Chapter 2

The incidence of rhegmatogenous retinal detachment surgery in the North of the Netherlands

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ABSTRACT

Purpose: To estimate the incidence of rhegmatogenous retinal detachment surgery (RRD) in the North of the Netherlands in 2008.

Methods: Retrospectively, using the surgical logs, all patients, if permanent residents of the North of the Netherlands, who had had surgery for primary RRD between January first, 2008 and January first, 2009, at the University Medical Center Groningen and the Antonius Hospital Sneek, were included. Excluded were patients operated on for RRD before 2008 and exudative, tractional, or traumatic retinal detachments. Information on date of birth, gender, affected eye, date of surgery, and prior cataract extraction (CE) in the affected eye was obtained. Using our data (n=297 eyes), we determined RRD surgery incidence in our population (1,704,783 people, census 2008), age distribution, male-to-female ratio, and prevalence of prior cataract extraction in RRD patients. Note: We conducted a comparable study in the entire Netherlands in which data on RRD surgery from January first, 2009 until January first, 2010 were collected. For comparison, data regarding the North of the Netherlands from that study will be briefly summarized in the present manuscript.

Results: RRD surgery incidence was 17.4/100,000 people per year (95% confidence interval [CI] = 15.4 - 19.4). RRD surgery incidence was highest, with 53.86/100,000 people per year, among individuals between 65 and 69 years of age, and increased significantly from age 50 years onwards (p < 0.01). It occurred 1.9 times as often in males as compared to females, and of all RRD patients, 39.7% had had prior CE. We observed no statistically significant differences in overall annual RRD surgery incidence rates between 2008 and 2009 population in the North of the Netherlands.

Conclusions: RRD surgery incidence in a given population is dependent on its demography. The population older than 50 years, and males are more susceptible to RRD. The annual incidence rates of RRD surgery in the North of the Netherlands are stable over a period of time.
INTRODUCTION

Rhegmatogenous retinal detachment (RRD), which refers to a separation of the neurosensory retina from the underlying retinal pigment epithelium due to a defect in the retina, is a potentially blinding ophthalmic pathology.\(^1\) Despite treatment advances, functional results remain poor, with only 42% of all RRD eyes achieving ≥ 20/40 vision, and only 37% achieving ≥ 20/50 in macula-off detachments.\(^2-3\)

In Western populations, the annual RRD surgery incidence over the past forty years has been reported as between 6.9 and 18.2 cases per 100,000 persons per year.\(^4-13\) During the 1970s, yearly RRD surgery incidence rates were 6.1-9.8 cases per 100,000 persons,\(^4-7\) increasing to 11.8-17.9 cases per 100,000 persons during the 1990s.\(^8-10\) A recent study conducted in a relatively young population reported an incidence of 12.05 cases per 100,000 people,\(^11\) whereas another recent study in a relatively older population reported an incidence of 18.2 cases per 100,000 people.\(^13\)

Differences between these studies may be explained either by methodological differences (e.g. different inclusion criteria, and differences in the provision of healthcare),\(^4-13\) or differences in the prevalence of risk factors for RRD (e.g. demographic characteristics (age and gender),\(^4-13\) prevalence of myopia, and volume of cataract surgery).\(^4-7,14\)

We were interested in the overall and age-specific annual incidence rates of RRD surgery in the North of the Netherlands. Since the incidence of RRD in our population cannot be reliably measured, RRD surgery was taken as a proxy hereof.

METHODS

Study population

The North of the Netherlands is composed of the provinces of Drenthe, Friesland, and Groningen. Based on the 2008 census, the total population of the North of the Netherlands consisted of 1,704,783 people.\(^15\) To be included in this study as an RRD case, the patient must have been permanent resident of one of the above provinces in 2008. Patients residing outside the above provinces were excluded.

All RRD patients from the area studied have been operated on either at the University Medical Center Groningen (UMCG) or the Antonius Hospital Sneek. The North of the Netherlands is a relatively isolated region in the Netherlands and the above mentioned hospitals are the only locations within this region where RRD-surgery is being performed. Therefore, we may assume that all RRD patients from Drenthe, Friesland, and Groningen will be referred to the UMCG or the Antonius hospital Sneek by regional ophthalmologists. In addition, patients from outside the three northern provinces may also be referred to either one of these hospitals. The latter patients can easily be identified by checking their address and they were excluded from the present study.
In a national study on RRD surgery, confirmation of this referral pattern was obtained for the year 2009.\textsuperscript{15,13} Both centers agreed to participate in this study. There are no patients lost to private practice, because vitreoretinal surgery in the Netherlands is not performed in private practices.

\textbf{Ethics statement}

The internal review board (IRB) of the University Medical Center Groningen waived the need for IRB approval. The study has adhered to the tenets of the Declaration of Helsinki. The internal review board committee of the UMCG waived the need for IRB approval and therefore also implicitly approved that obtaining written consent from the patients was not necessary and therefore written consent was not obtained.

\textbf{Data collection}

Data were collected retrospectively. All cases of primary RRD operated on from January 1, 2008, until January 1, 2009, were identified using the surgical logs and included. In the Netherlands, it is mandatory to keep a log of all performed surgeries. The logs contain patient specific data (name, data of birth, gender, and address), and surgery specific data (surgeon, surgical procedure, indication for surgery). The surgical logs were partly digital and partly hand-written. After identifying patients by using the logs, the patients' charts were obtained and checked for additional information by one of the authors (MP).

Rhegmatogenous retinal detachment was defined as a retinal elevation with any retinal break (found before or during surgery). All eyes with prior detachments or tractional (i.e. due to fibrovascular proliferation in proliferative diabetic retinopathy or retinopathy of prematurity), exudative (i.e. due to uveitis or scleritis), and traumatic (defined as a clear history of ocular trauma followed by retinal dialysis, occurring simultaneously with or following intraocular foreign body removal, or occurring simultaneously with or following ocular penetrating or perforating injury) retinal detachments were excluded. Patients with hereditary vitreoretinopathy (i.e. Sticklers vitreoretinopathy) were included. Reoperations within the study period were excluded (i.e. only the first surgical intervention was counted). Data for 297 eyes were included in the analyses.

Information collected included patient's age, gender, affected eye, macula-off or macula-on detachment, residence, date of RRD surgery, and history of CE. Macula-off RRD was defined as a macular elevation prior to or during surgery, or a visual acuity (VA) of less than 10/20 that could not be explained by other stated pathology.

Because all the surgical logs and the patients' charts were checked by one of the authors (MP), we have a high diagnostic accuracy, and can therefore be rather sure that tractional, exudative, and traumatic cases are excluded and that the included cases are true rhegmatogenous retinal detachments. There was no missing data, because the surgical logs always contained patients' specific data, as date of birth, gender, address and surgery specific data, as date of surgery. In
addition, the patients’ charts always stated preoperative data as lens status, macular status, VA, and pre- and intra-operative funduscopic aspect, and presence of retinal breaks.

Statistical analyses
The overall and age-specific annual incidence rates were calculated by dividing the number of new cases by target population size. Bilateral cases were counted separately, as these are a rarity. A 95% confidence interval of all the incidence rates was calculated. For comparing proportions we used the Chi-square test. A P-value £ 0.05 was considered statistically significant. All statistical analyses were performed using SPSS software package 12.0 (SPSS Inc., Chicago IL, USA) or Microsoft Office Excel 11 (Microsoft Corp., Redmond WA, USA).

Note: We conducted a comparable study in the entire Netherlands in which data on RRD surgery from January first, 2009 until January first, 2010 were collected. For comparison, data regarding the North of the Netherlands from that study will be briefly summarized in the present manuscript.[13]

RESULTS

Annual incidence rate of RRD surgery in 2008
Among the 1,704,783 residents of the three northern Dutch provinces in 2008, 297 new cases of RRD were treated either at the ophthalmology department of the UMCG (n=255) or at the ophthalmology department of the Antonius Hospital (n=42) (Table 1). Therefore, the overall annual incidence rate of RRD surgery was 17.4/100,000 people (95% CI = 15.4 - 19.4).

Right and left eyes, macular status
Of all patients, 291 (98.0%) suffered from a unilateral RRD, and three had a bilateral RRD. In unilateral RRD cases, 166 right and 125 left eyes were involved. Three patients suffered from bilateral RRD during the study period, resulting in a bilateral RRD rate of 1.0%. A detached macula was found in 172 eyes (57.9%).

Age and gender distribution
The median age of the patients was 60 years (range = 5-90). The median age did not differ between males (median 60, range 5-89 years) and females (median 61, range 19-90 years). There was a significant increase in age-specific annual incidence rates of RRD surgery from 50 years of age onwards (p < 0.01), and a significant decrease from 70 years of age onwards (p < 0.05) (Table 1, Figure 1). We noticed a peak age-specific annual incidence rate at 65-69 years of age, of 53.9/100,000 people (95% CI = 37.8 - 70.0) (Figure 1).
Figure 1: The incidence of rhegmatogenous retinal detachment in the North of the Netherlands per 100,000 people in 2008.

Table 1: Actual numbers of individuals and incidences of rhegmatogenous retinal detachment per age category in the population of the North of the Netherlands for males, females, and all individuals in 2008.

<table>
<thead>
<tr>
<th>Age range (years)</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Total with RRD</th>
<th>Males with RRD</th>
<th>Females with RRD</th>
<th>M-F ratiob</th>
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<tbody>
<tr>
<td></td>
<td>Number of individualsa</td>
<td>Total</td>
<td>Number</td>
<td>Incidence</td>
<td>Number</td>
<td>Incidence</td>
<td>Number</td>
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<tr>
<td>&lt; 5</td>
<td>93.9</td>
<td>48.0</td>
<td>45.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5-9</td>
<td>104.6</td>
<td>53.5</td>
<td>51.1</td>
<td>1</td>
<td>0.96</td>
<td>1</td>
<td>1.87</td>
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<td>10-14</td>
<td>101.5</td>
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<td>49.7</td>
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<td>20-24</td>
<td>105.5</td>
<td>54.4</td>
<td>51.1</td>
<td>4</td>
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<td>1.84</td>
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<tr>
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<td>11</td>
<td>28.58</td>
<td>7</td>
<td>48.93</td>
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<td>7.1</td>
<td>15.6</td>
<td>7</td>
<td>30.85</td>
<td>5</td>
<td>70.16</td>
</tr>
<tr>
<td>≥ 90</td>
<td>9.8</td>
<td>2.2</td>
<td>7.6</td>
<td>1</td>
<td>10.20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1704.8</td>
<td>847.0</td>
<td>857.8</td>
<td>297</td>
<td>17.42</td>
<td>193</td>
<td>22.79</td>
</tr>
</tbody>
</table>

RRD: rhegmatogenous retinal detachment; NA: not applicable. aActual number is given number*1000. bMale-to-female ratio.
**Phakic RRD eyes and RRD eyes with prior CE**

Of the 297 RRD cases, 179 involved phakic eyes (60.3%), and 118 involved eyes with prior CE (39.7%). The median age of phakic RRD patients was 59 years (range 4-89). This did not differ between males (median age 59, range 5-89 years) and females (median age 58, range 19-85 years). We noticed an increase in absolute numbers of RRD in phakic eyes from age 45 onwards, peaking at 55-59 years of age (n = 42) and decreasing thereafter (Figure 2). Among the 179 phakic-RRD cases, 118 involved males (65.7%), and 61 involved females (34.3%), resulting in a male-to-female ratio of 1.9:1. At age 75-79 years, there is a turning point in the proportion of phakic RRD eyes compared to RRD eyes with a history of CE (Figure 3).

![Figure 2: Absolute numbers of phakic RRD eyes and RRD eyes with a history of cataract extraction.](image-url)
The median age of patients with RRD in eyes with prior CE was 64 years (range 22-90). Among the 118 cases, 75 involved males (63.6%), and 43 involved females (36.4%), resulting in a male-to-female ratio of 1.7:1. The median age was 64 years for males (age range 39-88) and females (age range 22-90). We noticed an increase in absolute numbers of RRD in eyes with prior CE from age 40 onwards, peaking at 60-64 (n = 19), and 65-69 years of age (n = 19) and decreasing thereafter (Figure 2).

Annual incidence rate of RRD surgery in 2009
For comparison, data regarding the North of the Netherlands from a comparable study in the entire Netherlands in which data on RRD surgery from January first, 2009 until January first, 2010 were collected will be analysed. Of the 1,708,821 residents of the three northern Dutch provinces in 2009, 308 new cases of RRD were treated. Therefore, the overall annual RRD surgery incidence was 18.0/100,000 people (95% CI = 16.0 – 20.0). A detached macula was found in 189 eyes (61.4%). The median age of patients was 60 years (range = 10-91). A peak incidence was observed at 65-69 years of age, with an incidence of 47.0/100,000 people (95% CI = 32.2 – 61.7). Among the 308 incident cases, 193 involved males (63%) resulting in a male-to-female ratio of 1.7:1. The annual overall incidence rate of RRD surgery was 22.7/100,000 (95% CI = 19.5 – 25.9) in males and 13.4/100,000 (95% CI = 10.9 – 15.8) in females, and this difference was statistically significant.

A history of CE was present in 106 cases (32.6%). Patients with a history of CE had a higher median age (66 years of age) compared to the median age of phakic patients (58 years of age). The absolute number of phakic patients peaked at 55-59 years of age (n = 47) and decreased thereafter.
An increase in absolute numbers of RRD in eyes with prior CE was observed from age 45 onwards. Peak values were seen at 65-69 years of age (n = 15) and decreased thereafter. At 75-79 years of age there was a turning point in the proportion of phakic RRD eyes compared to RRD eyes with a history of CE.

We observed no statistically significant differences in overall annual RRD surgery incidence rates between the 2008 and 2009 population in the North of the Netherlands. Neither did these incidence rates differ significantly from the overall annual RRD surgery incidence rate in the entire Netherlands in 2009. The same observations were made for annual RRD incidence rates in males and females.

We observed no significant differences between the proportions of pseudophakic and phakic RRD patients in the North of the Netherlands between 2008 and 2009, and the North of the Netherlands and the Netherlands in 2009. We observed statistically significant differences between proportions of macula-on and macula-off RRD patients in the North of the Netherlands between 2008 (42% macula-off) and 2009 (61% macula-off, P <0.00001), and between The North of the Netherlands between 2009 (61% macula-off) and The Netherlands (54% macula-off) in 2009 (p = 0.0221).

**DISCUSSION**

The overall annual incidence rate of RRD surgery in 2008 in our population is high when compared to earlier reports in Western populations.[4-13] In line with previous reports, a peak age-specific annual incidence rate of RRD surgery was observed in the population 65-69 years of age, and a second smaller one at 75-79 years of age, while males were overrepresented in all age categories.[7,9] This suggests that the overall annual RRD surgery incidence is strongly dependent on demographic characteristics (i.e., age and gender distribution) in a given population. We noticed the highest numbers of phakic RRD patients at ages 55-59 years, and the highest numbers of post-CE RRD patients at ages 60-69 years. Also, the proportion of post-CE RRD increased with advancing age. Both observations may suggest that phakic and post-CE RRD are different entities. The fact that RRD is still a sight-threatening condition is underscored by the presence of a macular detachment in more than half of the patients.

**Annual incidence rate of RRD**

The provided high overall annual incidence rate of RRD surgery in the North of the Netherlands in 2008 of 17.4/100,000 does not seem to be an incidental overestimation, since an overall annual incidence rate of 18.0/100,000 (95% CI = 16.0 – 20.0) in 2009 was observed in this area. Also, the North of the Netherlands seems to be a good proxy for the entire Netherlands where an overall annual incidence rate of 18.9/100,000 (95% CI = 11.4 – 18.8) in 2009 was found.[13]
RRD and age/population aging

The strong association between annual incidence rates of RRD surgery and age has been reported extensively.\cite{4-10,13,17-19} This association has been found to be strongest in phakic RRD patients.\cite{11} Posterior vitreous detachment (PVD) is generally assumed to be the main cause of RRD in phakic eyes, since RRD is frequently associated with acute symptomatic PVD.\cite{1} PVD is a rarity in individuals younger than 50 years of age; on average, its onset is at 60 years, with increasing prevalence thereafter.\cite{20} This may well explain the median age and age peak in phakic RRD observed in our and other studies.\cite{4-10,13,17-19} The relationship between PVD and age is in line with described lower annual incidence rates of RRD surgery in relatively younger populations\cite{6-7,17} versus higher annual incidence rates of RRD surgery in relatively older population,\cite{8,13} including our own.

RRD and gender

The gender difference in annual incidence rates of RRD surgery observed in our study is supported by others,\cite{8-11,13} but it is not found consistently.\cite{5-7,18-19} One possible explanation for these inconsistencies may be a slightly unequal distribution of males and females across the age groups, although in most studies, as in our own, an equal distribution is found.\cite{6-9,13}

Both population aging and specific demographic characteristics in our population (i.e. age distribution and gender) could have contributed to the high annual incidence rate of RRD surgery observed in our population. Remarkably, there seems to be a broad variety in annual incidence rates of RRD surgery in demographically comparable populations, when comparing the older,\cite{4-5} the more recent,\cite{8,13} and our own studies.\cite{13} The discrepancy between the expected effect of demography and true annual incidence rates of RRD in different studies may indicate that factors other than age and gender must be responsible for this.

RRD and cataract extraction

One possible explanation may be the success of modern cataract surgery, since it has been postulated that the cumulative risk of RRD is increased by a factor of 5 in eyes with a history of CE,\cite{5} and the number of cataract extractions in the Netherlands has grown significantly over the last two decades. The increase in performed CE can be attributed to population aging, and hence a higher prevalence of cataracts. In addition, because of the success of phacoemulsification for CE, there has been a tendency to perform CE at an earlier stage. Both factors have resulted in a higher volume of CE performed in the recent past. (Estimated numbers for the Netherlands are 38,000 CE performed in 1991; 80,000 in 1998; and 120,000 in 2003).\cite{20} In line with this and in contrast to others, we found a high percentage of RRD patients with prior CE.\cite{4,10-11,13} In parallel to the increase in the volume of cataract surgery in the Netherlands, there has been a shift in surgical technique. Extracapsular cataract extraction (ECCE) has been replaced by the safer procedure of phacoemulsification.\cite{22-23} Furthermore, intracapsular cataract extraction (ICCE), the
procedure holding the highest risk of postoperative RRD, has just about been abandoned.\textsuperscript{[22-23]} Even though the relatively safer phacoemulsification technique probably mitigates the RRD risk in pseudophakic eyes to some extent, the overall contribution of CE to annual incidence rates of RRD surgery seems to be significant.

Unfortunately, reliable incidence rates for phakic versus post-CE RRD cannot be provided, since the prevalence of phakic versus post-CE eyes in most populations, including our own, is unknown due to incomplete registration systems.\textsuperscript{[5,10-11,13]} The differences in the shapes of the age-related distribution curves between phakic and post-CE RRD, and the shift in the proportion of phakic versus post-CE RRD eyes with advancing age, may be suggestive that phakic and post CE-RRD are different entities.\textsuperscript{[8,14,21,22-25]}

Several theories concerning the pathophysiological mechanisms on phakic versus post-CE RRD have been advocated. First, a newly induced PVD\textsuperscript{[24-25]} in non-PVD eyes can occur because CE causes mechanical\textsuperscript{[8]} and biochemical changes\textsuperscript{[26]} in the vitreous.\textsuperscript{[24-26]} Also, a second mechanism could be at play, namely, the altered mechanical forces at the anterior vitreous base area because of the loss of lens volume.\textsuperscript{[27]} This second mechanism would also explain the more anteriorly located small horseshoe-shaped tears that are frequently found in RRD eyes with prior CE.\textsuperscript{[27]}

**RRD and refractive errors**

It has consistently been found that high myopia is associated with RRD, especially bilateral RRD.\textsuperscript{[4,5,7]} Therefore, an increase in the prevalence of myopia in our population may have contributed partly to the increase in annual incidence rates of RRD surgery in our population. Unfortunately, we could not make any assumption on the relationship between RRD and myopia, as the distribution of refractive errors in our population is not known. Furthermore, in that they are only for two consecutive years, our data are too limited to draw any conclusions as to the risk of developing bilateral RRD. The risk of bilateral RRD varies among populations: for instance, in Sweden, 11.2\% of subjects had bilateral RRD over a time period of ten years\textsuperscript{[4-7]} compared to 6.7\% in Minnesota (USA)\textsuperscript{[8]} over a time period of twenty years.\textsuperscript{[8]} In all series, fellow eyes have an increased risk of developing RRD in due course.\textsuperscript{[8,11,13]}

**RRD and macula**

Macular status at presentation is an important prognostic indicator of visual outcome.\textsuperscript{[2,3]} We identified high numbers of macula-off detachment in our population.\textsuperscript{[8-9,13]} One possible explanation for this high number was our chosen definition of macula-off detachment. Not only was the clinical observation of subretinal fluid before or during surgery regarded as macula-off detachment, but we also included all eyes with VA $\leq$ 10/20 in the macula-off-group. Other possible explanations for this high rate of macula-off detachments include patient's and doctor's delay and rapidly progressive detachments. Patient's delay could be partly due to the inattention of the patient, and unfamiliarity with RRD and its symptoms in the general population. Given the peak
annual incidence rates of RRD surgery at a given age and the possible relationship with previous CE, it could be helpful to better inform the population at highest risk. For instance, opticians and optometrists could inform patients in need of optical correction for (high) myopia or presbyopia on clinical symptoms of RRD. Furthermore, ophthalmologists may stress the increased RRD risk after CE and the accompanying symptoms thereof, in line with, for example, the CE guidelines of the Dutch Ophthalmic Society.\textsuperscript{[130]}

Study characteristics
The annual incidence rates of RRD surgery provided in our manuscript are highly reliable, as our study adhered to crucial factors in obtaining its data. We evaluated a relatively large-sized and stable population and study data were collected over the same period as the demographical data to which they were compared.\textsuperscript{[5-8,11]} In contrast, other studies accumulated data over several years, and thus their populations may have fluctuated because of immigration and emigration.\textsuperscript{[4,6-10,17]} Also, demographic characteristics (e.g., age and gender distribution) are less reliable if the study period differs from the period over which the demographic data have been accumulated.

The provided annual incidence rates of RRD surgery may be regarded as a proxy for total annual RRD incidence rates in the North of the Netherlands. One may assume that virtually all patients suffering from an RRD in the Netherlands will visit an ophthalmologist and will be referred for treatment, because the health-care system in the Netherlands is affordable, easily accessible, and of high quality. However, we do not have data on the number of RRD patients that do not seek ophthalmological care due to various reasons. Such data could only be acquired by a cross sectional population study. Further, we do not have data on the number of patients that refuse surgery or will be ineligible for surgery, but we assume these numbers to be small. Also, we excluded traumatic RRD (retinal dialysis) and reoperations, whereas some other studies included such patients.\textsuperscript{[4-10,17-19]} In all retrospective and prospective studies designed to acquire data on RRD surgery incidence, researchers have to define eligible cases. It is inevitable that the chosen definition of RRD is of some influence on the observed incidence of RRD surgery. In addition, we cannot fully exclude the possibility that incidental patients had surgery elsewhere. All these aspects may have resulted in a slight underestimation of the true annual incidence rate of RRD. Another limitation is the retrospective character of the study.

CONCLUSION

Annual incidence rates of RRD surgery in the North of the Netherlands are high-, stable, and they seem to be representative for annual incidence rates of RRD surgery in the entire Netherlands. Differences in annual incidence rates of RRD surgery between populations can predominantly be explained by the prevalence of risk factors (i.e., age-distribution, gender, prevalence of refractive
errors, phakic eyes versus eyes with previous CE) in the population studied.\[^{3-11,13}\] Therefore, annual incidence rates of RRD surgery in the next decennia will probably be determined by population aging and trends in CE.

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