SCIENTIFIC REPORT

Decreasing strabismus surgery

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Aim: To determine whether there has been a consistent change across countries and healthcare systems in the frequency of strabismus surgery in children over the past decade.

Methods: Retrospective analysis of data on all strabismus surgery performed in NHS hospitals in England and Wales, on children aged 0–16 years between 1989 and 2000, and between 1994 and 2000 in Ontario (Canada) hospitals. These were compared with published data for Scotland, 1989–2000.

Results: Between 1989 and 1999–2000 the number of strabismus procedures performed on children, 0–16 years, in England decreased by 41.2% from 15 083 to 8869. Combined medial rectus recession with lateral rectus resection decreased from 5538 to 3013 (45.6%) in the same period. Bimedial recessions increased from 489 to 762, oblique tenotomies from 43 to 121, and the use of adjustable sutures from 29 to 44, in 2000. In Ontario, operations for squint decreased from 2280 to 1685 (26.1%) among 0–16 year olds between 1994 and 2000.

Conclusion: The clinical impression of decrease in the frequency of paediatric strabismus surgery is confirmed. In the authors' opinion this cannot be fully explained by a decrease in births or by the method of healthcare funding. Two factors that might have contributed are better conservative strabismus management and increased subspecialisation that has improved the quality of surgery and the need for re-operation. This finding has a significant impact upon surgical services and also on the training of ophthalmologists.

The number of children receiving surgical correction of their strabismus appears to be declining. A reduction of 42% in surgical episodes in the under 14 age group was reported in one region of England[1] and a 58% decrease in episodes of paediatric squint surgery in Scotland as a whole and a 59% decrease in the area of Tayside, respectively.[2] We set out to determine whether these regional changes were part of a national, secular change and whether they occurred across healthcare systems which are funded differently, as in Canada.

PATIENTS AND METHODS

Data on all strabismus surgery performed on children aged 0–16 years between 1989 and 2000 were obtained from hospital episode statistics, Department of Health, England. The data were compiled from returns sent by all (over 300) National Health Service trusts in England and Wales, or their precursor health authorities. The number of operations performed with private funding in independent hospitals and NHS paybeds was derived from an analysis of data collected for a national study of the apportionment of clinical services between the public and private healthcare sectors in England and Wales, for the years 1992–3 and 1997–8.[3] A child vision screening programme exists in only six of the Canadian provinces, so to rule out uncertainties in data collection only data from the most populous Canadian province of Ontario were included for comparison in this study. Data were available from 1994 to 2000. The number of operations performed on extraocular muscles (Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures (CCP) classification range 230–239) on children aged 0–16 as day cases or inpatients in Ontario hospitals was supplied by the Canadian Institute of Health Information, a not for profit agency, to which provincial health departments have returned hospital discharge data. National birth statistics for England and Wales from 1982 to 1999 were obtained from published reports of the Office of Population Censuses and Surveys.[4] Birth statistics for Ontario were provided by the government of Ontario.

Hospital episode statistics on surgical activities involving the eye muscles are classified according to the Office of Population Censuses and Surveys, Classification of Surgical Operations and Procedures Fourth Revision, 1990, into six three digit categories, each with fourth digit subdivisions according to the precise details of the procedure performed. Six categories include all the surgical procedures performed on eye muscles and represent the total number of strabismus operations undertaken in England and Wales—namely, C31, combined operations on eye muscles; C32, recession of eye muscle; C33, resection of eye muscle; C34, partial division of tendon of eye muscle; C35, other adjustment to eye muscle; and C37, other operations on eye muscle. We could not discount double counting across categories and in many instances we were unable to infer the type of strabismus from the surgical code. Our analysis was therefore limited to the total number of strabismus procedures performed in the past decade on children 0–16 years. Subcategories providing robust data that reflected significant changes in surgical trends over the past decade were also analysed—for instance, C31.1 (medial rectus recession with lateral rectus resection) and C31.2 (bilateral medial rectus recession), that are specific for the correction of convergent strabismus. Categories reflecting the use of inferior oblique tenotomies (C34.6), adjustable sutures (C35.3), and botulinum toxin (C37.8) were also analysed.

RESULTS

England and Wales

The total number of live births in England and Wales decreased by 9.6% from 1989 to 2000 (fig 1, table 1). Over this period the number of strabismus operations performed in NHS hospitals decreased by 41.2% from 15 083 to 8869. In the independent sector there was a decrease of 63.4% from 938 in 1992–3 to 343 in 1997–8.[3]

Individual strabismus procedures

This decrease was not uniform for individual procedures. Thus, even though the proportion of each type of strabismus surgery performed varied the decrease in each group was

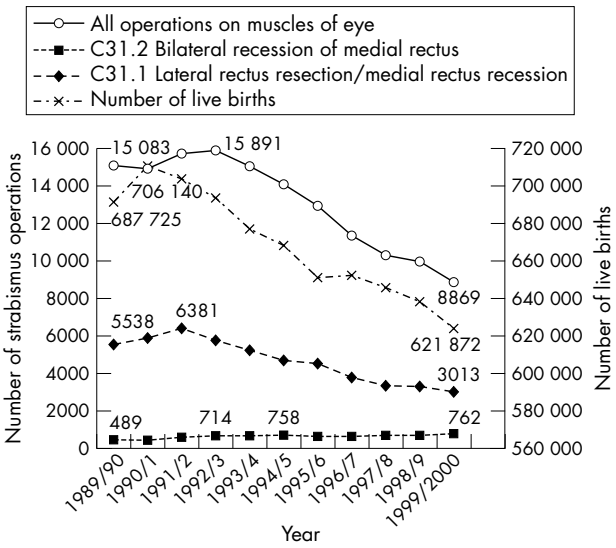

Figure 1 Total number of live birth and strabismus operations 1989–2000.

evident: combined operations on eye muscles (C31) fell by 32.7%, recession of eye muscle (C32) by 46.0%, resection of eye muscle (C33) by 43.9%, partial division of tendon of eye muscle (C34) by 48.6%, other adjustments to eye muscle (C35) by 65.0%, and other operations on eye muscle (C37) by 57.7%.

Medial rectus muscle recession and lateral rectus muscle resection (C31.1) decreased from 5538 procedures in 1989–90 to 3013 in 1999–2000, a decrease of 45.6% (fig 1). There was a trend towards bimedial recessions (C31.2) from 489 in 1989–90 to 762 in 1999–2000, a rise of 55.8%. Other procedures have reduced in frequency, such as botulinum toxin 59.8% (C37.8 from 331 to 133), while others have increased, including the primary use of adjustable sutures (C35.3) by 51.7% from 29 to 44 and inferior oblique tenotomies (C34.6) by 181.4% from 43 to 121.

Canada

The total number of live births, and the number of surgical procedures for strabismus performed on children aged 0–16 years in Ontario are shown in table 2. There was a 26.1% decrease in the number of strabismus procedures between the years 1994 and 2000.

DISCUSSION

There has been a major and continued decrease in the number of strabismus operations performed on children in England and Wales. In our opinion a switch from state to private sectors is unlikely. Although we were only able to present data from 2 years (1992–3 and 1997–8), the decrease in the state sector to be taken up by private practice would require an extraordinary and implausible seesaw in practice. Neither in England and Wales nor in Ontario could the decrease in strabismus surgery be accounted for by a chance reduction in live births. In addition, as shown in table 1 the change has been gradual, not abrupt, such as would happen if there were an artefactual explanation, like a change in coding practice. Thus, while acknowledging the imperfections of the data collected, in our opinion there is no reasonable doubt that this represents a real decrease in strabismus surgery on children both in England and Wales and in Canada.

The prevalence of strabismus ranges from about 3% to 5%[5–7] Its aetiology is complex, being influenced by hereditary[7 8] and environmental factors. The latter include maternal smoking during pregnancy,[9] maternal age at parity, low birth weight[10 11] and its complications (retinopathy of prematurity, refractive error or neurodevelopment delay), and the non-specific association of neurodevelopmental problems and multiple disabilities. Childhood infections such as measles or subclinical encephalitis have also been implicated.[12]

This reduction of 41% in strabismus operations cannot be fully accounted for by the 9.6% decrease in birth numbers; a change in the incidence of strabismus, a shift to private practice, or a major change in surgical signature. Although it is possible that increasing subspecialisation has improved the quality of surgery and the need for re-operation, our data could not show it. Similarly, the 26.1% reduction in strabismus surgery in Ontario cannot be fully accounted for by the 15.7% decrease in birth rate. The consistency of strabismus surgical rates across the different healthcare systems of England and Wales, Scotland, and Canada, suggests a concordance in surgical decision making, assuming similar incidence rates of strabismus (table 3).

Table 1 Number of live births from 1982–3 to 1999–2000 and strabismus procedures (total number and by category (C31 to C37)) from 1989 to 2000, England and Wales

Year	C31	C32	C33	C34	C35	C37	Total number of strabismus operations	Number of live births
1982–3								625 931
1983–4								629 134
1984–5								636 818
1985–6								656 417
1986–7								661 018
1987–8								681 511
1988–9								693 577
1989–90	6809	4285	2189	352	660	788	15 083	687 725
1990–1	7080	3894	2155	306	639	816	14 890	706 140
1991–2	7786	3939	2291	309	631	767	15 723	699 217
1992–3	7497	4400	2690	371	463	470	15 891	689 656
1993–4	7244	4150	2453	387	396	405	15 035	673 467
1994–5	6717	3815	2346	373	339	509	14 099	664 726
1995–6	6236	3638	2090	330	222	436	12 952	648 138
1996–7	5417	3202	1789	310	223	378	11 319	649 485
1997–8	5217	2751	1544	300	198	299	10 309	643 095
1998–9	5170	2654	1385	228	213	303	9953	635 901
1999–2000	4582	2313	1229	181	231	333	8869	621 872

See text for explanation of codes.

Table 2 Numbers of live births to mothers resident in Ontario and procedures to extraocular muscles on children aged 0–16 years in Ontario hospitals

Year	Number of live births	Total number of operations on extraocular muscles
1982	124 856	
1983	126 826	
1984	131 296	
1985	132 208	
1986	133 872	
1987	134 617	
1988	138 066	
1989	145 338	
1990	150 923	
1991	151 478	
1992	150 593	
1993	147 544	
1994	146 839	2280
1995	146 036	2026
1996	139 846	1885
1997	132 799	1972
1998	130 789	1901
1999	131 083	1887
2000	127 741	1685
% change 1991 to 2000	23 737/151 478 = −15.7%	
% change 1994 to 2000		595/2280 = −26.1%

Table 3 Numbers of operations on extraocular muscles in the year 2000, and operation rates

Area	Age group (years)	Operations on extraocular muscles	Population	Operation rate/10 000
Scotland	0–14	797	906 882	8.8
England and Wales	0–16	8769	11 305 870	7.8
Ontario	0–14	1618	2 232 750	7.2
	0–16	1683	2 547 495	6.6

Preschool vision screening was introduced in the 1960s. By 1988, 99% of national health authorities had a screening programme in place.[13 14] Ferguson *et al*[15] and Carney *et al*[1] suggested the decline in strabismus surgery was a result of improved health and preschool screening. MacEwan and Chakrabarti[2] disagreed by arguing that if screening had contributed to this decrease its effect would have been noted earlier as preschool screening was established a decade before the noted decrease in the number of surgical episodes.

MacEwan and Chakrabarti noted that the decrease was greatest for procedures to correct esotropia,[2] and also noted a recent trend towards full hypermetropic spectacle correction. We are unable to infer from our national data the reason for change in surgical procedures; however, advances in conservative management (treatment of the associated refractive error) offer a plausible explanation for at least some of the decrease.

This has important implications for service and training. There are about 670 consultants and 750 ophthalmic trainees in England and Wales, and there is a need, already informally recognised, for strabismus surgery on children to be undertaken only by those ophthalmologists specifically trained in paediatric ophthalmology. The number of strabismus procedures required for training in the United Kingdom has recently been reduced, but even so programmes need to be designed so that trainees achieve sufficient surgical volume to gain the necessary expertise.

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CONTRIBUTORS

AF and JY had the original idea, and devised the study protocol and methods of analysis; BW provided the private hospital data; AA, AF, JY, BW, AKA, and RMcN analysed the data; the article was revised and the final version was approved by all contributors.

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