



# Free Tissue Transfer in Pressure Ulcer Reconstruction: A Systematic Review

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## Abstract

**Background** Pressure ulcers (PUs) affect 2.5 million people in the United States annually and incur health-care costs of 11 billion dollars annually. Stage III/IV PU often require local flap reconstruction. Unfortunately, PU recurrence is common following reconstruction; recurrence rates as high as 82% have been reported. When local flap options are inadequate, free tissue transfer may be indicated but the indications have yet to be delineated. To develop evidence-based guidelines for the use of free flaps in PU reconstruction, we performed a systematic review.

**Methods** A systematic review of the available English-language, peer-reviewed literature was conducted using PubMed/MEDLINE, Google Scholar, Scopus, EMBASE, and the Cochrane Database of Systematic Reviews. Articles were manually reviewed for relevance.

**Results** Out of 272 articles identified, 10 articles were included in the final analysis. Overall, this systematic review suggests that free-flap PU reconstruction yields fewer recurrences compared with local flaps (0–20 vs. 13–82%). Further, several types of free flaps for PU reconstruction were identified in this review, along with their indications.

**Conclusion** Free tissue transfer should be considered for recurrent PU. We offer specific recommendations for their use in PU reconstruction.

## Keywords

- ▶ pressure ulcers
- ▶ pressure sores
- ▶ free flaps
- ▶ free tissue transfer
- ▶ recurrence

Pressure ulcers (PUs) affect 2.5 million people in the United States annually and incur health care costs of 11 billion dollars per year.<sup>1</sup> PU results from unrelieved pressure on soft tissue over a bony prominence.<sup>2</sup> The resulting wound may be exacerbated by factors that inhibit wound healing, including infection, inflammation, and edema. Approximately 70% of PUs involve the sacrum, ischial tuberosity, or greater trochanter, while 15 to 25% affect the lower extremities.<sup>3</sup>

Although PU management is well defined, there remains significant room for improvement. Stage-I and -II PUs can be managed conservatively with local wound care and pressure offloading. Stage-III and -IV PUs require surgical reconstruction because healing by secondary intention is excessively prolonged or stalled.<sup>4,5</sup> For these ulcers, the reconstructive workhorses are locoregional flaps.<sup>2</sup> However, 1-year recurrence rates as high as 82% (range: 13–82%) have been reported.<sup>1,6–13</sup>

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Because of these high recurrence rates and approximately 25% of PU patients develop additional PU,<sup>14,15</sup> local flap options can be depleted. In these patients, free flap reconstruction may be required. On preliminary review of the literature, no evidence-based guidelines regarding the use of free flaps in PU reconstruction were identified. Thus, the aims of this study were to perform a systematic review and develop evidence-based guidelines for the use of free flaps in PU reconstruction.

## Methods

### Literature Search

A literature search of available English-language, peer-reviewed literature with the help of a professional librarian was conducted. The search was performed in five electronic databases over the period of 1980 to 2019 as follows: (1) PubMed/MEDLINE, (2) Google Scholar, (3) Scopus, (4) EMBASE, and (5) the Cochrane Database of Systematic Reviews. The key words used were a combination of the following terms: “free flap,” “free tissue transfer,” “pressure ulcer,” “pressure sore,” “decubitus ulcer,” “ischial ulcer,” “sacral ulcer,” and “trochanteric ulcer.” Articles were then manually reviewed for relevance.

### Article Eligibility

Title and abstract of all retrieved records were independently screened for eligibility by two reviewers (C.R. and F.H.L.). To be included, the article had to meet the following inclusion criteria: (1) examined pressure ulcers in the ischium, sacrum, and/or trochanteric regions only, and (2) examined free flaps for pressure ulcer reconstruction. Articles were excluded if: (1) there was no focus on pressure ulcers and surgical intervention, or (2) there was a focus on a specific subpopulation.

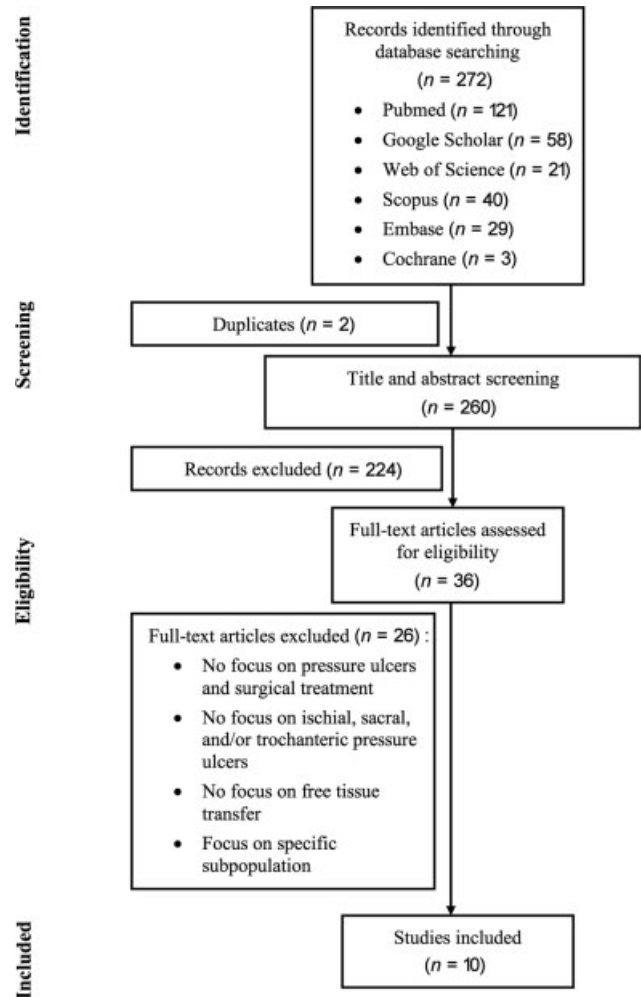
### Data Extraction

The following data were extracted from each article and used for descriptive comparisons: author, year, study design, sample size, ulcer location, type of flap, type of recipient vessel, recurrence rate, follow-up period, and study results.

## Results

### Systematic Literature Review

Our initial literature search identified 272 citations (→ Fig. 1). After eliminating duplicate articles and screening titles, abstracts, and full texts, 10 articles were included for final analysis (→ Table 1). The level of evidence (LOE) was low, eight were case reports (LOE V) and one was a retrospective case series (LOE IV). The highest quality study was a prospective case series (LOE IV) involving 11 spinal cord injury patients with stage-III or -IV ischial PUs who underwent reconstruction with free partial latissimus dorsi myocutaneous flaps.<sup>16</sup> Overall, the prospective case series and 100% of the case reports supported free tissue transfer as an effective reconstructive option for wound closure when local flaps are inadequate, depleted, or have failed.



**Fig. 1** Schematic of systematic literature review. Flow chart detailing the results of the screening process and final article inclusion for this systematic review of the literature.

## Discussion

Local flaps have been the mainstay of PU reconstruction since the 1970s, and PU recurrence rates have not significantly improved over the years.<sup>9</sup> Overall, this systematic review suggests that free flap PU reconstruction yields fewer recurrences compared with local flaps (0–20 vs. 13–82%). Moreover, our review identified several types of free flaps that have been used for pressure ulcer reconstruction along with their indications.

Free flaps that have been used in PU reconstruction include the latissimus dorsi myocutaneous flap, combined latissimus dorsi and serratus anterior muscle flap, and medial gastrocnemius myocutaneous flap. For patients with amputated or nonfunction limbs, the lower extremity is an excellent, low-morbidity donor site.<sup>17,18</sup> The inferior and superior gluteal vessels are the first choice recipient vessels; the deep femoral and inferior epigastric vessels are suitable recipient vessels, as well.

Flap selection is highly dependent on wound size and potential morbidity of muscle transfer. The latissimus dorsi myocutaneous flap should be selected when a large amount

**Table 1** Results from our systematic review of success and recurrence rates for free flap reconstruction of pressure ulcers (n = 10)

Authors	Year	Study design (LOE)	No. of patients	Location	Free flaps used	Recipient vessels	Success rate (%)	Recurrence rate (%)	Follow-up (mo)
Hallock <sup>21</sup>	1995	Case report (level V)	1	Ischial	Medial gastrocnemius myocutaneous flap	Inferior gluteal vessels	100	0	2
Park and Koh <sup>22</sup>	1998	Case report (level V)	5	Sacral	Latissimus dorsi myocutaneous flap	Superior gluteal vessels	100	0	2–40
Yoon et al <sup>23</sup>	2016	Case report (level V)	1	Sacral	Latissimus dorsi myocutaneous flap	Superior gluteal vessels	100	0	3
Chang and Lee <sup>24</sup>	2008	Case report (level V)	1	Ischial	Latissimus dorsi myocutaneous flap	Deep femoral vessels	100	0	36
Hung et al <sup>25</sup>	2000	Case report (level V)	6	Ischial, sacral	(1) Latissimus dorsi muscle/myocutaneous flap (2) Fillet leg flap (3) Combined latissimus dorsi and serratus anterior muscle flap	(1) Perforator vessels of the deep femoral system and the deep femoral vessels (2) Inferior epigastric vessels (3) Superior gluteal vessels (4) Inferior gluteal vessels	83	16	26–180
Jones <sup>26</sup>	2002	Case report (level V)	1	Ischial	Medial gastrocnemius myocutaneous flap	Inferior gluteal vessels	100	0	18
Feliciano et al <sup>27</sup>	2007	Case report (level V)	3	Ischial, sacral	Latissimus dorsi myocutaneous flap	(1) Superior gluteal vessels (2) Inferior gluteal vessels (3) Saphenous vein arteriovenous loop to the femoral vessels	100	0	2–8
De la Fuente et al <sup>28</sup>	2008	Case report (level V)	2	Ischial	Medial gastrocnemius myocutaneous flap	Inferior gluteal vessels	100	0	12–20
He et al <sup>16</sup>	2012	Prospective case series (level IV)	11	Ischial	Partial lateral latissimus dorsi myocutaneous flap	Superior gluteal vessels	100	0	18–114
Lemaire et al <sup>29</sup>	2008	Retrospective case series (level IV)	6	Sacral, ischial, trochanteric	(1) Parascapular flap (2) Fillet leg flap (3) Latissimus dorsi myocutaneous flap (4) Combined latissimus dorsi and serratus anterior muscle flap	(1) Superior gluteal vessels (2) Superficial femoral vessels (3) Deep femoral vessels (4) Deep inferior epigastric vessels	80	20	12–43

Abbreviation: LOE, level of evidence.

**Table 2** Four evidence-based guidelines for the use of free flaps in pressure ulcer reconstruction

1.	Adjacent tissue is compromised leaving few appropriate local flaps for coverage. Reasons for compromise include prior surgeries, radiation therapy, refractory infection, and diminished vascularity
2.	Free flaps should be used if local flap options have been exhausted
3.	Free flaps should be considered for patients prone or more susceptible to recurrent pressure ulcer. This vulnerable population includes patients with limited mobility and altered sensorium such as paraplegics or patients with spinal cord injuries
4.	Free flaps can be used in conjunction with fasciocutaneous or myocutaneous flaps to completely fill ulcer cavities too large for local flap coverage alone

of well-vascularized tissue is needed for wound coverage. However, this flap may be contraindicated in paraplegic patients that rely on upper body strength for mobility and truncal support. The fillet leg flap provides a substantial amount of soft tissue for adequate wound coverage and filling of the ulcer cavity but should only be selected for patients with nonfunctional limbs due to donor site disfigurement. Lastly, the medial gastrocnemius myocutaneous flap offers adequate volume replacement, sufficient skin coverage, and low donor site morbidity; it can be useful for paraplegic patients that need to preserve upper body musculature for mobility.

Our review found that the latissimus dorsi myocutaneous flap was the most commonly used free flap for sacral ulcers, while the most commonly used free flaps for ischial ulcers were both latissimus dorsi myocutaneous flap and the medial gastrocnemius flap. Although only one trochanteric PU case requiring free tissue transfer was identified in our systematic review, the latissimus dorsi myocutaneous flap provided excellent coverage.

When selecting recipient vessels, the gluteal vessels are most useful for ischial and sacral ulcers. The inferior gluteal vessels have an advantage over the superior gluteal vessels for ischial ulcers in particular due to its closer proximity to the ischium. The inferior epigastric vessels are best suited for trochanteric ulcers, as these vessels are convenient and a great match when the thoracodorsal vessels are used.

Consideration of free flap PU reconstruction should be based on the state of the local tissue, size of the ulcer, and risk of recurrence. Independent risk factors for PU recurrence include age, male sex, altered sensorium, moisture, immobility, malnutrition, and friction injury.<sup>19</sup> The populations most at risk for developing PU are the elderly, acutely ill patients, and those with impaired mobility or sensation. In the paraplegic patient, ischial PU develop due to prolonged pressure on the ischial tuberosity.<sup>20</sup> PU recurrence is a major problem for these patients, even when closure is performed under minimal tension.

Free flaps are useful for recurrent and chronic PU when local flap options are limited due to local tissue fibrosis or when local flap options have been exhausted. In circumstances of local tissue compromise and infection, free flaps incorporating muscle can eliminate dead space and enhance infection control by improving vascularity of the wound and surrounding tissue.<sup>16</sup> Free flaps also provide adequate

wound coverage when local flaps are not large enough or when patients lack ample local subcutaneous tissue.

## Conclusion and Recommendations

Overall, we believe free tissue transfer should be considered for recurrent PU and we offer specific indications for their use in PU reconstruction (► **Table 2**).

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### Conflict of Interest

None declared.

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