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Economic aspects of mandibular third molar surgery

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Abstract

Objective. The aim of this study was to make estimates from a dental care and societal perspective on costs of mandibular third molar surgery. ***Material and methods.*** A total of 64 patients were recruited from three Swedish oral and maxillofacial specialist clinics. Calculations were made prospectively on utilization of labor time, specific medical services and materials, and standardized utilization of other direct costs. Indirect costs were identified from patient surveys. ***Results.*** The base case average direct cost of surgery was 217 Euro. Adding the patient's average cost due to absence from work and transportation of 333 Euro increased overall costs to 550 Euro per patient. About 86% of the patients reported some absence following surgery. ***Conclusions.*** The indirect costs were on average higher than the direct costs, i.e. the patient's loss of time caused higher costs than the intervention per se. Appropriate indications for mandibular third molar removal can minimize the risks of complications and individual or societal costs.

Key Words: *Economics, oral surgery, third molar*

Introduction

In recent years, critical outcome studies of prophylactic surgery of mandibular third molars have been presented [1–5] that should lead to a more restrictive approach to prophylactic surgery. A shift toward a less interventionist approach can also be justified by the findings reported in studies of longstanding retention of mandibular third molars that presented a low incidence of pathology [6–9]. However, even with this unambiguous view, surgery of mandibular third molars is a common procedure at oral and maxillofacial surgery clinics. Annual estimated costs for this type of surgery in the UK are ≈ £30 million for the National Health Service [10] and £20 million in the private healthcare sector [11]. The latest available information about the level of mandibular third molar surgery at Sweden's oral and maxillofacial surgery clinics is ≈ 20 000 operations per year [12].

Quality of care is of vital importance, but economic aspects must also be taken into account when available resources are limited. Costs of different interventions, as well as comparisons of the costs and effects of interventions, have important implications for decision making and the setting of priorities in healthcare. However, indirect costs due to losses of productivity resulting from sickness absence following the intervention also need to be identified. No Swedish studies have been performed yet with the aim of making more extensive estimates of costs associated with mandibular third molar surgery. Thus, the aim of this study was to perform economic analyses from a societal perspective in order to examine the expected costs for mandibular third molar surgery.

Material and methods

Specialist clinics and patients

Three oral and maxillofacial specialist clinics, two university hospitals and one central hospital in the National Health Service of southern Sweden participated. Data on resource utilization were prospectively collected between December 2002 and

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February 2005. The clinics differed in terms of the number of specialists and non-specialists (residents and general dental practitioners). Two of the specialist clinics also had an oral and maxillofacial radiology clinic.

At least 20 consecutive patients at each of the three clinics were asked to participate in the study. Only one third molar per patient was to be included. All molars had at least one pathologic condition. A total of 64 patients were recruited: 38 women and 26 men. The average age was 28 years, with a range of 17–56 years. All patients agreed to participate in the study. The study was approved by the Research Ethics Committee at Lund University, Lund, Sweden (LU 50-02).

The following types of patients were excluded:

- Patients who had undergone radiation therapy in the head and neck region.
- Patients who were to undergo surgery under general anesthesia or intravenous sedation. However, patients given per oral sedation were included.
- Patients with congenital or acquired coagulation disorders (including patients treated with warfarin). However, patients to whom aspirin and/or clopidogrel had been prescribed were included.

Calculation of mandibular third molar surgery costs

Definitions of the economic terms used in this study are presented in Table I. The calculations of mandibular third molar surgery costs were made from a dental care and societal perspective, i.e. calculations were based on direct costs for dental care, and on indirect costs defined as the patient's absence from work due to pain after interventions, i.e. societal losses of productivity, as well as the patient's cost of transportation [13]. From a theoretical economic perspective, resource utilization was assumed to have the same valuation and to be distributed equally among all included patients at the participating clinics [14]. That assumption could not be confirmed on the basis of accounting data only. Furthermore, the composition of patients may have an impact on costs at each dental clinic, but that composition was not known in detail. A pragmatic solution was to use the valuation of costs of labor (dentists, dental nurses, secretaries) according to official statistics [15]. Costs of specific materials were calculated according to specified per diem rates. Costs for rent and depreciation were based on accounting data from the included clinics and added as a per-surgery average. Finally, overhead charges were added as a percentage to the other direct costs according to one Swedish study, i.e. added costs of 20.5% [16]. As alternatives, 50% was added, but to costs of labor only, following the method used for the Swedish Dental Care reform of 2008, and 11.85%, as found in another Swedish study on public dental healthcare [17].

Table I. Definitions of economic terms used in the study.

Term	Definition
Direct costs	Utilization of resources for dental care and treatment
Indirect costs	Resources lost as a consequence of losses of productivity due to the patient's sickness absence because of, e.g., pain
Costs of labor	The mean average salary for dentists, dental nurses, and secretaries for county councils, including payroll taxes and adding patient-related time to total time
Resource utilization	Prospectively registered patient-specific data and assumed standardized resource utilization
Standardized resource utilization	Time of secretaries for each intervention, basic resources used during surgery (gloves, sheets, compresses, knife blades, sutures, burrs, etc.), renting (including depreciation of capital costs for building and payment of interest, cleaning, maintenance, heating, electricity), depreciation costs for equipment used, and overhead costs
Overhead costs	Non-patient-related costs associated with central administration, management, etc.
Patient-specific data	Costs of labor (dentist, dental nurse, secretary) and patient-related resources used during surgery (X-rays, pharmacy, sedation, etc.)

The patient-specific data concerned costs of labor (dentist, dental nurse, secretary) and specific resources used during surgery (e.g. X-rays, pharmacy, sedation). According to findings by Svedberg et al. [18], all patient-related time makes up ≈ 79% of total time for dentists and hygienists. It was assumed that this proportion also held true for dental nurses. This ratio of patient-related time to total time was included in the calculations of costs in order to perform the addition for non-patient labor time.

Standardized resource utilization concerned the time spent by secretaries for each intervention, as well as basic resources used during surgery (e.g. gloves, sheets, compresses, knife blades, sutures, burrs; Table II), rent (including depreciation of capital costs for buildings and interest payments, cleaning, maintenance, heating, electricity), depreciation costs for equipment used (when appropriate), and overhead costs (as a percentage charge).

Costs for transportation of patients were assumed to correspond to the patient's time for transportation to the dental ward (except walking) according to the patient survey, assuming an average speed of 60 km/h, and to a cost per kilometer (18 SEK/10 km) corresponding to official tax reductions due to costs of transportation for Swedish citizens (Swedish Tax Agency, 2008 regulation).

Indirect costs due to losses of productivity from sickness absence following the intervention were

Table II. Basic consumables used during mandibular third molar surgery.

Item	Costs (Euro) per piece
Gown (×2)	4.75
Cover (patient's body)	2.68
Cover (patient's face)	0.52
Plastic cover for hand piece wire	1.61
Plastic cover for handle on lamp	0.84
Saline bag	2.12
Saline hose	1.12
Burrs	5.47
Gloves (×2)	0.73
Suction tube	1.50
Knife blade	0.99
Gauze	0.28
Cap and face mask	0.67
Suture	3.63

specified from the patient survey. However, we could not control for an unemployed student having a specified sickness absence. The patient's time off work was calculated as average labor costs, payroll taxes included, and stratified by age and gender [15].

Accounting cost data were expressed at the price level of 2005, and converted to the 2008 price level using the Swedish Consumer Price Index for 2008 [19]. Costs in SEK were then transformed to Euros for the year 2008, when one Euro averaged SEK 9.60.

Statistics

Regression analyses based on linear models were performed in order to investigate correlations (Stat graphics Version 5.0). The level of significance was set at $p = 0.05$.

Results

The average direct dental cost of surgery was 217.21 (SD 47.78) Euro per patient if the overhead charges were 20.5% (base case), and 197.99 Euro if overhead charges were 11.85. Finally, if 50% overhead charges were added to costs of labor only, the estimated cost was 199.76 Euro per patient.

Dividing the total direct cost of surgery by the dentist's time gives an estimated arithmetic average cost of 4.95 Euro per dentist minute, according to the base case calculation. The average dentist's time was 43.69 min per intervention.

The estimated costs can be compared with the official price, i.e. government reimbursement plus the patient's deductible, to give a total of 188.92 Euro. The difference between our calculated average direct cost of surgery and that of the official price was 28.29 Euro per surgery, i.e. a "loss" compared to the official price. A large share of the direct costs per patient was for labor. The latter costs are a function of the time used for each patient and the cost per minute, of which the dentist's time is decisive for the surgery as such. A correlation could thus be expected between the dentist's time (minutes) and the direct cost of surgery, as shown in Figure 1. Using a linear model to describe the relation between the dentist's time per surgery and direct costs per surgery (according to the base case), the equation of the fitted model can be stated as follows, using a 99% confidence level and excluding two outliers:

Direct costs = 109.91+(1.537×dentist's time).

Adjusted for degrees of freedom, the R^2 was 0.5546; thus, the model explained 55.5% of the variability of direct costs as expressed by the dentist's time only.

Adding indirect costs due to absence from work after mandibular third molar surgery according to the patient survey, and adding the patient's costs of transportation, total average cost increases from 217.21 Euro (base case) to 550.03 Euro per patient. A majority of the patients (86%) reported some loss of productivity, on average 1.57 days, but one patient had 22 days. About 65% of patients had total costs, i.e. direct plus indirect, of ≤ 500 Euro, and only four (6%) had total costs of ≥ 1000 Euro (Figure 2).

Looking at the structure of direct costs, on average the cost of labor directly involved corresponded to 42.2% of the direct costs per patient (base case), while material used during surgery was 32.2%. The remaining 25.6% of direct costs consisted of rent and depreciation, and overhead costs (Table III).

Discussion

Based on dental office and patient surveys, we calculated the patient-specific cost for 64 consecutive patients at three dental clinics. According to our estimates, the average direct dental clinic cost was 217 Euro, but between 198 and 200 Euro using other overheads. The model used, i.e. resource utilization according to surveys of time used for consecutive patients of different categories of dental employees, indicates that there is a relatively high correlation between the dentist's time used for an individual patient and the total direct dental cost ($R^2 = 0.55$).

When indirect costs were added to the direct dental cost, i.e. the patient's estimated sickness absence expressed as loss of productivity and costs of transportation, the base case increased from 217 Euro to 550 Euro, or by ≈ 150%, which is often the case in healthcare [14]. This stresses the importance of also

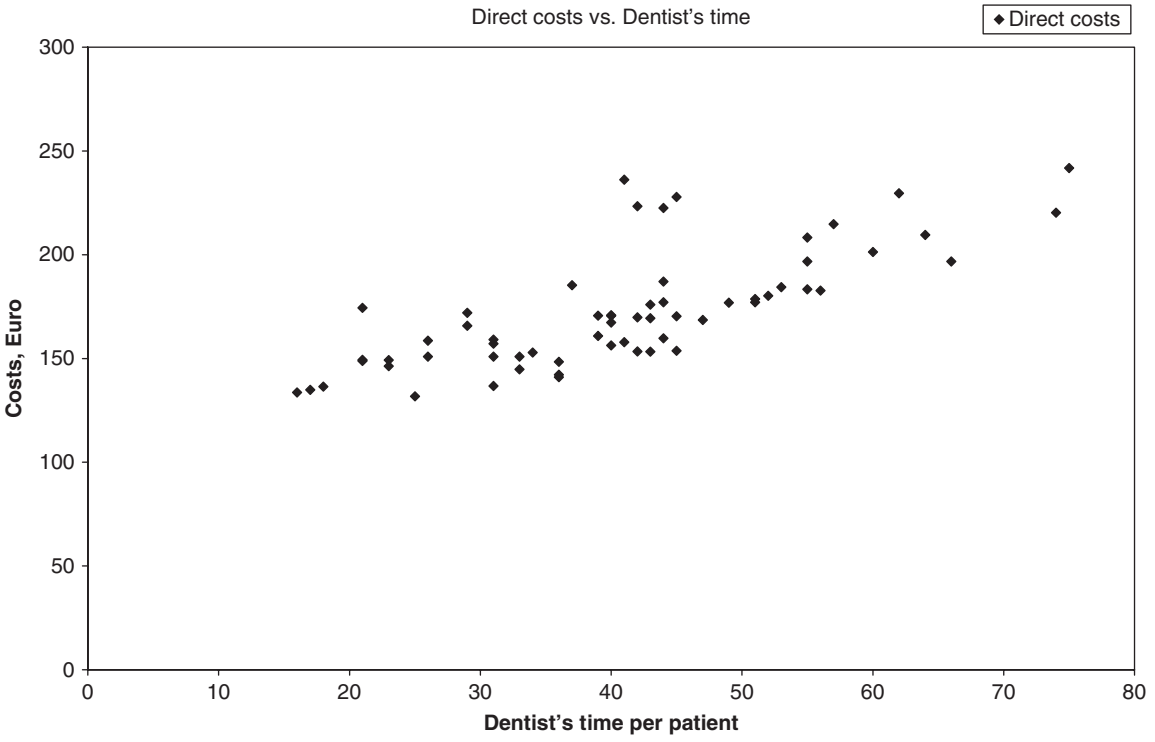

Figure 1. Direct clinical costs versus dentist's total time per patient during third molar surgery procedure; two outliers excluded.

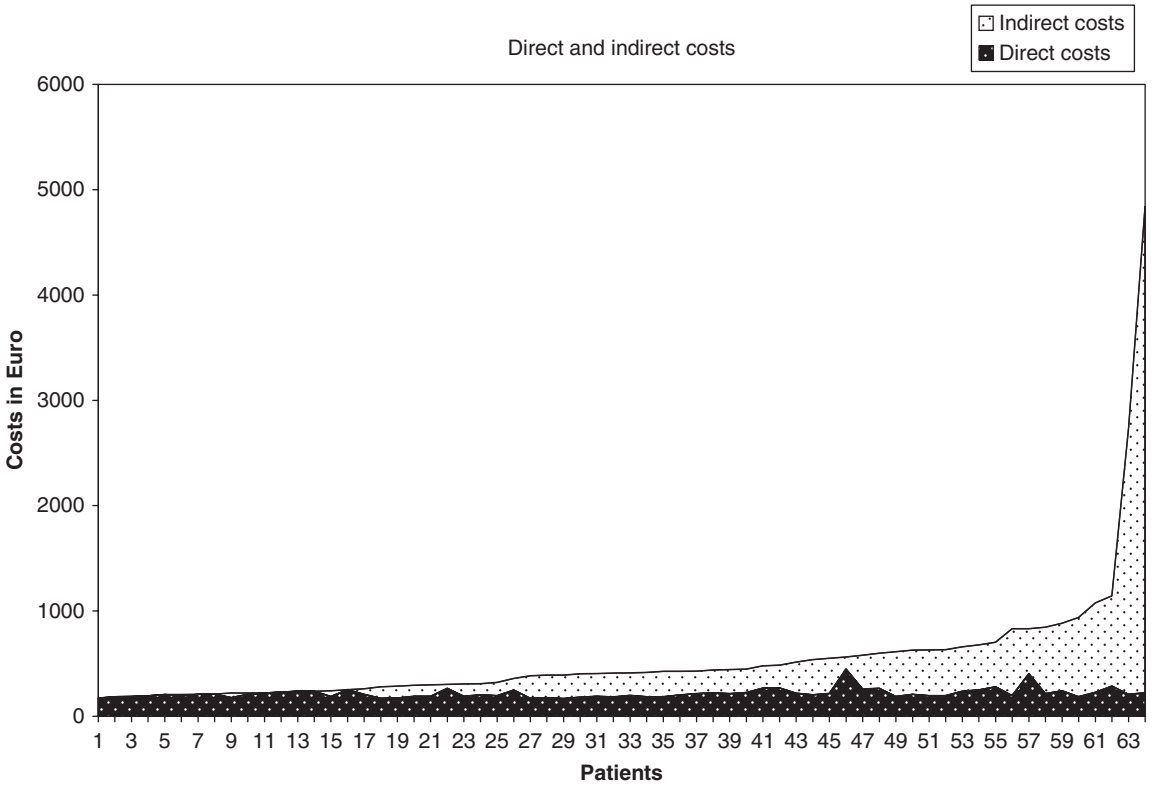

Figure 2. Direct and indirect costs for each included patient having third molar surgery performed, in rising order of total costs.

including societal costs when setting priorities in dental care. The average number of days of sickness absence was 1.57. However, one patient had 22 days, and if that patient was excluded, the average number of days would have been reduced to ≈ 1.22 days. The latter average corresponds well to a Norwegian estimate of sickness absence after mandibular third molar surgery, i.e. 1.07 days [20]. These findings, i.e. that

Table III. Average direct cost per patient, base case, in Euros. Structure of costs and percentage of total.

Type of resource	Utilization	Estimated cost (Euro) Mean	SD	% of total
Labor directly involved	Minutes	91.66	34.09	42.2
Materials	Per diem	69.94	8.51	32.2
Renting plus depreciation	Standardized	18.69	–	8.6
Overhead, base case	Standardized	36.92	–	17.0
Total		217.21	47.78	100

the indirect costs have such a great impact on the costs of the total surgery process, also have an important clinical implication concerning the decision as to whether or not to remove a mandibular third molar. Thus, appropriate indications for mandibular third molar removal are of great importance to minimize costs from a societal perspective. Also, good accessibility of oral and maxillofacial clinics can reduce traveling costs when this type of surgery is to be performed.

So far, there are no published studies in Sweden on mandibular third molar surgery to compare with our study on costs. However, in a study in Sweden on caries prevention at 26 dental healthcare clinics, Oscarson et al. [17] found the percentage of labor costs to be on average 67%, with a minimum of 58% and a maximum of 78%. Our study (base case) found a figure of 42.3% for labor costs, but adding overhead charges, which normally cover different management services, we get 59.3%, thus within the range of labor costs found by Oscarson et al. [17].

To our knowledge, only one study (from Wales) tried to estimate resource utilization during mandibular third molar surgery [21]. It is interesting and perhaps surprising that consumables (defined as diagnostic and surgical equipment, pharmaceutical and surgical supplies), staff costs and overheads, i.e. the cost structure expressed as a percentage of total costs for a patient's visit, are so similar.

This study suggests high costs for society concerning mandibular third molar surgery. A great many molars give symptoms to the patient or have pathological conditions and must inevitably be removed. However, weaker indications for removal, e.g. prophylactic, should be questioned due to the risks of complications and the high costs for the individual and for society [22].

Conclusions

There is a need for further studies of the costing of third molar surgery. Our sample was small and geographically limited. There is a great need for better accounting data in Swedish dental care in order to make suitable calculations of costs. Indirect costs were higher than direct costs in the mandibular third molar surgery procedure, thus appropriate indications for mandibular third molar removal are of great importance to minimize costs from a societal perspective.

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References

[1] Friedman JW. Containing the cost of third-molar extractions: a dilemma for health insurance. Public Health Rep. 1983;98:376–84.
[2] Tulloch JFC, Antczak-Bouckoms AA, Ung N. Evaluation of the costs and relative effectiveness of alternative strategies for the surgery of mandibular third molars. Int J Technol Assess Health Care. 1990;6:505–15.
[3] Mercier P, Precious D. Risks and benefits of surgery of impacted third molars. Int J Oral Maxillofac Surg. 1992;21:17–27.
[4] Friedman JW, Atchison KA. The standard of care: an ethical responsibility of public health dentistry. J Public Health Dent. 1993;53:165–9.
[5] Brickley M, Kay E, Shepherd JP, Armstrong RA. Decision analysis for lower-third-molar surgery. Med Decis Making. 1995;15:143–51.
[6] Stanley HR, Alattar M, Collett WK, Stringfellow HR, Spiegel EH. Pathological sequelae of "neglected" impacted third molar. J Oral Pathol. 1988;17:113–7.
[7] Eliasson S, Heimdahl A, Nordenram Å. Pathological changes related to long-term impaction of third molars. A radiographic study. Int J Oral Maxillofac Surg. 1989;18:210–2.
[8] Garcia RI, Chauncey HH. The eruption of third molars in adults: a 10-year longitudinal study. Oral Surg Oral Med Oral Pathol. 1989;68:9–13.
[9] Ahlqwist M, Gröndahl H-G. Prevalence of impacted teeth and associated pathology in middle-aged and older Swedish women. Community Dent Oral Epidemiol. 1991;19:116–9.
[10] Landes DP. The relationship between dental health and variations in the level of third molar removals experienced by populations. Community Dent Health. 1998;15:67–71.
[11] Shepherd JP, Brickley MR. Surgical removal of third molars (Editorial). Br Med J. 1994;309:620–1.
[12] Nordenram Å, Hultin M, Kjellman O, Ramström G. Indications for surgical removal of the mandibular third molar. Study of 2,630 cases. Swed Dent J. 1987;11:23–9.
[13] Rice DP. Cost-of-illness studies: fact or fiction? Lancet. 1994;344:1519–20.

[14] Drummond MF, O'Brian B, Stoddart G, Torrance G. Methods for the economic evaluation of health care programmes. 2nd ed. Oxford: Oxford University Press; 1997. p 54.
[15] Statistics Sweden. Wage and salary structures and employment in county councils. Average monthly salary by occupational group. [Updated 26 May 2009; cited 26 August 2009]. Available from: http://www.scb.se/Pages/TableAndChart_28319.aspx.
[16] KällestÅl C, Oscarson N, Holm AK. Costs for prevention of dental caries in a group of Swedish teenagers. Swed Dent J. 1997;21:193–7.
[17] Oscarson N, KällestÅl C, Karlsson G. Methods of evaluating dental care costs in the Swedish public dental health care sector. Community Dent Oral Epidemiol. 1998;26:160–5.
[18] Svedberg Y, Malmqvist J, Johnsson T. A method for the dental care activities time study using observer monitored counting of frequencies. Swed Dent J. 1993;17:155–63.
[19] Statistics Sweden. Consumer Price Index (CPI). [Updated 11 August 2009; cited 26 August 2009]. Available from: http://www.scb.se/Pages/TableAndChart_256273.aspx.
[20] Berge TI. Inability to work after surgical surgery of mandibular third molars. Acta Odontol Scand. 1997;55:64–9.
[21] Edwards MJ, Brickley MR, Goodey RD, Shepherd JP. The cost, effectiveness and cost effectiveness of removal and retention of asymptomatic, disease free third molars. Br Dent J. 1999;187:380–4.
[22] Friedman JW. The prophylactic extraction of third molars: a public hazard. Am J Public Health. 2007;97:1554–9.