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Reconstructive

Outcomes of Pressure Sore Surgery in Patients with Spinal Cord Injury and Spasticity

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Background: Spasticity is a serious complication of spinal cord injury/disease (SCI/D) that affects 60%–80% of patients with this condition. The presence of spasticity can have a significant impact on the outcomes of reconstructive surgical interventions, such as those on pressure sores (PSs). Moreover, in the conservative treatment of PSs, spasticity may prevent maintaining adequate postures to avoid skin friction or traction. The aim of this study is to describe the PS reconstruction outcomes in a cohort of patients with SCI/D affected by spasticity.
Methods: In this retrospective study of patients with SCI/D consecutively admitted to Montecatone Rehabilitation Institute between October 2013 and March 2022, 54 PSs were treated in 46 people with spasticity.
Results: Postsurgery complications occurred in 26 of 54 treated PS, of which seven were major. Eleven patients experienced more than one complication. The overall incidence of postsurgical complications was 48.1%, and the incidence of major complications was 13%. Median length of hospital stay was 3.8 versus 1.8 months. Compared with other reports in the literature of PS reconstruction in patients with SCI/D, we found higher rates of overall, minor, and major complications.
Conclusions: Spasticity proved to be an important condition to consider, and its treatment requires specialized physicians. The collaboration between plastic surgeons and spasticity specialists is crucial to define the best treatment to reduce postoperative complications. *(Plast Reconstr Surg Glob Open 2024; 12:e5632; doi: 10.1097/GOX.0000000000005632; Published online 1 March 2024.)*

INTRODUCTION

Spasticity is a serious complication of spinal cord injury/disease (SCI/D) that causes disabling problems such as pain, spasms, discomfort, and musculoskeletal retractions below the neurological level of injury. Spasticity is defined as a sensorimotor disorder resulting from an upper motor neuron lesion, presenting as intermittent or sustained involuntary muscle activation combined with an abnormal spinal response to multiple afferent impulses.[1–3] It affects 60%–80% of patients with SCI/D, of whom more than 50% need therapy. Its prevalence has been reported as 78%–93% in patients with cervical SCI, 75% in patients with thoracic SCI, and 50% in patients with thoracolumbar SCI/D.[5–7] Spasticity largely impairs rehabilitation outcome because it interferes with mobility and self-care activities.[8]

In the field of reconstructive surgery of patients with SCI/D, the presence of spasticity should be given special attention, as it can have a significant impact on the outcomes of surgical interventions, such as pressure sores (PSs), which are a frequent complication, with a prevalence reported in the literature around 40% in patients with quadriplegia and nearly 50% in those with paraplegia.[4] Spasms may cause significant complications, especially in the case of reconstruction with muscle flaps, but also in fascial flaps because they induce abnormal postures that can stretch the surgical wounds.

The debridement of PSs can cause large tissue losses that must be filled with adequate volume of tissue to reduce the risk of complications, such as seromas and hematomas. This goal can be obtained using muscle or musculocutaneous flaps, as they provide an adequate volume of tissue able to fill the defect and avoid dead spaces. For these reasons, in the case of reconstructive interventions for PSs, flaps of the rectus femoris, tensor fasciae

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latae, vastus lateralis, or other muscles of the thigh are often used, thanks to the proximity to the surgical site and the convenience of preparation.

An abnormal contraction of a muscle used for reconstruction can lead to traction on surgical wounds, causing diastasis due to premature detachment of the sutures, bleeding, and hematoma formation.[9] More specifically, in the case of reconstruction of a PS with transposition of a muscle flap, the spasms can cause premature failure of the sutures, spatial dislocation of the flap, prolonged healing times, and even the failure of the reconstruction itself. Moreover, in conservative treatment of PSs, spasticity may lead to difficulties in maintaining adequate postures to avoid skin frictions or traction. In addition, the presence of a wound may increase spasticity in patients with SCI/D.

There are several treatments described for spasticity. Physical therapies[10] have a temporary effect to reduce spasticity or as a preparation for other rehabilitation exercises. These include passive stretching and electric stimulations, both on antagonist muscles and on spastic ones, with the aim of straining the neuromuscular plate. Systemic pharmacotherapy[6] is based on drugs acting on the central nervous system that reduce the tonic stretch reflex and the flexor reflex, thus reducing muscle tone. These include GABA-ergic drugs (baclofen and benzodiazepines), alpha-adrenergic agonists (clonidine and tizanidine), and calcium antagonists on the muscle fibers (dantrolene). Neuromuscular blocks are indicated in the case of spasticity with a focal distribution, or with the involvement of only one or a few articular fulcrums. Botulinum toxin or phenol injections are used. Botulinum toxin works by blocking or reducing the release of acetylcholine at the level of the neuromuscular plate resulting in transient palsy (chemodenervation).[11–15] It is injected intramuscularly, under ultrasound or electromyography guidance, if needed. The effects begin after a few days with a maximum of 30 days and last for 4–6 months. Nerve blocking consists of applying a chemical agent on a nerve to reduce its conduction (chemical neurolysis), causing reduction in tone by breaking the reflex arc. The use of a local anesthetic causes a temporary block of a few hours and allows a diagnostic evaluation. On the other hand, a therapeutic block of long duration is obtained with neurolytic substances, which can be performed only on selected motor nerves/branches. The injection is performed through a neurostimulation technique, in which the needle acts as a stimulator to allow the injection to take place close to the target nerve. Phenol is usually used, which induces protein denaturation with necrosis of the nerve fibers. The effect lasts from 3 to 8 months.[16] Baclofen has proved to be an excellent drug for the management of spasticity, but it crosses the blood–brain barriers with difficulty; therefore, high dosages are required by mouth, causing significant side effects. Administration into the subarachnoid space bypasses the blood–brain barrier, obtaining greater therapeutic effects even with lower doses (1:100). The administration of intratecal baclofen takes place through a programmable electronic pump positioned in the abdominal area in a subcutaneous pocket, connected to a catheter that is inserted into the subarachnoid space at the level of the L3-L4 or L4-L5 vertebrae and goes back up to T6-T12.[17]

Scant evidence from small series or case reports is available in the literature concerning the impact of spasticity in patients with SCI/D treated for PSs.[18,19]

This retrospective observational study aims to contribute further evidence by describing the postsurgical outcomes of patients with SCI/D affected by spasticity and surgically treated for PSs.

Takeaways

Question: Spasticity is a frequent complication of spinal cord injury and can have a significant impact on the outcomes of reconstructive surgical interventions.

Findings: The overall incidence of postsurgical complications was 48.1%, and the incidence of major complications was 13%. Compared with other reports in the literature of pressure sore reconstruction in patients with spinal cord injury/disease, we found higher rates of overall, minor, and major complications.

Meaning: Spasticity proved to be an important condition to consider, and its treatment requires specialized physicians.

MATERIALS AND METHODS

Study Design, Participants, and Setting

This retrospective study includes people with SCI/D consecutively admitted to a rehabilitation hospital highly specialized in SCI/D (the Montecatone Rehabilitation Institute) for PS surgical treatment between October 2013 and March 2022. Inclusion criteria were age older than 18 years, focal or generalized spasticity, PS of grade IV according to the depth of the wound established by the American National Pressure Ulcer Advisory Panel,[20] and PS reconstruction with a muscle flap. Exclusion criteria included any associated cerebral lesion.

At the Montecatone Rehabilitation Institute, there is a team of neurophysiologists and physiatrists dedicated to patients suffering from spasticity. The collaboration between the plastic surgeon and the neurophysiologist allows the management of spasticity therapy as a function for the reconstructive surgery of the PS, when necessary, to optimize the results. The plastic surgeon discusses the reconstructive procedure with the neurophysiologist; the best therapeutic approach to spasticity is then evaluated to optimize the result of the intervention and reduce the risk of complications related to the patient's spasticity. The postoperative treatment is administered according to our institutional protocol.[21]

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Variables

Demographic, SCI/D-related, clinical, and inpatient characteristics were collected from medical records.

Demographics included age and sex; SCI/D-related characteristics included etiology, neurological level of injury and completeness measured by the Abbreviated Injury Scale grade.[22] Clinical characteristics included the main risk factors for PS (cardiovascular disease, diabetes, obesity, smoking status, and other comorbidities) and PS localization.

Inpatient characteristics included the type of treatment for spasticity (systemic pharmacotherapy, neuromuscular blocks, nerve blocking, and baclofen); time between SCI and hospital admission; time between PS onset and surgical treatment; postsurgical complications rated with the Clavien-Dindo grade,[23] considered minor when rated less than 3 and major when rated 3 or higher; PS recovery; time between surgery and PS complete recovery; and length of hospital stay.

The main outcome was the occurrence of postsurgery complications. Secondary outcomes were the occurrence of major postsurgical complications (flap detachment and flap necrosis), the occurrence of minor postsurgical complications (hematoma, seroma, dehiscence, and partial skin graft healing), complete recovery, time between surgery and complete recovery, length of hospital stay, and any recurrence or occurrence of any new PS. Recurrence and/or occurrence of any new PS were recorded during the follow-up visit that is routinely administered after 6 (±3) months from discharge.

Statistical Analysis

Age was summarized as mean and SD, whereas the other quantitative variables (timing) were summarized as median and interquartile range. Categorical variables were described using frequencies and percentages.

Incidence with 95% confidence interval (95% CI) was reported for primary outcome and major complications.

All analyses were performed using Stata statistical software version 15 (StataCorp. 2017. Stata Statistical Software: Release 15; StataCorp LLC, College Station, TX).

RESULTS

Patient Characteristics

Between October 2013 and March 2022, 410 patients with SCI were admitted to MRI for PS surgical treatment, of whom 46 had spasticity. These were 93% men, with a mean age of 49.2±10.5 years (range: 24–71). Spinal cord injury was traumatic in 93% and complete in 87% of patients; the neurological level was thoracic in 80% of cases and cervical in the remaining 20%. Sixty-five percent of patients had at least one risk factor for PS; the complete description of the sample is shown in Table 1.

PS Characteristics and Type of Spasticity Treatment

During the study period, two patients were admitted twice for different PSs, whereas six patients were treated for two PSs within the same hospital admission. The analysis includes 54 PSs surgically treated. The lesions were trochanteric in 91% of cases and sacral in only five cases. The median time between PS onset and surgery was 2.1 years (interquartile range: 1.0–3.5).

Table 1. Patient Characteristics

	N = 46
Age, mean ± SD	49.2±10.5
Male sex, n (%)	43 (93)
Traumatic injury, n (%)	43 (93)
Neurological level, n (%)	
Cervical	9 (20)
Thoracic	37 (80)
Complete lesion (AIS A), n (%)	40 (87)
Cardiovascular disease, n (%)	12 (26)
Diabetes, n (%)	8 (17)
Obesity, n (%)	4 (9)
Other comorbidity, n (%)	3 (7)
Smoking, n (%)	20 (43)

AIS, Abbreviated Injury Scale.

All patients underwent physical therapy for spasticity. In addition, 33 cases (61%) were treated with pharmacological therapy, 10 cases (19%) with pharmacotherapy and neuromuscular blocks, four cases with pharmacotherapy and baclofen, three cases with neuromuscular blocks, and two cases with neuromuscular blocks and baclofen.

Postsurgical Complications, Recovery, and Length of Stay

Postsurgery complications occurred in 26 of 54 treated PSs, of which seven were major (detachment in six cases and detachment + necrosis in the other). Minor complications included seroma (13, 24%), dehiscence (13, 24%), hematoma (six, 11%), and partial skin graft healing (one case). Eleven patients experienced more than one complication.

The overall incidence of postsurgical complications was 48.1% (95% CI: 34.3%–62.2%), and the incidence of major complications was 13% (95% CI: 5.4%–24.9%).

In two cases, there was an incomplete PS recovery, one for deep wound dehiscence and one for partial necrosis of the flaps. Time between surgery and complete recovery varied from 1 to 8 months, median time 55 (IQR: 44–73) days. Median length of stay was 3.8 months (IQR: 2.0–6.1). At the follow-up, one recurrence and three cases with new PSs were reported.

DISCUSSION

Many comorbidities may affect the outcome in PS reconstruction in patients with SCI/D; among these, spasticity is an important aspect to consider. Satisfactory results with the use of botulinum toxin to prepare muscle flaps before PS reconstruction in a small series of patients with SCI/D affected by PS and spasticity was already reported.[24] In this retrospective study, we have described the PS reconstruction outcomes in a larger cohort of patients with SCI/D affected by spasticity. All the patients were treated according to our institutional protocol.[21] In the postoperative period, bed rest for three consecutive weeks without weight bearing on the operated site is mandatory, and the person's position is changed every 4 hours. Drains are usually removed after 5–7 days and, after that, physiotherapy starts with passive and active mobilization of upper extremities, together with education on

Table 2. Sample Size and Outcomes of the Literature Studies

	No. PS	Overall Complication (%)	Minor Complication (%)	Major Complications (%)	Recurrence Rate (%)
Lindqvistet al[25]	143	43	37	6	25
Morel et al[26]	85	88	74	14	31
Tadiparthi et al[27]	60	31	22	9	6
Biglari et al[28]	657	20	14	6	
Disa et al[29]	66	36	24	12	37
Sirimaharaj and Charoenvicha[30]	272	6	0.37	5.63	16.54
Chiu et al[31]	181	46.4			16
Singh et al[32]	35	25.71	22.9	2.9	17.14
MRI[21]	442	17,5	13,6	3,9	1,4
MRI spasticity	54	48,1	35,1	13	1,8

preventive strategies. Antimicrobial therapy is adjusted by the infectious disease specialist based on the histological and microbiological findings on surgical specimens. Stitches are removed after 3 weeks and sitting is allowed for 1 hour a day for 7 days. The wound is checked every day after sitting to modulate sitting time and prevent immediate complications. Daily sitting time is increased by 1 hour every week, and the person is discharged after rehabilitation to 3 hours in a sitting position per day without wound complications. Concerning reconstruction techniques, we usually prefer fasciocutaneous flaps in sacral and ischiatic sores, and muscle flaps only in trochanteric sores, as previously reported.[21] Prealbumin level, a generally recognized, very impactful comorbidity leading to complications, is routinely monitored and corrected in the preoperative period in all patients. Spasticity can be a problem in both cases, due to spasms directly on the muscle used for reconstruction and to the abnormal position of the patients, induced by upper or lower arm spasms, which can increase tension on the sutures. The incidence of postsurgical complications was significantly higher than that found in a previous study carried out in our center on all patients with SCI/D treated for PSs,[21] both for any complications [48.1% (95% CI: 34.3%–62.2%) versus 17.5% (95% CI: 14%–21.4%)] and major complications [13% (95% CI: 5.4%–24.9%) versus 3.9% (95% CI: 2.3%–6.2%)]. Median length of hospital stay was 3.8 versus 1.8 months, resulting in a higher stay in patients affected by spasticity. In terms of recurrences, no differences were found between our results [one of 54 (1.8%)] and those of the previous study [six of 434 (1.4%)].[21] The comparison of the results previously reported by our institution on a series of patients with SCI/D treated for PSs and the results of this series of patients with SCI/D affected by chronic spasticity treated for PSs demonstrates the role of spasticity in increasing complication rate. The physiopathology of spasticity-related wound complications can be summarized as follows: in the immediate postoperative spasticity may determine sutural separation; after initial wound healing, spasticity determines tension on the margins, and tension devascularizes the margins with marginal flap necrosis and wound breakdown. The treatment of spasticity is not standardized because we usually start from the patient's usual therapy, then adjust it on the clinical evaluation of spasms. The only adjunctive therapy is muscle flap preparation with botulinum toxin, administered before surgery.[24] In the literature, no reports analyzed the correlation between spasticity and complications after PS reconstruction. Compared with the results of other case series of PS reconstruction in patients with SCI/D, we found higher rates of overall, minor, and major complications (Table 2). The median rate of overall complications is 34.5% (range: 6%–88%) versus 48.1% in our series; median rate of minor complications is 30.7% (range: 0.37%–74%) versus 35.1% in our series; and median rate of major complications is 8.48% (range: 5.63%–14%) versus 13% in our series. The recurrence rate in our series is 1.8% versus a median reported rate of 19.4% (range: 6%–31%). These findings suggest the role of spasticity in the increase of complication rate in patients with SCI/D affected by spasticity and treated for PSs. A possible explanation is that spasticity affects the immediate result of the reconstruction, with higher early complication rate and does not affect the long-term result in the case of complete wound healing. Only the study conducted by Sirimaharaj and Charoenvicha[30] considered spasticity as a risk factor of recurrence. Intrathecal baclofen was reported as an effective method to control spasticity and reduce recurrence rates.[33] In our experience, baclofen was added as oral therapy, but it was not so effective in the early postoperative period; that can be explained by the important role of surgery as a trigger to increase spasticity. Other methods based on electric stimulation to reduce spasticity was described, but we usually do not use them in surgical patients. Local electric stimulation of the muscles is difficult to apply in the postoperative period due to the requested position that the patient must assume to prevent complications on the sutures. Central stimulations required another surgery that is not justified only by a PS reconstruction, in our opinion. Furthermore, concerning nonpharmacological interventions, electroneuromuscular stimulation and transcranial direct current stimulation have a moderate evidence, whereas low evidence is reported for rehabilitation programs, such as movement therapy, stretching, and occupational therapy.[34] Another possibility to prevent spasticity in PS reconstruction with muscle flaps is to cut the motor nerve of the interested muscle.[35] This technique is useful, but it presents a possible risk to damage the vascular pedicle of the flap. In our experience it is rarely necessary to dissect the muscle up to the pedicle, and the usage of other methods, such as botulinum

toxin administered before surgery into the muscle, presents low risk and reduces the surgical time. Permanent surgical muscle denervation may be considered, but the procedure determines worsening of muscle atrophy; in fact, even if patients with SCI already present muscle atrophy compared with control patients, spasms have a role in keeping some extent of trophism. Muscle atrophy and decreased thickness of the reconstructive flap are not desirable; therefore, a temporary denervation using botulinum toxin injection is preferred to permanent surgical denervation. We usually use rectus femoralis and vastus lateralis flaps in trochanteric PS reconstruction. The tensor fascia lata flap is largely described in the literature but, in our opinion, provides less volume to fill deep defects, and, in the case of recurrence, it is difficult to use other local muscle flaps. Most of our trochanteric sores are treated with Girdlestone arthroplasty[36] for the debridement, and the tensor fascia lata flap is insufficient to fill in the dead space. For these reasons, it is important to evaluate and treat spasticity before surgery for PSs. In our population of patients with SCI/D treated for PSs, the presence of spasticity proved to have a key role in the incidence of complications.

CONCLUSIONS

SCI/D is a complex condition, and all its aspects must be taken into consideration. In the field of reconstructive surgery for PSs, a multidisciplinary approach is needed to prevent possible complications, which are frequent in this kind of surgery. Spasticity is demonstrated to be an important comorbidity to consider, and its treatment requires specialized physicians. A collaboration between plastic surgeons and spasticity specialists is fundamental to define the best treatment for the patient, to reduce postoperative complications. Further prospective studies specifically designed to analyze the impact of spasticity on PS reconstruction are warranted to confirm our preliminary results.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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