Demographical factors on adult individuals who’s root filled upper first molar was extracted between 2009 and 2014

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Aim
The aim of this thesis was to study the demographics of Swedish adult individuals who had one of their first upper molars root filled in 2009 and subsequently extracted between 2009-2014 and to compare them to individuals not extracting the equivalent teeth.

Material and methods
Data on the individuals were collected from the Swedish Social Insurance Agency. The sample consisted of 4362 adult individuals whose root filled upper first molars were extracted between 2009 and 2014. A control group of 4362 individuals who had not had their root filled upper first molar extracted by 31st December 2014 was created for comparison. Demographical factors chosen to study were: nationality, mean disposable income, educational level, age, civil status and gender. This data was collected from Statistics Sweden.

Results
In the study group 85% were Swedish born and 15% were not whereas in the control group 86% were Swedish born and 14% were not. Regarding mean income, educational level and age, only small differences were observed between the study group and control group. No differences were observed between unmarried in the study group and control group. In the study group 51.2% were divorced and 48.8% in the control group. Regarding gender 51.8% were female in the study group, 48.2% in the control group.

Conclusion
Only small, if any, differences were noted between Swedish adult individuals who had one of their first upper molars root filled in 2009 and subsequently extracted between 2009-2014 and the control group who retained the equivalent teeth.
Demografiska faktorer för vuxna individer vars rotfyllda första överkäksmolar extraherats mellan 2009 och 2014

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Sammanfattning

Syfte

Material och metod

Resultat
Av de individer som fått sin första överkäksmolar extraherad var 85 % födda i Sverige och 15% var födda utomlands. 86 % i kontrollgruppen var födda i Sverige, 14 % utomlands. Avseende medelinkomst, utbildningsnivå och ålder, kunde endast små skillnader ses mellan den studerade gruppen och kontrollgruppen. Inga skillnader noterades bland ogifta mellan den studerade gruppen och kontrollgruppen. 50,4 % i den studerade gruppen var gifta, 49,6 % i kontrollgruppen. 51,2 % var skilda i den studerade gruppen, 48,8 % i kontrollgruppen. 51,8 % var kvinnor i den studerade gruppen, 48,2 % i kontrollgruppen. Siffrorna var omvända hos män.

Slutsats
Endast små, om några, skillnader i demografiska faktorer kunde ses mellan individer som fått sin första överkäksmolar extraherad och en grupp som inte fått motsvarande tand extraherad efter utförd rotfyllning år 2009.
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Introduction

**Endodontic treatment**

When the barrier function of the tooth and pulp is compromised, endodontic treatment may be indicated. This is done by mechanically cleaning the root canal and thereafter ensuring that a competent seal is attained so no bacterial leakage can occur. When present, the treatment is also aimed at relieving symptoms due to infection e.g. toothache and to prevent suppuration and further spread of infection. If the treatment is successful, the tooth can function well in the dentition, stay free of symptoms and root canal infection. In cases of preexisting apical bone loss around the apex due to infection within the root canal, this infection may be eliminated and bone healing will occur (1).

Teeth undergoing root canal treatment has a relative high success rate when periapical healing is the outcome measure (1). A question discussed is whether root filled teeth are weaker than non-root filled teeth and therefore prone to extractions. It is an obvious fact that the tooth structure weakens from the removal of dental tissue during a root canal treatment and there is also indications that masticatory loading is higher in non-vital than vital teeth (2); still root filled teeth seems to have a high survival rate. A study undertaken in the US concluded that 97% of the 1.5 million root filled teeth that were studied, survived and were in good condition eight years after the initial treatment was performed. Of the teeth that were extracted in the study, 85% did not have a coronal restoration (3). This might indicate that a proper coronal seal, strong enough to withstand the forces of mastication and bacterial invasion, is necessary for the survival of the tooth.

In a large epidemiological study in Taiwan (4), a total of 1.588,217 million non-surgically root canal treated teeth were studied to their first untoward event. A total of 7.9% of the teeth were extracted, evenly distributed throughout the five-year follow up. Thus, the total survival of root filled teeth in this population was 92.1%. The study involved teeth treated both in private practices and in hospitals. Extractions were found to be less common in teeth root filled in private practices compared to in hospitals. In a retrospective study by Lazarski et al., (5) it was found that 94.4% of root canal treated teeth retained after 3.5 years.

According to a prospective study by Ng et al. (6) 4-year tooth survival was 95% following root canal treatment. Thirteen common pre- and postoperative prognostic factors for the survival were identified in the study. Some of the prognostic factors that affected the survival of the tooth was the presence of preoperative pain and extrusion of gutta-percha. As in the study by Salehrabi and Rotstein (3), the coronal restoration seemed to have an impact on tooth survival as teeth restored with only temporary fillings had a low survival rate.

Even though there are studies on prognostic factors and survival of root canal treated teeth the evidence is not strong. According to the Swedish Council on Health Technology Assessment (SBU, Statens beredning för medicinsk och social utvärdering) (1), there is lack of evidence regarding survival and success of root canal treated teeth as well as on how different treatment methods affects the prognosis of the treated tooth. Since different pathological conditions of the pulp and periapical tissues demands various courses of treatments, it is important to get answers to these questions, especially since root canal treatments are frequently performed dental procedures. Based on data from the Swedish Social Insurance Agency (SSIA, Försäkringskassan), almost a quarter of a million root fillings were performed in Sweden during 2009 (7).
Demographics
Both through a health economic and an individual perspective it is of great importance to understand factors related to the success and survival of the root canal treated tooth. This includes apprehending knowledge both from a biological as well as from a demographical point of view. Demographics typically includes statistical data of a population, commonly in regard to average age, income, education, etc. and should be studied in relation to the prevalence to diseases and treatments and therefore also in individuals undergoing root canal treatments. There are only few studies on this matter and therefore demographics in relation to oral health is also presented in the subsequent text.

Ethnicity
Regarding ethnicity, a study by Lundegren et al. (8), conclude that ethnicity and level of education has an influence on the prevalence of apical destructions. Patients born in another country than Sweden had almost two times higher prevalence of apical destructions compared to patients born in Sweden. Other studies makes similar conclusions concerning oral health and ethnicity; in the years 1996-1997 there was a higher risk of having dentures amongst people born abroad compared to the Swedish born population (9). Fewer dental visits were also seen in the population of people born abroad. However, a study by Kirkevag and Wenzel (10), identified no correlation between the presence of apical periodontitis and the socioeconomic factors studied, including ethnicity.

Both The Swedish National Audit Office (SNAO, Riksrevisionen) (11) and SSIA (12), recognize that people who are born abroad have a higher need for dental treatment and are less likely to visit a dental practice despite of a subjective need.

Income and education
In a report from the SSIA (12), significant differences were seen between high and low-income individuals in regards to dental visits. Prophylactic dental care includes basic oral examination, prophylactic and non-surgical periodontal treatment, which is equivalent to visits that comprise the following treatment codes (SSIA): 101, 102, 105, 201, 202, 203, 204, 311, 321, 341, 342. Between 1 July 2008 and 30 June 2010, 68% of the Swedish population had prophylactic dental care e.g. in general 2.1 visits per person over the 24-month period. During the same period of time, a total of 71% of the adult population visited a dental clinic. The low income-group had fewer prophylactic visits compared to groups with higher income. It was also concluded that amongst patients with low income the difference between prophylactic and non-prophylactic visits was greater, i.e. less prophylactic visits, compared to patients with higher income. Out of the men with low income, only 45% visited the dental clinic compared to 76% of the men with higher income (12).

Poor economy (11) is one of the reasons why people do not visit the dentist, followed by a low subjective need. Amongst the people with low income, low dental treatment cost is more important than for groups with higher income. These results have been presented by SNAO (11) in an analysis of the current dental reform. It is concluded that the highest frequency of dental visits is seen among those with high income, born in Sweden and/or people with post upper secondary school- or further education. In the survey by SNAO, a group of people was asked if they chose not to visit a dental clinic, despite a subjective need. A total of 20% answered “yes” to this question. The people that answered, “yes” to this question, are amongst those that have the fewest dental visits. These people belonged either to the low-income group, the youths or to the group of people that were born abroad. Seven percent of the participants in the survey described their oral health as quite bad or very bad, which in turn SNAO interprets as sign of a greater need of dental care. This group comprises
participants with low education, no employment or born abroad. The interpretation of SNAO is in line with the conclusion of the Social Security report 2012:10 (13). According to the report, half of the people that stated that they had subjective quite bad to very bad oral health, reported that they have no regular contact with a dental clinic. This figure can be compared to 12% of the people that reported good to very good oral health. Apart from the report by SNAO there have also been published research on the matter; Lundegren et al. (8) showed that individuals with university education had fewer missing teeth and fewer caries lesions than individuals with lower education and according to Hjern et al. (9), people with low educational level (0-9 years) stated a lower frequency of dental visits than people with higher education (13 or more years).

Age
The influence of age on periapical status and oral health is complex. According to a systematic review by Ng. et al. (14), there is no clear influence of age on the success rate of root canal treatment. Some studies showed no influence at all, but on the other hand other studies could see a decrease in success rate with increasing age.

There is a difference in prevalence of visits to dental clinics depending on age; where young people visit more infrequently than the older population. This is due to the fact of improved oral health amongst young people and less need for dental care compared to the older population (12). The highest frequency of dental visits can be seen amongst 50-74 year olds. From this report an important observation was made concerning the age structure in the low-income group compared to the high-income group, where 33% of the people in the low-income group is above 65 years old and 33% are 20-29 years old. The age structure is quite different when compared to the high-income groups; 3% of the people aged 20-29 and only 15% are over 65 years old. The group of people 65 years and older has a higher demand for dental treatment compared to the younger ones.

Civil status
Civil status seems not just to influence the choice of treatment but also the utilization of dental care. Reasons for retaining or extracting a tooth due to toothache in position five have been analyzed by SSIA (12). In the report a total of 79 844 men and women participated. From this study the SSIA could conclude how civil status affected the choice of treatment and also how the chosen treatment were followed through in the different civil status groups. Highest refunds from the dental insurance are seen in groups of patients that are married or are registered partners without any children (12). Lower refunds can be seen amongst patients who are unmarried or without a registered partner. This is likely because in the latter group the majority are younger individuals with lesser need for dental treatment. The difference in payment from the dental insurance between single parents and married/partner with children are low. Low differences can be seen between these two groups regarding income. Compared to other civil status groups, single parents are more likely to grade their oral health low and due to economical reasons they tend to avoid dental treatment even though there is a subjective need for it (15).

It is more likely that a single-parent do not complete a root canal treatment and they are also more likely to choose a composite filling as the final restoration for the root filled tooth, rather than a crown, On the other hand married/partner is more likely to undergo root canal treatment and choose post, core and crown therapy (12). Apical periodontitis, caries activity and frequency in dental visits are factors known to be influenced by socioeconomic factors according to Lundegren et al. (8).
The Swedish dental insurance system

According to the Swedish Dental Law, the goal of the dental care is good oral health and dental care on equal terms for the entire Swedish population (3). A new insurance system for dental treatments was introduced in Sweden in 2008 in line of the goal of the Swedish Dental Law. This new dental reform is based on a system where people pay up to 3000 SEK annually and thereafter dependent on the additional costs for that same year. The refund from the insurance can be either 50% or 85% of the additional costs. In addition to this everyone aged 20-30 years and everyone aged 75 years and older, receive a 300 SEK benefit and those aged 30-74 years receive a 150 SEK benefit each year.

Costs of root canal treatments vary due to the free price setting by each individual dentist or dental clinics. The Dental and Pharmaceutical Benefits Agency (TLV, Tandvårds- och läkemedelsförmånsverket) has made a reference price list on which the insurance refund is based on and most dentists use this price list as guidance for the own treatment prices.

The purpose of the dental reform, among others, is to provide and facilitate a service to the people most in need of dental care. In 2009 SSIA paid a total (Allmänna Tandvårdsbidrag and Hökgostnadsskydd) of 4.45 billion SEK for dental treatments. Thirty five percent of the patients had treatment cost above 3000 SEK and were thus entitled to additional refunds from the SSIA, at a cost of 3.7 billion SEK. About 3% of these patients received the higher refunds, i.e. 85% of the reference price of the treatments.

As stated before, according to the Swedish Dental Law, the goal of the dental care is good oral health and dental care on equal terms for the entire Swedish population (16). Since dental treatment is only partially funded by the SSIA, it is of great importance to establish whether or not demographical factors differ among individuals extracting or retaining root filled teeth.

Aim

The aim of this master project was to study the demographics of adult individuals whose upper first molar was root filled in Sweden 2009 and later extracted and compare the data to a control group whose upper first molar was root filled during the same year but not later extracted.

Hypotheses

Since a number of studies indicate that there is inequity in demographics in relation to oral health, need of dental care and use of dental care resources, the following hypothesis was constructed:

There is a
• lower mean income,
• higher mean age,
• lower education level and
• lower percentage of individuals registered as being married/registered partner amongst individuals who have their upper first molar extracted after endodontic treatment.
Material and method

Data collection on root fillings
The entire Swedish population aged 20 and above, is entitled by law to dental care refunds from SSIA. Practically all Swedish dentists, both in the private and in the public dental sector are affiliated to SSIA and report the diagnostic and treatment codes for each individual patient after any given procedure. A database at the SSIA containing information on dental treatments was used to identify all teeth in Sweden that were root filled by dentists affiliated to the SSIA during 1st January to the 31st December 2009.

The treatment codes (501, 502, 503, 504), corresponding to instrumentation and root filling of teeth with 1-4 or more root canals, were used to identify teeth that had been root filled. To identify root filled teeth that were extracted, information regarding treatment codes used in conjunction with extraction codes (401, 402, 403, 404) were collected from the material. The teeth that had been root filled in 2009 were followed over a prolonged period of time, i.e. until the 31st December 2014. Data on completion of a root filling in 2009 and recordings of extraction of these root filled teeth during the subsequent 5 to 6 years provided a possibility to evaluate the tooth survival of root filled teeth.

The data obtained from SSIA was controlled for any obvious duplicates or other error sources such as reporting a root filling several times on the same tooth and day. As a result, the data consisted of 249 499 root fillings performed in 217 047 individuals. Some teeth had been root filled more than once during 2009 but only the initial root canal treatment code was used, which then concluded in a total number of 248 299 root filled teeth. These teeth formed the base of this study. Upper first molars were the most frequently root filled teeth and therefore this group of teeth was chosen to be analyzed in this study. The process of receiving data is thoroughly described in Fransson et al. (7).

Data collection on demographics
Demographical data on the individuals receiving a root filling during 2009, identified through SSIA, were received from Statistics Sweden (SCB, Statistiska centralbyrå). When the control and selection of the material from SSIA was completed, extraction of demographical information from SCB was initiated.

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Figure 1. The selection process of the two study groups. The first selection consisted of the total number of root canal treated teeth in Sweden in 2009. The second selection consisted of 36 139 upper first molars. 4 362 of them were extracted some time after root canal treatment and during the observation period. From the 36 139 root filled upper first molars a control group was created, which consisted of upper first molars that were root filled in 2009, but retained during the observation period.
A total of 4,362 (12.1%) upper first molars that received root canal treatments in 2009 were identified as being extracted at some point during the 5-6 year follow-up. This group of teeth formed the base for this master thesis. In order to study the differences in demographical factors, a control group was created by randomly selecting upper first molars root filled in 2009 that were not extracted and thereby still retained in the mouth by 31st December 2014. To specify, the randomly selected group was constructed as follows: the group of retained root filled upper root canal treated teeth (n=31,777) were listed in chronological order by SSIA, that is according to the age of the patient when the caregiver completed the root filling. In order to avoid getting a skew control sample due to age, the list of retained root filled upper root canal treated teeth had to be rearranged and were therefore randomly given a number between 1-100 by using a function in the IBM SPSS Statistics Version 22 (SPSS Inc, Chicago, IL). Thereafter, the first 4362 upper first molars on the new list were chosen to be included in the study and served as a control group. The results were analyzed with Pearsons Chi-square test and t-test.

**Demographic variables**
The demographic variables studied can be described as:

**Nationality**
Individuals born in Sweden and individuals born abroad as registered at SCB.

**Disposable income**
Disposable income is described by SSIA. It is calculated by a summation of the household disposable income, multiplied with the individual’s consumption weight and thereafter divided by the entire household consumption weight. The full description can be seen at SSIA (15).

**Educational level**
Educational level was based on the Swedish educational system by data from SCB (*Sun2000Niva*)

1. Primary school less than 9 years
2. Primary school longer than 9 years (10 years)
3. Upper secondary school
4. Post upper secondary school less than 2 years
5. Post upper secondary school longer than 2 years
6. Postgraduate studies
7. Unknown

**Age**
Age is described as mean age (years) and based on data from SSIA.

**Civil status**
Civil status was based on data from SCB (Civil):

1. Married or registered partner
2. Single or widow/widower
3. Divorced or divorced partner
Gender

Men and women as registered at SSIA.

All data was entered into and analyzed in IBM SPSS Statistics Version 22 (SPSS Inc, Chicago, IL).

Before the analysis could be made, the material from SSIA had to be controlled and checked for obvious error sources within the group of upper first molars. Twenty-four of the samples were found to be duplicates, i.e. those individuals had both upper first molars root filled in 2009. Those duplicates were manually altered to add up to the total number of 4362 in each group (a total of 8724 individuals).

For some individuals, one or more demographic variable from SCB were missing. These individuals were not excluded until that specific missing demographic variable was analyzed.

Ethical considerations

From an ethical point of view, it is important to use the information available from the SSIA and SCB to the full extent. A lot of resources are spent on collecting this type of data, both from the government side but also from the individual dentist who after every session has to report the most accurate information to SSIA regarding the patient’s treatment. The demographical information received from SSIA and SCB contains sensitive data on the subjects involved in this study. Despite this, at no point were the individuals’ personal numbers known to or handled by the authors. The personal numbers were replaced by SSIA with a numerical number and therefore unidentifiable to the authors. The same number was linked to the SCB documents in order to correlate data from SSIA with data from SCB. The material was analyzed in a computer without Internet access in order to avoid any risk of leakage of personal data on the subjects involved, although, the possible risks regarding personal data leakage were counterbalanced by the benefits of this study. On a society level it would be of great value to find out the long-term survival of root filled teeth. Since the financial resources from the government are limited, it is of great importance to know how the resources are best spent. Identifying the demographical factors that may or may not differ regarding the survival of root filled teeth would not only provide useful information and allow dentists to provide a better course of treatments for their patients, but also create a better understanding of the utilization and resource efficiency of the current dental insurance system. Also, this knowledge might give a better insight into how the Swedish dental law (1985:125) is implicated in the insurance system. The data and information has been restricted to a few people involved in the project and the computer has been kept in a secure and safe location when not in use.

The committee on Investigations involving human subjects at Lund University (Dnr 211/800) has approved this study.

Results

Description of the samples
Specifications of the individuals are shown in Table 1. The samples included a higher number of upper first molars in the second quadrant than in the first quadrant.

The results as seen in Table 1 shows within each demographical variable none or only minor differences between the two studied groups. In the study group 85% were Swedish born and 15% were not whereas in the control group 86% were Swedish born and 14% were not. Regarding mean income, a difference of 1% was observed between the study group and the control group. Regarding educational level, only small differences were observed between the groups. The mean age in the study group was 51.1 years and 52.7 years in control group. No differences were observed between unmarried in the study group and the control group. In the study group 51.2% were divorced and 48.8% in the control group. Regarding gender 51.8% were female in the study group, 48.2% in the control group. A higher percentage of individuals in both groups were seen amongst the older population, 50-70 year olds in regards to having a root filling performed, as shown in Figure 2. The differences were only significant for nationality and gender (Pearsons chi-square test, \( p=0.007 \) vs. \( p=0.01 \) with one degree of freedom).
Table 1. Results of total number of individuals with upper first molars root filled in 2009 and demographical factors for the study group and for the control group. The study group includes individuals where the root filled upper first molar was later extracted and the control group includes individuals who had their root filled upper first molar retained by 31st December 2014.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Study group (extracting)</th>
<th>Control group (retaining)</th>
<th>Number of individuals with available data for the specific factor</th>
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</tr>
<tr>
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<td>2121</td>
<td>2052</td>
<td></td>
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<tr>
<td>Tooth 26</td>
<td>2241</td>
<td>2310</td>
<td></td>
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<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>8724</td>
</tr>
<tr>
<td>Nationality</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Swedish born</td>
<td>85%</td>
<td>86%</td>
<td></td>
</tr>
<tr>
<td>Born abroad</td>
<td>15%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
<td>8722*</td>
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<tr>
<td>Mean disposable income in hundreds/year (SEK)</td>
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<tr>
<td>Mean disposable income in hundreds/year (SEK)</td>
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<td>2037.5</td>
<td>8711**</td>
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<tr>
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<td>7.1%</td>
<td></td>
</tr>
<tr>
<td>Elementary &gt;9</td>
<td>10.6%</td>
<td>10.7%</td>
<td></td>
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<tr>
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<td>Post upper secondary &gt;2</td>
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<td>28%</td>
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<tr>
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<td>1.3%</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
<td>8661***</td>
</tr>
<tr>
<td>Mean age</td>
<td>52.7 years</td>
<td>51.1 years</td>
<td>8724</td>
</tr>
<tr>
<td>Civil status</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Unmarried</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>49.6%</td>
<td>50.4%</td>
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<tr>
<td>Divorced</td>
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<td>48.8%</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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<td>8711****</td>
</tr>
<tr>
<td>Gender</td>
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</tr>
<tr>
<td>Male</td>
<td>48.2%</td>
<td>51.8%</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>51.8%</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>8724</td>
</tr>
</tbody>
</table>

* 2 individuals were excluded due to missing variable  
** 13 individuals were excluded due to missing variable  
*** 63 individuals were excluded due to missing variable
**** 13 individuals were excluded due to missing variable

**Figure 2.** Frequency of adult individuals with root filled extracted teeth (study group) and root filled retained teeth (control group) at different ages (years).

**Discussion**

The study revealed only small, if any, demographical differences between adult individuals who had an upper first molar root filled in 2009 which was later extracted and individuals who had their root filled upper first molar retained. The final material consisted of 99.5% of the original data received from SSIA. The observational period stretched from January 2009 to 31st December 2014.

This study is based on data concerning an entire population of adult individuals whose first upper molar was root filled in 2009 and subsequently extracted between 2009 and 2014. Since this study involves an entire population it has a major advantage compared to other types of studies. The main advantage with a directory study is that an entire population can be studied retrospectively. On the other hand, directory studies do generate a lot of hypotheses that can be difficult to answer. For example, the directory study does not describe the pre-treatment conditions of the involved teeth, for example status of the pulp and peri-apical bone. The analysis of the results of a directory study is then impeded, since the reasons of the results are unknown. Also it is not possible to create subgroups of primary diagnosis, reasons for treatment and if the root canal treatment is primary or retreatment. A RCT-study could describe the pre-treatment conditions of the population and give a more describing result. Of course, one cannot make a prospective clinical study of the entire population of root canal treated teeth in the adult population of Sweden.

The use of a directory study makes it possible to study the entire population, in this case individuals who had a root filled upper first molar extracted. It is important to remember that the population of individuals is comprised of them that the care-giver, in this case the dentist, makes a correct registration of to the SSIA. The information received from a directory study is based only on what is registered, which is something to keep in mind when analysing the results.
The study group consists of the entire population of adult individuals whose upper first molar was root filled in 2009 and subsequently extracted during the period 2009-2014. In contrast to the study group, the control group consists of only a sample of the total population of 36 139 teeth.

**Nationality**
A small, but significant, difference could be observed between the study group and the control group. It is likely that when root canal treatment is performed and proper sealing is made, the longevity of the tooth is not affected by the patients’ nationality. Therefore, any large difference between people born abroad and people born in Sweden should not be possible to see in the short observation time of this thesis. On the other hand, according to the Social Security Report 2011 (12), patients born abroad have fewer dental visits in general. The likelihood of periapical disease may then also be higher (8).

**Disposable income**
Disposable income is the amount of money that individuals have available for spending and saving after income taxes have been accounted for. A more detailed calculation of disposable income can be found at SCB (1).
Interpreting disposable income is difficult to do and also the accuracy of it is questionable. According to the results, several individuals had a negative disposable income in 2009, which means that the total expenditure exceeded the total income. Despite this, many of the individuals with a negative disposable income had root canal treatment performed in 2009. Still, the results of this thesis show that there is practically no difference in disposable income between individuals who retained and individuals who extracted their upper first molar. This might be due to the high treatment success and survival (6,17), regarding root filled teeth and the short period of time this study was conducted. Disposable income is not a factor that influences the extraction of an upper first molar within a period of 5-6 years after treatment. However, if the choice of permanent seal (filling/crown) influence the longevity of the root canal treated tooth (17), one could speculate that disposable income will have a higher influence on whether or not the tooth should be extracted. There is no information available regarding the individuals that turned down the initial root canal treatment in 2009 when suggested by their dentist, i.e. chose extraction rather than endodontic treatment, or the group of people not visiting a dental clinic despite a subjective or objective need.

There could be a number of different reasons for extracting a tooth that has previously been root filled. If the prognosis of the tooth is bad, extraction might be preferred rather than trying to treat the tooth by revising the root filling or do apical surgery. No significant differences were seen between people with high-or low income when it came to retaining a root filled tooth. The differences might instead be seen in what kind of replacement you have for the now missing tooth. One could speculate that the high-income group might replace the missing tooth with an implant or a bridge if possible, whilst the low-income group might choose to not replace the tooth at all or if replacement is to be made choose a removable option.

**Education**
One could assume that the level of education for the individual would play a role in whether or not the root filled tooth were to be extracted at some point. For the follow up period of 5-6 years, no differences were noticed between the groups. One study that investigated a possible connection, could not state that educational level had an effect on periapical status (10). A lower educational level is also more common amongst the older population compared to the younger population. At the same time, the older population has a higher need for dental
treatment. Therefore, care needs to be taken not to make false assumptions that educational level and dental care are correlated. In an earlier study, noticeable differences have been seen in groups with low- respective high educational level when it comes to oral hygiene and oral status (8). One could then imagine that in the long run, people with low educational level would have to extract root filled teeth to a higher degree than people with higher educational level, due to secondary caries. This follow-up period must be considered too short to see any effects of secondary caries, due to the fact that caries in adults develops, in general, at a slower pace than the follow-up period in this thesis. Amongst several reasons for endodontic treatments, caries is the most common one (18). The study sample is in accordance with the national level of education (19), where approximately 50% of the population between 25-64 years of age has an education equivalent to upper secondary school. Approximately 30% has an education of some kind of post upper secondary school education.

**Age**

The mean age for having endodontic treatment seems to be in accordance with Kirkevang et al. (2003) and the age range is also in accordance with social security reports (12). In the Social security reports from SSIA (12,13), the patients that regularly visit the dental office are most often in the middle-aged group (50-74). With increased age, visits to the dental office become less regular although the need for treatment might be high. The older age groups are more likely to have a lower disposable income compared to younger patients, which may influence the choice of treatment (12).

No differences could be seen in terms of age between the two studied groups. Within the groups, extractions were more common amongst the older population. This could be explained by the fact that in an older tooth with obliterated root canals the technical challenge of making a proper root filling is greater than in a younger tooth with wider canals. This in turns leads to a root filled tooth less capable of withstanding the forces of mastication and therefore a higher risk of bacterial leakage due to a broken barrier.

According to Lazarski et al. (2001) (5), age is not a specific reason for failure of treatment or risk for periapical disease. According to a Social security report (12) it is likely that high age is correlated to an increased need for treatment but there is a reduced frequency of dental visits. One could speculate that the follow-up period is too short to notice any differences due to higher age.

**Gender**

No differences were seen in terms of tooth extractions between the genders. In previous studies (6,10,12), women have been shown to visit dental clinics on a more regular basis than men. This in turn would in theory result in a lower total number of extractions due to the frequency in check-up and prophylactic visits, though this could not be concluded in this study.

**Civil status**

It is difficult to discuss the impact of social status on whether or not upper first molars retain after endodontic treatment. Partly due to the fact that the SSIA analysis document have more detailed definitions of civil status, that originates from SCB, which makes comparison between this master thesis and the SSIA analysis document difficult (13). Unmarried people are more likely to have fewer dental visits (12), but this is mainly due to lower age in this group of people and therefore lesser need for dental treatment. To retain teeth is instead related to age and need for dental treatment rather than civil status. The lack of differences between the study groups ought to be due to a short follow-up period within this study. There are evidence that married/registered partners are more likely to undergo root canal treatment
and later also prosthetic treatment (12). Single women with children are more likely to avoid dental care even though they have a subjective need for treatment. This is thought to be mainly due to financial reasons.

The small or even unnoticeable differences seen between the variables studied can be interpreted as if there are no correlations between socio-economic status and dental treatment, although that might not be entirely true. Since it is not possible within this thesis to study the group of patients that chose not to have root canal treatment done in spite of need, conclusions regarding the availability of the dental insurance system cannot be made. Also, the possible future treatments after tooth extraction are not known. A viable choice when root canal treated teeth have to be extracted is prosthetic treatment, for example installation of an implant or a bridge construction. These treatment options are expensive and according to SSIA reports (12,13), it is not likely that the insurance system is accessible for all people due to the high initial cost paid by the patients themselves. A high-income patient may choose extraction, since there are other options for treatment rather than secondary root canal treatment or apical surgery. The patient with lower income may choose the same treatment, extraction, but due to the cost there are fewer treatment options in the second stage.

Conclusion

This study investigated demographical factors on adult individuals that had a root filled upper first molar extracted and where the initial root filling was made in 2009. During the 5-6 year follow-up no or little differences regarding demographic factors could be noticed between individuals who extracted their root filled upper first molars and those individuals who did not. The results indicate that a longer follow-up period is needed to increase the value of this type of study and gain knowledge about the long-term influences of demographical factors on extraction of root filled teeth.
References


(18) Bjorndal L, Laustsen MH, Reit C. Root canal treatment in Denmark is most often carried out in carious vital molar teeth and retreatments are rare. Int Endod J 2006 Oct;39(10):785-790.
