

# Shoulder Pain After Stroke

## A Prospective Population-Based Study

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**Background and Purpose**—Shoulder pain is a well-known complication after stroke, but data on prevalence, predictors, and outcome in unselected stroke populations are limited.

**Methods**—During a 1-year period, 416 first-ever stroke patients were included in the population-based Lund Stroke Register. After 4 months, 327 patients were followed up and 1 year later, the surviving 305 patients were followed up again. General status (National Institutes of Health Stroke Scale score) was registered at stroke onset. Shoulder pain intensity (visual analog scale, score 0 to 30=no–mild and 40 to 100=moderate–severe pain); arm motor function; restricted dressing and/or ambulating; and functional status (Barthel Index) were registered at both follow ups.

**Results**—Shoulder pain onset within 4 months after stroke was reported by 71 patients (22%). Among the 61 patients able to score the visual analog scale, 79% had moderate–severe pain. One year later, 8 of these 71 patients had died, 17 had no remaining pain, and 28 additional patients had developed shoulder pain since the first follow up. Lost or impaired arm motor function and high National Institutes of Health Stroke Scale score were predictors of shoulder pain. Shoulder pain restricted daily life often or constantly when dressing for 51%/31% and when ambulating for 29%/13% of the patients at 4 and 16 months, respectively.

**Conclusion**—Almost one third of the 327 patients developed shoulder pain after stroke onset, a majority with moderate–severe pain. Shoulder pain restricts patients' daily life after stroke. The increased risk of shoulder pain for patients with impaired arm motor function and/or low general status needs close attention in poststroke care. (*Stroke*. 2007;38:343-348.)

**Key Words:** arm motor function ■ outcome ■ pain intensity ■ shoulder pain ■ stroke

Shoulder pain has been reported to be one of the most common complications after stroke.<sup>1,2</sup> The incidence varies between 9% and 40% depending on patient group and study design.<sup>1–4</sup> Different studies have used various terms for shoulder pain, eg, shoulder pain in hemiplegia,<sup>5–8</sup> hemiplegic shoulder pain,<sup>9</sup> and poststroke shoulder pain.<sup>4</sup> Sometimes, it is unclear whether only proximal pain in the arm was assessed or if also more distal arm pain was included.<sup>10</sup> Shoulder pain hinders rehabilitation, is an important contributor to length of hospital stay,<sup>11</sup> and has been associated with depression<sup>4</sup> and decreased quality of life.<sup>12</sup> Several factors have been related to shoulder pain after stroke such as paralysis,<sup>3,4,13,14</sup> restricted range of motion in the shoulder,<sup>5,6,13</sup> spasticity,<sup>7,8</sup> right hemispheric cerebrovascular lesion and left hemiplegia,<sup>6,8</sup> sensory abnormalities,<sup>4,8</sup> diabetes mellitus,<sup>3</sup> low Barthel Index score,<sup>11</sup> and inappropriate handling of the patient.<sup>9</sup> Recovery from shoulder pain may occur in 80%.<sup>4</sup>

We recently reported that pain of any type and location is common in patients after a stroke.<sup>15</sup> The aim of this report was to provide more detailed data about shoulder pain, including prevalence, characteristics, influence on daily life,

and predictors, in a population-based group of first-ever stroke patients.

### Materials and Methods

A total of 416 consecutive first-ever stroke patients with stroke onset between March 1, 2001, and February 28, 2002, was included in the Lund Stroke Register. The Lund Stroke Register covers the population of Lund-Orup, including 8 municipalities with 234 505 inhabitants (December 31, 2001) representing the local catchment area of Lund University Hospital. The methods for detecting the first-ever stroke patients during the defined period have been described previously.<sup>15</sup> All patients but one with a final diagnosis of first-ever stroke underwent computed tomography scan of the brain.

During the first days at the hospital ward, all patients were assessed by a physical therapist, an occupational therapist, and a nurse in accordance with clinical routine to establish rehabilitation needs. Patients needing rehabilitation after discharge from the acute care ward are routinely referred to the specialized rehabilitation unit, the hospital outpatient rehabilitation unit, or rehabilitation in the community or primary care.

All surviving patients were contacted 4 (follow-up I) and 16 months (follow-up II) (median) after stroke onset and offered a personal appointment with a nurse specialist (A.J.) and a physical therapist (I.L.), who performed all follow-up assessments in collab-

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oration. Approximately 70% of the patients examined were able to come to the outpatient clinic, whereas the remainder was examined in primary care centers (approximately 10%), nursing homes (approximately 10%), or their own homes (approximately 10%).

Informed consent was obtained from each participant or, if the patients were confused or had sensory dysphasia, their spouses or significant others. The study was approved by the Ethics Committee of the Faculty of Medicine, Lund University.

### Baseline Assessments

We registered the following baseline variables: age, gender, National Institutes of Health Stroke Scale (NIHSS) score, main type stroke (cerebral infarction, intracerebral hemorrhage, subarachnoid hemorrhage, undefined) and subtype stroke. The version of the NIHSS we used included an item for right and left hand motor function (maximum 2 points for each hand).<sup>16</sup> The stroke subtype was defined according to the Oxfordshire Community Stroke Project classification system: total anterior circulation syndrome; large anterior circulation infarct with both cortical and subcortical involvement, partial anterior circulation syndrome (more restricted and predominantly cortical infarcts), lacunar syndromes (infarcts confined to the territory of the deep perforating arteries), and posterior circulation syndrome (infarcts clearly associated with the vertebrobasilar arterial territory).<sup>17</sup> Because impaired glucose metabolism has been associated with shoulder impairment,<sup>18</sup> we also registered presence of diabetes mellitus (blood glucose  $\geq 6.1$  mmol/L or serum glucose  $\geq 7.0$  mmol/L at repeated measurements or earlier diagnosed). Patients were asked if they had ever experienced shoulder pain before stroke onset (yes/no).

Primary activities of daily living before stroke were assessed by interview regarding ambulation indoor and outdoor, dressing, and toileting.<sup>19</sup> Patients were considered to have been independent if they had been able to manage these activities without help.

### Follow-Up Assessments

At follow up, the patients' functional status was assessed with Barthel Index (BI) and divided into 3 grades of dependence: independence (BI score 95 to 100), moderate dependence (BI score 60 to 90), and major dependence (BI score 0 to 55).<sup>20,21</sup>

Patients' views on different aspects of shoulder pain that had developed after stroke were explored by a structured questionnaire including time of onset (0 to 2 weeks after stroke onset, 2 weeks to 2 months after stroke, or  $>2$  months after stroke), frequency (constantly, often, or occasionally), use of analgesics, relation to movement or rest, and to dressing and ambulation. At the time of the interview, patients indicated their worst self-perceived shoulder pain during the past 48 hours on a 0 to 100 mm visual analog scale (VAS) marked at one end "no pain" and at the other "worst imaginable pain". The VAS scores were registered in 10-mm intervals. VAS score 0 was defined as no pain, 10 to 30 as mild pain, and 40 to 100 as moderate-severe pain.<sup>22</sup> If the investigators suspected Central Post Stroke Pain, the patient was referred to a neurologist for diagnosis and treatment according to criteria described in previous studies.<sup>23,24</sup> Patients with shoulder pain at follow-up I were asked if they had had any kind of poststroke arm training program after discharge from the hospital (yes/no). We used question 1 and 2 in the Short Form 36 item health survey (SF-36) to register the patients' self-perceived general health at present and 1 year ago.<sup>25</sup> These questions are part of a full analysis of SF-36 for this patient group that has been published previously.<sup>26</sup> If the patient's cognitive function rendered the assessment of shoulder pain difficult, we also interviewed the spouse, other family members, or contact persons among nursing home personnel.

### Clinical Examinations

At both follow ups, the physical therapist (I.L.) performed the following examinations:

1. Arm motor function was assessed by asking the patient to elevate his or her arms to 90°, from this position supinate his

or her hands and keep this position for 10 seconds. This assessment has been found reliable in a test at Uppsala University Hospital of the Motor Assessment Scale (MAS)<sup>27</sup> and the new version is called M-MAS UAS-95.<sup>28</sup> In our study, the arm motor function was registered on a scale (1 to 3) with 1 indicating loss of motor function, 2 reduced motor function, and 3 normal function.

2. Sensory disturbance (yes/no) for light touch of the arm was registered.
3. Subluxation was registered as present/not present by palpation with the patient in a sitting position.<sup>29</sup>

### Statistical Analysis

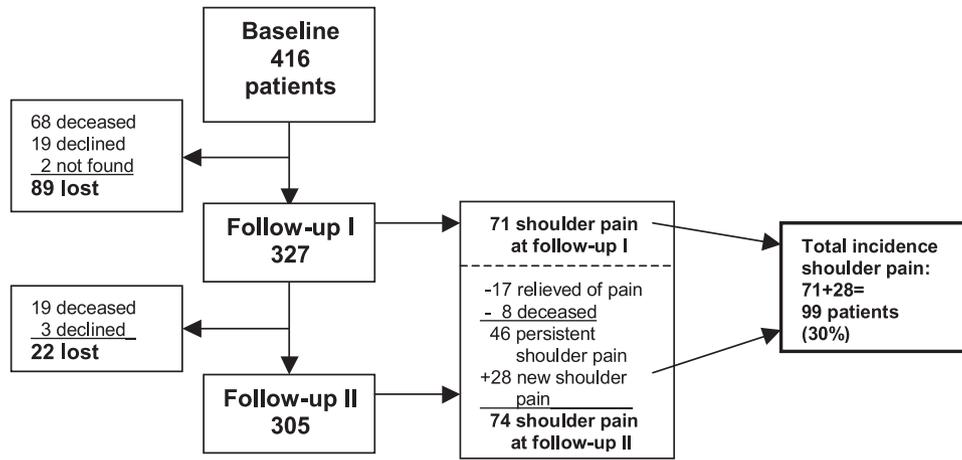
Using Mann-Whitney and  $\chi^2$  test, we examined if there was an association between shoulder pain and the variables specified under the subheading "baseline assessments," characteristics of patient groups at follow-up I regarding functional status (BI), questions 1 and 2 of SF-36, arm motor function, sensory disturbance for light touch, and subluxation. The individual shoulder pain VAS scores and frequency of shoulder pain at the 2 follow ups were compared using Wilcoxon signed rank test. The association between shoulder pain at follow-up I/II and the following baseline variables was tested with forward logistic regression analysis: diabetes mellitus, NIHSS total score, NIHSS item 5 (arm motor function),<sup>16</sup> gender, age, main type and subtype of stroke. Probability values of  $<0.05$  were considered significant.

### Results

At follow-up I, 327 patients were assessed (68 of the 416 initially included patients were dead, 19 declined to participate, and 2 could not be located); thus, 94% of the survivors were followed up. At follow-up II, 19 further patients were dead and 3 declined to participate; thus, 305 patients (99% of the survivors) were assessed at this time. The patient flow chart is illustrated in the Figure. Assistance with pain assessments from personnel, spouse, or other family members was needed for 12% of the patients at both follow ups. Demographic baseline characteristics of the patients are shown in Table 1. At baseline, 98% of the patients reported that they had been independent before stroke.

#### Follow-Up I

Shoulder pain with onset after stroke was reported by 71 patients (22%). The groups with and without shoulder pain with onset after stroke are presented in Table 2. Among the patients without shoulder pain, 21% had a shoulder pain history before stroke, whereas a larger proportion (28%; not significant) among the 71 patients had experienced shoulder pain at any time before the stroke. A larger proportion of patients were independent in the group without shoulder pain (75%) than in the group with shoulder pain (37%) after stroke. We found a relation between the prevalence of shoulder pain and arm motor function. The proportion of shoulder pain was 83% among patients with no motor function, 50% among patients with reduced arm motor function, but only 5% among patients with normal arm motor function ( $P<0.001$ ). Characteristics of shoulder pain after stroke are specified in Table 3. A large proportion of the patients with shoulder pain were restricted in different activities of daily life. Only 4 patients had shoulder pain related to Central Post Stroke Pain. Among the 71 patients, 42 reported that they had some kind of poststroke arm training program after discharge from the hospital.



Patient flow chart.

**Follow-Up II**

At follow-up II, 74 (24%) of the 305 patients had shoulder pain, 46 of them with pain onset between baseline and follow-up I and 28 patients with pain onset after follow-up I. Approximately the same proportion of patients had a shoulder pain history before stroke, 22% and 23%, respectively (not significant), in the groups without and with shoulder pain. The total number of patients with shoulder pain onset during the study period was 71+28=99 patients (30% of the 327 patients at follow-up I).

shoulder pain at follow-up II. The pain frequency ( $P=0.007$ ) and also pain when dressing ( $P=0.025$ ) were reduced among the 46 patients who still had shoulder pain at follow-up II (Table 3). Also, pain intensity for the 41 patients able to score VAS at follow-up II was lower than at follow-up I (median score 50 versus 40,  $P=0.003$ ). However, among these 41 patients, 25 still had moderate–severe pain at follow-up II. Among the total of 99 patients with shoulder pain as specified under the subheading “Follow-Up II”, 11 reported a relation between shoulder pain and a fall accident.

**Evolution of Shoulder Pain With Time**

Among the 63 survivors at follow-up II who reported shoulder pain at follow-up I, 17 patients (27%) had no remaining

**Predictors of Shoulder Pain**

As presented in Table 2, the univariate analyses show significant differences at follow-up I in patients with or

**TABLE 1. Baseline Variables and Their Relation to Shoulder Pain at Follow-Ups I and II**

	Follow-Up I			Follow-Up II		
	Total (n=327)	No Shoulder Pain* (n=256)	Shoulder Pain* (n=71)	Total (n=305)	No Shoulder Pain* (n=231)	Shoulder Pain* (n=74)
Male, n (%)	195 (60)	150 (59)	45 (63)	182 (60)	135 (58)	47 (64)
Age, mean	73.1	73.3	72.3	72.5	72.6	72.2
Age, range	17–102	32–102	17–96	17–96	17–95	32–96
NIHSS mean score	5.4	3.9	10.8†	5.1	4.1	8.0†
Shoulder pain history before stroke, n (%)	74 (23)	54 (21)	20 (28)	67 (22)	50 (22)	17 (23)
Diabetes mellitus, n (%)	48 (15)	33 (13)	15 (21)	43 (14)	29 (13)	14 (19)
Main type stroke, n (%)						
Cerebral infarction	292 (89)	227 (89)	65 (92)	272 (89)	203 (88)	69 (93)
Intracerebral hemorrhage	21 (6)	18 (7)	3 (4)	19 (6)	15 (6)	4 (5)
Subarachnoid hemorrhage	13 (4)	10 (4)	3 (4)	13 (4)	12 (5)	1 (1)
Undefined	1 (0.3)	1 (0.4)	...	1 (0.3)	1 (0.4)	...
Subtype stroke, n (%)						
Lacunar syndromes	105 (32)	83 (33)	22 (31)	101 (33)	76 (33)	25 (34)
Partial anterior circulation syndrome	117 (36)	100 (39)	17 (24)	108 (36)	85 (37)	23 (31)
Posterior circulation syndrome	54 (16)	47 (18)	7 (10)	52 (17)	41 (18)	11 (15)
Total anterior circulation syndrome	38 (12)	16 (6)	22 (31)	31 (10)	17 (7)	14 (19)
Subarachnoid hemorrhage	13 (4)	10 (4)	3 (4)	13 (4)	12 (5)	1 (1)

% indicates proportion of the total group in each column.

\*Shoulder pain with onset after stroke; † $P<0.001$ , significant differences between the groups with and without shoulder pain; ‡ $P<0.05$ , significant differences between the groups with and without shoulder pain.

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**TABLE 2. Characteristics of Patient Groups at Follow-Up I**

	Shoulder Pain With Onset After Stroke Total n=71, N (%)	No Shoulder Pain With Onset After Stroke Total n=256, N (%)	<i>P</i>
Functional status*			<0.001
Independence	26 (37)	193 (75)	
Moderate dependence	22 (31)	43 (17)	
Major dependence	23 (32)	20 (8)	
Self perceived ill health†	16 (23)	21 (8)	<0.001
Self perceived much worse health now than 1 year ago‡	32 (45)	46 (18)	<0.001
Arm motor function			<0.001
No function	19 (27)	4 (2)	
Reduced function	40 (56)	40 (15)	
Normal function	12 (17)	212 (83)	
Sensory disturbance for light touch‡	22 (31)	17 (7)	<0.001
Subluxation	29 (41)	10 (4)	<0.001

\*Independence indicates BI 95–100, moderate dependence BI 60–90, severe dependence BI 0–55; †questions 1 and 2 of the SF-36 Health Survey; ‡two patients with pain and 3 patients without pain could not be assessed as a result of bad general condition.

without shoulder pain regarding functional status (BI), self-perceived health, sensory disturbance, subluxation, and particularly arm motor function.

The logistic regression analysis showed that low general status (NIHSS) ( $P=0.008$ ) and loss or reduction of arm motor function at baseline (NIHSS item 5) ( $P=0.03$ ) were independently related to prevalence of shoulder pain at follow-up I. At follow-up II, only loss or reduction of arm motor function at baseline (NIHSS item 5) was an independent predictor of shoulder pain ( $P<0.001$ ).

### Discussion

To our knowledge, this is the first report of a significant association between lost or reduced arm motor function and shoulder pain in a population-based group of patients after stroke assessed by repeated clinical examinations and personal interviews over 16 months. Poor arm motor function and its relation to shoulder pain has been previously described,<sup>3,4,13,14</sup> but the considerably larger proportion of shoulder pain in patients with complete loss of arm motor function compared with the patient group with reduced arm motor function is a novel finding. Our results indicate that low general status at baseline (NIHSS) and affected arm motor function are predictors of shoulder pain after stroke.

The large proportions of patients with frequent shoulder pain at both follow ups indicate a need for a more active pain treatment. Insufficient pain relief might otherwise obstruct rehabilitation of the arm function with a consequent risk of persisting arm dysfunction and reduced possibilities to carry out professional as well as leisure activities. The patients with shoulder pain assessed their general health to be worse than the group without shoulder pain. Depression and reduced quality of life among patients after stroke with pain has been described,<sup>12</sup> but it has not been clearly established if these factors are directly related to the severity of pain, higher degree of impairment, or other factors.

Our finding that 22% and 24% of the patients at follow-ups I and II, respectively, experienced shoulder pain with onset after stroke corresponds well with 23% 6 months after stroke in another population-based study,<sup>3</sup> in which a questionnaire rather than clinical examination was used for assessment of pain. In our study, shoulder pain occurred in a comparatively larger proportion of the total group of 327 patients (22%) within the first 4 months after stroke than between follow-ups I and II (8%).

Assessment of shoulder pain after stroke could be facilitated if a definition of shoulder pain after stroke could be agreed on internationally. The term PULP (Post-Stroke Upper Limb Pain) has been suggested.<sup>10</sup> Another challenge is to distinguish shoulder pain related to stroke from other types of shoulder pain.<sup>10</sup> Other possible contributing factors worth considering in relation to shoulder pain may be, for example, rheumatic disease or trauma.<sup>3</sup> In patients with stroke, impaired postural control and balance may increase the fall risk, which may result in shoulder pain.<sup>30</sup>

The correlation between shoulder pain and subluxation, and also the methods of diagnosing subluxation, have been discussed in several reports.<sup>31,32</sup> In our study, we could not examine the patients radiologically, but we assessed subluxation by palpation as a screening method, which has been described previously.<sup>32</sup>

Possible strategies to prevent shoulder pain have been discussed. In one report, it is recommended that patients with stroke should be taught to use a range-of-motion exercise program to prevent complications such as shoulder pain.<sup>31</sup> There is also evidence that the efficacy of supportive devices in preventing subluxation and shoulder pain should be tested in randomized trials.<sup>33</sup> Another recent report suggests that electrostimulation may have a potential as treatment to promote motor recovery and possibly prevent shoulder pain, but further studies must be more carefully designed to obtain more reliable results.<sup>34</sup>

**TABLE 3. Characteristics of Shoulder Pain With Onset After Stroke**

	Follow-Up I, Total n=71, n (%)	Follow-Up II, Total n=74‡, n (%)
Pain onset		
0–2 weeks after stroke onset	39 (55)	25 (32)
2 weeks–2 months after stroke	21 (30)	14 (19)
>2 months after stroke	11 (15)	35 (47)
Pain frequency*		
Constantly	8 (11)	4 (5)
Often (daily)	52 (73)	44 (60)
Occasionally (≤once a week)	11 (16)	26 (35)
Situations with pain*		
Movements	69 (97)	69 (93)
Rest	16 (23)	17 (23)
Pain when dressing*		
Constantly	11 (16)	11 (15)
Often	25 (35)	12 (16)
Occasionally	13 (18)	19 (26)
Pain hinders in ambulation*		
Constantly	6 (9)	4 (5)
Often	14 (20)	6 (8)
Occasionally	14 (20)	14 (19)
VAS >40 previous 48 hours*†	48 (79)	41 (59)
Pharmacologic pain treatment*	32 (45)	31 (42)

\*The patients' report of the situation at the time of the interview; †10 and 5 patients could not score VAS at follow-ups I and II, respectively; ‡46 patients with pain onset before follow-up I and 28 patients with pain onset after follow-up I.

### Methodological Aspects

An advantage of our study is the population-based design with a well-defined catchment area and a careful case ascertainment and the thoroughness in following up the patients resulting in very few dropouts. The varying results in previous studies may be caused by different methods of assessment and different study designs making it difficult to compare our results with other studies.

Limitations of our study include that 14% of the patients at follow-up I and 7% at follow-up II were not able to score VAS because of dysphasia, severe cognitive impairment, or difficulty to discriminate pain from other pathological sensations (Table 3). These factors indicate a difficulty for patients with stroke to describe their situation and also a complexity for healthcare personnel to interpret the patients' descriptions. It could have been of interest to use a pain diary to enable the patients to assess their pain continuously,<sup>35</sup> but some of the patients would have been unable to fulfill the assessment for the previously mentioned reasons. Other methods to assess pain are possible but also have restrictions, eg, the Ritchie Articular Index<sup>36</sup> measures pain in a passive movement situation. The use of proxies has been found feasible rather

than excluding patients who cannot fully respond by themselves.<sup>37</sup>

Sensory disturbance in the form of pin-prick sensation could have been added to our study. However, more complex sensory modalities would have been difficult to perform because patients with dysphasia, cognitive dysfunction, and/or affected body awareness may have difficulties cooperating.

### Conclusions

Almost one third of the 327 patients developed shoulder pain after stroke onset, the majority of whom had moderate–severe pain. Shoulder pain restricts patients' daily life after stroke. The increased risk of shoulder pain for patients with impaired arm motor function and/or low general status needs close attention in poststroke care.

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### Disclosures

None.

### References

- Langhorne P, Stott DJ, Robertson L, MacDonald J, Jones L, McAlpine C, Dick F, Taylor GS, Murray G. Medical complications after stroke: a multicenter study. *Stroke*. 2000;31:1223–1229.
- McLean DE. Medical complications experienced by a cohort of stroke survivors during inpatient, tertiary-level stroke rehabilitation. *Arch Phys Med Rehabil*. 2004;85:466–469.
- Ratnasabapathy Y, Broad J, Baskett J, Pledger M, Marshall J, Bonita R. Shoulder pain in people with a stroke: a population-based study. *Clin Rehabil*. 2003;17:304–311.
- Gamble GE, Barberan E, Laasch HU, Bowsher D, Tyrrell PJ, Jones AK. Poststroke shoulder pain: a prospective study of the association and risk factors in 152 patients from a consecutive cohort of 205 patients presenting with stroke. *Eur J Pain*. 2002;6:467–474.
- Bohannon RW, Larkin PA, Smith MB, Horton MG. Shoulder pain in hemiplegia: statistical relationship with five variables. *Arch Phys Med Rehabil*. 1986;67:514–516.
- Joynt RL. The source of shoulder pain in hemiplegia. *Arch Phys Med Rehabil*. 1992;73:409–413.
- Van Ouwenaar C, Laplace PM, Chantraine A. Painful shoulder in hemiplegia. *Arch Phys Med Rehabil*. 1986;67:23–26.
- Poulin de Courval L, Barsauskas A, Berenbaum B, Dehaut F, Dussault R, Fontaine FS, Labrecque R, Leclerc C, Giroux F. Painful shoulder in the hemiplegic and unilateral neglect. *Arch Phys Med Rehabil*. 1990;71:673–676.
- Wanklyn P, Forster A, Young J. Hemiplegic shoulder pain (hsp): natural history and investigation of associated features. *Disabil Rehabil*. 1996;18:497–501.
- Price CIM. Treatment of shoulder and upper limb pain after stroke: an obstacle course for evidence-based practice. *Reviews in Clinical Gerontology*. 2003;13:321–333.
- Roy CW, Sands MR, Hill LD, Harrison A, Marshall S. The effect of shoulder pain on outcome of acute hemiplegia. *Clin Rehabil*. 1995;9:21–27.
- Widar M, Ahlström G, Ek AC. Health-related quality of life in persons with long-term pain after a stroke. *J Clin Nurs*. 2004;13:497–505.
- Roy CW, Sands MR, Hill LD. Shoulder pain in acutely admitted hemiplegics. *Clin Rehabil*. 1994;8:334–340.
- Jespersen HF, Jorgensen HS, Nakayama H, Olsen TS. Shoulder pain after a stroke. *Int J Rehabil Res*. 1995;18:273–276.
- Jönsson AC, Lindgren I, Hallström B, Norrving B, Lindgren A. Prevalence and intensity of pain after stroke: a population based study focusing on patients' perspectives. *J Neurol Neurosurg Psychiatry*. 2006;77:590–595.
- Hacke W, Kaste M, Fieschi C, von Kummer R, Davalos A, Meier D, Larrue V, Bluhmki E, Davis S, Donnan G, Schneider D, Diez-Tejedor E,

- Trouillas P. Randomised double-blind placebo-controlled trial of thrombolytic therapy with intravenous alteplase in acute ischaemic stroke (ECASS II). Second European–Australasian Acute Stroke Study Investigators. *Lancet*. 1998;352:1245–1251.
17. Bamford J, Sandercock P, Dennis M, Burn J, Warlow C. Classification and natural history of clinically identifiable subtypes of cerebral infarction. *Lancet*. 1991;337:1521–1526.
  18. Mäkelä M, Heliövaara M, Sainio P, Knekt P, Impivaara O, Aromaa A. Shoulder joint impairment among Finns aged 30 years or over: prevalence, risk factors and co-morbidity. *Rheumatology (Oxford)*. 1999;38:656–662.
  19. Glader EL, Stegmayr B, Norrving B, Terént A, Hulter-Åsberg K, Wester PO, Asplund K. Sex differences in management and outcome after stroke: a Swedish national perspective. *Stroke*. 2003;34:1970–1975.
  20. Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. *Md State Med J*. 1965;14:61–65.
  21. Muir KW, Lees KR, Ford I, Davis S. Magnesium for acute stroke (intravenous magnesium efficacy in stroke trial): randomised controlled trial. *Lancet*. 2004;363:439–445.
  22. Kelly AM. The minimum clinically significant difference in visual analogue scale pain score does not differ with severity of pain. *Emerg Med J*. 2001;18:205–207.
  23. Andersen G, Vestergaard K, Ingeman-Nielsen M, Jensen TS. Incidence of central post-stroke pain. *Pain*. 1995;61:187–193.
  24. Hansson P. Post-stroke pain case study: clinical characteristics, therapeutic options and long-term follow-up. *Eur J Neurol*. 2004;11(suppl 1):22–30.
  25. Ware JE Jr, Sherbourne CD. The MOS 36-item Short-Form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30:473–483.
  26. Jönsson AC, Lindgren I, Hallström B, Norrving B, Lindgren A. Determinants of quality of life in stroke survivors and their informal caregivers. *Stroke*. 2005;36:803–808.
  27. Carr JH, Shepherd RB, Nordholm L, Lynne D. Investigation of a new motor assessment scale for stroke patients. *Phys Ther*. 1985;65:175–179.
  28. Barkelius K, Johansson A, Körm K, Lindmark B. Reliabilitets- och validitetsprövning av modifierad motor assessment scale enligt Uppsala Akademiska Sjukhus-95. *Nordisk fysioterapi*. 1997;1:121–126.
  29. Bohannon RW, Andrews AW. Shoulder subluxation and pain in stroke patients. *Am J Occup Ther*. 1990;44:507–509.
  30. Tyson SF, Hanley M, Chillala J, Selley A, Tallis RC. Balance disability after stroke. *Phys Ther*. 2006;86:30–38.
  31. Zorowitz RD, Hughes MB, Idank D, Ikai T, Johnston MV. Shoulder pain and subluxation after stroke: correlation or coincidence? *Am J Occup Ther*. 1996;50:194–201.
  32. Paci M, Nannetti L, Rinaldi LA. Glenohumeral subluxation in hemiplegia: an overview. *J Rehabil Res Dev*. 2005;42:557–568.
  33. Ada L, Foongchomcheay A, Canning C. Supportive devices for preventing and treating subluxation of the shoulder after stroke. *Cochrane Database Syst Rev*. 2005;CD003863.
  34. Pomeroy VM, King L, Pollock A, Baily-Hallam A, Langhorne P. Electrostimulation for promoting recovery of movement or functional ability after stroke. *Cochrane Database Syst Rev*. 2006;CD003241.
  35. Rowbotham MC, Twilling L, Davies PS, Reisner L, Taylor K, Mohr D. Oral opioid therapy for chronic peripheral and central neuropathic pain. *N Engl J Med*. 2003;348:1223–1232.
  36. Bohannon RW, LeFort A. Hemiplegic shoulder pain measured with the Ritchie Articular Index. *Int J Rehabil Res*. 1986;9:379–381.
  37. Dorman PJ, Waddell F, Slattery J, Dennis M, Sandercock P. Are proxy assessments of health status after stroke with the EuroQol questionnaire feasible, accurate, and unbiased? *Stroke*. 1997;28:1883–1887.

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