Acta Neurochir (2016) 158:969–974
DOI 10.1007/s00701-016-2760-1

CLINICAL ARTICLE - SPINE

The use of surgery for cervical degenerative disease in Norway in the period 2008–2014

A population-based study of 6511 procedures

Jon-André Kristiansen[1] · Lise Balteskard[2] · Haldor Slettebø[3] · Øystein P. Nygaard[4] · Bjarne Lied[5] · Frode Kolstad[3] · Tore K. Solberg[6]

Received: 21 September 2015 / Accepted: 24 February 2016 / Published online: 17 March 2016

Abstract
Background The incidence rate of surgical treatment of cervical degenerative diseases (CDD) has increased in the USA and a large geographic variation has been shown. Little is known about such rates in Scandinavia and Europe. The aim of this population-based study was to (1) investigate annual incidence rates of operations performed in Norway, (2) to compare trends and variations in rates for surgical indications with and without myelopathy, and (3) to compare variations in the use of surgery between residential areas.
Methods Patients operated for CDD and recorded in the Norwegian Patient Registry from 2008 to 2014 were evaluated according to residential areas (resident county and Regional Health Authority (RHA) area), age, gender, treating hospital, and whether myelopathy was present or not. Surgical rates were adjusted for age and gender. Data from private health care were also included.
Results The annual surgical rates increased by 74.1 % from 2008 to 2014 (12.5/100,000 inhabitants). The largest increase was for surgical treatment of radiculopathy, 86.5 %. Surgical rates for CDD varied in 2014 with a ratio of 1.5 between the highest and lowest RHA and with a ratio of 2.5 between the different residential counties within one RHA. The treatment rates for myelopathy were relatively stable over time, but showed an increase of 2.1/100,000 (44.6 %) from 2013 to 2014.
Conclusions Our study shows that the rate of surgical treatment for radiculopathy due to CDD has increased substantially from 2008 to 2014 for all RHAs in Norway. The incidence rate for surgical treatment of myelopathy was more stable. An unexplained and moderate geographic variation was found.

Keywords Cervical degenerative disease · Geographic variation · Radiculopathy · Myelopathy · Surgery rates

Presented at Conference: Abstract presented at the Norwegian Neurosurgery Association Annual Meeting 2013.

✉ Jon-André Kristiansen
jon.a.kristiansen@gmail.com

[1] Diakonhjemmet Hospital, Diakonveien 12, 0370 Oslo, Norway

[2] Center of Clinical Documentation and Evaluation, Northern Norway Regional Health Authority, Postbox 6, 9038 Tromsø, Norway

[3] Department of Neurosurgery, Oslo University Hospital, Sognsvannsveien 20, 0424 Oslo, Norway

[4] Department of Neurosurgery, St. Olavs Hospital, Trondheim University Hospital, Sluppen, NO-7006, Postbox 3250, Trondheim, Norway

[5] Department of Neurosurgery, Oslo University Hospital, Kirkeveien 166, 0450 Oslo, Norway

[6] Department of Neurosurgery, University Hospital of North Norway, Tromsø, Norway

Introduction

Degenerative changes in the cervical spine, known as spondylosis, are also common in asymptomatic individuals [1, 2]. Protruding discs, spondylotic bone spurs, and ligament thickening can affect nerve roots or the spinal cord and cause clinical syndromes such as cervical radiculopathy and/or myelopathy. Cervical radiculopathy affects 83.2/100,000 per year in the USA [3]. The incidence and prevalence rate of spondylotic cervical myelopathy are unknown [4]. These conditions can be managed conservatively or surgically [5–7]. In most cases, the indication for operative treatment of cervical radiculopathy is relative, whereas progressive myelopathy often is regarded as a more absolute indication [8]. The exact

incidence rates for surgical treatment of each of these two clinical entities have not been reported previously in the literature.

Data from the USA show that there has been a large increase in the use of the cervical spine surgery, from 14.7/100,000 per year in 1992 to 60.8/100,000 in 2009 [9, 10] and there seems to be a considerable geographical variation [10–12], none of which can be explained by higher incidence or regional differences in morbidity. To the best of our knowledge, the surgical rate and regional variation has not been described earlier in Norway or Europe. The purpose of this study was to (1) investigate incidence rates of operations performed for degenerative changes in the cervical spine in Norway, (2) to compare trends and variations in rates for different surgical indications, with and without myelopathy, and (3) to identify variations between residential areas in use of surgery. Large differences could reflect inequalities in health services, necessitating further investigations into this subject.

Materials and methods

Data for this population-based study were acquired through a systematic search in the government funded Norwegian Patient Registry (NPR), which is used as an administrative database for all government funded health services.

Individual-level data were available on age, gender, place of residence, and treatment center. Surgical procedures were identified from the Nordic Medico-Statistical Committee (NOMESCO) classification of surgical procedures (NCSP) and diseases from The World Health Organization's International Classification of Disease, 10th revision (ICD-10). Both scheduled and emergency admissions were included. Surgery for degenerative changes in the cervical spine was defined as a presence of any of the NCSP codes as shown in Table 1 combined with an ICD-10 diagnosis identifying cervical location and indicating radiculopathy or spondylosis, without additional diagnoses indicating myelopathy. Surgery for myelopathy was defined as the presence of an NCSP code in combination with an ICD-10 diagnosis listed as myelopathy in Table 1, regardless of the presence of other ICD-10 diagnoses listed as radiculopathy or spondylosis. All cases with diagnoses of tumors, trauma, or primary infections were excluded.

Patients were divided into four residential areas according to the catchment areas for the four Regional Health Authorities in Norway. Each of the RHA contains several of a total of 19 counties. In the public health care, cervical spine surgery is centralized to the five university hospitals located in the different RHAs; in Trondheim, Bergen, Stavanger, Oslo, and Tromsø. Public hospitals and private clinics with reimbursement agreements receive government funding based on the diagnosis-related groups system (DRG) by a mandatory reporting of their hospital activity data, e.g., coding for diagnosis (ICD-10) and surgical treatment (NCSP) to the NPR. We therefore find it reasonable to assume that virtually all procedures performed by institutions with reimbursement agreements are recorded in the NPR. In addition to those reported to the NPR, a small number of operations have been performed in private health care without reimbursement agreements, mainly in one, and by far the largest clinic, The Oslofjord Clinic (OFC). In the present study, this clinic contributed with additional information regarding numbers of patients treated with surgery for CDD each year. Their records included data on county of residence of their patients and mean age, but no individual data on age, gender, or presence of myelopathy. As a consequence, these data (9.1 %) were not age and gender adjusted, and after clinical assumption, all patients were classified as radiculopathy. Only a few other small clinics without public reimbursement were sporadically performing cervical spine surgery. In order to identify the exact number of other procedures for CDD not reported to the NPR during the study period, we conducted a telephone survey among the remaining relevant private clinics.

Table 1 Procedural codes from the NCSP and ICD-10 codes differentiating myelopathy and spondylosis and or radiculopathy

Surgical procedures on the cervical column, NCSP
ABC 01, 10, 20, 21, 30, 50, 60, 99 – *Decompression of spinal cord and nerve roots*
NAB 90, 91 – *Primary prosthetic replacement of joints of spine*
NAC 90 – *Secondary prosthetic replacement of joints of spine*
NAG 00, 10, 30, 40, 60, 70 – *Excision, reconstruction, and fusion of joints of the spine*
NAK 10 – *Resection or excision of vertebrae*
Investigated for, but not found: NAE 90, NAF 90, NAG 20
ICD-10 Codes considered as myelopathy
M47.1, – *Spondylosis with myelopathy*
M48.02 – *Other spondylopathies with myelopathy*
M50.0 – *Cervical disc disorders with myelopathy*
G82.1, G82.4 – *Paraplegia and tetraplegia*
G83.0, G83.2 – *Other paralytic syndromes*
G95.2 – *Unspecified compression of the spinal cord*
G99.2 – *Myelopathy in diseases classified elsewhere*
ICD-10 Codes considered as radiculopathy or spondylosis
M47.2, 47.21, 47.22, 47.23 - *Other spondylosis with radiculopathy*
M47.8, 47.81, 47.82, 47.83 - *Other specified spondylosis*
M48.0, 48.01-03 - *Spinal stenosis*
M50.1-3, 50.8, 50.9 - *Cervical disc disorders*
M53.0, 53.1 – *cervicocranial and cervicobrachial syndrome*
M54.2 - *Cervicalgia*
M99.3-7, *Foraminal stenosis*

Statistical analyses and ethics

To allow comparison between residential areas, all surgery rates were adjusted for age and gender by the direct method

using the Norwegian population in 2013 as reference. The *p* value for trend for the increase in age- and gender-adjusted surgical rates was calculated by using a linear regression model. All analyses were performed with SAS Enterprise Guide v. 5.1 (SAS Institute Inc.) and Microsoft Excel (2013).

The Center of Clinical Documentation and Evaluation has concession from the Norwegian Data Protection Authority and confidentiality exemption from the Regional Committee for Medical and Health Research Ethics (REC –North). The concession provides access to unique personal data from the Norwegian Patient Registry with information about patients treated at Norwegian hospitals in the period 2008–2014.

Results

The total number of procedures in Norway increased from 711 in 2008 to 1356 in 2014. Of the 6511 procedures, 593 (9.1 %) were performed in private health care. According to our telephone survey, other private surgical units without public reimbursement had only performed 21 (0.3 %) operations that had not been included in this survey. Thus, our study comprises 99.7 % of the operations for CDD performed in Norway during the study period.

Of 5918 operations in the public health system, 55.8 % were performed on men. The mean age at time for surgery was 50.8 years for women and 52.2 years for men, and 79.4 % of operations were performed for radiculopathy and 20.6 % for myelopathy. Mean age for those operated in the private health care was 49.0 years (Fig. 1).

We observed an increase of 74.1 % in annual rates for treatment of CDD, from 16.9/100,000 in 2008 to 29.4/100,000 in 2014. P for trend = 0.008. The annual surgical rate for CDD with radiculopathy increased with 86.5 %, from 12.1/100,000 in 2008 to 22.6/100,000 in 2014, while it was relatively stable for myelopathy around 4.7/100,000 from 2008–2013 with a more pronounced increase from 2013–2014 from 4.7/100,000 to 6.8/100,000.

In all of the residential areas of the RHAs, the surgical rates were increasing during the study period. Patients settled in central Norway had the highest increase, 100 %, from 9.6/100,000 in 2008 to 19.2/100,000 in 2014. Patients settled in southern and eastern Norway RHA had the lowest increase, 69.6 %, from 17.1/100,000 in 2008 to 29.0/100,000 in 2014 (Fig. 2). Most of the increase between 2013 and 2014 occurred in western and southern and eastern Norway RHAs. The surgical rates for myelopathy have remained relatively stable around the national average over the years for all RHAs.

The average surgery rates between 2008 and 2014 varied by 40.6 % between the southern and eastern Norway and the central Norway RHAs. Between the other RHAs, the differences were smaller.

The largest difference in average surgical rates between counties within an RHA was found in the western Norway RHA, the incidence rate in Rogaland (29.5/100,000) was 2.5 times larges than in Sogn and Fjordane (11.8/100,000). In the southern and eastern Norway RHAs, there was a similar gap. The incidence rate in Østfold (31.3/100,000) was 2.3 times larger than in Telemark (13.9/100,000). Patients from all counties in Norway were treated in private health care. The contribution of surgery performed in the private sector did not seem to change the regional differences in surgical incidence rates, observed in the public health care, but followed the same patterns (Fig. 3).

From 2008 to 2014, the surgery rates for patients aged 50–55 increased from 36.8/100,000 per year to 70.1 per 100,000 per year. For patients aged 75–80, there was an increase from 7.4/100,000 per year in 2008 to 23.7 per 100,000 in 2014, i.e., by a factor of 3.2.

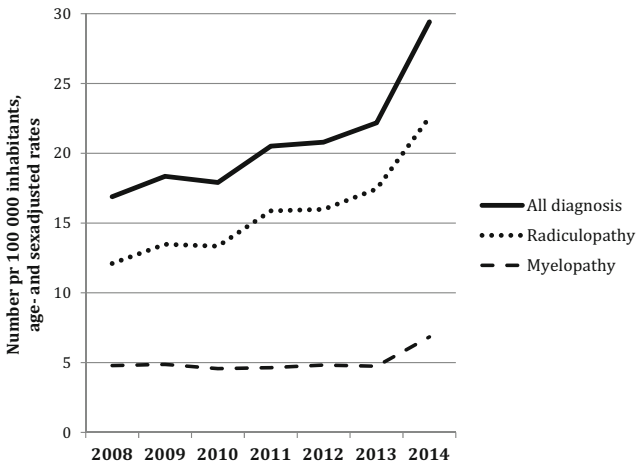

Fig. 1 National numbers of neck surgery by diagnosis, 2008–2014 public and private hospitals, per 100,000 inhabitants

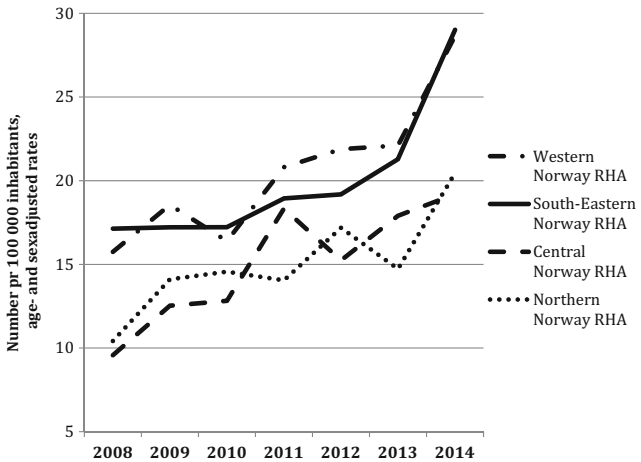

Fig. 2 Numbers of CDD procedures all diagnosis, averages 2008–2014 per county, public and private hospitals, per 100,000 inhabitants. Age and sex adjusted only for public hospitals

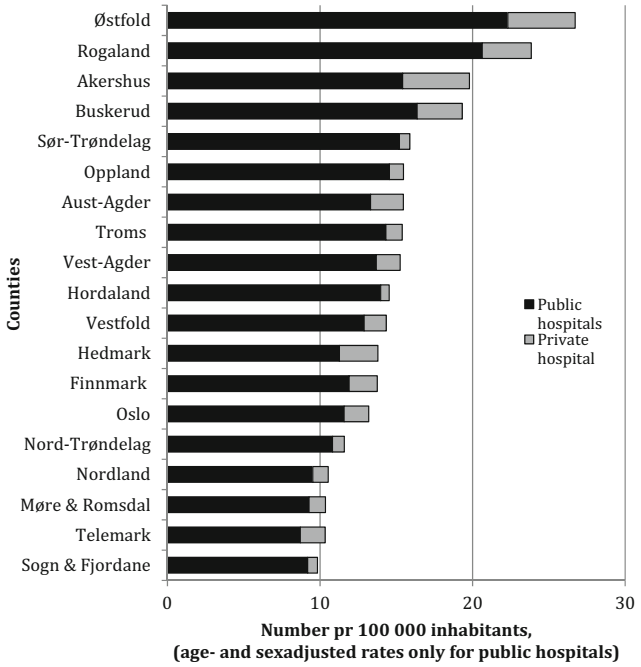

Fig. 3 Numbers of CDD procedures all diagnosis, averages 2008–2014 per county, public and private hospitals, per 100,000 inhabitants. Age and sex adjusted only for public hospitals

Discussion

This population-based study, including 99.7 % of all neck surgery performed in Norway, shows that the incidence rate of procedures for CDD in Norway increased by 74.1 % from 2008 (16.9/100,000) to 2014 (29.4/100,000), and by 86.5 % for the subgroup operated for radiculopathy. The increase was highest among patients aged 75–80 years. The average for the period varied by 40 % between RHAs and by a factor of 2.5 within one RHA. The treatment rate for myelopathy was more stable throughout the observation period and similar across population areas.

In the USA, the growing rate of surgery for CDD in the population and regional variation are well-known and debated phenomena and may have many different causes [13–18]. Despite striking differences in surgical incidence rates, for example between 17/100,000 and 172/100,000 in the American Medicare system, previous studies have shown that the prevalence of degenerative spine conditions varies little between geographic areas [12, 19]. This study was not designed to investigate underlying mechanisms. However, variation was mainly found for the more relative surgical indication, radiculopathy, as opposed to the more absolute indication, i.e., myelopathy. It is therefore unlikely that an increase in CDD morbidity or differences between residential areas can explain our findings. It is also unlikely that this variation is caused by differences in demographics, general morbidity, geographical distance to the surgical units, or access to health services in general [20]. The differences in surgical rates we found between counties could more likely be explained by local difference in referral praxis and treatment traditions, event though they occur within the same RHA. Compared to average surgical rates from the USA of 60.8/100,000, the Norwegian rates and the geographic variation seem to be no more than moderate [10–13, 21, 22]. We have no evidence for what the appropriate rate of surgery in our population should be. Davis et al. [23] argued that economic incentives through reimbursement agreements will influence the surgery rates. A study from Dartmouth Medical School in the USA showed that availability of imaging techniques accounts for 22 % of the variation in utilization of spine surgery [12]. Other studies have also indicated that more imaging can lead to more referrals to surgical treatment [9, 12, 22–24]. A study from Weber et al. from 2014 reported that surgery for primary intraspinal tumors increased in correlation with an increased availability of diagnostic magnetic resonance imaging before 2002 [25].

Several authors have proposed that a technological advance in surgery and anesthesiology makes operative treatment safer and more accessible, also for the older population with more comorbidity [9, 21–23, 26, 27]. The aging of the population in itself would also increase the utilization of spine surgery due to the progressive nature of CDD [9, 10, 23, 26]. We found the highest increase among patients aged 75–80 (Fig. 4). The average age increased by 1.5 years during the 7-year period, while the average age in the Norwegian population only increased by 0.4 years in the same period. A growing supply of spinal surgeons could also increase the demand for cervical spinal procedures [9, 21–23, 26], as seen for degenerative disorders of the lumbar spine [28, 29].

The abrupt increase from 2013 to 2014 was highest in RHAs and counties with high utilization of both private and public surgical units. The reason why the inhabitants in these areas have easier access to surgery for CDD remains unexplained. We found no proportionate increase in age over these 2 years.

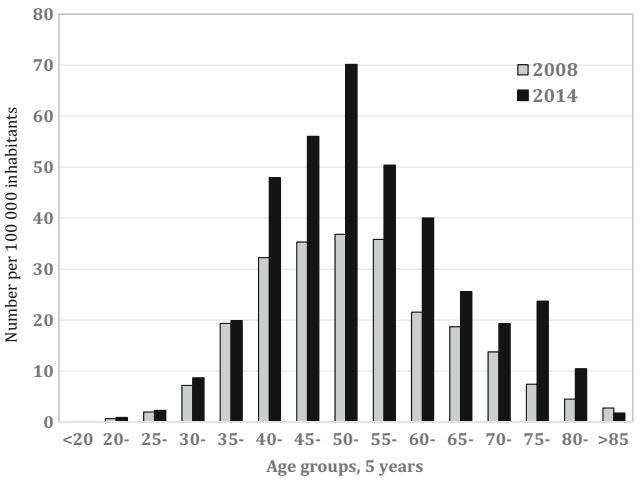

Fig. 4 Numbers of CDD procedures per 100,000 inhabitants in public hospitals in Norway in 2008 and in 2014 by 5-year age groups

The most striking difference between health care in Norway and in the USA is the high-frequency private health insurance and a much more frequent use of private surgical hospitals in the USA. In Norway, all citizens have public health insurance, and the use of private supplementary health insurance has traditionally been low, but has shown considerable growth during the last decade [30–32]. This has paved the way for private clinics without public reimbursement agreements, which offer fast-track treatment for patients with private health insurance. The market for private clinics is therefore likely to grow, and this could lead to an increase in the incidence of surgery for CDD. In our study, we could not find that the contribution from the private health care compensated the regional differences in surgical rates.

In many cases, it is unclear whether CDD conditions should be treated surgically or conservatively [5, 6]. It has been reported that a high level of agreement on treatment indications among health care providers is associated with low-grade variation in surgical incidence rates, and that lack of therapeutic consensus may lead to a higher variation [12]. One reason why the variation was small as compared to the USA may be the small number of surgical units in Norway, making it easier to establish consensus about therapeutic guidelines.

One study reported that patients from small areas with low spine surgery rates experienced better outcomes than those from areas with high incidence [33]. To study how surgical rates are associated with patient outcomes, it will be necessary to link incidence rates, not only to outcome, but also baseline data about indications for surgery. Such information will be available from large clinical spine surgery registries, and have been presented for surgery in the lumbar spine [34].

Strengths and limitations

The strength of this study is the almost complete inclusion (99.7 %) of the Norwegian population that experienced neck surgery through a mandatory national registry, NPR, and self-reported from Oslofjord clinic. The most important limitations of our study are those inherent to large population registries as the NPR, such as false registration and wrongful use of coding systems. Reporting to the NPR is mandatory and integrated in the administrative systems and electronic patient records of the hospitals. It is a prerequisite for reimbursement. However, it is impossible to rule out that some cases may not have been reported.

Operations performed in private health care (9.1 %) were lacking information about age and gender per county and adjusting rates for age and gender was not possible. This could theoretically bias our estimates. However, earlier research has shown that the patient population at the OFC was very similar to those handled in the public health service [27]. Another limitation is the lack of clinical data on health state, work status, and reoperation rates.

Conclusions

Our study shows that the rate of surgical treatment for radiculopathy due to CDD has increased significantly over 7 years in Norway, especially among those aged 75–80 years. The incidence rate for surgical treatment of myelopathy was more stable. An unexplained and moderate geographic variation was found, more between smaller residential areas (counties) than between larger ones (Regional Health Authority Areas)

Compliance with ethical standards For this type of study formal consent is not required.

Funding No funding was received for this research.

Conflict of interest All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

References

1. Boden SD, McCowin PR, Davis DO, Dina TS, Mark AS, Wiesel S (1990) Abnormal magnetic-resonance scans of the cervical spine in asymptomatic subjects. A prospective investigation. J Bone Joint Surg Am 72:1178–1184
2. Lehto IJ, Tertti MO, Komu ME, Paajanen HE, Tuominen J, Kormano MJ (1994) Age-related MRI changes at 0.1 T in cervical discs in asymptomatic subjects. Neuroradiology 36:49–53
3. Radhakrishnan K, Litchy WJ, O'Fallon WM, Kurland LT (1994) Epidemiology of cervical radiculopathy. A population-based study from Rochester, Minnesota, 1976 through 1990. Brain 117(Pt 2): 325–335
4. Boogaarts HD, Bartels RHMA (2013) Prevalence of cervical spondylotic myelopathy. Eur Spine J 24:139–141
5. Fouyas IP, Statham PF, Sandercock PA (2002) Cochrane Review on the role of surgery in cervical spondylotic radiculomyelopathy. Spine 27:736–747
6. Nikolaidis I, Fouyas IP, Sandercock PA, Statham PF (2010) Surgery for cervical radiculopathy or myelopathy. Cochrane Database Syst Rev:Cd001466
7. Robinson J, Kothari M (2014) Clinical features and diagnosis of cervical radiculopathy. Accessed 27.02 2014
8. Rao RD, Gourab K, David KS (2006) Operative treatment of cervical spondylotic myelopathy. J Bone Joint Surg Am 88:1619–1640
9. Oglesby M, Fineberg SJ, Patel AA, Pelton MA, Singh K (2013) Epidemiological trends in cervical spine surgery for degenerative diseases between 2002 and 2009. Spine 38:1226–1232

10. Wang MC, Kreuter W, Wolfla CE, Maiman DJ, Deyo RA (2009) Trends and variations in cervical spine surgery in the United States: Medicare beneficiaries, 1992 to 2005. Spine 34:955–961, **discussion 962–953**
11. Angevine PD, Arons RR, McCormick PC (2003) National and regional rates and variation of cervical discectomy with and without anterior fusion, 1990–1999. Spine 28:931–939, **discussion 940**
12. Sciences DMSCftEC, Research MMCCfO, Evaluation (2000) Dartm. Atlas Musculoskelet Health Care. AHS Press
13. Cowan JA Jr, Dimick JB, Wainess R, Upchurch GR Jr, Chandler WF, La Marca F (2006) Changes in the utilization of spinal fusion in the United States. Neurosurgery 59:15–20, **discussion 15–20**
14. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL (2003) The implications of regional variations in Medicare spending. Part 1: the content, quality, and accessibility of care. Ann Intern Med 138:273–287
15. Gornick M (1982) Trends and regional variations in hospital use under Medicare. Health Care Financ Rev 3:41–73
16. Knickman JR, Foltz AM (1984) Regional differences in hospital utilization. How much can be traced to population differences? Med Care 22:971–986
17. Welch WP, Miller ME, Welch HG, Fisher ES, Wennberg JE (1993) Geographic variation in expenditures for physicians' services in the United States. N Engl J Med 328:621–627
18. Wennberg J, Gittelsohn (1973) Small area variations in health care delivery. Science 182:1102–1108
19. Walsh K, Cruddas M, Coggon D (1992) Low back pain in eight areas of Britain. J Epidemiol Community Health 46:227–230
20. Health NIoP (2014) Admitted to hospital, somatic disorders (C) − both genders, all ages, per 1000, standardised . http://www.norgeshelsa.no/norgeshelsa/. Accessed 03.10.14 2014
21. Marawar S, Girardi FP, Sama AA, Ma Y, Gaber-Baylis LK, Besculides MC, Memtsoudis SG (2010) National trends in anterior cervical fusion procedures. Spine 35:1454–1459
22. Patil PG, Turner DA, Pietrobon R (2005) National trends in surgical procedures for degenerative cervical spine disease: 1990–2000. Neurosurgery 57:753–758, **discussion 753–758**
23. Davis H (1994) Increasing rates of cervical and lumbar spine surgery in the United States, 1979–1990. Spine 19:1117–1123, **discussion 1123–1114**
24. Lurie JD, Tosteson TD, Tosteson AN, Zhao W, Morgan TS, Abdu WA, Herkowitz H, Weinstein JN (2014) Surgical versus nonoperative treatment for lumbar disc herniation: eight-year results for the spine patient outcomes research trial. Spine 39: 3–16
25. Weber C, Gulati S, Jakola AS, Habiba S, Nygaard OP, Johannesen TB, Solheim O (2014) Incidence rates and surgery of primary intraspinal tumors in the era of modern neuroimaging: a national population-based study. Spine 39:E967–E973
26. Deyo RA, Mirza SK (2006) Trends and variations in the use of spine surgery. Clin Orthop Relat Res 443:139–146
27. Lied B, Ronning PA, Halvorsen CM, Ekseth K, Helseth E (2013) Outpatient anterior cervical discectomy and fusion for cervical disk disease: a prospective consecutive series of 96 patients. Acta Neurol Scand 127:31–37
28. Cherkin DC, Deyo RA, Loeser JD, Bush T, Waddell G (1994) An international comparison of back surgery rates. Spine 19:1201–1206
29. Rajaee SS, Bae HW, Kanim LE, Delamarter RB (2012) Spinal fusion in the United States: analysis of trends from 1998 to 2008. Spine 37:67–76
30. Grasdal AL, Monstad K (2011) Inequity in the use of physician services in Norway before and after introducing patient lists in primary care. Int J Equity Health 10:25
31. Iversen T, Kopperud GS (2005) Regulation versus practice—the impact of accessibility on the use of specialist health care in Norway. Health Econ 14:1231–1238
32. Kiil A (2012) Does employment-based private health insurance increase the use of covered health care services? A matching estimator approach. Int J Health Care Finance Econ 12:1–38
33. Keller RB, Atlas SJ, Soule DN, Singer DE, Deyo RA (1999) Relationship between rates and outcomes of operative treatment for lumbar disc herniation and spinal stenosis. J Bone Joint Surg Am 81:752–762
34. Grotle M, Solberg T, Storheim K, Laerum E, Zwart JA (2014) Public and private health service in Norway: a comparison of patient characteristics and surgery criteria for patients with nerve root affections due to discus herniation. Eur Spine J 23: 1984–1991