






CHAPTER **SEVEN**

HEALTHCARE COSTS AND LOSS OF PRODUCTIVITY IN PATIENTS WITH TRAPEZIOMETACARPAL OSTEOARTHRITIS

Submitted

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ABSTRACT

Purpose To analyze the economic aspects of conservative and surgical treatment of patients with trapeziometacarpal osteoarthritis (TMC OA) with regard to costs associated with healthcare and loss of productivity.

Methods Prospective cohort study including patients with TMC OA who received either surgical or conservative treatment. Healthcare costs were measured using our clinic's earnings in Swiss francs (CHF). Patients were assessed at baseline and 3, 6, and 12 months after the intervention. Employed patients filled out the Work Productivity and Activity Impairment Questionnaire (WPAI) to assess absenteeism, presenteeism, and overall costs due to loss of productivity.

Results We included 161 patients, 58 of whom were in employment Healthcare costs were CHF 10,303 in the surgery group and CHF 622 in the conservatively treated group. The total productivity loss in the surgical group increased from baseline to 3 months (50% versus 64%) but decreased significantly to 25% at 1 year. Total productivity loss in the conservative group was more stable over time (52% at baseline to 48% at 1 year). Estimated annual healthcare and productivity costs were higher in the surgical group (CHF 20,210) compared with the conservatively treated group (CHF 6,877).

Discussion With respect to both healthcare and loss of productivity, surgery was associated with considerably higher costs than conservative treatment. However, we cannot make any treatment recommendations, because the indications for conservative management and surgery are different. The extent of improved productivity after more than one year and its related economic consequences should be the subject of further research.

INTRODUCTION

In recent years, economic evaluations have become increasingly important because of the growing emphasis on cost containment. The evaluation of both costs and benefits allows more comprehensive consideration of the value of a particular intervention[1]. In addition to direct healthcare expenses, the costs associated with loss of productivity lead to substantial economic consequences for the patient, the employer, and society[2, 3].

People with hand osteoarthritis (OA) report limitations in daily life which may also affect their working ability[2]. Loss of productivity arises from two sources: absenteeism and presenteeism[4]. Absenteeism can be quantified by the time absent from work due to illness[4]. Presenteeism is defined as the reduction in productivity while at work because of an individual's state of health[5]. Costs due to absenteeism are quite straightforward to record, while the costs of presenteeism often remain hidden[4].

Absenteeism in patients with trapeziometacarpal (TMC) OA may be due directly to their condition, but surgical intervention may also lead to a relatively long period of sick leave. Full work incapacity of eight weeks can be expected after trapezium resection with tendon interposition, followed by another eight weeks with a working ability of only 50%[6]. Despite these postoperative limitations, 90% of the patients can expect to return to the same level of occupation as before their illness[6].

Studies investigating presenteeism for patients with OA of any joint[7, 8] and patients with rheumatoid arthritis[9, 10] showed that the costs associated with presenteeism were considerably higher than those for absenteeism.

Economic evaluations in orthopedics, especially for the hand, are scarce. Economic studies have been published only for the treatment of Dupuytren's disease[11-13], hand and wrist injuries[3, 14], and for ganglia and trigger fingers[13, 15], with only limited information about the economic consequences due to absenteeism and presenteeism.

The objective of this study was to analyze the economic aspects of conservative and surgical treatment of patients with TMC OA, with regard to the costs associated with healthcare and loss of productivity.

MATERIALS AND METHODS

Study design

This economic evaluation is part of a mono-center prospective, cohort study on the outcomes of conservative and surgical treatment in patients with TMC OA. It was conducted in the Department of Hand Surgery in an orthopedic clinic in Switzerland. This clinic is a non-profit organization, administered by a private foundation, in which 8,700 elective inpatient and outpatient operations on the musculoskeletal system are performed each year. This study was approved by the local ethics committee.

Patients

The parent study included all patients, with a radiographically proven diagnosis of TMC OA, who underwent either conservative or surgical treatment for that condition in the months from September 2011 to November 2012. Exclusion criteria were: TMC OA was not the main problem

at the time of consultation, rheumatoid arthritis, concomitant surgery on other fingers, legal incompetence, poor general condition precluding study participation, previous inclusion in the study for the other hand, and insufficient knowledge of the German language to complete the questionnaires. All eligible patients were asked to participate by their treating hand surgeon, and were consecutively enrolled in the study after they had given written informed consent.

For the present economic analysis, the surgical group included patients who received the following treatment: trapeziectomy with LRTI or arthrodesis of the TMC joint. Trapeziectomy with LRTI was carried out according to Epping[16], Weilby[17], or Sigfusson and Lundborg[18] whichever method was preferred and routinely performed by each surgeon. Additional procedures, such as carpal tunnel release or arthrodesis of the metacarpophalangeal (MCP) joint I were also performed, if required. In the conservatively treated group, the analysis included patients given corticosteroid injections into the TMC joint by their treating hand surgeon. In each case, the decision for the treatment strategy was made by the treating surgeon in discussion with the patient. Physical or occupational therapy might have been prescribed additionally in both groups, if it was indicated.

Assessments

Baseline assessments were made at the preoperative consultation for surgical patients and on the day of injection for the conservatively treated patients. Sociodemographic and disease-related data were gathered at this visit. Follow-up assessments were scheduled at 3, 6, and 12 months after treatment. If routine medical care did not require a checkup at these times, patients came for a study visit with an independent examiner, for which they were not charged.

At each study visit, patients completed a questionnaire set consisting of the Michigan Hand Questionnaire (MHQ)[19] and the Work Productivity and Activity Impairment Questionnaire (WPAI)[20]. Additionally, we asked about the duration of sick leave due to the TMC OA, work status, and income.

The *MHQ,* developed by Chung et al.[19], is a hand-specific questionnaire which yields results for each hand separately. The psychometric properties of the MHQ have been assessed in patients with TMC OA and show overall good reliability, validity, and responsiveness[21]. The total score ranges from 0 to 100 with a higher score indicating better performance. The German version[22] has been used for this study and the data for the affected hand were analyzed.

The *WPAI*[20] is a quantitative assessment of absenteeism, presenteeism, and overall productivity loss attributable to a specific health problem during the previous 7 days. There are several versions available. We used the Swiss-German translation of the WPAI Specific Health Problem version 2.0 with the generic term "problem" being replaced by the word "Daumensattelgelenksarthrose" [osteoarthritis of the thumb saddle joint]. The WPAI is the instrument most frequently used to measure health-related productivity and its psychometric properties have been assessed for various medical conditions[23]. It consists of six questions regarding employment status (Q1), hours absent from work due to TMC OA (Q2), hours absent from work due to other reasons (Q3), hours actually worked (Q4), the extent to which the person was limited at work due to TMC OA (Q5), and the extent to which TMC OA affected daily activities other than work (Q6). WPAI outcomes are expressed as impairment percentages, with higher numbers indicating greater impairment and less productivity[24, 25].

Healthcare costs

Healthcare costs were measured by the clinic's earnings, as extracted from the hospital accounting system for the following treatment events: preoperative consultations, intervention, follow-up consultations, and treatment of complications. Earnings from the baseline date until the date of the 1 year follow-up were recorded. All monetary numbers were recorded and reported in Swiss francs (CHF). One Swiss franc is equivalent to 0.72 United States dollars, 0.56 euro and 0.50 pounds sterling[26].

Furthermore, the length of hospital stay for postoperative patients, as well as the type of insurance, was extracted from the hospital accounting system. There are three types of inpatient hospital care in Switzerland, depending on whether the patient has general, semi-private, or private health insurance. All outpatient treatment (conservative treatment and consultations) is covered by the general insurance, so the insurance type was not specified for these patients. The earnings of the clinic for patients with a general insurance are based on flatrate payments. For patients with additional (semi-) private insurance, the hospital charges additional fees.

Loss of productivity

Loss of productivity over one week was calculated for employed patients. We chose the human capital (HC) method, because the duration of absenteeism is typically less than 6 months and patients usually return to work following treatment for TMC OA. The HC method counts any hour not worked as an hour lost. Other methods, such as the friction-cost method, only count as lost those hours not worked until another employee takes over the patient's work[27]. Using the WPAI data, we calculated the percentage of absenteeism, presenteeism and overall work productivity loss for one week[24, 25]: Absenteeism = Q2 / (Q2 + Q4); Presenteeism = Q5 / 10; Overall work productivity loss = Absenteeism + [(1 - absenteeism / 100) x presenteeism]. The costs associated with loss of productivity were calculated by multiplying the corresponding score with the weekly working hours and the hourly wage. For the wages, we used norm values for monthly income of the Swiss population, stratified by sex and age group[28]. Hourly wages were calculated from the monthly wage (divided by 21.75 x 8, with 21.75 being the average monthly working days and 8 being the daily working hours)[29], resulting in values of CHF 29 to CHF 43 per hour for our patients.

Statistics

Baseline differences between the treatment groups were evaluated with a two-group, two-tailed t-test for continuous variables. For nominal data, we used the two-group test of proportions. We used one-way ANOVAs to determine any differences in the earnings of the clinic, the length of hospital stay, and the MHQ total score between patients with different types of insurance. Loss of productivity was compared between the treatment groups using a two-group, two-tailed t-test. Within-group changes regarding productivity over the year were analyzed using an ANOVA with Scheffé's post-hoc adjustment for multiple comparisons.

The WPAI provides data on loss of productivity for only one week. As we were interested in the annual costs, we made a linear extrapolation of each measurement time point for absenteeism and presenteeism and calculated the area under the curve. For this analysis, the value for absenteeism at baseline in the surgical group was set at 100%, because all patients were on full sick leave during the first day after surgery. This analysis was not feasible if follow-up data for a patient were missing. Based on the assumption of values missing at random (MAR), we substituted missing data for

absenteeism and presenteeism by multiple imputation. An imputation model for each follow-up was built containing the absenteeism / presenteeism data of the other follow-ups. We created 20 imputed datasets and pooled them using Rubin's combination rules. The annual healthcare and productivity costs were estimated with these data for all patients irrespective of their working status. For non-working patients, loss of productivity was set at 0.

RESULTS

This study included 161 patients, mean age 64 years, 103 of whom had surgery and 58 were managed conservatively (Table 1). Forty-one percent of the patients treated surgically had only a general insurance, while 59% had additional (semi-) private insurance. At one year, data were available from 130 patients, corresponding to a follow-up rate of 81%.

Healthcare costs

Average earnings of the clinic were CHF 10,303 and CHF 622 for the surgical and conservatively treated group, respectively ($p \leq 0.001$). In three patients, complications affecting the M. Flexor Carpi Radialis tendon occurred after surgery. Overall, average costs for complications were CHF 58 per operated patient (Table 2).

Table 1 Sociodemographic baseline data of 161 included patients with TMC OA. Values $p \leq 0.05$ are marked in bold.

Characteristics	Total group (n = 161)	Surgery (n = 103)	Conservative (n = 58)	p-value
Sex female; no. (%)	136 (84)	90 (87)	46 (79)	0.175
Age in years; mean ± SD	63.9 ± 9.1	63.6 ± 8.8	64.4 ± 9.8	0.590
MHQ total score; mean ± SD	52 ± 16	48 ± 15	59 ± 13	**≤ 0.001**
Insurance for surgery; no. (%)				
General		42 (41)		
Semi-private		34 (33)		
Private		27 (26)		
Employment status; no. (%)				
Employed, fully able to work	46 (29)[1]	31 (30)	15 (26)	
Employed, partly unable to work due to TMC OA	4 (2)	4 (4)	0 (0)	
Employed, partly unable to work due to other reasons	6 (4)	2 (2)	4 (7)	
Employed, unable to work due to TMC OA	1 (1)	1 (1)	0 (0)	
Employed, unable to work due to other reasons	1 (1)	1 (1)	0 (0)	
Unemployed/retired/housewife	101 (63)	64 (62)	37 (64)	
No information	2 (1)		2 (3)	
Contractual weekly working hours; mean ± SD[2]	31 (12)	31 (12)	31 (13)	0.968

TMC OA = Trapeziometacarpal osteoarthritis
MHQ = Michigan Hand Questionnaire
[1] due to rounding errors, the sum of the percentages is higher than 100
[2] among employed patients

Comparing the different types of insurance, patients with only general insurance provided significantly lower earnings for the clinic and had shorter hospital stays, although no difference in the outcome could be detected (Table 3).

Loss of productivity

At baseline, 58 patients in both groups had paid work. Employed patients had an average of 10 weeks complete sick leave following surgery. In addition, nine patients also had partial sick leave (50-80%, for 3 to 4 weeks). Three patients reported that they had no sick leave at all.

Overall, except for the 3-month follow-up in the surgical group, costs for loss of productivity due to presenteeism were considerably higher than costs for absenteeism (Table 4). The total productivity loss in the surgical group increased from baseline to 3 months (50% versus 64%) but decreased significantly to 25% at 1 year. Total productivity loss in the conservative group was more stable over time (52% at baseline to 48% at 1 year. Regarding the weekly costs of overall loss of productivity, there was a significant decrease in both groups over one year, with a significant decrease in the surgical group between 3 and 6 months ($p \leq 0.001$), and a decrease in the conservative group between baseline and 3 months ($p = 0.027$).

No differences regarding absenteeism, presenteeism, and overall costs due to productivity loss were found between the two groups at baseline and 6 months. At 3 months, the overall loss

Table 2 Average earnings of the clinic in Swiss Francs (CHF) by treatment event and intervention group. Mean values ± standard deviations are given.

	Earnings	
	Surgery (n = 103)	**Conservative (n = 58)**
Preoperative consultation	317 ± 144	
Treatment	8,868 ± 3,622	622 ± 337[b]
Follow up consultations	1,061 ± 538	
Complications[a]	58 ± 395	
Total earnings	10,303 ± 3,730	622 ± 337

[a] mean calculated for all 103 surgical patients, of whom 3 actually had complications
[b] includes follow up consultations for conservative patients

Table 3 Average among surgically treated patients (n = 103) for earnings of the clinic in Swiss Francs (CHF), length of inpatient stay, and health status measured with the Michigan Hand Questionnaire (MHQ) by insurance type. Mean values ± standard deviations are given. Values $p \leq 0.05$ are marked in bold.

	General Insurance (n = 42)	**Semi-private Insurance (n = 34)**	**Private Insurance (n = 27)**	**p-value**
Surgery earnings (CHF)	5,412 ± 1,657	10,288 ± 1,910	12,455 ± 2,683	**≤ 0.001**
Length of inpatient stay (days)	1.7 ± 0.7	2.1 ± 0.5	2.1 ± 0.5	**0.012**
MHQ total score baseline	45 ± 15	48 ± 17	51 ± 161	0.223
MHQ total score 1 year	78 ± 16	79 ± 17	81 ± 16	0.771

Table 4 Absenteeism, presenteeism, overall productivity loss and associated costs for one week at the different study time points for employed patients (n = 58). Mean values ± standard deviations are given; p-values are given for the comparison between both intervention groups and within the groups. Values p ≤ 0.05 are marked in bold.

	Surgery (n = 39 at baseline)	Conservative (n = 19 at baseline)	p-value (between group comparison)
Absenteeism (%)			
Baseline (n = 58)	7 ± 19	3 ± 7	0.421
3mo follow up (n = 56)	43 ± 47	6 ± 23	**0.002**
6mo follow up (n = 47)	8 ± 22	1 ± 2	0.226
1 year follow up (n = 41)	2 ± 10	4 ± 11	0.560
p-value (within-group comparison)	**≤ 0.001**	0.525	
Costs of absenteeism per week (CHF)			
Baseline	78 ± 193	45 ± 98	0.485
3mo follow up	431 ± 529	43 ± 144	**0.003**
6mo follow up	99 ± 295	8 ± 32	0.262
1 year follow up	22 ± 84	34 ± 87	0.688
p-value (within-group comparison)	**≤ 0.001**	0.815	
Presenteeism (%)			
Baseline	45 ± 28	50 ± 24	0.544
3mo follow up	24 ± 29	33 ± 22	0.284
6mo follow up	28 ± 24	40 ± 27	0.151
1 year follow up	24 ± 21	46 ± 23	**0.006**
p-value (within-group comparison)	**≤ 0.001**	**0.003**	
Costs of Presenteeism per week (CHF)			
Baseline	478 ± 360	548 ± 364	0.492
3mo follow up	239 ± 296	316 ± 312	0.369
6mo follow up	261 ± 200	415 ± 329	0.055
1 year follow up	268 ± 274	366 ± 341	0.339
p-value (within-group comparison)	**≤ 0.001**	**0.010**	
Overall work productivity loss (%)			
Baseline	50 ± 29	52 ± 23	0.742
3mo follow up	64 ± 37	38 ± 26	**0.010**
6mo follow up	33 ± 28	40 ± 27	0.403
1 year follow up	25 ± 23	48 ± 23	**0.007**
p-value (within-group comparison)	**≤ 0.001**	0.051	
Costs of overall work productivity loss per week (CHF)			
Baseline	556 ± 400	593 ± 359	0.736
3mo follow up	670 ± 469	359 ± 315	**0.012**
6mo follow up	360 ± 346	423 ± 334	0.565
1 year follow up	290 ± 300	400 ± 376	0.330
p-value (within-group comparison)	**≤ 0.001**	**0.025**	

of productivity was 64% for patients who had undergone surgery, while the figure was 38% for conservatively treated patients. At 1 year, however, patients treated conservatively reported 48% loss of productivity, which is significantly more than in the surgical group with only 25%.

The estimated costs due to loss of productivity for one year showed that surgery was about CHF 13,000 more expensive than conservative treatment (Table 5). Costs from absenteeism were higher in the surgical group while costs from presenteeism were higher for those managed conservatively.

DISCUSSION

The results of this economic analysis showed that healthcare costs for conservative treatment of TMC OA were much lower than for surgery. Patients with private insurance provided the clinic with more earnings than patients with general insurance, although we found no differences in the treatment outcome. Between baseline and the 1-year follow-up, there was at first an increase and then a significant decrease in loss of productivity in the surgical group, whereas productivity loss was more stable over time in the conservatively treated group. Estimated combined annual healthcare and productivity costs were considerably higher in the surgical group.

As expected, the clinic earns significantly more money from patients with additional (semi-) private insurance. This is not only due to a higher charge per day, but also to a significantly longer stay. People with (semi-) private insurance pay more in insurance premiums and, in return, get more benefits, such as treatment by a senior physician, double- or single-room accommodation in the hospital, and complementary and alternative medical (CAM) treatment, none of which are covered by the general insurance. Despite these additional benefits, we did not see a better treatment outcome in these patients. This may be because trapeziectomy with LRTI is a straightforward operation that provides good overall results and patient satisfaction[30-32], irrespective of whether the senior surgeon or another consultant performs the surgery. Another study in our clinic, investigating patients who underwent total shoulder replacement, confirms that the insurance status has only weak association with the outcome[33]. Further studies are needed to determine whether these results can be extrapolated to other medical facilities and other countries. In the United States, for example, where a different health insurance system exists, patients with private insurance have been shown to have lower risk-adjusted mortality rates than patients in other payer groups[34].

Regarding absenteeism, we found that patients have an average of 10 weeks sick leave after surgery, leading to high productivity losses. The relevance of costs associated with absenteeism

Table 5 Estimated average annual costs for surgery and conservative treatment (CHF) for all patients (n = 161).

	Surgery	Conservative	p-value
Healthcare costs	10,303	622	**≤ 0.001**
Loss of Productivity costs			
Absenteeism	5,750	217	**≤ 0.001**
Presenteeism	4,157	6,038	0.269
Total annual costs	20,210	6,877	**≤ 0.001**

in patients with hand and wrist injuries is substantiated by data from the Netherlands, where these costs were found to be considerably higher than the health-care costs[3].

In our patients, the costs associated with presenteeism were considerably higher than for absenteeism at all points in time, except 3 months after surgery when some patients were still on sick leave. Higher loss of productivity while at work than when absent from work has also been shown in studies investigating employees with arthritis[35, 36], patients with OA at any joint[7, 8], and patients with rheumatoid arthritis[9, 10]. Goetzel et al.[36] concluded that 77% of the total costs for arthritis are attributable to presenteeism.

In contrast to absenteeism, the quantification of presenteeism remains a complex task[5]. Several questionnaires for loss of productivity are available, but there are no clear guidelines on which one to choose[5, 37, 38]. Furthermore, the way to quantify the economic burden from the various questionnaires is not standardized, making it impossible to compare the results of different studies[5]. We choose the WPAI to assess loss of productivity, because the answers can be easily converted into numbers for absenteeism and presenteeism[5]. In our opinion, however, the WPAI has some shortcomings in that it estimates loss of productivity for only one week. This short recall period is useful from a methodological point of view, in order to minimize recall bias, but it necessitates interpolation to estimate costs over the entire year[23]. Additionally, presenteeism in the WPAI was reported on a numeric rating scale ranging from 0 to 10. If patients gave a score of 8 out of 10, would that necessarily mean that they were only able to work 20%, leading to an 80% loss for the employer[39]? We would question that interpretation and suggest that the high costs of presenteeism may be overestimated, which has also been indicated in other studies[9].

This study has some limitations: On the basis of our data, we cannot make any treatment recommendations, as the two patient groups are not comparable regarding either indication or outcome. We have, in fact, described the outcomes of two different treatment strategies in two groups of patients with different characteristics. Making any direct comparison between the two interventions would be prone to confounding by indication. Future studies, preferably with a randomized design, should focus on the cost-utility analysis of comparable interventions in order to provide treatment recommendations, bearing in mind the economic consequences[1, 40]. Additionally, many of our patients were not willing to report their income, so we used norm data for the hourly income of the Swiss population when calculating the costs associated with loss of productivity. Missing values for absenteeism and presenteeism forced us to impute these data, so that the results are more of an approximation than actual figures. Our data regarding costs due to loss of productivity should be extrapolated carefully. The monetary values are strongly dependent on the income, contractual weekly working hours, and ratio of the employed to and non-working patients in the study population.

In summary, we can conclude that surgery was associated with considerably higher costs than conservative treatment, with respect to both healthcare and loss of productivity. However, we cannot make any treatment recommendations, because the indications for conservative management and surgery are different. Moreover, treatment recommendations also have to consider the clinical and subjective outcome, which is beyond the scope of this paper. The extent of the improved productivity of surgical patients after more than one year and its related economic consequences should be the subject of further research.

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