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**Incidence and characteristics of cataract surgery in France from 2009 to 2012: a national population study**

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## **ABSTRACT**

**Objective:** To report age- and sex-specific incidence rates of cataract surgery in France and evaluate the trends of cataract surgery from 2009 to 2012.

**Design:** Cohort study

**Subjects:** Data for all patients who underwent primary cataract surgery in France between January 2009 and December 2012 were collected from the national database.

**Methods:** Annual incidence rates were calculated and adjusted to the corresponding-year national population data from the French national institute of statistics. Kaplan-Meier analysis was used to assess the time between surgeries for both eyes and the relationship between age and interval for bilateral surgery.

**Main Outcome Measures:** Age- and sex-specific incidence of cataract surgery.

**Results:** Over the 4 years, 2,717,203 eyes in 1,817,865 patients (59.1% women, mean age 73.5±0.015 years) underwent cataract surgery. Between 2009 and 2012, the total number of operated eyes per year increased, from 634,070 to 723,172 (+14.0%) and the number of patients with one or both eyes undergoing cataract surgery decreased, from 475,301 to 449,318 (-5.5%). The incidence of cataract surgery increased from 9.86 to 11.08/1,000 person-years and that of operated patients (one or both eyes) decreased from 7.39 to 6.89/1,000 person-years. The incidence of cataract surgery ranged from 1.06/1,000 person-years for patients 40-49 years old to 65.94/1,000 person-years for those 80-89 years old. Between 2009 and 2012, the probability of second-eye surgery 12 months after the first-eye surgery increased from 40.6% to 51.2% (P<.0001). The median interval for surgery between eyes was 29 (interquartile range 14-86) days and decreased over the study period (P<.0001). The rate of posterior capsular tear was 0.20%, with a higher proportion from extracapsular extraction than phacoemulsification (7.9% vs 0.15%; P<.0001). The proportion of patients who underwent cataract surgery with a history of high myopia or eye trauma or retinal detachment was 0.49%, 0.21%, and 0.80% respectively.

**Conclusions:** This study documented the incidence and trends in cataract surgery in the overall population in France. Between 2009 and 2012, the number of people undergoing cataract surgery slightly decreased, but the total number of operated eyes increased because the proportion of surgeries on the second eye increased.

## **Introduction**

Cataract is the most common eye disease in older adults and is a major cause of vision impairment and blindness worldwide.<sup>1</sup> Cataract surgery is the most commonly performed procedure in people > 65 years old in the developed world.<sup>2</sup> Additionally, with the aging of the population in Western countries, the number of people with cataract surgery is increasing.<sup>3</sup>

Two studies based on general population data reported on the incidence of cataract surgery: the Swedish National Cataract Register reported an incidence of 9.0/1,000 person-years in 2009,<sup>4</sup> and the Rochester Epidemiology Project, performed in Olmsted County, Minnesota, USA, reported an incidence of 11.0/1,000 person-years in 2011.<sup>5</sup> A few reports of the incidence of cataract lens opacities were based on a limited cohort of patients.<sup>6,7</sup>

Detailed incidence data regarding cataract surgery are important for determining community surgical needs and assessing the potential impact of intervention strategies. An efficient source of incidence data on cataract surgery in France is the national administrative database of hospitalizations (Programme de Médicalisation des Systèmes d'Information [PMSI]) which reports all cataract surgeries performed in France. The PMSI database has provided accurate population-based data.<sup>8,9</sup>

The purpose of the current study was to assess the incidence of cataract surgery in France between 2009 and 2012. Secondary objectives were to determine the characteristics of patients who underwent cataract surgery, the surgical techniques used, the per-operative complication incidence and the time between surgeries for both eyes as well the relationship with age.

## **Methods**

The study protocol was approved by the national health authority in France.

### *Data source*

The data for all patients who underwent cataract surgery in France between January 2009 and December 2012 were collected from the PMSI, similar to the US Medicare system. Since 2004, each hospital's budget depends on the medical activity described in the PMSI, which compiles discharge abstracts related to all admissions in the 1,546 French healthcare facilities, public or private. Information in these abstracts covers both medical and administrative data, including identification number, date of birth, and gender of patients. These data are rendered anonymous, and discharge abstracts related to a given patient can be linked, as usually done with Medicare data. Routinely collected medical data include the principal diagnosis, secondary diagnoses, and procedures performed. Diagnoses identified during the hospital stay are coded according to the International Classification of Diseases, Tenth Revision (ICD-10). The French data from the national institute of statistics was used to obtain population census data between 2009 and 2012 by sex and age group.<sup>10</sup>

### *Data extraction*

For each patient, cataract surgery was identified by the PMSI code BFGA004 corresponding to cataract extraction performed by phacoemulsification with intraocular lens implantation in a capsular bag, or by BFGA002, BFGA006, BFGA008 or BFGA009, corresponding to manual extracapsular extraction. Patients with previous retinal surgery were not included. The peri-operative vitrectomy procedure used for posterior capsular rupture was recorded if the code BFGA008 was associated with the surgical care.

Sociodemographic variables including age and gender were recorded. Eye characteristics, including high myopia and a history of eye trauma, were collected with ICD-10 diagnostic codes H44.2 or H52.1 and S05, respectively. Before extraction of the cohort, 0.26% of persons were

not included because of presumed coding errors. Excluded persons were younger ( $p < 0.01$ ) and the proportion of women were lower ( $p < 0.01$ ) as compared with the study population.

### *Statistical analysis*

Characteristics of patients who underwent cataract surgery in France are presented with mean  $\pm$  SE and relative frequencies. Annual incidence rates by age group were adjusted to the corresponding year population data from the national institute of statistics in France. Kaplan-Meier analysis was used to assess the interval between surgeries for both eyes and the relationship between age and interval for bilateral surgery. The duration of follow-up after cataract extraction was based on the patient's last registration in the database, which was December 2012 for all patients. Differences in intervals between surgeries for both eyes were investigated by the log-rank test. Significance was set at  $P < .01$ . Analysis involved use of SAS v9.3 (SAS Inst., Cary NC).

## **Results**

### *Overall and age- and sex-specific incidence of cataract surgery*

Between 2009 and 2012, 2,717,203 eyes in 1,817,865 patients (59.1% women, mean age  $73.5 \pm 0.015$  years) underwent cataract surgery in France (**table 1**).

The total number of operated eyes per year increased, from 634,070 to 723,172 (+14.0%), but the number of patients with one or both eyes undergoing cataract surgery decreased, from 475,301 to 449,318 (-5.5%) (**table 1**). The corresponding incidence of cataract surgery increased from 9.86 to 11.08/1,000 person-years and the number of operated patients (one or both eyes) decreased from 7.39 to 6.89/1,000 person-years (**figure 1; table 1**).

The incidence of cataract surgery ranged from 1.06/1,000 person-years for people 40 to 49 years old to 5.04, 20.57, 59.33, 65.94 and 26.38/1,000 person-year for those 50-59, 60-69, 70-79, 80-

89 and  $\geq 90$  years old, respectively (**table 1**). The proportion of operated women increased among age groups, from 46.7% for those 40-49 years old to 49.7%, 54.5%, 60.4%, 63.3%, 67.0% for those 50-59, 60-69, 70-79, 80-89 and  $\geq 90$  years old, respectively. In age group 60-79 years old, the incidence was higher for women and in age group  $\geq 80$  years old, incidence was higher for men (**figure 2**).

### *Characteristics of cataract surgery in France between 2009 and 2012*

Phacoemulsification was used in 99.3% of surgeries (**table 2**). Use of extracapsular lens extraction decreased between 2009 and 2012 (0.83% vs 0.58%, respectively;  $P < .0001$ ). The proportion of patients who underwent cataract surgery with a history of high myopia or eye trauma or retinal detachment was 0.49%, 0.21%, and 0.80% respectively (**table 2**). The rate of anterior vitrectomy for posterior capsular tear was 0.20% overall, with a higher occurrence from extracapsular extraction than phacoemulsification (7.9% vs 0.15%,  $P < .0001$ ) (**table 2**).

### *The time between surgeries for both eyes decreased between 2009 and 2012*

Between 2009 and 2012, the probability of second-eye surgery 12 months after the first-eye surgery increased from 40.6% to 51.2% ( $P < .0001$ ; **table 3**). The probability of second-eye surgery increased within 7, 15, 30 or 60 days after surgery for the first eye ( $P < .0001$ ; **table 3**).

The median (interquartile range) number of days for surgery between eyes was 29 (14-86) and decreased over the study period ( $P < .0001$ ; **figure 3**).

The probability of second-eye surgery within 15 days after first-eye surgery was higher for younger than older patients (logrank  $P < .0001$ ; **figure 4**).

## Discussion

The PMSI program, with its exhaustive national database from the 1,546 French healthcare facilities, public or private, has allowed for assessing the characteristics and trends of cataract surgery in France. This study documented age-specific rates for the incidence of cataract surgery in the overall population in France. The proportion of bilateral surgery increased from 2009 to 2012 and the time between surgeries for both eyes decreased, with a higher proportion of younger than older patients undergoing surgery on both eyes within an interval of 13 days. The rate of the main per-operative complication, vitrectomy for posterior capsular tear, was 0.2%, with a notable higher occurrence with extracapsular extraction than phacoemulsification.

The incidence of cataract surgery has increased in the developed world during the last decade with the conversion from extracapsular extraction to phacoemulsification.<sup>4,5,11,12</sup> The rate of cataract surgery in Sweden increased from 4.5 to 9.0/1,000 person-years from 1992 to 2009<sup>4</sup> and in Minnesota from 8.5 to 11.0/1,000 person-years from 2005 to 2011.<sup>5</sup> In France, between 2009 and 2012, the incidence of cataract surgery increased from 9.86 to 11.08/1,000 person-years, but the incidence of operated patients (one or both eyes) decreased from 7.39 to 6.89/1,000 person-years.

In the present study and in previous studies,<sup>11,12</sup> the incidence of cataract surgery increased for older age groups. Cataract reflects well-described aging processes in the lens. By the age of 80 years, 80% of people will have a significant cataract in one or both eyes or will undergo cataract surgery.<sup>7</sup> During the 4-year period of the study, the age-specific incidence increased in all age groups over 50 years old. The age-group incidence was close to that observed in previous studies.<sup>4,5</sup> The mean age with cataract surgery ranged from 73.0 years in 2011 in Minnesota<sup>5</sup> to 74.9 years in 2009 in Sweden.<sup>4</sup> In the present study, the mean age was 73.4 years in 2012.

In Western countries, the mean lifespan is increasing. Most older adults are living independently at home; however, difficulties in performing daily tasks increase with age.<sup>13</sup> Bilateral cataract surgery has markedly improved vision-related limitations in activity.<sup>14</sup>

Previous study noted a difference in surgical frequency by gender,<sup>15</sup> which was also observed in the present analysis. The proportion of women who underwent cataract surgery in Sweden was 61.0% in 2009.<sup>4</sup> In the present study, the proportion of women was 59.1%. Furthermore, a delay of surgery was observed for men with lower incidence in younger patients and higher incidence in older ones (figure 2). The transition to the phacoemulsification technique for surgery occurred in France during the 1990s and in the present study, was used for 99.3% of surgeries. The extracapsular extraction remained used for some patients and decreased between 2009 and 2012 (0.8% to 0.6% of surgeries). We documented the rate of vitrectomy for capsular tear, which was 0.20%, with higher occurrence with extracapsular extraction than phacoemulsification (7.9% vs 0.15%;  $P < .0001$ ). This difference is probably due to the need for extracapsular extraction being limited to patients with very dense cataracts or loose zonules who are at increased risk of capsular tear. This rate was consistent over the 4-year period. Because of the high association of this complication with incidence of post-operative retinal detachment<sup>16</sup> and endophthalmitis,<sup>17</sup> a close follow-up of patients with capsular tear is necessary.

In the Swedish population, the proportion of patients with cataract surgery in the second eye increased from 28.5% to 40.4% from 1992 to 2009.<sup>4</sup> We found that in France, the proportion of patients undergoing surgery in the second eye within 1 year increased between 2009 and 2012 (40.6% to 51.2%) and also within 7, 15, 30 or 60 days after surgery for the first eye. This trend in cataract surgery practice explains the increased number of operated eyes even though the number of people undergoing surgery slightly decreased over the 4-year period. One hypothesis to explain this effect in France is the shift to earlier and more frequent second-eye surgery. In regions with a low density of surgeons, the delay for cataract diagnosis is increasing. Thus, when

the patient consults for cataract, both eyes need surgery. Conversely, in regions with a high density of surgeons, the more frequent second-eye surgery could be due to the documented benefits of bilateral surgery<sup>14</sup> and higher demand for high-quality vision in older people. Furthermore cataract surgery has undergone significant developments in order to become an effective procedure that provide early recovery of vision. The higher proportion of surgery between eyes observed in younger patients may be related to higher demand in working people.

Strengths of the study are the population size, the national recruitment, the importance of its findings and potential impact on public health. Given the reliance on *PMSI* codes for the selection of patients and the ascertainment of outcomes, there was a potential for misclassification- or underdetection-related biases. However this may have only a minor impact on the findings. Finally, the results of the present study may be specific to the French healthcare system and its financial resources and cannot be generalized a priori to other countries with different healthcare systems or different levels of funding.

In conclusion, this study documented trends in cataract surgery and age-specific rates for the incidence of surgery in the overall population in France. Between 2009 and 2012, the number of people who underwent surgery slightly decreased, but the total number of operated eyes increased because the proportion of surgeries on the second eye increased; as well, the time between surgeries for both eyes decreased, with a higher proportion of younger than older patients undergoing surgery on both eyes within 15 days.

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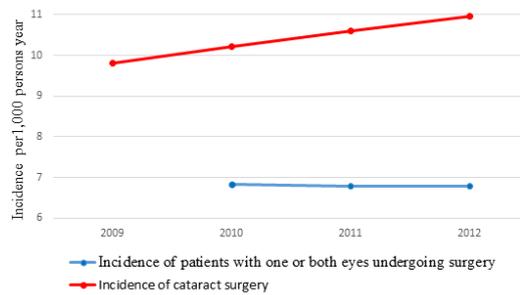
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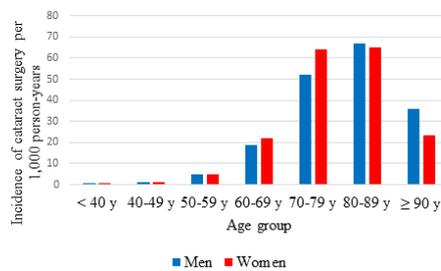
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## Figures legends

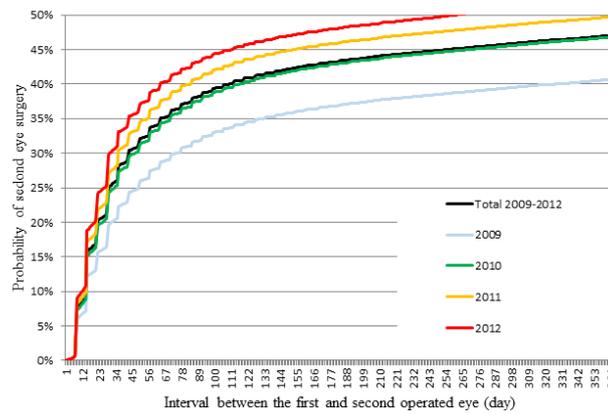
**Figure 1. Incidence of cataract surgery and of patients undergoing cataract surgery in one or both eyes between 2009 and 2012.**



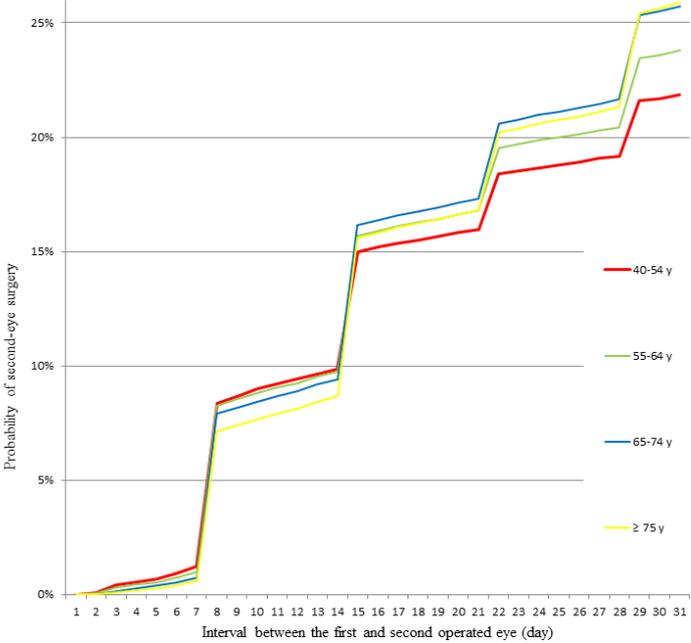
**Figure 2. Age- and sex-specific incidence of cataract surgery in the total cohort of patient (2009-2012).**



**Figure 3. Relationship between the time interval for bilateral surgery and probability of bilateral surgery between 2009 and 2012. The time between surgery for both eyes decreased (log-rank  $P < .0001$ ). The median interval for surgery between eyes was 29 (interquartile range 14-85) days.**



**Figure 4. Relationship between age and time interval for bilateral surgery. A short interval of surgery < 14 days between eyes was more frequent for younger than older age groups (log-rank  $P < .0001$ ).**



**Table 1. Incidence of cataract surgery from 2009 to 2012 in France by age group**

	2009	2010	2011	2012	Total 2009-2012
<b>Age, mean±SE</b>	73.6 ±0.03	73.5±0.03	73.5±0.03	73.4±0.03	73.5±0.015
<b>&lt; 40 y</b>	32,539,507	32,498,504	32,440,658	32,363,744	
No. of cataract surgery	3,858	3,783	3,970	4,002	15,613
Incidence/1,000 person-years	0.12	0.12	0.12	0.12	0.12
Gender, % women	41.6%	41.4%	40.6%	42.7%	41.6%
<b>40-49 y</b>	9,007,052	9,009,993	9,027,087	9,060,930	
No. of cataract surgery	9,461	9,578	9,575	9,502	38,116
Incidence/1,000 person-years	1.05	1.06	1.06	1.05	1.06
Gender, % women	46.7%	46.3%	47.3%	46.4%	46.7%
<b>50-+59 y</b>	8,506,949	8,499,268	8,490,633	8,522,516	
No. of cataract surgery	41,108	42,057	43,395	44,763	171,323
Incidence/1,000 person-years	4.83	4.95	5.11	5.25	5.04
Gender, % women	48.8%	49.7%	50.2%	50.0%	49.7%
<b>60-69 y</b>	6,219,419	6,482,736	6,788,293	7,078,052	
No. of cataract surgery	119,197	130,359	142,176	154,834	546,566
Incidence/1,000 person-years	19.17	20.11	20.94	21.88	20.57
Gender, % women	54.2%	54.2%	54.4%	55.1%	54.5%
<b>70-79 y</b>	4,764,103	4,755,154	4,697,361	4,625,310	
No. of cataract surgery	268,616	277,097	282,299	289,815	1,117,827
Incidence/1,000 person-years	56.38	58.27	60.10	62.66	59.33
Gender, % women	60.9%	60.5%	60.3%	59.9%	60.4%
<b>80-89 y</b>	2,838,530	2,931,159	2,979,759	3,023,603	
No. of cataract surgery	182,180	191,121	198,469	204,493	776,263
Incidence/1,000 person-years	64.18	65.20	66.61	67.63	65.94
Gender, % women	64.3%	63.3%	63.0%	62.6%	63.3%
<b>≥ 90 y</b>	428,940	436,125	509,609	577,582	
No. of cataract surgery	9,650	11,717	14,365	15,763	51,495
Incidence/1,000 person-years	22.50	26.87	28.19	27.29	26.38
Gender, % women	67.0%	67.0%	67.0%	67.0%	67.0%
<b>Total</b>	64,304,500	64,612,939	64,933,400	65,251,737	
No. of cataract surgery	634,070	665,712	694,249	723,172	2,717,203
Incidence/1,000 person-years	9.86	10.30	10.69	11.08	10.49
Incidence of one or both eyes undergoing surgery	7.39	6.92	6.87	6.89	7.02
Gender, % women	59.5%	59.1%	58.9%	58.7%	59.1%

**Table 2. Characteristics of cataract surgery in France from 2009 to 2012 among patients >40 years**

	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>Total 2009-2012</b>
<b>Surgical technique</b>					
Phacoemulsification (%)	99.2	99.3	99.4	99.4	99.3
Extracapsular extraction (%)	0.83	0.70	0.64	0.58	0.68
<b>Anterior vitrectomy for per-operative capsular rupture (%)</b>					
	0.23	0.20	0.19	0.21	0.20
Phacoemulsification (%)	0.16	0.14	0.14	0.16	0.15
Extracapsular extraction (%)	7.3	8.1	8.2	8.4	7.9
<b>Eye characteristics of patients</b>					
High myopia (%)	0.56	0.51	0.47	0.43	0.49
History of eye trauma (%)	0.21	0.23	0.20	0.19	0.21
History of retinal detachment (%)	-	0.81	0.98	1.11	0.80

**Table 3. Proportion of bilateral surgery**

<b>Proportion of patient undergoing bilateral surgery</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>Total</b>	<b>P value 2009-2012</b>
Within 7 days	5.98%	7.16%	8.07%	8.91%	7.51%	<.0001
Within 15 days	12.3%	15.3%	17.2%	18.8%	15.8%	<.0001
Within 30 days	19.8%	24.4%	27.2%	29.9%	25.2%	<.0001
Within 60 days	27.6%	33.0%	36.2%	38.7%	33.7%	<.0001
Within 1 year	40.6%	46.6%	49.4%	51.2%	46.8%	<.0001