



Case Report

Functional Upper Limb Assessment After Sternal Clavicular Joint Resection Without Prosthetic Reconstruction

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Abstract

The Sternal Clavicular Joint (SCJ) resection is used as a treatment for SCJ infections. Reconstruction with a prosthesis can lead to reinfection, but theoretically, it is preferable due to functional impairment risk. However, the post-operative functional upper limb evaluation is poorly documented. The objective is to assess the upper limb function after SCJ resection and reconstruction without a prosthesis to determine if there is any functional impact and to grade it.

We performed clinical and functional evaluations of patients with SCJ resected and reconstructed without prosthesis as treatment of SCJ infection in the period between 2012-2018. The evaluation was composed of a questionnaire (pain scale and daily activity evaluation) and examination (inspection, mobility and strength). 9 patients were assessed, from whom 7 had unilateral surgery. The questionnaires regarding pain and daily activities limitations showed improvement in 100% of the cases. Just one case of possible nerve injury with paresthesia. On the physical exam, only small alterations on inspection were found in 8 patients. Mobility was considered normal in 33%, partially impaired in one test in 22% and partially impaired in two or more tests in 44% of cases. Strength was graded 5 (maximum strength) and symmetric in seven patients. Patients after SCJ resection without prosthetic reconstruction showed a good outcome, especially on pain and daily activity. Even though, a small impact in mobility and strength has occurred.

Keywords: Sternal Clavicular Joint; Nerve Injury; Negative-Pressure Wound Therapy

Introduction

The Sternal Clavicular Joint (SCJ) infection is rare and most of the time associated with comorbidities and predisposing factors like a central venous catheter, drug abuse, loss of immunity, diabetes and obesity. Diagnosis should be based on history, clinical examination and radiological studies, mainly computed tomography scan, magnetic resonance imaging and bone scintigraphy in some cases. The radiological examination is important not only for diagnoses but also in surgical planning.

Treatment begins with antibiotics, which sometimes may be enough. However, some cases may develop complications like sepsis, severe pain, movement limitation, extra-capsular fluid, abscess, osteomyelitis, empyema or mediastinitis. Surgical procedure must be considered to avoid or treat complications when the patient does not show clinical improvement.

The surgical approach of SCJ can be done by debridement, en bloc resection with or without other structures, for example, first rib resection. There are few studies about the best surgical approach, due to the low incidence of SCJ infection [1]. One of the main unexplored surgical issues about this topic is the necessity of chest wall reconstruction by the clavicle and first rib fixation to the sternum. In order to perform it, foreign material is needed; can be done with flexible materials, such as polypropylene mesh or osteosynthesis materials like steel plates and screws. But considering the infectious context of the disease, the use of prosthetic material should be avoided, because it can lead to reinfection [2]. However, the limitations that these patients can possibly have without clavicle fixation, are still uncertain. Therefore, this study was conducted to assess the upper limb functional impact of the patients who have SCJ resected without prosthetic reconstruction for infectious disorders.



Figure 1: CT scan showing right first rib infection.

Methods

Study Design

Retrospective study with patients operated for infectious involvement of the SCJ treated by en bloc resection and reconstruction without prosthesis. The patients were evaluated in the outpatient clinic as usual during the post-operative period by the assistant surgeon and a physiotherapist.

Selection

Patients with septic arthritis in whom SCJ was removed and chest wall reconstruction was performed without fixation, by the Thoracic Surgery Department in a Quaternary Care University Hospital from 2012 to 2018. Exclusion criteria were resection due to cancer, not en bloc resection or just SCJ debridement and chest wall reconstruction with prosthesis. Written informed consent was obtained from all patients.

Evaluation

The questionnaire was applied and a physical examination was performed on the late post-operative consultation, at least 3 months after surgery.

The questionnaire assessed pain, daily activity performance and signs of nerve injury (paresis/paresthesia).

- *Pain Scale:* Applied on pre and postoperative periods. Values between 0-10 in which 0 means the absence of pain and 10 is incapacitating pain
- *Daily Activity Performance:* Patients were asked about the limitations in carrying out daily activities, regarding the pre and postoperative periods
- *Nerve Injury:* Patients were asked if there was any sign suggestive of nerve damage

Physical examination was performed by the specialized physiotherapist. Comprising inspection, mobility and strength.

- *Inspection:* Inspection has evaluated the position of the head, shoulder, clavicle, elbow, forearm, cervical and thoracic spine in association with the surgical site and dominant hand. Contracture as well as atrophy of shoulder muscular groups was observed. Patients submitted to unilateral resection had the distance between acromion and spinous process measured and compared in search of asymmetry
- *Palpation:* The palpation of the shoulder girdle was performed looking for contraction
- *Mobility:* It was assessed through abduction, adduction, elevation, depression, protraction, retraction and Apley tests. Classified in total mobility or partial reduced

Tests

- Apley: asked the patient to touch the mid-upper angle of the contralateral scapula passing behind the head, considered positive in case of pain or limited movement
- -Elevation: the patient should raise the shoulders and asymmetry/pain must be observed
- Depression: scapula must be moved down; is a movement against elevation
- Protraction: performed by the anterior serratus, the medial edges of the scapula should be moved anteriorly, increasing the distance from the midline
- Retraction: played by the trapezium in association with the rhomboids, medial borders of the scapula should approach the midline; reverse movement to protraction
- Abduction: upper limb must be raised in order to increase the distance from the midline
- -Adduction: upper limb must be mobilized in such a way that approach to the midline

Strength

Evaluated by performing the same mobility tests except for Apley, in association with the resistance of requested movement. During the tests, a score of 0-5 was assigned. 0: stands for absence of force and 5: maximum force. The difference between the mean of both sides, in patients with unilateral resection, was classified as symmetric or asymmetric.

Surgical Technique

Patients were approached by inverted "L" shape incision or hockey stick incision (Fig. 1,2), which has good exposure of SCJ and adjacent musculoskeletal structures. The extent of resection was estimated by imaging findings and dictated by intraoperative judgment, in case of infection or inflammatory signs not only restricted to SCJ. The reconstruction was primary closure in all cases, the defect was covered with adjacent muscles and skin advance.



Figure 2: Inverted "L" shaped or hockey stick incision.

Case Series

We evaluate nine cases, six males, seven were unilateral, the left side was affected in five cases and the mean age was 55.5 years old. Regarding the extent of resection, two cases presented an infection restricted to SCJ, while four cases showed an association with the first rib. Only in one case, the second and third rib involvement was associated with aneurysmal dilation of the ipsilateral internal thoracic artery and finally, we had two bilateral cases.

Wound complications, such as dehiscence in patient number 7 and reinfection in patient number 4, could be noticed. Bough used Negative-Pressure Wound Therapy (NPWT) as a bridge for definitive closure with myocutaneous flap.

After the surgical procedure, we observed pain improvement in 100% (8 de 8) of the patients. In patient 2 this variable was not accessed due to the patient's cognitive deficit (Table 1,2).

Patient	Age (years)	Surgical Side	Pain Scale			Daily Activities Limitations		
			Pre	Post	Imp	Pre	Post	Imp ^{&}
1	74	Right	10	0	Yes	Present	Absent	Yes
2	25	Bilateral	NE*	NE*	NA [#]	Present	Absent	Yes
3	58	Left	8	0	Yes	Absent	Absent	NA [#]
4	48	Left	10	2	Yes	Present	Absent	Yes
5	61	Left	10	4	Yes	Present	Absent	Yes
6	55	Left	10	0	Yes	Present	Absent	Yes
7	57	Right	7	0	Yes	Present	Absent	Yes
8	53	Bilateral	10	0	Yes	Present	Absent	Yes
9	69	Left	10	4	Yes	Present	Absent	Yes

*: not evaluated, #: not applicable; &: improvement

Table 1: Results of the applied questionnaire, pain, daily activities limitation and referred discomfort.

Eight patients (1, 2, 4, 5, 6, 7, 8, 9) referred for limitations in performing daily activities, which was not repeated after the procedure. Evidence of nerve damage was founded in only one case (patient 5) due to the complaint of paresthesia.

Regarding the inspection, we found that the difference in the distance between the acromion and spinous process on both sides was a minimum of 1 cm and a maximum of 3 cm. In healthy patients, this difference can be considered physiological in up to 5 cm. So, no patient had a major alteration on inspection, however, some degree of visual asymmetry was found in the majority of the patients who had a unilateral operation (six of seven patients).

After shoulder girdle palpation, trapezius contracture was evident on the affected side in four cases (1, 2, 5, 9). Atrophy of the muscular group was not evidenced in any of the cases. We have found an association between post-operative pain and muscle contraction in only 2 patients.

Three patients (33%), (3,4,5) did not show mobility reduction, whereas two patients (22%) (6,8) has a partial reduction in one of the tests. In four patients (44%) (1,2,7,9) there was a partial reduction in two or more of the mobility tests. On Table 2 we analyzed only patients with unilateral surgery looking for the comparison, between sides.

Patient	Surgical Side	Dominant Side	Inspection		Mobility		Strength	
			Abnormality	Symmetry	Scale	Symmetry	Scale	Symmetry
1	Right	Right	Mild	asymmetric	P.R.M	asymmetric	5	symmetric
3	Left	Right	Mild	asymmetric	TOTAL	symmetric	5	symmetric
4	Left	Right	Mild	asymmetric	TOTAL	symmetric	5	symmetric
5	Left	Ambi	Mild	symmetric	TOTAL	symmetric	5	symmetric
6	Left	Right	Moderate	asymmetric	P.R. O	symmetric	5	symmetric

7	Right	Right	Mild	asymmetric	P.R.M	asymmetric	4	asymmetric
9	Left	Left	Moderate	asymmetric	P.R.M	asymmetric	4	asymmetric
Ambi: Ambidextrous; Summary of Mobility Grading; PRO: Partial Reduction in One test; MPR: partial reduction in more than one test; TOTAL: Total Mobility								

Table 2: Post-operative physical exam evaluation of patients with unilateral operation comparing sides (Operated x Non-operated).

Five patients (71%) presented symmetric strength performance. On the other hand, two patients showed asymmetric results regarding the two-sided strength comparison [1-7]. Patient 7 has the most extensive resection, including the clavicle, first, second, third rib and the upper part of the sternum. In addition, patient 9, has the biggest impact even in mobility tests. However, despite this asymmetry finding on the strength of these two patients the loss of strength even on these patients was small, as both patients graded 4 on the strength test scale.

Discussion

The infectious involvement of the SCJ is a rare condition, with approximately 250 cases reported in the last 50 years¹. Due to the low incidence, the literature is based on reports, case series and experience of single groups or institutions. Outcomes are generally based on surgical technique or infectious control.

Song, et al., reported a series of 7 cases in 2002, of which 6 patients were treated with drainage, debridement and antibiotic with a failure rate of 83%. SCJ was resected in association with adjacent structures and primary closure was performed with the pectoralis muscle, to solve the infection issue [4]. In our institution, the surgical procedure is always considered in case of clinical failure. We perform en-bloc resection, sometimes associated with adjacent structures to avoid clinical deterioration and reinfection.

Carlos, et al., compared 8 cases between two surgical techniques, open debridement (when the findings have restricted the articulation without osteomyelitis) and en bloc resection [5]. The average hospitalization was 12.9 days in the second and 23.5 days in the first (delayed primary closure). Puri, et al., analyzed 20 patients of which 10 were managed with delayed open wound, associated NPWT; and 10 were treated as primary closure. This group has more wound complications but does not require prolonged wound care [7]. We recommend the primary closure unless we stay in doubt about tissue viability. NPWT is used as a bridge for the definitive closure.

Kachala, et al., responsible for the largest current series, published 40 cases in 2016, referring to 20 years [8]. In addition, groups were divided into resection with primary closure and resection and delayed closure associated with the use of NPWT. There was no change in the outcome of the two groups. Even if it's the largest modern case series, we still face small sample size limitations. In spite of comparing surgical approaches, our study proposal is to assess limb functions with non-prosthetic chest wall reconstruction. The functional aspect is still less explored, sometimes just mentioned without further details. This work reaffirms the resection of the SCJ as a treatment of choice for infectious disease refractory to the use of clinical treatment already proved to be an effective and safe procedure.

The major limitation of our study is the retrospective design; however, we provide the first evidence in the literature regarding the late postoperative results of the SCJ resection and reconstruction without prosthesis. Another limitation is the time between surgery and evaluation which was not standardized. However, no patient has less than 3 months after surgery and since we prioritize the evaluation between the operated side versus the non-operated side in the same patient the time interval limitation should be reduced.

Conclusion

The postoperative evaluation of the patients submitted to resection and reconstruction without prosthesis showed good results regarding the improvement of pain and daily activities performance. However, it has a small impact on mobility and strength in the postoperative period, which was well tolerated by the patients. Our outcomes also reinforce the utility of further studies, especially with large sample sizes and comparisons with patients who are treated with prosthetic reconstruction.

Conflict of Interests

The authors have no conflict of interest to declare related to this article.

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Declaration of Conflicting Interests

No author has a conflict of interest to declare.

Ethical Approval

The ethics committee approved this study.

Informed Consent

Written informed consent was obtained from all individual participants included in the study.

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