

## The Natural Course of Serratus Palsy at 2 to 31 Years

Veera Pikkarainen MD, Jyrki Kettunen PT, PhD,  
Martti Vastamäki MD, PhD

Received: 12 June 2012 / Accepted: 15 November 2012 / Published online: 1 December 2012  
© The Association of Bone and Joint Surgeons® 2012

### Abstract

**Background** The natural course of isolated serratus palsy is obscure. Residual winging, muscle weakness, and fatigability reportedly occur in half of the patients. Because we believed isolated serratus palsy might have a better natural course than earlier thought, we evaluated our long-term records.

**Questions/purposes** We determined duration of symptoms and whether scapular winging, ROM, and pain recover or persist after isolated serratus palsy without any particular treatment.

**Methods** We retrospectively reviewed 37 patients with isolated serratus palsy treated by observation without any brace or surgery. We determined the degree of scapular

winging, ROM, and pain. The minimum followup was 2 years (median, 18 years; range, 2–31 years) after onset of symptoms.

**Results** The duration of scapular winging averaged 16 months (range, 2–30 months). Winging of the scapula disappeared in 29 (78%) of the patients, flexion recovered to normal in 30 (82%) and abduction in 33 (89%). Of the 37 patients, 11 (30%) were pain-free; pain at rest was absent from 17 (46%), occurred seldom in seven (19%), and was temporary in 12 (32%); one patient had pain at rest continuously. None of the patients desired other treatment such as a brace or surgery.

**Conclusions** The natural course of isolated serratus palsy in clinically mild cases is not as favorable as we had expected. Symptoms mostly recover in 2 years, but at least one-fourth of the patients will have long-lasting symptoms, especially pain. We could identify no factors to allow us to appropriately choose patients with serratus palsy for observation only.

**Level of Evidence** Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

The institution of one or more of the authors (MV) has received, during the study period, funding from EVO, HUS (government grant from the Helsinki University Hospital District).

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request. Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were concluded in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at ORTON Research Institute, Invalid Foundation, Helsinki, Finland.

J. Kettunen  
ORTON Research Institute, Invalid Foundation,  
Helsinki, Finland

V. Pikkarainen  
Arcada University of Applied Sciences, Helsinki, Finland

M. Vastamäki (✉)  
ORTON Research Institute and ORTON Hospital, Invalid  
Foundation, Tenholantie 10, 00280 Helsinki, Finland  
e-mail: martti.vastamaki@orton.fi

### Introduction

The natural history of isolated serratus palsy is unclear [1, 2, 4, 6–8, 11, 13, 15]. Complete or almost complete spontaneous recovery with some residual winging reportedly occurs in 70% to 80% of patients [1, 4, 11], but according to other authors, residual winging, muscle weakness, and fatigability occur in 25% to 57% of patients [2, 6–8]. Some factors related to etiology appear to influence the course; iatrogenic long thoracic neuropathy, for example, is associated with only partial recovery of

scapular winging [9], but other clinical factors and electromyography findings do not appear to correlate with recovery of serratus function [5].

The etiology of serratus palsy generally is believed to relate to blunt shoulder trauma or overuse [20]. Its incidence might be approximately 0.2% of all patients with shoulder disorders [13]. Serratus palsy occurs on the dominant side in 86% to 95% [4, 5]. While we do not know the explanation for this occurrence, the palsy may result from more exertion by the dominant hand. The most common treatment options depend on severity: observation without any specific treatment [2, 4–6], a scapular protective brace [10], neurolysis of the long thoracic nerve, or dynamic muscle transfers [3].

Based on the experience of the senior author (MV) in treating approximately 250 isolated serratus palsies, we believed the natural course of untreated palsies might be better than is reported in small series of 10 to 20 patients with followups ranging from 2 to 5 years [2, 4, 6] or in larger series of 50 and 64 patients with followups of 4 and 1 years [5, 10]. We also consider that better knowledge of the natural history might help us when choosing the best treatment for isolated serratus palsy.

We therefore determined (1) duration of symptoms; (2) presence of long-term scapular winging; (3) ROM; and (4) pain in patients with isolated serratus palsy.

## Patients and Methods

We retrospectively identified 239 patients with scapular winging first diagnosed as isolated neurogenic serratus palsy who had visited the senior author's offices between 1980 and 2008. This large number of patients was likely related to the senior author's interest in the entity and to his publications. Of the 239 patients with scapular winging we excluded 28 for the following reasons: (1) more than the long thoracic nerve affected on electromyography (such as Parsonage-Turner) in 10 patients; (2) neurologic disorders like facioscapulohumeral syndrome in four patients; (3) functional palsies caused by shoulder problems causing scapular winging in four; and (4) insufficient patient status recordings in 10. These exclusions left 211 patients; of these 74 were treated by observation or physiotherapy and

137 treated by a brace or surgery. The results of those groups will be presented elsewhere. The indications for observation were mild paresis (winging  $\leq 3$  cm) and only a small limitation in active ROM (flexion  $\geq 125^\circ$ ) [19]. Patients not meeting these criteria were treated by brace or surgery. In addition, five patients doing work that did not demand heavy use of the upper extremities were treated by observation even though palsy was more severe. Criteria for inclusion in the study were (1) scapular winging caused by serratus palsy; (2) isolated long thoracic nerve palsy verified by electromyography; (3) adequate recordings of history and clinical findings at the beginning of symptoms; and (4) no particular treatment for serratus palsy (such as a scapular protecting brace or nerve release). Of the 74 patients treated by observation or physiotherapy, one had died, six were unreachable (no address available), and one lived abroad, leaving 66. Of the 66 patients invited to participate, 37 (50%; males 59%) attended the final followup. The 37 patients (38 shoulders) not attending the final followup were excluded, however we have clinical followup records for 23 of the 37 patients, mean 33 months (median, 15 months, range, 3–132 months) after the first consultation with the senior author. The mean age of the remaining 37 patients at the onset of symptoms was 34 years (range, 12–54 years). Minimum followup was 2 years (mean, 17.0 years, median, 18.2 years; range, 2–31 years). We had 35 (95%) right-handed patients (palsy on the right side in 33), and two left-handed patients (palsy on the left side in one) (Table 1). We obtained permission to perform this study from the ethics committee of the hospital district where the study was conducted.

Initial evaluation by the senior author included a detailed medical history and physical examination and an electromyographic examination. The severity of the winging was graded [19]: Grade I reflected winging of 1 to 2 cm; Grade II, greater than 2 to 3 cm with flexion limited; Grade III, 4 cm or greater, flexion to the horizontal level, abduction limited; and Grade IV, winging greater than 4 cm and abduction severely limited. The amount of scapular winging arms at  $90^\circ$  active unresisted flexion was used for grading. The grade of palsy seldom was recorded during the first consultation per se but could be calculated afterward by the amount of scapular winging in centimeters and the amount of humeral forward flexion and abduction.

**Table 1.** Demographics of patients with isolated serratus palsy at the onset of symptoms

Number of patients	Males	Right side (%)	Age (years; mean) (range)	Duration of pain (%)			Intensity of pain (%)				Heaviness of work (%)		
				< 1 week	1–4 weeks	> 1 month	Unbearable	Hard	Mild	No pain	Heavy	Moderate	Light
37	22 (59%)	92	33.7 (11.8–54.0)	31	38	31	27	46	19	8	27	24	49

However, the reliability of this grading scheme is as yet unknown. At the first consultation, at 90° flexion, mild winging (1–2 cm) occurred in 37%, moderate winging (> 2–3.5 cm) in 49%, and severe winging ( $\geq 4$  cm) in 14%. Active shoulder motion was measured with a handheld goniometer assessing bilateral active motion simultaneously with the patient in a standing position. Active forward flexion and abduction were evaluated by measuring the angle formed by the arm and thorax. For the 37 patients, the first consultation took place within 6 months after the onset of symptoms for 17 and within 1 year for 20.

Twenty of the 37 patients had no physiotherapy; seven had one to four sessions, and 10 had five to 15 sessions of physiotherapy (each session with 20 to 30 minutes of supervised ROM and strengthening exercises with gentle massage) before the first consultation by the senior author. Of 17 patients who received any amount of physiotherapy, seven considered physiotherapy worthless; for eight it helped a little, but for two patients, physiotherapy exaggerated the symptoms.

Custom-made, partly literature-based questionnaires (Appendix 1) were mailed to the patients along with the invitation to participate in the study. The questionnaire included questions regarding demographics, work history, onset of symptoms and preceding factors, treatment, healing, and current condition. One dichotomous question was whether the patients considered themselves healed or not healed of the disease. The patients completed these questionnaires at home and returned them to be checked at followup.

At followup, all 37 patients underwent a physical examination by an independent observer (VP), who again recorded the patients' medical history, also checking previous treatment records from other hospitals received by fax or mail. The etiologic subgroups were recorded as traumatic, inflammatory (when some kind of severe infection preceded serratus palsy), or idiopathic [5]. Because we found a clear etiologic subgroup of exertion (strenuous work or hobby, overuse), that became its own subgroup. Scapular winging and active shoulder ROM were measured similarly like in the first consultation. We determined whether the palsy was totally, partially, or not at all healed as indicated by scapular winging, flexion strength, and ROM (totally healed = no scapular winging, normal flexion strength and ROM; not at all healed = situation similar as or worse than at the first consultation; partially healed = the others).

At the first consultation for the 37 patients, flexion was normal (155° or greater) for 42%, it was between 125° and 155° for 44%, and was 120° or less for 14%. Abduction was normal (165° or greater) for 51%, between 115° and 160° for 46%, and 110° or less for one patient. Scapular winging

was recorded with a handheld measure in centimeters as the posterior displacement of the medial border of the scapula from the posterior thorax, ie, from the level of the healthy scapula, at the level of maximal winging; this occurred mostly near the inferior medial border of the scapula in four positions: a static position, arms resting at the sides; arms at 90° flexion; arms at 90° resisted flexion; and the arm in a passive cross-arm position. Shoulder flexion strength was measured with a Salter spring balance. Grip strength also was measured for hand dominance comparison.

The first symptom of the disease was pain in 26 patients (70%), weakness of the limb in seven (19%), and winging of the scapula in four (11%). Half of the patients noticed weakness of the arm and winging of the scapula during the first week after the onset of symptoms, one-fifth recognized no weakness at all, and one-third noticed no winging at all. Winging was noticed by 16 patients him- or herself (43%), by a physiotherapist in seven (19%), or by a doctor in eight (22%). Twenty-two (59%) of the patients contacted a doctor during the first week after onset of symptoms and 10 (27%) contacted a doctor during the next 3 weeks.

Pain at the onset of the disease as recalled the patients was unbearable in 10 (27%), severe in 17 (46%), and mild in seven (19%); three patients (8%) reported no pain. The duration of pain, also recalled by 32 patients, was less than 1 week in 10 (31%), 1 to 4 weeks in 12 (38%), and more than 1 month in 10 (31%). Early in the disease, half the patients used no painkillers, one-third used nonnarcotic painkillers only temporarily, and one-sixth used them daily during the first 2 weeks, whereas four (11%) had to use painkillers daily for longer than 1 month. Sick leave after the onset of serratus palsy averaged 3 months (range, 0–24 months).

Descriptive data are presented as proportions or as means (range). Statistical differences in patients' characteristics such as ROM, scapular winging, and pain were determined in categorical variables using Pearson's chi-square test and in continuous variables with Student's *t*-test. Statistical analysis was performed with SPSS<sup>®</sup> 19.0 for Windows (SPSS Inc, Chicago, IL, USA).

## Results

Mean duration of disease was 16 months (median, 15 months, range, 2–30 months) with 38% achieving healing in 1 year and 78% in 2 years. In eight patients (22%) the disease lasted 24 months or longer. Ten of the patients who achieved clinical healing without scapular winging considered themselves not healed completely, but they stated a healing time of mean 18 months.

At followup 29 patients (78%) had no winging of the scapula at 90° flexion. One patient had mild winging, four had moderate, and three had severe winging (Table 2).

**Table 2.** ROM and scapular winging in the patients with isolated serratus palsy\*

Variable	Shoulder flexion (degrees)	Shoulder abduction (degrees)	Winging in 90° flexion (cm)	Winging in resisted 90° flexion (cm)	Winging in cross-arm position (cm)
Included patients <sup>†</sup>					
Baseline*	144	163	2.8	3.5	3.2
Number of patients	36	35	34	27	15
Followup (N = 37 patients)	161	181	0.8	0.9	0.7
Only clinical followup <sup>‡</sup>					
Baseline*	139	157	2.9		
Number of patients	23	23	23		
Followup	151	172	1.3		
Number of patients	21	21	23		

\* No particular treatment at first consultation by the senior author; †mean 17 years after the onset of symptoms in 37 surveyed patients; ‡in 23 patients only with routine clinical followup mean 33 months (median, 15 months) after the onset of symptoms.

The winging at the initial or last clinical followup was similar in patients not attending and those attending the final evaluation (Table 2).

At followup, flexion was normal for 82% and abduction for 89%. Shoulder flexion strength at followup was  $\pm 1.5$  kg compared with the healthy side for 76% of patients. The flexion at the initial or last clinical followup was similar in patients not attending and attending the final evaluation (Table 2).

At followup, 49% still experienced some kind of pain symptoms. Pain at rest was absent in 46%, existed seldom in 19%, and was temporary in 32%. One patient had pain at rest continuously. Only 30% had no pain at exertion, whereas temporary pain during exertion occurred in 41%. Half of the patients had used no painkillers during the previous year (Table 3).

We found no differences concerning scapular winging, ROM, or pain at followup between sexes, in any age groups, or in patients who had received five to 15 sessions of physiotherapy or who had no physiotherapy. We found, however, a tendency toward a better clinical outcome in the infection etiology subgroup (Table 4).

Twenty-one patients (57%) considered themselves totally healed, 12 (32%) had no residual symptoms, five (14%) had symptoms rarely, 16 (43%) had pain sometimes, and four (11%) had pain continuously. According to each patient's opinion regarding recovery, 19% still had symptoms remaining, although winging was clinically absent (Table 5). Based on the patients' opinions, patients younger than 35 years had a tendency toward a worse healing rate ( $p = 0.086$ ) than did patients older than 35 years: eight of 19 (42%) versus 13 of 18 (72%), respectively (Table 5).

Work demands at the onset of symptoms were light (office work, homemaker) for 18 patients (49%), moderate for nine (24%), and heavy (strenuous manual labor) for 10 (27%). At followup, these figures changed to 23 (62%),

**Table 3.** Pain in the patients with isolated serratus palsy\*

Pain	None (%)	Seldom (%)	Sometimes (%)	Continuously (%)
None	51			
At rest	46	19	32	3
On exertion	30	22	40	8
Painkiller use	52	25	17	6

\* Patients without any particular treatment at a mean of 17 years after the onset of symptoms.

nine (24%), and five (14%). Only three patients had changed their occupations, and four had retired as a result of the palsy. Among the retired patients, three did heavy work and one moderate. All but two patients reported managing well in activities such as hair combing, toothbrushing, and daily home tasks. For most of the patients (from 29 to 33 of the 37 patients), carrying a shopping bag, lifting things onto a shelf, or sleeping on the affected side were easily manageable tasks. Working on a horizontal plane, playing tennis, or other similar kinds of sports was easily manageable for 23 (62%) of the patients.

## Discussion

The natural course of isolated serratus palsy is obscure owing to the published studies with small series [1, 2, 4, 6–9, 11, 12, 18, 21]. It therefore is unclear whether scapular winging and pain are always relieved and motion and function restored without treatment. Based on the 40-year clinical experience of the senior author, we theorized that the outcome for isolated serratus palsy without any particular treatment modalities might be better than stated. Therefore to learn the long-term natural outcome of

**Table 4.** Clinical healing of the patients with isolated serratus palsy in subgroups

Subgroup	Number of patients	Clinically no palsy		Clinically partial or total palsy	
		Number of patients	Percent	Number of patients	Percent
All	37	27	73	10	27
Male	22	16	73	6	27
Female	15	11	73	4	27
Age at the onset of symptoms					
Younger than 35 years	19	14	74	5	26
Older than 35 years	18	13	72	5	28
No physiotherapy	26	19	73	7	27
Physiotherapy	11	8	73	3	27
Trauma in etiology	12	8	67	4	33
No trauma	25	19	76	6	24
Exertion in etiology	22	17	77	5	23
No exertion	15	10	67	5	33
Infectious	9	8	89	1	11
Noninfectious	28	19	68	9	32
Heaviness of work					
Light	27	19	70	8	30
Hard	10	8	80	2	20

**Table 5.** Subjective healing of the patients with isolated serratus palsy in subgroups

Subgroup	Number of patients	Patients' subjective opinion			
		Healed		Nonhealed	
		Number of patients	Percent	Number of patients	Percent
All patients	37	21	57	16	43
Male	22	12	55	10	45
Female	15	9	60	6	40
Age at the onset of symptoms					
Younger than 35 years	19	8	42	11	58
Older than 35 years	18	13	72	5	28
No physiotherapy	26	16	62	10	38
Physiotherapy	11	5	45	6	55
Trauma in etiology	12	7	58	5	42
No trauma	25	14	56	11	44
Exertion in etiology	22	12	55	10	45
No exertion	15	9	60	6	40
Infectious	9	7	78	2	22
Noninfectious	28	14	50	14	50
Heaviness of work					
Light	27	15	56	12	44
Hard	10	6	60	4	40

isolated serratus palsy, we determined (1) the duration of symptoms; (2) long-term scapular winging; (3) ROM; and (4) pain in 37 patients with isolated serratus palsy

scheduled for supervised observation without any particular treatment except physiotherapy in 17 patients at the beginning of the disease.

We acknowledge limitations in our study. First, we studied patients only from the practice of one surgeon with numerous exclusions. We also included patients with only mild paresis of the long thoracic nerve, Grades I or II using the Vastamäki grading [19], although five patients (14%) doing light work had Grade III palsy. However, these five patients did not differ in outcome from the others, therefore, their inclusion should be justified. While we believe no classification adequately stratifies winging, our findings likely would not apply to patients with more severe involvement. In addition, we could evaluate only 50% of the patients meeting our inclusion criteria. We had routine clinical followup records for 23 of the 37 patients (62%) who did not attend the final evaluation, which showed that they did not differ from the patients who were evaluated. However, we do not know whether some of the patients had received treatment for serratus palsy after the primary clinical followups. Second, concerning evaluation, we obtained no validated functional scores at the time the patients initially were seen or at followups, because no valid score presently exists, therefore we opted for a self-made one. We consider that in evaluation of serratus palsy, scapular winging, shoulder ROM, strength in flexion, and pain are the most important factors. We did not find any comments in the literature concerning these matters in serratus palsy. In addition, the amount of winging is not easy to measure in every case because the shape of this area may differ considerably. We simply measured the posterior displacement of the medial border of the scapula from the posterior thorax in centimeters comparing the posterior displacement with the level of the healthy scapula. There are better measurement techniques such as use of a special tool to measure more accurate displacement [16], but such a tool was unavailable, and it might have been too

cumbersome for clinical use when compared with a simple centimeter measure.

Foo and Swann [4] reported 14 cases with a mean recovery time of 13 months, Fardin et al. [2] reported five cases requiring 15 months recovery time (Table 6), and Kumschick [11] reported six cases with a mean 19-month recovery time. In our series, 29 patients recovered at a mean of 16 months, at least within 2 years; eight of our patients (22%) did not record their healing time. We thus believe that in isolated serratus palsy one should wait at least 2 years before performing any reconstructive surgery.

Winging of the scapula disappeared in 60% to 75% of the patients in small series of four to 10 patients [2, 8, 11, 14, 17] or in similar series in only 36% to 47% of patients [6, 7, 13] (Table 6). In our series, winging was absent from 78% of the patients. This did not always mean that the patient was asymptomatic. Only 71% of patients without winging considered themselves to be totally healed. This was somewhat confusing when taking account that scapular winging was one criterion for patient selection.

Few studies treat ROM separately from other measures [6, 11]. In one group of 12 patients, ROM recovered to normal in eight (67%) [6], and among another eight, in seven (88%) [11]. In our patients, flexion was normal in 82%, averaging 161°, and abduction in 89%, averaging 181°.

Pain generally has not been considered a problem according to published studies [2, 4, 5, 13, 17]. Kumschick [11] found that of eight patients, one had occasional mild pain in the shoulder region, although scapular winging had disappeared. However, half of our patients still had some pain. Only 30% had no pain on exertion with temporary pain on exertion reported by 41%. Most of our patients had clinically less severe serratus palsy. We are unable to determine how our results compare with those of more

**Table 6.** Literature on the natural course of isolated serratus palsy

Study	Number of patients	Mean age (years) (range)	Males (%)	Affected side right (%)	Recovery time (mean months) (range)	Mean followup (years) (range)	Treatment physiotherapy/none	Recovery complete (%)	Etiology trauma/exertion/other
Foo and Swann [4]	20	42(18–70)	40	95	13(6–24)	5½–12)	5/15	70	3/5/12
Fardin et al. [2]	10	26(10–43)	50	90	15(7–22)	2½–4)	0/10	60	2/0/8
Goodman et al. [6]	12	(5–55)	42			4½(1–7)	10/2	42	5/0/7
Klebe et al. [10]	64	38(15–75)	67			1	64/0	56	24/15/25
Friedenberg et al. [5]	50	38(16–69)	82	86*		4		56	17/20†/13
Current study	37	34(12–54)	59	92	16(2–30)	17(2–31)	17/20	76	12/16/9

\* Dominant limb; †inflammatory.

severe cases, because the grade or the severity of cases in these studies was not stated [5, 6, 13].

We believe the natural course of serratus palsy in clinically less severe cases is benign with symptoms recovering in 78% of patients by 2 years. However, our long-term results were not as favorable as we had believed. At least one-fifth of the patients had long-lasting scapular winging and decreased flexion strength, one-fifth will have decreased ROM, and half may have some kind of pain. We found no factors predicting which patients in this group with milder serratus palsy would need more treatment than just observation. We still have no appropriate means to decide what treatment we should use for isolated serratus palsy. We use our grading system and observation for patients with Grades I and II palsy.

**Acknowledgments** We thank Carol Norris PhD, for language revision.

### Appendix 1. Serratus palsy questionnaire

Name \_\_\_\_\_

1. Date
2. Sex
3. Age
4. Hand dominance
5. Palsy side
6. I understand what serratus palsy means.
7. I have enough information about the disease.
8. The physical heaviness of the work at the time of the first symptoms:
  - a. Light
  - b. Moderate
  - c. Hard
9. The physical heaviness of the work now:
  - a. Light
  - b. Moderate
  - c. Hard
10. How hard was your work at the onset of symptoms?
  - a. Mainly sitting, not much walking
  - b. I walked quite a lot but did not lift or carry heavy things
  - c. I had to walk a lot or lift things or walk upstairs, etc
  - d. My work was heavy physical work and I had to lift or carry heavy things
11. How hard is your work now?
  - a. Mainly sitting, not much walking
  - b. I walk quite a lot but did not lift or carry heavy things
  - c. I have to walk a lot or lift things or walk upstairs, etc
  - d. My work is heavy physical work and I have to lift or carry heavy things
12. The time of the first symptoms of serratus palsy \_\_\_\_\_
13. What symptom came first?
  - a. Pain
  - b. Weakness of the arm
  - c. Winging of the scapula
14. The hardness of the pain was:
  - a. Mild
  - b. Hard
  - c. Unbearably hard
15. What was the duration of the pain?
  - a. Less than 1 week
  - b. 1–2 weeks
  - c. 3–4 weeks
  - d. More than 1 month; how long? \_\_\_\_\_
16. When did you notice the weakness of the upper extremity?
  - a. During the first week
  - b. During 2–3 weeks
  - c. During 1–2 months
  - d. I did not notice it
17. When was the winging of the scapula noticed?
  - a. During the first 2 weeks
  - b. After 3–4 weeks
  - c. After 1–2 months
  - d. Later; when? \_\_\_\_\_
18. Who noticed the winging?
  - a. Me
  - b. Physiotherapist
  - c. Doctor
  - d. Family member
  - e. Other person; who? \_\_\_\_\_
19. How fast did you contact a doctor?
  - a. During the first week
  - b. During the first month
  - c. Later; when? \_\_\_\_\_
20. How much sick leave did you have? Did some of these things precede your sickness?
21. Trauma
  - a. No
  - b. A hit to the shoulder area
  - c. Stretching injury
  - d. Another trauma; what? \_\_\_\_\_

22. Exertion
- No
  - Hands over horizontal plane working
  - Abundant lifting/carrying
  - Sports; what kind?  
\_\_\_\_\_
  - Delivery
  - Another exertion; what?  
\_\_\_\_\_
23. Infection
- No
  - Mild infection
  - Severe infection, demanding bed rest
24. Operation
- No
  - Operation of axilla, chest, or throat area
  - Operation of other areas
  - Other intervention demanding anesthesia; what?  
\_\_\_\_\_
25. Painkiller use at the start of the disease
- No
  - Now and then
  - Daily for 1–2 weeks
  - Daily for 3–4 weeks
  - Daily for more than 1 month
26. Physical therapy at the start of the disease
- No
  - Now and then
  - 5–15 times
  - 16–30 times
  - Over 30 times
27. How did the physical therapy help?
- Well
  - A little
  - Not at all
  - It made the symptoms worse
28. How could you manage these activities with the palsy side?
- Hair-combing
  - Brushing teeth
  - Carrying a shopping bag
  - Sleeping on the disease side
  - Playing tennis, etc
  - Lifting things to a shelf
  - Working hands above a horizontal plane
  - Normal daily routines
29. I am
- Employed; my profession/job is  
\_\_\_\_\_
  - Pensioned
  - Unemployed
  - Something else
30. Have you changed your profession/job as a result of the serratus palsy?
31. Do you still have pain as a result of the serratus palsy?
32. Have there been changes in pain during the last years?
- No
  - Yes, pain has diminished
  - Yes, pain has increased
33. There is pain on exertion.
- Not at all
  - Seldom
  - Sometimes
  - Constantly
34. There is pain at rest.
- Not at all
  - Seldom
  - Sometimes
  - Constantly
35. Have you received physical therapy during the last year for the serratus palsy?
36. Have you used painkillers during the last year for the shoulder area pain?
- Not at all
  - Seldom
  - Sometimes
  - Constantly
37. How can you manage these activities with the palsy side?
- Hair-combing
  - Brushing teeth
  - Carrying a shopping bag
  - Sleeping on the disease side
  - Playing tennis, etc
  - Lifting things to a shelf
  - Working hands above the horizontal plane
  - Normal daily routines
38. I am totally cured of the serratus palsy.
39. The healing took \_\_\_\_\_ months.
40. I have residual symptoms from the serratus palsy.
- Not at all
  - Seldom
  - Sometimes
  - Constantly



41. I have had to give up my work as a result of the serratus palsy.
42. I have another disease of the musculoskeletal system. What? \_\_\_\_\_
43. I have other diseases. What? \_\_\_\_\_

## References

1. Brientini JM, Vichard P, Rousselot JP, Monnier G. [Isolated paralysis of the serratus anterior muscle: an unknown pathology] [in French]. *Chirurgie*. 1988;114:338–343.
2. Fardin P, Negrin P, Dainese R. The isolated paralysis of the serratus anterior muscle: clinical and electromyographical follow-up of 10 cases. *Electromyogr Clin Neurophysiol*. 1978;18:379–386.
3. Fery A, Sommelet J. [Paralysis of the serratus anterior muscle. Results of treatment of 12 cases including 9 surgically treated and a general review of the literature] [in French]. *Rev Chir Orthop Reparatrice Appar Mot*. 1987;73:277–288.
4. Foo CL, Swann M. Isolated paralysis of the serratus anterior: a report of 20 cases. *J Bone Joint Surg Br*. 1983;65:552–556.
5. FriedenberG SM, Zimprich T, Harper CM. The natural history of long thoracic and spinal accessory neuropathies. *Muscle Nerve*. 2002;25:535–539.
6. Goodman CE, Kenrick MM, Blum MV. Long thoracic nerve palsy: a follow-up study. *Arch Phys Med Rehabil*. 1975;56:352–358.
7. Gozna E, Harris R. Traumatic winging of the scapula. *J Bone Joint Surg Am*. 1979;61:1230–1233.
8. Gregg J, Labosky D, Harty M, Lotke P, Ecker M, DiStefano V, Das M. Serratus anterior paralysis in the young athlete. *J Bone Joint Surg Am*. 1979;61:825–832.
9. Kauppila LI, Vastamaki M. Iatrogenic serratus anterior paralysis: long-term outcome in 26 patients. *Chest*. 1996;109:31–34.
10. Klebe TM, Dossing KV, Bienstrup T, Nielsen-Ferreira J, Rejsenhus I, Aalkjaer G, Breddam M. [Scapulae alatae-angels' wings: a study of 64 patients treated with braces and physical therapy at the Viberg's hospital] [in Danish]. *Ugeskr Laeger*. 2003;165:1779–1782.
11. Kumschick G. [On the pathogenesis and prognosis of serratus muscle paralysis] [in German]. *Schweiz Arch Neurol Neurochir Psychiatr*. 1968;101:235–250.
12. Martin JT. Postoperative isolated dysfunction of the long thoracic nerve: a rare entity of uncertain etiology. *Anesth Analg*. 1989;69:614–619.
13. Overpeck DO, Ghormley RK. Paralysis of the serratus magnus muscle caused by lesion of the long thoracic nerve. *JAMA*. 1940;114:1994–1996.
14. Packer GJ, McLatchie GR, Bowden W. Scapula winging in a sports injury clinic. *Br J Sports Med*. 1993;27:90–91.
15. Pikkarainen V, Vastamäki M. [Serratus palsy: long-term outcome in 85 patients] [in Finnish]. *Suomen Ortopedia ja Traumatologia*. 2009;32:249–251.
16. Plafcan DM, Turczany PJ, Guenin BA, Kegerreis S, Worrell TW. An objective measurement technique for posterior scapular displacement. *J Orthop Sports Phys Ther*. 1997;25:336–341.
17. Schultz JS, Leonard JA Jr. Long thoracic neuropathy from athletic activity. *Arch Phys Med Rehabil*. 1992;73:87–90.
18. Vastamäki M. [Paralysis of the serratus anterior muscle] [in Finnish]. *Duodecim*. 1985;101:969–976.
19. Vastamäki M. Accessory nerve palsy and serratus palsy. *Ann Chir Gynaecol*. 1996;85:167–171.
20. Vastamäki M, Kauppila L. Etiologic factors in isolated paralysis of the serratus anterior muscle: a report of 197 cases. *J Shoulder Elbow Surg*. 1993;2:240–243.
21. Wood VE, Frykman GK. Winging of the scapula as a complication of first rib resection: a report of six cases. *Clin Orthop Relat Res*. 1980;149:160–163.