Public health implications

- Children living near high voltage installations have above normal exposure to electromagnetic fields in the 50 Hz range
- About 0·5% of Danish children are exposed to measurable levels from such installations
- A positive association was observed in this study between all major types of childhood cancer combined and exposure to average magnetic field strengths of 0·3-0·4 μT or more, which were measured in distances of up to 50 metres from an overhead power line
- Data indicate that the proportion of childhood cancers caused by electromagnetic fields must be small
- A possible biological mechanism behind the observed associations still needs to be determined

lymphoma separately at 0·1 μT or more; the subgroup most affected was children with Hodgkin's disease, which is not normally regarded as being aetiologically related to childhood leukaemias. If the observed associations are causal, as indicated by the case-control analysis, descriptive data on electricity consumption and incidence of childhood cancer in the national population indicate that the aetiological fraction must be small. It may be that severe exposure occurs only rarely—for example, in infants and small children residing near powerful, high voltage installations who have prolonged, uniform exposure to electromagnetic fields in the 50 Hz range. It must be kept in mind, however, that no agreement has yet been reached on any cellular process that would induce or facilitate a carcinogenic response to extremely low energy fields.

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Risk of cancer in Finnish children living close to power lines

Pia K Verkasalo, Eero Pukkala, Mikko Y Hongisto, Jorma E Valjus, Pekka J Järvinen, Kauko V Heikkilä, Markku Koskenvuo

Department of Public Health, PO Box 52 (Mannerheimintie 96 A), SF-00014 University of Helsinki, Finland
Pia K Verkasalo, *research scientist*
Kauko V Heikkilä, *systems analyst*

Finnish Cancer Registry, Institute for Statistical and Epidemiological Cancer Research, SF-00170 Helsinki
Eero Pukkala, *research scientist*

Imatran Voima Oy, SF-01019 IVO, Finland
Mikko Y Hongisto, *research engineer*
Jorma E Valjus, *research manager*
Pekka J Järvinen, *research manager*

Department of Public Health, University of Turku, Lemminkäisenkatu 1, SF-20520 Turku, Finland
Markku Koskenvuo, *professor*

Correspondence to: Professor Koskenvuo.

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Abstract

***Objective*—To investigate the risk of cancer in children living close to overhead power lines with magnetic fields of ⩾0·01 microteslas (μT).**

***Design*—Cohort study.**

***Setting*—The whole of Finland.**

***Subjects*—68 300 boys and 66 500 girls aged 0-19 years living during 1970-89 within 500 m of overhead power lines of 110-400 kV in magnetic fields calculated to be ⩾0·01 μT. Subjects were identified by record linkages of nationwide registers.**

***Main outcome measures*—Numbers of observed cases in follow up for cancer and standardised incidence ratios for all cancers and particularly for nervous system tumours, leukaemia, and lymphoma.**

***Results*—In the whole cohort 140 cases of cancer were observed (145 expected; standardised incidence ratio 0·97, 95% confidence interval 0·81 to 1·1). No statistically significant increases in all cancers and in leukaemia and lymphoma were found in children at any exposure level. A statistically significant excess of nervous system tumours was found in boys (but not in girls) who were exposed to magnetic fields of ⩾0·20 μT or cumulative exposure of ⩾0·40 μT years.**

***Conclusions*—Residential magnetic fields of transmission power lines do not constitute a major public health problem regarding childhood cancer. The small numbers do not allow further conclusions about the risk of cancer in stronger magnetic fields.**

Introduction

The possible carcinogenic effect of electric power lines was raised in the late 1970s when an epidemiological study reported a twofold to threefold risk for childhood cancer close to power lines.[1] Magnetic fields have been regarded as the possible causative agent because, unlike electric fields, they penetrate normal building materials.

In residential surroundings one of the sources of extremely low frequency magnetic fields is the power lines used for transmission (high voltage power lines) or distribution of electricity. Other sources of magnetic fields at home include wiring and grounding systems within the buildings as well as various electrical appliances.

Since the original report seven other case-control studies have been published on the risk of cancer in children living close to power lines or exposed to residential magnetic fields.[2-8] Altogether four of six studies on overall cancer risk in children found some indication of an increased risk[1-4] and two did not.[5,6] Four[1-4] of five studies on nervous system tumours, five[1,3,4,6,7] of seven studies on leukaemia, and all four studies on lymphoma,[1-4] using various exposure assessment methods, reported increase in risk. One study on nervous system tumours[6] and two studies on leukaemia[2,8] detected no evidence of increased risk.

In Finland, reliable population based registers made it possible to investigate in a nationwide cohort study whether children exposed to the magnetic fields of power transmission lines have an increased risk of cancer overall and particularly of leukaemias, lymphomas, or nervous system tumours.

Methods

The study was restricted to a cohort of children aged 0-19 years living at any time in 1970-89 within 500 m of overhead power lines of 110, 220, or 400 kV in calculated magnetic fields of $\geq 0.01\ \mu T$. Data on the location, voltage, apparent power, and tower types of the 110-400 kV power lines were provided by major Finnish power companies. These data cover about 18 000 km, 90% of the total length of power lines in Finland.[9]

The exact locations of the power lines were verified on basic maps (scale 1:20 000) to correspond to their extent at the end of 1989. Then the routes of power lines were digitised at the National Board of Surveys. The computerised data on power lines were linked to the register of buildings and individual premises of the central population register, a nationwide database containing detailed information on practically every building in Finland. The shortest distances between the power lines and the central points of buildings were calculated by using exact coordinates of both buildings and power lines. Buildings within 500 m of power lines were identified.[9]

The magnetic fields (magnetic flux density) at the central points of these buildings were calculated separately for each of the years 1970-89 at the power company Imatran Voima Oy. Variables taken into account in calculating magnetic fields were current, typical locations of phase conductors in power lines, and the shortest distance to the centre of the building. Currents were calculated from operational or nominal voltages and the apparent power of all power lines.[9]

Data on power line currents (load flows) were collected by three methods: point estimates of annual average currents for 1984-9 were generated by a power system simulator; existing load flow documents furnished corresponding power information for 1977-83; and power data from 1977, corrected for completion years of power lines, served as estimates for 1970-6. If several power lines were within 500 m of a building, the combined effect of all power lines was estimated.[9]

Further data collection was restricted to buildings with annual magnetic fields of $\geq 0.01\ \mu T$ for one or more years between 1970 and 1989. This low limit for magnetic field level was chosen to include most buildings in Finland likely to have increased magnetic fields from power lines.[9]

Children living in these buildings for any period between 1970 and 1989 were identified from the personal data file of the central population register by means of automatic record linkage using the building codes assigned to every building in Finland. The personal data file contains computerised information on virtually all Finnish people alive or deceased since 1 January 1974, including every address and official dates of moving in and out since 1984, along with a maximum of two addresses before 1984. Data on deaths and residential history were drawn from this register.

The Finnish cancer registry, founded in 1952, receives information on all cases of cancer that come to the attention of hospitals, pathological and haematological laboratories, and practising physicians.[10] In 1989 cancer diagnoses were based on histological confirmation in 89·0% of cases and solely on death certificates in 1·2% of cases. Cases of cancer in the cohort were identified from the cancer registry by record linkage using the unique personal numbers assigned to every resident of Finland. Histologically benign neoplasms outside the nervous system were excluded. The specific cancer types selected to be studied were all primary tumours of the nervous system (code 193, including neuroblastoma, of the seventh revision of the *International Classification of Diseases*), leukaemias (code 204, *ICD-7*), and lymphomas (codes 200-202, *ICD-7*). Gliomas (code 47, American Cancer Society *Manual of Tumor Nomenclature Coding*[11]), were analysed separately from other nervous system tumours; leukaemias were analysed by cell type, and lymphomas were divided into Hodgkin's disease and non-Hodgkin's lymphomas.

The study subjects were classified into categories according to two estimates of magnetic field exposure: magnetic field (in μT) and the cumulative exposure (in μT years), the sum of the products of the average exposure each year and the duration of such exposure. The cut points for magnetic field and cumulative exposure (table I) were selected a priori on the basis of the distribution of the number of exposed children and taking into account the typical residential magnetic field level of $0.1\ \mu T$. Calculation of person years began on 1 January 1974 at the earliest or on the day when the child met the exposure criteria—that is, lived for the first time in a residence with a magnetic field exceeding the lower limit of the exposure category in question or had the cumulative exposure needed for the cumulative exposure category. Calculation of person years ended when the child entered the next exposure category, at the 20th birthday, at death, or on 31 December 1990, whichever occurred first. The observed numbers of cases and person years at risk were counted by sex, age, calendar period, and exposure category. The expected numbers of cases were calculated in five year age groups by multiplying the stratum specific number of person years by the corresponding cancer incidence in Finland. The standardised incidence ratios were calculated by dividing the observed number of cases by the number expected. The exact 95% confidence intervals were defined under the assumption that the observed number of cases followed the Poisson distribution.

Results

The 68 300 boys and 66 500 girls in the cohort contributed almost one million person years: boys 501 600 and girls 476 500 (table I). The study base (person years of children under follow up) constituted

TABLE I—*Children exposed to magnetic fields, Finland, 1974-90. Numbers are given in thousands; percentages are given in parentheses*

Exposure	No of children (n=134 800)	Person years (n=978 100)
Magnetic field (μT):		
0·01-0·04	104·1 (77·2)	763·1 (78·0)
0·05-0·09	15·0 (11·1)	104·7 (10·7)
0·10-0·19	8·5 (6·3)	60·0 (6·1)
≥0·20	7·3 (5·4)	50·3 (5·1)
Cumulative exposure (μT years):		
0·01-0·04	68·1 (50·5)	558·8 (57·1)
0·05-0·09	23·7 (17·6)	158·4 (16·2)
0·10-0·19	18·7 (13·9)	113·3 (11·6)
0·20-0·39	11.3 (8·4)	70·3 (7·2)
0·40-0·99	8·1 (6·0)	48·8 (5·0)
1·00-1·99	2·8 (2·1)	16·8 (1·7)
≥2·00	2·0 (1·5)	11·6 (1·2)

TABLE II—*Cancer in children exposed to magnetic fields, Finland, 1974-90*

Magnetic field (μT)	Boys: No of cases observed	Boys: No of cases expected	Boys: Standardised incidence ratio (95% confidence interval)	Girls: No of cases observed	Girls: No of cases expected	Girls: Standardised incidence ratio (95% confidence interval)	Total: No of cases observed	Total: No of cases expected	Total: Standardised incidence ratio (95% confidence interval)
Nervous system tumours:									
0·01-0·19	22	22·33	0·99 (0·62 to 1·5)	12	17·49	0·69 (0·36 to 1·2)	34	39·82	0·85 (0·59 to 1·2)
≥0·20	5	1·18	4·2 (1·4 to 9·9)	0	0·98	(0 to 3·8)	5	2·16	2·3 (0·75 to 5·4)
Leukaemia:									
0·01-0·19	15	19·38	0·77 (0·43 to 1·3)	17	16·72	1·0 (0·59 to 1·6)	32	36·10	0·89 (0·61 to 1·3)
≥0·20	1	1·01	0·99 (0·025 to 5·5)	2	0·92	2·2 (0·26 to 7·9)	3	1·93	1·6 (0·32 to 4·5)
Lymphoma:									
0·01/0·19	5	10·38	0·48 (0·16 to 1·1)	10	6·17	1·62 (0·78 to 3·0)	15	16·55	0·91 (0·51 to 1·5)
≥0·20	0	0·54	(0 to 6·8)	0	0·34	(0 to 11)	0	0·88	(0 to 4·2)
Cancers at other sites:									
0·01-0·19	20	22·41	0·89 (0·55 to 1·4)	28	22·29	1·3 (0·84 to 1·8)	48	44·70	1·1 (0·79 to 1·4)
≥0·20	2	1·17	1·7 (0·21 to 6·2)	1	1·25	0·80 (0·02 to 4·5)	3	2·42	1·2 (0·26 to 3·6)
All cancers:									
0·01-0·19*	62	74·50	0·83 (0·64 to 1·1)	67	62·67	1·07 (0·83 to 1·4)	129	137·17	0·94 (0·79 to 1·1)
≥0·20†	8	3·9	2·0 (0·88 to 4·0)	3	3·49	0·86 (0·18 to 2·5)	11	7·39	1·5 (0·74 to 2·7)

*Including 21 gliomas, 13 other nervous system tumours, 28 acute lymphatic leukaemias, one acute myeloid leukaemia, three other leukaemias, eight non-Hodgkin's lymphomas, and seven cases of Hodgkin's disease. The 47 other tumours occurred in subsequent primary sites: 10 in bones, seven in soft tissues, six in kidneys, five in colon, three each in ovaries and skin (two melanomas), two each in liver, testicles, eyes, and thyroid, one each in salivary glands, nasopharynx, vagina, pineal gland, and an unknown site.

†Three gliomas, two other nervous system tumours (one acoustic neurinoma and one neuroblastoma), three acute leukaemias, one melanoma of the skin, one adenocarcinoma of the thyroid, and one nephroblastoma.

TABLE III—*Cumulative exposure to magnetic fields and incidence of cancer in children in Finland, 1974-90*

Cumulative exposure (μT years)	Boys: No of cases	Boys: Standardised incidence ratio (95% confidence interval)	Girls: No of cases	Girls: Standardised incidence ratio (95% confidence interval)	Total: No of cases	Total: Standardised incidence ratio (95% confidence interval)
Nervous system tumours:						
0·01-0·39	20	0·92 (0·57 to 1.4)	12	0·70 (0·36 to 1·2)	32	0·82 (0·56 to 1·2)
≥0·40	7	4·2 (1·7 to 8·6)	0	(0 to 2·8)	7	2·3 (0·94 to 4·8)
Leukaemia:						
0·01-0·39	15	0·79 (0·44 to 1·3)	17	1·0 (0·60 to 1·6)	32	0·90 (0·62 to 1·3)
≥0·40	1	0·74 (0·02 to 4·1)	2	1·9 (0·002 to 6·7)	3	1·2 (0·26 to 3·6)
Lymphoma:						
0·01-0·39	5	0·50 (0·16 to 1·2)	9	1·5 (0·70 to 2·9)	14	0·88 (0·48 to 1·5)
≥0·40	0	(0 to 3·8)	1	1·7 (0·04 to 9·3)	1	0·64 (0·02 to 3·6)
Cancer at other sites:						
0·01-0·39	19	0·87 (0·52 to 1·4)	28	1·3 (0·87 to 1·9)	47	1·1 (0·80 to 1·4)
≥0·40	3	1·5 (0·32 to 4·5)	1	0·49 (0·01 to 2·7)	4	1·0 (0·27 to 2·6)
All cancers:						
0·01-0·39	59	0·81 (0·62 to 1·1)	66	1·1 (0·84 to 1·4)	125	0·93 (0·78 to 1·1)
≥0·40	11	1·9 (0·93 to 3·3)	4	0·8 (0·22 to 2·0)	15	1·4 (0·77 to 2·3)

4·3% of the person years lived by all Finnish children aged 0-19 during the study period. The mean length of follow up in the cohort was 7·3 years. Only 5·4% (7300) of the study subjects had been exposed to magnetic fields of ≥0·20 μT; 9·6% (12 900) of study subjects had a cumulative exposure of ≥0·40 μT years before the age of 20.

During the 17 year observation period 140 cases of childhood cancer were seen in the whole cohort; 145 cases were expected (tables II and III). A total of 39 nervous system tumours, 35 leukaemias, 15 lymphomas, and 51 other malignant tumours were observed.

The standardised incidence ratio for nervous system tumours among all children exposed to magnetic fields of ≥0·20 μT was 2·3 (five cases observed, 95% confidence interval 0·75 to 5·4); the corresponding standardised incidence ratio with a cumulative exposure estimate of ≥0·40 μT years was 2·3 (seven cases observed, 0·94 to 4·8).

The standardised incidence ratio for nervous system tumours among boys exposed to magnetic fields of ≥0·20 μT was 4·2 (five cases observed, 1·4 to 9·9); the corresponding standardised incidence ratio with a cumulative exposure estimate of ≥0·40 μT years was 4·2 (seven cases observed, 1·7 to 8·6). Three of these tumours, though with different morphologies and locations (one pilocytic astrocytoma of cerebrum, one oligoastrocytoma of spinal medulla, one schwannoma of acoustic nerve) were diagnosed in one 18 year old boy who had neurofibromatosis type 2. No nervous system tumours were found among girls in the same exposure categories. The results for gliomas and other nervous system tumours were essentially similar.

No significantly increased risks for leukaemias, lymphomas, other cancers, or all cancers were observed among children at any magnetic field or cumulative exposure level.

Discussion

Our study is the first to apply a cohort approach with person years in investigating the risk of cancer in children living close to power lines. Only three previous studies on the risk of childhood cancer have estimated exposure by calculating magnetic fields.[4-6] Cumulative exposure estimates have been used only once before.[4]

While conducting the study we faced some of the general problems of this field of study. Firstly, the need to estimate exposures of numerous people posed a challenge of developing methods to calculate historical magnetic fields. Secondly, the rarity of childhood cancer combined with the relatively uncommon experience of exposure to power lines could easily have led to difficulties in gaining meaningful results. The study size was sufficient to detect (α=0·05, power=0·80) a twofold increased risk for all cancers among all children living in magnetic fields of ≥0·20 μT, as well as a threefold risk for nervous system tumours and leukaemias and a fivefold risk for all lymphomas. Thirdly, several competing hypothetical biological mechanisms have been proposed to explain the possible carcinogenic effect in the vicinity of power lines.[12] Magnetic field rather than electric field was chosen as the study variable because only it penetrates the walls of houses.

ESTIMATING EXPOSURE

The method of calculating the magnetic field in the present study was designed to give point estimates of annual average magnetic fields at the central points of buildings. The operational situation in the Finnish transmission grid in early October has been found by experience to correspond to the average annual power. This assumption was tested by plotting the estimates of annual average load currents (l_A) against their actual arithmetic means (l_M); these were based on recordings of power level once every hour throughout the years 1988-92 in a sample of 230 transmission lines. This distribution was best estimated by the linear model $l_M = 0{\cdot}83 \times l_A$. The proportion of variation in the mean of the load current explained by the current measured in October was 85%. Because operational voltages of power lines remain practically constant over time, apparent power can be regarded as directly proportional to current and thus also to magnetic field.

Some obvious sources of error in estimating children's exposure to magnetic fields were unavoidable. The different lengths of time children spent at home and their exposure to magnetic fields from sources other than power lines[13] could not be taken into account.

CHILDHOOD CANCER

Our study showed a fourfold risk for nervous system tumours among boys, but no increased risk among girls. The risk was largely attributable to one boy with neurofibromatosis type 2 disease who had three primary tumours of the nervous system. Had we restricted the analysis to first primary cancers, the standardised incidence ratios for boys would have been non-significant. The increased risk for nervous system tumours among boys, however, parallels Wertheimer and Leeper's observations of a similar increase.[1]

Our results give only weak support to the four previous reports that indicate some increased risk for nervous system tumours in children living close to power lines[1-4] (table IV). They agree with the results of two recent occupational studies showing an increased risk for brain tumours among electrical workers.[14,15]

The increased risk for nervous system tumours among boys was observed in the cumulative exposure category of $\geqslant 0{\cdot}40\,\mu T$ years. Magnetic fields of $\geqslant 0{\cdot}20\,\mu T$ generated by power lines of 110 kV, 220 kV, and 400 kV almost never occur outside the distance of 60 m, 70 m, and 150 m, respectively. We estimated that at present about 1000 Finnish boys are exposed to magnetic fields of $\geqslant 0{\cdot}20\,\mu T$ generated by transmission power lines. Therefore, assuming a standardised incidence ratio of 4·2 for nervous system tumours, about one excess case would be expected every second year among the exposed boys in the whole country.

Our study does not confirm the results of some previous reports of an increased risk for leukaemia[1,3,4,6,7] and lymphoma.[1-4] As in the study by Tomenius,[2] in our study the slight increase in the overall risk of cancer was attributable to the increase in nervous system tumours. The four other studies with an increase in overall risk found an increased risk for several types of cancer.[1-4]

Little is known about risk factors in most childhood cancers.[16-17] One of the original studies on power lines and cancer was later suggested to be biased by the differing urban-rural distribution of cases of leukaemia and controls.[18] In our study, members of the cohort living in rural districts experienced 22% of all person years of exposure to magnetic fields between 1974-90. In the whole of Finland 42% of the person years were experienced by people living in rural districts. The incidence of childhood leukaemia showed no urban-rural difference, but the other types of childhood cancer were some 5% more common in urban municipalities than in rural ones. This means that our estimates for cancer risk are slightly higher than they would have been if the urban-rural distribution in our cohort had been the same as in the whole population.

In conclusion, our study shows no significant increase in the incidence of leukaemia, lymphoma, or cancers overall in children exposed to residential magnetic fields from power transmission lines in Finland. The significant increase in the incidence of nervous system tumours among boys is likely to be a

Public health implications

- The use of electricity has increased severalfold during the past decades but little is known about the health impacts of exposure to electromagnetic fields
- Previous epidemiological studies focused mainly on the carcinogenic effect of residential magnetic fields to children, but results have been inconsistent; the public has been worried about some results that suggest an increased risk for childhood cancers
- This study found no increased risk of overall cancer, leukaemia, lymphoma, or nervous system tumours in children exposed to residential magnetic fields close to transmission power lines in Finland
- The results suggest that magnetic fields of transmission power lines, when occurring at levels close to $0{\cdot}2\,\mu T$, do not form a major public health risk regarding childhood cancers
- The possibility of risk at higher magnetic field levels cannot, however, be eliminated on the basis of this study

TABLE IV—*Studies on risk of nervous system tumours in children living close to power lines*

Study	Conclusion	Exposure	No of exposed cases	Odds ratio (95% confidence interval)
Wertheimer and Leeper (1979)[1]	Indication of increased risk	Wire coding, high *v* low current configuration codes at death addresses	30	2·4 (1·2 to 5·0*)
		Wire coding, high *v* low current configuration codes at birth addresses	22	2·4 (1·0 to 5·4*)
Tomenius (1986)[2]	Indication of increased risk	Distance to 200 kV power line $\leqslant$ 150 m at birth and diagnosis residences	9†	3·9 (0·8 to 18·0*)
		Magnetic field of $\geqslant 0{\cdot}3\,\mu T$, based on measurements at birth and diagnosis residences	13†	3·7 (1·1 to 13·0*)
Savitz *et al* (1988)[3]	Indication of increased risk	Magnetic field of $\geqslant 0{\cdot}2\,\mu T$, based on measurements under conditions of low power use at diagnosis residence	2	1·0 (0·2 to 4·8)
		Wire coding, high *v* low current wire configurations at diagnosis residence	20	2·0 (1·1 to 3·8)
		Wire coding, very high *v* low buried wire configurations at diagnosis residence	3	1·9 (0·5 to 8·0)
Feychting and Ahlbom (1992)[6]	No evidence of increased risk	Distance of 200-400 kV power line $\leqslant$ 50 m, at time closest to diagnosis	1	0·5 (0·0 to 2·8)
		Magnetic field of $\geqslant 0{\cdot}2\,\mu T$, calculated for time closest to diagnosis	2	0·7 (0·1 to 2·7)
		Magnetic field of $\geqslant 0{\cdot}2\,\mu T$, spot measurements at residence closest to time of diagnosis	5	1·5 (0·4 to 4·9)
Olsen *et al* (1993)[4]	Some indication of increased risk	Magnetic field of $\geqslant 0{\cdot}25\,\mu T$, calculated for the address within a specific distance of a power line	2	1·0 (0·2 to 5·0)
		Magnetic field of $\geqslant 0{\cdot}4\,\mu T$, calculated for the address within a specific distance of a power line	2	6·0 (0·7 to 44·0)

*Calculated using data given in original report. †Number of dwellings.

chance finding. The results suggest that the risk of childhood cancer in the vicinity of these power lines is not a major public health concern. The relation between a risk of childhood cancer and exceptionally high levels of residential exposure to magnetic fields should not, however, be inferred from this study.

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Arthroscopic surgery compared with supervised exercises in patients with rotator cuff disease (stage II impingement syndrome)

Jens Ivar Brox, Peer H Staff, Anne Elisabeth Ljunggren, John Ivar Brevik

Department of Physical Medicine and Rehabilitation, Ullevaal University Hospital, 0407 Oslo, Norway
Jens Ivar Brox, *research fellow*
Peer H Staff, *director*
Anne Elisabeth Ljunggren, *adjunct professor in physiotherapy*

Department of Social Networks and Health, Ullevaal University Hospital, 0407 Oslo, Norway
John Ivar Brevik, *researcher*

Correspondence to: Dr Brox.

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Abstract

***Objective*—To compare the effectiveness of arthroscopic surgery, a supervised exercise regimen, and placebo soft laser treatment in patients with rotator cuff disease (stage II impingement syndrome).**

***Design*—Randomised clinical trial.**

***Setting*—Hospital departments of orthopaedics and of physical medicine and rehabilitation.**

***Patients*—125 patients aged 18-66 who had had rotator cuff disease for at least three months and whose condition was resistant to treatment.**

***Interventions*—Arthroscopic subacromial decompression performed by two experienced surgeons; exercise regimen over three to six months supervised by one experienced physiotherapist; or 12 sessions of detuned soft laser treatment over six weeks.**

***Main outcome measures*—Change in the overall Neer shoulder score (pain during previous week and blinded evaluation of function and range of movement by one clinician) after six months.**

***Results*—No differences were found between the three groups in duration of sick leave and daily intake of analgesics. After six months the difference in improvement in overall Neer score between surgery and supervised exercises was 4·0 (95% confidence interval −2 to 11) and 2·0 (−1·4 to 5·4) after adjustment for sex. The condition improved significantly compared with placebo in both groups given the active treatments. Treatment costs were higher for those given surgery (£720 *v* £390).**

***Conclusions*—Surgery or a supervised exercise regimen significantly, and equally, improved rotator cuff disease compared with placebo.**

Introduction

Pain in the shoulder is a common medical problem. Its prevalence was 14% in a Swedish epidemiological study.[1] Work or leisure activities that entail raising the arms or working with hand tools increase the risk of developing shoulder pain.[2-5] The prevalence of supraspinous tendinitis was 18% among welders.[3]

Ischaemia, inflammation, and degeneration are related to age and overload of the tendons of the short rotator muscles and are present in rotator cuff disease.[6-8] Impingement of the cuff and the subacromial bursa on elevation increases the pain and may contribute to long term changes. Rotator cuff disease or the impingement syndrome is classified according to its progression: acute inflammation (tendinitis or bursitis) (stage I); degeneration or chronic inflammation,[7] or both (stage II); rupture and arthritis (stage III).[9]

Commonly, rest, analgesics, anti-inflammatory drugs, local steroid injections, and remobilisation with simple exercises will resolve most cases of tendinitis.[10] The results of the long term outcome of these treatments, however, is not promising,[11] although open anterior and arthroscopic acromionplasty have a success rate of 80-90%.[12-14] We compared arthroscopic subacromial decompression and supervised exercises in a controlled, randomised series of patients with rotator cuff disease. To our knowledge, such a study has not been published before.

Subjects and methods

SELECTION OF PATIENTS

General practitioners serving a population of half a million were invited to refer patients with rotator cuff disease.

Patients were included if they were aged 18-66; had had pain in the shoulder for at least three months that had been resistant to outpatient physiotherapy and non-steroid and steroid anti-inflammatory drugs; had dysfunction or pain on abduction; had a normal passive glenohumeral range of movement; had pain during two of the three isometric-eccentric tests (abduction at 0° and 30° and external rotation)[15]; and had positive results in tests for impingement.[9] Lignocaine (6 ml; 10 mg/ml) was injected anteriorly into the subacromial space.[15] The diagnosis was confirmed if pain was