# Physiotherapeutic treatment and clinical evaluation of shoulder disorders

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# 4 IMPACT OF ADHESIVE CAPSULITIS AND ECONOMIC EVALUATION OF HIGH-GRADE AND LOW-GRADE MOBILISATION TECHNIQUES

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## Abstract

The purpose of this study was to estimate the impact of adhesive capsulitis on costs and health and to compare the cost-utility of high-grade and low-grade mobilisation techniques (HGMT and LGMT).

In a randomised controlled trial, 92 patients with adhesive capsulitis received either HGMT or LGMT and were followed for one year. Outcome measures were quality adjusted life years (QALYs) according to the Short Form 6D (SF-6D) and societal costs estimated from cost questionnaires.

Estimated costs and QALYs in both randomisation groups were similar, except for the number of treatment sessions (18.6 for HGMT versus 21.5 for LGMT), with an estimated cost difference of € 105 in favour of HGMT ($p$= 0.001, 95% CI € 43 to € 158). In the entire sample, the average valuation of health improved from 0.597 at baseline to 0.745 after a year. The burden due to adhesive capsulitis was estimated at 0.048 QALY and € 4,521 per patient. About half these costs were due to absenteeism, which, during the first quarter, amounted to 38% of the total working hours.

In conclusion, the cost-utility analysis does not allow for an evidence-based recommendation on the preferred treatment. Based on the clinical outcome measures, HGMT are still preferred to LGMT. The estimated substantial burden, both to the patient and to society, suggests that effective early treatment of adhesive capsulitis is warranted to attempt to accelerate recovery.

## Introduction

Adhesive capsulitis or frozen shoulder is characterised by painful stiffness of the shoulder that may persist for several years. It is a common disorder, with an estimated annual incidence of 3 to 5% in the general population.[1,2] Advocated treatments include rest and analgesics, corticosteroid injections, acupuncture, physical therapy, manipulation under anaesthesia, and arthroscopic or open surgery. There is no general acceptance of one standard treatment.[3]

Economic evaluations can provide useful information to support medical decisions and the allocation of health care resources [4], but, so far, no economic evaluations of adhesive capsulitis or its treatments have been published. Some studies do claim that a particular treatment is cost-effective, but they do so without actually analysing costs. [5,6] Some studies report on return to work, but without estimating the associated costs. [7–9]

Our study compared high-grade and low-grade mobilisation techniques (HGMT and LGMT, also known as end-range and mid-range mobilisation techniques) in the treatment of adhesive capsulitis. The clinical comparison previously showed that in both groups, patients improved significantly.[10] After three months, 87% of the patients in both the HGMT and the LGMT group reported improved or much improved shoulder function. In general, the improvements were somewhat greater in the HGMT than in the LGMT group, with statistically significant differences in passive abduction (at 3 and 12 months), active external rotation (at 12 months), passive external rotation (total period), and shoulder disability (total period) measured using both the Shoulder Rating Questionnaire and the Shoulder Disability Questionnaire. [11,12] Moreover, patients in the HGMT group required fewer treatment sessions.

The current paper contains two different types of economic analyses for adhesive capsulitis. First, a cost-utility analysis is presented, comparing HGMT and LGMT with respect to societal costs and quality adjusted life years. Next, a burden-of-illness study is presented, estimating the impact of adhesive capsulitis on costs and health.

### Methods

The economic evaluation was carried out alongside a randomised controlled trial, whose design and clinical results have been described in detail elsewhere. [10] To compare both interventions reliably on the primary outcome measure of improvement in active abduction at three months, a required sample size of at least 90 patients was estimated. Between August 1999 and January 2002, 100 patients who suffered from unilateral adhesive capsulitis for at least 3 months and who experienced at least a 50% decrease of passive joint mobility, were enrolled in the study (Table 4.1).

Patients were referred to the department of Physical Therapy of the Leiden University Medical Center by orthopaedists from the Leiden University Medical Center or from four regional non-university hospitals. Randomisation was concealed: after the baseline assessments, an administrative assistant allocated the eligible patients to HGMT or LGMT according to a computer-generated permutated-blocks randomisation scheme, with stratification for the presence of diabetes mellitus and for joint

capacity, measured by arthrography (≤ 15 cm $^3$ or > 15 cm$^3$). The local Medical Ethics Committee approved the protocol and all patients gave written informed consent.

**Table 4.1. Inclusion and exclusion criteria**

| |
|---|
| Inclusion criteria: |
| • Unilateral adhesive capsulitis, defined as more than 50% loss of passive movement of the shoulder joint compared to the non-affected side, in one or more of three movement directions (i.e. abduction in the frontal plane and/or forward flexion and/or external rotation in 0° abduction), |
| • At least three months of complaints, |
| • Ability to complete questionnaires in Dutch. |
| Exclusion criteria: |
| • Former manipulation under anaesthesia of the affected shoulder, |
| • Rheumatoid arthritis, osteoarthritis, damage of the glenohumeral cartilage, Hill Sachs-lesion, osteoporosis or malignancies in the shoulder region, |
| • Neurological deficits affecting shoulder function in activities of daily living, |
| • Pain and/or disorders of the cervical spine, elbow, wrist and/or hand, |
| • An injection with corticosteroids in the affected shoulder in the preceding four weeks. |

## Intervention

In the HGMT group mobilisation techniques (grade III–IV) were used, as described by Kaltenborn and Maitland.[10,13–15] These mobilisation techniques are performed in the end-ranges of the limited joint mobility of the shoulder and are intended to influence the capsular adhesions, treat the stiffness and subsequently increase the joint mobil - ity. The duration of prolonged stress on the shoulder capsule in the end-range position varied according to the patient's tolerance. In the LGMT group the therapist explicitly informed the patients that all techniques should be performed without causing pain in the shoulder (grade II).

In both groups patients were treated twice weekly for 30 minutes during a period of 12 weeks and were encouraged to attend all treatment sessions. From 6 weeks onward, treatment could be reduced in frequency, or stopped, if the therapist noticed a normal range of motion in the shoulder, compared to the unaffected side.

## Assessment of costs

Societal costs during the one-year follow-up period were assessed in accordance with current guidelines for economic evaluations.[16] Costs are reported as undiscounted an - nual costs, converted to price level 2004 euros using the price index rate for the Dutch

health care sector (obtained from Statistics Netherlands, www.cbs.nl). Euros can be converted to U.S. dollars using the Dutch purchasing power parity index for 2004: € 1 = $ 1.09 (www.oecd.org).

To assess the costs of the mobilisation techniques, the number of sessions of the initial mobilisation techniques was obtained from the study registration. The societal costs per session were estimated at € 36 per session, which includes the standard Dutch reimbursement for individual physical therapy of € 22 per session (www.ctg-zaio.nl). This tariff is based on standard annual wages and on practice costs, divided over 16 sessions per day and 230 working days per year. As many physical therapists obtain their entire income from this tariff, it is a reasonable reflection of the true costs of physical therapy. The societal costs per session further include time and travel costs incurred by the patient. Time costs were estimated at 1 hour valued at € 10.[17] Based on an average travelling distance of 5 km, travel costs were estimated at € 4.

Health care due to adhesive capsulitis prior to the study period was reported retrospectively by the patients at baseline. All health care during the study period was reported by the patients using quarterly cost questionnaires. Health care was valued according to Dutch standard prices that were designed to reflect societal costs and to standardise economic evaluations[18] or, if standard prices were not available, charges were used (www.ctg-zaio.nl). All prices include time and travel costs[19], based on national averages. The prices per session or consultation ranged from € 3 for hydrotherapy[20] to € 78, on average, for alternative medicine. Hospitalisations were valued at € 351 and € 457 per day for general and university hospitals respectively, plus, on average, € 818 per hospitalisation for specialist care and physical therapy. Hospitalisations for treatment of the affected shoulder were classified as due to adhesive capsulitis, which included manipulation under general anaesthesia and acromioplasty. Home nursing care was valued at € 35 per hour. Purchased medication was valued according to the Pharmacotherapeutic Compass (www.fk.cvz.nl), plus € 7 for each purchase other than over-the-counter medications.

Non-health care costs were also reported by the patients in the quarterly cost questionnaires. Expenses due to adhesive capsulitis were valued as reported by the patients. Patients in paid labour reported in detail on hours of absenteeism and also how many days work they would need to make up for inefficiency during the days they were not absent. Both absenteeism and inefficiency were valued using the patient's gross income per hour. Time spent on unpaid labour[21] was compared to the age and gender specific average over the entire sample, and the difference was valued at € 10.[17] Using this method, patients who reported more unpaid labour than average have negative costs (profits). Domestic help was valued at € 20 per hour, and reported informal care at € 10, with a maximum of 28 hours per week.[17]

## Assessments of utility and quality adjusted life years.

Utility is the valuation of the health of the patient[22], on a scale from zero (as bad as death) to one (as good as full health). Patients described their general health status using the Short-Form 36-Item Health Survey (SF-36).[23] The SF-36 consists of 36 items

on physical and social functioning, role limitations, mental health, vitality, pain, and perception of general health. From the SF-36, the Short Form 6D (SF-6D) utility index was calculated. [24] This utility index reflects how the general public values the health status described by the patient; this type of appraisal is preferred for economic evaluations from a societal perspective.

The influence of separate domains of the SF-6D was analysed by replacing the responses to all other domains with the best possible response. Because the SF-6D utility scoring function is non-additive in the separate domains, the losses due to the separate domains do not add up to the total utility loss.

Quality adjusted life years (QALYs) were calculated as the area under the utility curve. A year lived in full health corresponds with 1.0 QALY, whereas, for example, a year in which utility linearly increases from 0.6 to 0.8 represents 0.7 QALY, that is 0.3 QALY loss compared to full health. QALYs aim to be a measure capturing the two central goals of health care: prolonging life and improving health. As a result it is the preferred measure for economic evaluations, allowing for comparison of diverse treatments and patient groups.

## Analysis

Patients were evaluated according to intention-to-treat. Fifteen cost questionnaires (4.1%, from 13 different patients) and one SF-6D measurement (0.3%) were missing. Missing measurements were imputed by carrying forward the previous available measurement.

For all outcome measures, differences were tested using double-sided non-parametric bootstrapping [25], with 1,000,000 replications and 0.05 significance threshold. Reported confidence intervals (CIs) are the corresponding asymmetric 95% trimmed intervals. Bootstrapping explicitly compares the means in both groups, without making distributional assumptions, thus allowing for skewed distributed costs.

The cost-utility analysis estimates differences between HGMT and LGMT, whereas the burden-of-illness study estimates the impact of adhesive capsulitis, irrespective of randomisation. Burden attributable to a particular illness is usually estimated by comparing individuals who have that illness to individuals who do not. For adhesive capsulitis this method cannot be used, because patients frequently have coexisting diseases of which the burden would unjustly be attributed to adhesive capsulitis. Instead, because adhesive capsulitis is a temporary disease, the final fourth quarter was used to estimate burden in the absence of adhesive capsulitis, except for cost items that were explicitly recorded as attributable to adhesive capsulitis. If Ci denotes costs in the i-th quarter (i=1..4), then the attributable costs are estimated by $(C_1 - C_4) + (C_2 - C_4) + (C_3 - C_4)$, i.e. the annual costs minus four times the costs during the fourth quarter. If the burden due to adhesive capsulitis during the fourth quarter is still substantial, then the burden without adhesive capsulitis will be overestimated and that attributed to adhesive capsulitis will be underestimated.

## Results

Of the 100 randomised patients, the initial four were excluded from the economic evaluation because for logistical reasons they were unable to fill out the initial cost questionnaire. Four more patients withdrew from the study without follow-up. Table 4.2 shows the baseline characteristics of the included 92 patients. There were no statis - tically significant differences between both randomisation groups ( $p \geq 0.15$). Also, the eight excluded patients did not differ significantly from the included patients ( $p \geq 0.11$, data not shown).

**Table 4.2. Baseline characteristics * of included patients (n=92)**

| | HGMT | LGMT | *p*-value† |
|---|---|---|---|
| Randomised patients | 49 | 51 | |
| Included patients | 44 | 48 | 0.48 |
| General characteristics | | | |
| Age, in years | 51 (47–56) | 51 (45–57) | .92 |
| Female | 29 (66%) | 33 (69%) | .83 |
| Educational level: low/secondary/high | 16 / 17 / 11 | 14 / 22 / 12 | .72 |
| Paid employment | 31 (70%) | 32 (67%) | .82 |
| Working hours per week‡ | 32 (19–40) | 34 (23–40) | .72 |
| Disease characteristics | | | |
| Dominant shoulder affected | 20 (45%) | 29 (60%) | .21 |
| Duration of complaints | 8 (5 –12) | 9 (6–15) | .35 |
| Diabetes mellitus | 7 (16%) | 8 (17%) | 1.00 |
| Other chronic diseases | 7 (16%) | 11 (23%) | .44 |
| Prior treatment of adhesive capsulitis | | | |
| No prior treatment | 0 (0%) | 2 (4%) | .50 |
| Pain medication at baseline | 17 (39%) | 19 (40%) | 1.00 |
| Shoulder injections | 28 (64%) | 28 (58%) | .67 |
| Number of shoulder injections‡ | 2 (1–3) | 3 (1–5) | .62 |
| Acupuncture | 3 (7%) | 1 (2%) | .50 |
| Physical therapy | 34 (77%) | 40 (83%) | .60 |
| Number of physical therapy sessions ‡ | 15 (9–28) | 19 (12–38) | .15 |
| Surgery | 2 (5%) | 3 (6%) | 1.00 |

*Measures show either the number of patients (with percentage), or the median (with interquartile range 25th–75th).
†Mann-Whitney U test, Pearson Chi-Square test or Fisher's exact test, where appropriate.
‡Among those with non-zero values.

**Table 4.3. Average annual health care costs per patient, by treatment (in €)**

| | HGMT Volume | HGMT Costs | LGMT Volume | LGMT Costs | *p*-value* |
|---|---|---|---|---|---|
| Physical medicine | | | | | |
| HGMT & LGMT | 18.6 | 663 | 21.5 | 768 | .001 |
| Other physical therapy | 7.5 | 268 | 7.9 | 282 | .88 |
| Other physical medicine | 1.3 | 44 | 2.5 | 101 | .25 |
| - Manual therapy | .3 | 16 | .9 | 40 | .54 |
| - Exercise therapy | .1 | 4 | .6 | 22 | .24 |
| - Chiropractor | .3 | 10 | 1.0 | 39 | .42 |
| - Hydrotherapy | .6 | 13 | .0 | 0 | .44 |
| Consultations | | | | | |
| Specialists | 4.5 | 306 | 5.5 | 219 | .30 |
| - Orthopaedist | 1.2 | 72 | .7 | 39 | .09 |
| - Surgeon | 1.0 | 53 | .6 | 34 | .41 |
| - Internist | .6 | 52 | .4 | 35 | .45 |
| - Other specialists | 1.7 | 129 | 3.8 | 111 | .78 |
| General practitioner | 4.8 | 160 | 5.9 | 184 | .63 |
| Occupational physician | 2.0 | 133 | 2.1 | 134 | .98 |
| Paramedical professionals | 1.1 | 67 | .9 | 48 | .50 |
| - Labour expert | .4 | 25 | .4 | 23 | .89 |
| - Social worker | .3 | 14 | .2 | 10 | .72 |
| - Other | .4 | 28 | .2 | 15 | .53 |
| Alternative medicine | .3 | 23 | .4 | 35 | .69 |
| Hospitalisations | | | | | |
| Due to adhesive capsulitis | 14% | 260 | 2% | 29 | .07 |
| Other hospitalisations | 16% | 573 | 10% | 370 | .52 |
| Miscellaneous | | | | | |
| Shoulder injections | 41% | 3 | 15% | 1 | .19 |
| Analgesics | | 41 | | 16 | .11 |
| Other medication | | 11 | | 2 | .21 |
| Medical devices | | 2 | | 17 | .44 |
| Home nursing care | | 0 | | 88 | .44 |
| Total health care costs | | 2552 | | 2293 | .58 |
| (SD) | | (2182) | | (2198) | |

*Average costs in HGMT group (n=44) versus average costs in LGMT group (n=48), tested using two-sided non-parametric bootstrapping.

## Cost-utility analysis

Of all types of health care utilisation, the only statistically significant difference between the patients receiving the high-grade and low-grade mobilisation techniques was the 2.9 difference in the number of sessions of initial therapy (Table 4.3). The associated cost difference was estimated at € 105 in favour of HGMT ($p$= 0.001, 95% CI € 43 to € 158), of which € 64 was for the therapy itself and € 41 was for time and travel costs incurred by the patient.

Physical therapy and other physical medicine was also less frequent in the HGMT group, but not significantly so. The cost difference for physical medicine is counterbalanced by non-significant differences in the other health care categories. Hospitalisations due to adhesive capsulitis were especially more frequent in the HGMT group. The overall difference in health care costs was estimated at € 259 in favour of LGMT ($p$= 0.58, 95% CI € -644 to € 1162).

**Table 4.4. Average annual societal costs per patient, by treatment (in €)**

| | HGMT Volume | HGMT Costs | LGMT Volume | LGMT Costs | $p$-value* |
|---|---|---|---|---|---|
| Productivity | | | | | |
| Unpaid productivity | 22.4 h/wk | 474 | 24.8 h/wk | -435† | .47 |
| Paid productivity loss | 228.8 h | 4555 | 227.7 h | 4173 | .80 |
| Among employed: | | | | | |
| - Absenteeism | 240.6 h | | 307.5 h | | |
| - Loss due to inefficiency | 64.5 h | | 34.0 h | | |
| Miscellaneous | | | | | |
| Domestic care | 32.0 h | 628 | 26.0 h | 510 | .64 |
| Informal care | 46.1 h | 459 | 33.9 h | 338 | .68 |
| Out-of-pocket expenses | | 140 | | 33 | .46 |
| - Of which at work | | 101 | | 17 | .46 |
| - Of which private | | 39 | | 15 | .51 |
| Total non-health care costs | | 6257 | | 4618 | .41 |
| (SD) | | (10297) | | (8215) | |
| Total societal costs | | 8809 | | 6911 | .37 |
| (SD) | | (10800) | | (8790) | |

*Average costs in HGMT group (n=44) versus average costs in LGMT group (n=48), tested using two-sided non-parametric bootstrapping.
†Negative costs indicate savings, due to more than average unpaid labour.

**Table 4.5. Average Quality Adjusted Life Years, by treatment**

| | HGMT | LGMT | *p*-value* |
|---|---|---|---|
| QALYs (SD) | .695 (.104) | .702 (.091) | .71 |
| Loss due to (SD) | | | |
| Physical functioning | .084 (.035) | .087 (.033) | .59 |
| Social functioning | .039 (.038) | .042 (.035) | .71 |
| Role limitations | .061 (.031) | .046 (.034) | .03 |
| Mental health | .052 (.024) | .057 (.030) | .46 |
| Vitality | .011 (.013) | .015 (.014) | .16 |
| Pain | .076 (.047) | .072 (.044) | .66 |

*Average in HGMT group (n=44) versus average in LGMT group (n=48), tested using two-sided non-parametric bootstrapping.

All non-health care costs showed no significant difference (Table 4.4). The largest observed difference was the non-significant difference of € 909 in unpaid labour in favour of LGMT ($p$= 0.47, 95% CI € -1564 to € 3352). The estimated overall difference in non-health care costs was € 1639 in favour of LGMT ( $p$= 0.41, 95% CI € -2606 to € 5212). Since both the health care and the non-health care costs were estimated in

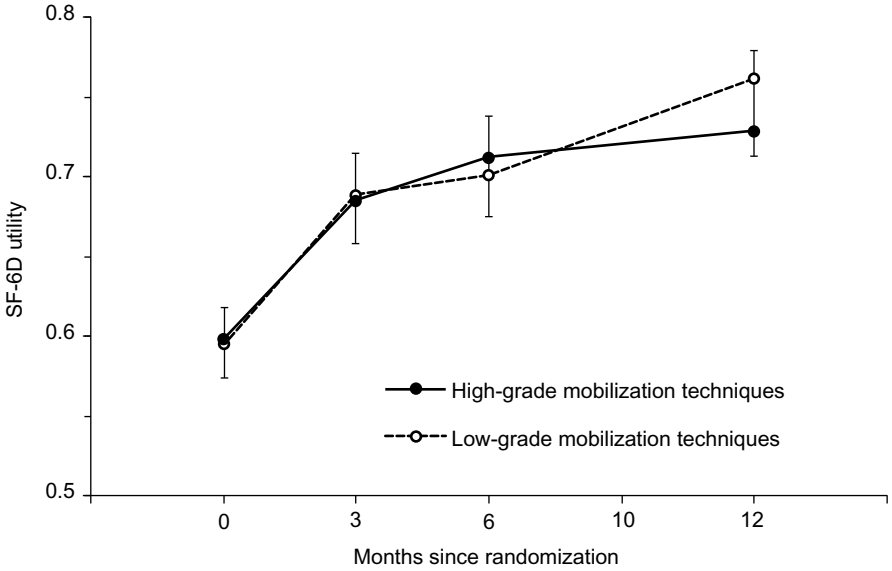


*Figure 4.1. Average utility, by treatment. Utility is measured on a scale from 0.0 (as bad as death) to 1.0 (full health). Error bars indicate 95% confidence intervals for the mean over the entire study population.*

**Table 4.6. Costs attributable to adhesive capsulitis, in entire sample (in €)**

| | Annual costs | 4th Quarter costs | Attributable* costs | *p*-value‡ |
|---|---|---|---|---|
| Prior health care costs | — | — | 1040 † | — |
| Physical medicine | | | | |
| HGMT & LGMT | 718 | 0 | 718 † | <.001 |
| Other physical therapy | 276 | 90 | -84 | .001 |
| Other physical medicine | 74 | 11 | 32 | 0.38 |
| Consultations | | | | |
| Specialists | 260 | 63 | 7 | .57 |
| General practitioner | 172 | 43 | 0 | .19 |
| Occupational physician | 134 | 15 | 74 | <.001 |
| Paramedical professionals | 57 | 12 | 8 | .62 |
| Alternative medicine | 29 | 3 | 16 | .38 |
| Hospitalisations | | | | |
| Due to adhesive capsulitis | 139 | 27 | 139 † | .08 |
| Other hospitalisations | 468 | 69 | 193 | .39 |
| Miscellaneous | | | | |
| Shoulder injections | 2 | 1 | 2 † | .85 |
| Analgesics | 28 | 7 | 0 | .11 |
| Other medication | 6 | 0 | 4 | .30 |
| Medical devices | 9 | 1 | 7 | .44 |
| Home nursing care | 46 | 23 | -46 | .08 |
| Non-health care costs | | | | |
| Unpaid productivity loss | 0 | 164 | -655 | .04 |
| Paid productivity loss | 4356 | 363 | 2903 | <0.001 |
| Domestic care | 566 | 138 | 14 | .45 |
| Informal care | 396 | 83 | 65 | .28 |
| Out-of-pocket expenses | 84 | 5 | 84 † | .44 |
| Total health care costs (SD) | | | 2110 (2206) | <.001 |
| Total non-health care costs (SD) | | | 2411 (7500) | .001 |
| Total societal costs (SD) | | | 4521 (8090) | <.001 |

*Annual costs minus four times the costs during the fourth quarter, except for cost items that were explic - itly recorded as attributable to adhesive capsulitis.
†These cost items were explicitly recorded as attributable to adhesive capsulitis.
‡Average within subject change from first to fourth quarter in total sample (n=92) versus nil, tested using two-sided non-parametric bootstrapping.

favour of LGMT, the total societal costs were also in favour of LGMT. The difference was estimated at € 1898, but was not statistically significant ( $p$= 0.37, 95% CI € -2551 to € 5711).

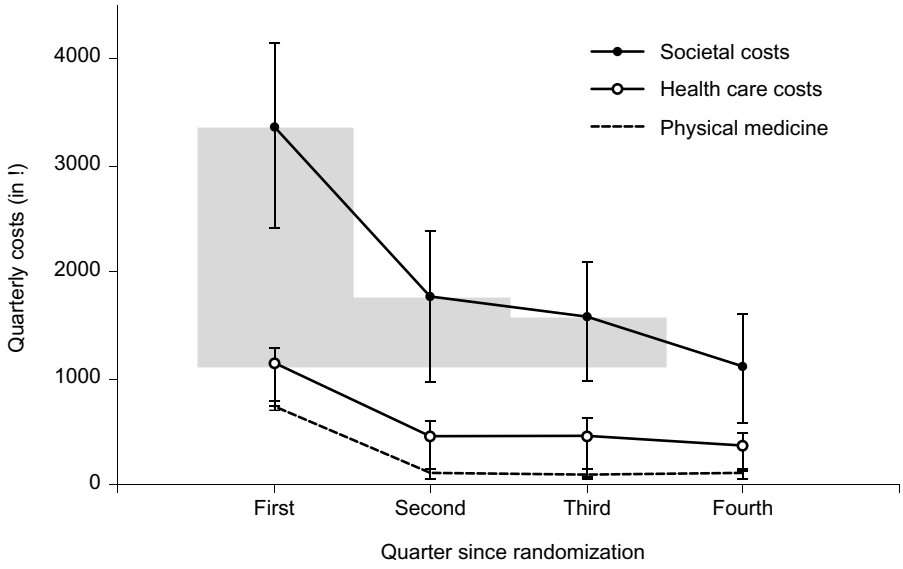


*Figure 4.2. Average costs, in entire sample. The shaded area indicates the societal costs attributed to adhesive capsulitis. Error bars indicate 95% confidence intervals for the mean over the entire study population.*

Utility in the HGMT and LGMT groups did not show a considerable or statistically significant difference (Figure 4.1, Table 4.5). The difference was estimated at only 0.007 ($p$= 0.71, 95% CI -0.032 to 0.049). Also, the separate domains of the SF-6D showed no significant differences ($p \geq 0.16$), except that the HGMT group reported more role limitations ($p$= 0.03).

## Burden-of-illness study

Over the entire sample, several outcome measures showed statistically significant changes during the follow-up period, suggesting a causal relationship between adhesive capsulitis and those outcome measures. Assuming that adhesive capsulitis is no longer a burden in the fourth quarter, the excess burden in the first three quarters is attributable to adhesive capsulitis. For example, the shaded area in Figure 4.2 indicates the societal costs attributable to adhesive capsulitis during the follow-up period.

The value of health care attributable to adhesive capsulitis prior to inclusion was estimated at € 1040 (Table 4.2 and 4.6, 95% CI € 804 to € 1211) and, together with the costs during the study period, at € 2110 (95% CI € 1635 to € 2547). Due to substitution with the initial mobilisation techniques, other physical therapy showed a statistically significant increase over time, from € 7 in the first quarter to € 90 in the last. On the

**Table 4.7. Average utility over time, in entire sample**

| | Months since randomisation | | | | *p*-value per comparison* | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | 3 | 6 | 12 | 0 vs 12 | 0 vs 3 | 3 vs 6 | 6 vs 12 |
| SF-6D utility | 0.597 | 0.686 | 0.706 | 0.745 | <.001 | <.001 | .07 | <.001 |
| Loss due to | | | | | | | | |
| Physical functioning | 0.118 | 0.089 | 0.082 | 0.073 | <.001 | <.001 | .10 | .01 |
| Social functioning | 0.052 | 0.041 | 0.039 | 0.035 | .002 | .05 | .59 | .49 |
| Role limitations | 0.079 | 0.058 | 0.051 | 0.042 | <.001 | <.001 | .07 | .02 |
| Mental health | 0.060 | 0.055 | 0.055 | 0.050 | .01 | .21 | .98 | .13 |
| Vitality | 0.014 | 0.015 | 0.013 | 0.011 | .08 | .45 | .28 | .12 |
| Pain | 0.115 | 0.077 | 0.071 | 0.061 | <.001 | <.001 | .12 | .01 |

*Average within subject change in total sample (n=92) versus nil, tested using two-sided non-parametric bootstrapping. All statistically significant changes are improvements.

other hand, costs for visits to the occupational physician significantly decreased, from € 60 to € 15.

Attributable non-health care costs were estimated at € 2411 (95% CI € 814 to € 3921). These costs consist mostly of productivity losses. Average absenteeism among employees considerably improved from 129 hours in the first quarter to 68, 53, and 24 hours in later quarters, which constituted 38%, 20%, 16% and 7% of the total working time respectively. Assuming that the hours over 24 hours per quarter are attributable to adhesive capsulitis, the attributable productivity costs were estimated at € 2903 per patient (95% CI € 1738 to € 3790). These costs were partly compensated by unpaid labour. Possibly because absenteeism increases the time spent at home, average unpaid labour decreased statistically significantly from 26 hours in the first quarter to 22 hours in the last quarter. Assuming that the hours above 22 hours per week are attributable to adhesive capsulitis, the attributable savings are estimated at € 655 (95% CI € -348 to € 1675). Together with the health care costs, the estimated total societal costs amount to € 4521 per patient (95% CI € 2803 to € 6152).

The average SF-6D utility improved by 0.147 (95% CI 0.119 to 0.174) during the year (Figure 4.1, Table 4.7). The largest improvement is observed during the initial quarter ($p < 0.001$). During the second quarter the improvement is not statistically significant ($p = 0.07$), but during the second half-year the improvement was again highly significant ($p = 0.001$). All domains of the SF-6D showed statistically significant improvements over the year ($p \leq 0.01$), except the vitality domain ($p = 0.08$). The utility improvement was mostly due to improvements in the levels of pain (33%), physical functioning (27%), and role limitations (22%). Improvements in these three domains were also statistically significant during the second half-year ( $p \leq 0.05$).

The average number of QALYs over the entire sample was 0.697. Assuming that without adhesive capsulitis the patients would, on average, have had the concluding 0.745 utility throughout the entire year (Table 4.7), the QALY loss due to adhesive capsulitis is estimated at 0.745-0.697=0.048 QALY ($p < 0.001$, 95% CI 0.032 to 0.060 QALYs).

## Discussion

Our study compared high-grade and low-grade mobilisation techniques in the treatment of adhesive capsulitis. The clinical comparison previously showed that high-grade mobilisation techniques were more effective than low-grade mobilisation techniques in regaining glenohumeral joint mobility and improving overall function, and also that they required less treatment sessions. [10] The economic evaluation presented here rendered no other statistically significant difference than that same difference in the number of treatment sessions: on average 18.6 for HGMT versus 21.5 for LGMT. Based on the current standard tariff for individual physical therapy in the Netherlands, the associated cost difference is € 105 in favour of HGMT, of which € 64 is for the therapy itself and € 41 is for time and travel costs incurred by the patient. For all other cost categories the differences were non-significant, but their size was substantial and one cannot exclude the possibility that, for example, the observed difference in favour of LGMT in hospitalisations due to adhesive capsulitis is indeed caused by the difference in mobilisation techniques. Our study had insufficient power to reliably compare the more variable types of costs separately. Moreover, the estimated difference in QALYs was non-significant and small. As a result, the economic analysis does not allow for an evidence-based recommendation on the preferred treatment. Based on the clinical outcome measures, HGMT are still preferred to LGMT. [10] The fact that most patients had had physical therapy prior to inclusion in the study, suggests that HGMT are also preferred to those other types of physical therapy, but without randomised comparison it is not possible to reliably establish the relative performance of other treatment strategies, or even the advantage of HGMT compared to natural history.

Besides the economic comparison of patients receiving high-grade or low-grade mobilisation techniques, our study also included a burden-of-illness analysis describing the population of patients with adhesive capsulitis as a whole. The average valuation of health in our entire sample improved considerably from 0.597 at baseline to 0.745 after a year. These values are comparable to those for patients with relatively severe [26] and relatively mild rheumatoid arthritis [27], respectively. Clearly, after a year the valuation of health was still far from optimal. This is, in part, due to residual adhesive capsulitis, since 9 to 18% of the patients still indicated an impaired shoulder function to some extent.[10] However, the reported 7% absenteeism during the fourth quarter is somewhat comparable to absenteeism rates in the Netherlands overall, suggesting that for most patients adhesive capsulitis no longer provides major problems, at least at work. It would seem that coexisting diseases contribute to the considerable remaining burden in this population. Besides diabetes mellitus, a variety of other chronic diseases were

reported, and most reported hospitalisations were for reasons other than adhesive capsulitis.

The health burden due to adhesive capsulitis was estimated at 0.048 QALY, mainly due to impairment of physical functioning, role limitations and pain. Absenteeism decreased from 38% of the total working time in the first quarter to 7% in the fourth quarter. Societal costs due to adhesive capsulitis were estimated at € 4521 per patient, of which 47% were health care costs and 53% were non-health care costs. Assuming a 3% incidence in the general population[1,2], the estimated societal costs would amount to € 136 per inhabitant annually. For the patients in our study, the estimated burden is likely to be an underestimate, because of the implicitly assumed negligible attributable burden in the fourth quarter and because health burden and labour costs prior to inclusion in the study could not be estimated. On the other hand, for the general adhesive capsulitis population our estimates could also overestimate the true burden if the patients enrolled in our trial were not representative, for example because our patients were referred by orthopaedists and may have had a higher than average disease severity. Furthermore, the burden in settings other than that in our study can be influenced by differences in economic climate and treatment patterns.

Cost-of-illness and burden-of-illness studies estimate the cost and health burden due to a particular illness and are often used to show the importance of that illness and to justify funding of treatment and research. Contrary to cost-utility analyses, their usefulness for policy making is highly debatable, because a heavy burden is not necessarily accompanied by efficient opportunities for reduction. [28–30] We do think that the impact of adhesive capsulitis is easily underestimated, but our main reason to report the burden-of-illness study was to inform clinical decision-making. In our study, the median duration of complaints prior to inclusion was nine months, whereas after three months 87% reported improved or much improved shoulder function. Although not corroborated by randomised research, this does suggest that both HGMT and LGMT were effective in treating adhesive capsulitis. Postponing treatment could possibly have prevented treatment for some patients, but for most patients the disease duration would have lengthened and the productivity costs, in particular, would have increased accordingly. Therefore, the burden-of-illness study indicates that those who are reluctant to initiate effective treatment because of cost considerations should reconsider their policy. Although adhesive capsulitis is considered a self-limiting disease in which the symptoms will slowly resolve themselves after 2 or 3 years, the estimated substantial burden, both to the patient and to society, suggests that effective early treatment of adhesive capsulitis is warranted in order to attempt acceleration of recovery.

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