major complications was 16%, the rate of minor complications was 10%, and the rate of recurrences was 11%. 4. Higher complication rate was significantly associated with osteomyelitis ($p=0.002$) and increased hospitalisation days ($p<0.0001$).

		5. Higher recurrence rate was significantly associated with increased hospitalisation days ($p < 0.0001$).
Yusmido et al. 2014 Malaysia Case Series N=3	<p>Population: Mean age=40 yr; Gender: males; Level of injury: T3=1, T10=2; Etiology of injury: traumatic=2, transverse myelitis=1.</p> <p>Intervention: Elective proximal lower limb amputation to treat chronic complicated pressure injuries.</p> <p>Outcomes: Length of hospital stay; World Health Organization Quality of Life (WHO-QOL); Spinal Cord Independence Measure (SCIM).</p>	<ol style="list-style-type: none"> 1. In the 3 patients, the number of hospital stays was reduced by 203, 130, and 290 d after intervention. 2. After intervention, the WHO-QOL score was increased by 11%, 5.9%, and 53%. 3. After intervention, the SCIM score was increased by 12%, 2.89%, and 1.39%.
Biglari et al. 2014 Case Series Germany N=352	<p>Population: Gender: males=285, females=67; Level of injury: cervical=89, thoracic=227, lumbar=36; ASIA classification: A=268, B/C=84; Number of pressure injuries=657; Pressure injury classification: I=84, II=152, III=254, IV=167.</p> <p>Intervention: Patient records were reviewed for those receiving flap surgery.</p> <p>Outcomes: Rate and type of complications.</p>	<ol style="list-style-type: none"> 1. Of the 421 flaps used, there were 87 complications, consisting of 27 cases of suture line dehiscence, 22 cases of infection, 17 cases of hematoma, 12 cases of partial necrosis, and 9 cases of total flap necrosis. 2. Tensor fascia lata flaps had the highest rate of complications (48.6%) and rotation flaps had the lowest rate of complications (11.5%).
Grassetti et al. 2014 Case Series Italy N=143	<p>Population: Median age=51 yr; Gender: males=87, females=56; Level of injury: traumatic paraplegia=58, traumatic tetraplegia=49, non-traumatic paraplegia=21, non-traumatic tetraplegia=14; Pressure injury stage: IV.</p> <p>Intervention: Patient charts were reviewed for those receiving perforator flap surgery.</p> <p>Outcomes: Rate and type of complications.</p>	<ol style="list-style-type: none"> 1. 5.6% of patients had major complications requiring reoperation, 4.2% of patients developed a new occurrence, and 22.4% had a recurrence at 2 yr. 2. Overall complication percentage was 22.4%, resulting in an average of 5.8 additional days of bed rest. 3. When developing a risk estimation model for developing recurrence, the type of perforator flap used (P-FAP vs I-GAP, $p=0.035$) and coronary artery disease ($p=0.017$) were significantly associated with higher risk and renal disease was significantly associated with lower risk ($p=0.017$).
Kim et al. 2014 Korea Case Series N=14	<p>Population: Mean age=52.8 yr; Gender: males=11, females=3; Level of injury: paraplegia=11, tetraplegia=2, ambulant=1; Injury etiology: SCI=12, spinal stenosis=1, spinal cord metastases=1; Number of pressure injuries=16.</p> <p>Intervention: Data was retrospectively analyzed for those with ischial pressure sores reconstructed using both a profunda femoris artery perforator flap and a muscle flap.</p> <p>Outcomes: Recurrence rate; Complication rate.</p>	<ol style="list-style-type: none"> 1. In the mean follow-up period of 27.9 mo, wound dehiscence occurred in 25% of ulcers and 1 case recurred after 34 mo. 2. Post-operative follow-up at 18 mo revealed no evidence of recurrence or complications.