Factors affecting choices of extraction vs endodontic treatment among general dentists in northern Sweden

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Number of words in abstract: 206
Number of words in text: 4103
Number of tables and figures: 6
Number of cited references: 23
Abstract

Background
Decision-making within the dental field is an essential factor that influences every aspect of the profession. It is of absolute importance for patients to receive the most suitable treatment for their individual situation.

Aim
The aim of this study was to examine whether dentists in the county of Västerbotten, Sweden, made suitable therapy choices when faced with teeth with diseases in the dental pulp or in the periradicular tissues.

Methods
This was executed by analyzing data from patient journals and deciding whether the chosen treatment was the optimal one or if considered questionable. When faced with questionable treatment choices, the aim was to determine if there was a common denominator between these cases.

Factors taken in consideration when analyzing the journals were the patient’s sex and age, the tooth treated, the total number of teeth including wisdom teeth, x-ray images, cause of the treatment, sex of the dentist responsible and a description of case. In total, 360 patients were analyzed, and 51 were excluded.

Result
The result showed that 95% of the analyzed patient cases had a suitable treatment.

Conclusion
The conclusion was that dentists in Västerbotten make good treatment choices and that it is not possible to draw any conclusions regarding the questionable treatments.
Background

Endodontics is the practice where the dental pulp and the surrounding tissues are diagnosed and treated, aiming to cure or prevent disease (Britannica, 2020). The pulp is composed of soft tissue containing inter alia odontoblasts, cells of the immune system, lymphatic vessels, blood vessels supplying the tooth with nutrients and nerves that innervates the tooth (Torabinejad, Walton and Fouad, 2015).

Pathology in the pulp
The pulp tissue can become inflamed due to mechanical, bacterial, thermal and chemical irritants. In some cases, the pulp has an ability to heal and reverse the inflammatory process if the irritation is not too severe. In other cases, the inflammation causes an increased blood flow, leading to increased interstitial fluid. In those cases, the pulp cannot heal and eventually becomes necrotic. A necrotic pulp becomes infected by bacteria in most cases and a consequence of that can be an inflammation of periradicular tissues (Torabinejad, Walton and Fouad, 2015).

When the blood supplement of the pulp gets restricted, immune cells cannot access the inside of the tooth and microorganisms can live and reproduce in the empty pulp cavity. In the periradicular tissue, the host defense mechanisms function normally, and the immune system is able to defeat the bacteria that might exit the root canal (Siqueira, 2011). However, if the infected root canal is not treated, the bacteria can cause a reaction where the host attempts to fight the bacteria off, resulting in periradicular bone loss due to inflammation (Torabinejad, Walton and Fouad, 2015).

Treatment of the pulp
In order to keep the tooth in the dentition, it is necessary to prepare the root canal system and clean out the pulp cavity and root canals. Through instrumentation with files, the necrotic tissue is removed and the root canal is shaped to be suitable for a root filling. To make the canal sterile, antibacterial irrigants are used, such as calcium hydroxide and sodium hypochlorite. The latter is used to flush out debris and disinfects the root canal system (Hülsmann and Schäfer, 2009).

Once the pulpal space is cleaned out, it should be obturated with filling material to prevent bacteria from recolonizing the area. A dense and well-done coronal restoration is in addition an important feature in order to prevent bacteria from
recolonizing the tooth. It provides a seal between the bacteria in the oral cavity and the inner space of the tooth (Siqueira, 2011).

**Extraction**

There are cases when no other treatment than an extraction is possible in order to clear the infection. A tooth can for example be heavily restored, have a severe periodontal disease, extensive caries, having received a failed endodontic treatment and/or have been subjected to trauma not possible to treat, leaving extraction as the only option. These states can in addition, lead to infection and pain (Hollins, 2015). There are however other reasons as to why a tooth is extracted that is not entirely explained by pathology. In for example prosthetic treatment plans, a tooth with a poor prognosis can be extracted when it fulfills no purpose in the planned treatment, is not possible to rehabilitate properly or makes the prognosis worsened (Andersson, Kahnberg and Pogrel, 2014; Hollins, 2015).

A patient can request an extraction based on economic reasons, implying that the tooth is extracted even if there was a possibility of saving it with for instance an endodontic treatment. There is a difference in cost when comparing extractions to endodontic treatments, and usually an extraction is the cheaper alternative (Andersson, Kahnberg and Pogrel, 2014).

**Complicating factors for endodontic treatment**

There are some cases where endodontic treatment is not possible, such as some cases of split teeth and vertical root fractures (Torabinejad, Walton and Fouad, 2015). When a fracture extends all the way to the pulp, bacteria and other microorganisms might enter the pulp and cause necrosis (Hülsmann, Schäfer, 2009).

In cases where a fracture is so severe that both the crown and root are involved and the crack extends to proximal surfaces, keeping the tooth in dentition is impossible. There is a possibility to treat some fractures, however if the fracture extends to the apical third of the tooth, the prognosis for treatment is poor and extraction might be the best option (Torabinejad, Walton and Fouad, 2015).

Other factors that might complicate the endodontic treatment are perforations, instrument fractures, resorptions, obliterations and teeth with complicated canal
anatomy that are not possible to treat or have a bad prognosis (Hülsmann, Schäfer, 2009; Andersson, Kahnberg and Pogrel, 2014).

Dental fear
Dental fear is a factor affecting a patient greatly, he or she can have difficulties visiting the dental office and coming for regular check-ups. Furthermore, the outcome of the treatment can be affected by the patient's dental anxiety (Ayer, 2005). A study by Svensson 2020, showed that in a group of 3500 patients, 80.9% did not have any dental anxiety, 9.8% reported low dental anxiety, 4.5 moderate and 4.7% severe dental anxiety (Svensson, 2020). It is of absolute importance to inform and discuss the treatment with the patient in order for him or her to be able to choose the most suitable one (Andersson, Kahnberg, Pogrel, 2014).

County of Västerbotten
Västerbotten is a county situated in the northern part of Sweden and has 271 736 inhabitants and an area of 54 665 km². The county is divided into 15 regions and the area extends from the Norwegian border to the coast of the Baltic Sea (Regionfakta, 2021). In Västerbotten, a total of 156 dentists are employed, among these, 98 are employed in state-owned clinics (Socialstyrelsen, 2021).

The diagnosis and debiting codes in Sweden
Within the Swedish dentistry, different codes are used to represent different diagnoses. The diagnosis code that is in focus in this study is 3051, this code represents diseases in the dental pulp or in the periradicular tissues (Kunskapsstödet, 2020).

Furthermore, there are different series of debitation codes that are used for different treatments. Code-series of interest for this study are the 400- and 500-series. The 400-series represent treatments that imply the removal of a tooth. The 500-series represent treatments that include different types of endodontic treatment (Kunskapsstödet, 2020).

Dentistry in Sweden
During recent years, different regions in Sweden have reported a lack of dentists. According to the National Board of Health and Welfare, 17 out of 21 counties are
lacking dentists and in addition to that, the amount of newly examined dentists has decreased between 2015-2019 (Socialstyrelsen, 2021).

In Västerbotten and the regions Dalarna and Norrbotten, it is reported that the lack of dentists is creating long queues for patients to receive dental care and as a result, the children and patients with acute pain, are prioritized (Danielsson, 2020; Ehlin, 2019; Sundén, 2017).

In Sweden, about 80% of the adult population visits dental clinics regularly, however there are some groups of people that do not visit the dentist at all, or only in acute cases. This might lead to a bigger need of treatment later on, when the disease stays unnoticed for a long period of time. It is known that young people, people with lower income, low levels of education, those born in foreign countries and single parents, are to a further extent not visiting the dental clinics regularly (Försäkringskassan, 2012).

According to studies, about 20% of the Swedish population do not visit dental clinics even if they have the need to do so, due to the costs. In addition, the probability of refrain dental visits is higher in groups with a bad dental status. Other groups that tend to seek help only in acute cases are those who stay unemployed for a longer period of time, people with financial aid and sickness benefit for longer than 90 days (Försäkringskassan, 2012).

It is not necessary for healthy patients to visit dental care every year, however, it is noted that since 2011, even those who visit dental care every other year or every third year, has decreased. On the other hand, the number of patients over 75 years of age, who seek dental care is increasing. This is most likely reflecting an increased need of dental care due to more teeth in the dentition compared to before and that the remaining teeth have been subjected to treatment such as fillings, root-canal treatments etc. (Socialstyrelsen, 2020).

It is noted that dentists tend to write concise journals, that can be lacking important information concerning reasons for the patients visit, medical history, dental status and the treatment plan. It is of importance for dentists to make documentation compatible with the Swedish insurance company in order to gain benefit from the
state dental care support. As a result, the documentation can instead be insufficient and not describing the care a patient has received properly (Socialstyrelsen, 2020).

Dental care in Sweden is not included in the general health care, implying that the patient pays for the treatment from the year they turn 24 (Försäkringskassan). In some cases, they have to pay quite a high price for dental care. This may in some cases be a decisive reason for some patients to only visit dental clinics with acute problems and choosing the cheapest treatment (Tandvårds- och läkemedelsförmånsverket, 2021).

**Communication in dentistry**

During recent years, the approach a clinician has when making decisions on the patients’ behalf, has shifted to a model called shared decision making. This imposes a mutual agreement between the patient’s preferences and the clinician’s knowledge that results in a suitable treatment. Since the patient is now more active in the choice of treatment, it is essential that he or she receives information and of great importance that it is understandable, so that a suitable choice can be made. Interaction between the patient and clinician is important in the decision-making process and greatly affects the patient’s acceptance and willingness for involvement in choice of treatment (Rajagopal, Kelly, 2020).

It is crucial when communicating with a patient to present an appropriate amount of information to avoid a situation where the information is too extensive and too complicated for the patient to understand. It is also noted that the style in which information is shared, might affect the patients’ judgement. Depending on the kind of information the clinician chooses to share, for example failure or success percentage, this might affect the patient. Likewise, the emotional and cognitive state of parts involved in a decision will have influence. Furthermore, it is stated that a patient is often more prone to bias and influence when visiting a dental clinic (Rajagopal, Kelly, 2020).

**Aim**

The aim of this study was to examine whether dentists in the county of Västerbotten, Sweden, made suitable therapy choices when faced with teeth with diseases in the dental pulp or in the periradicular tissues.
Material and Method

For this study, nine clinics from Västerbotten county were chosen. These clinics should be representative of Västerbotten county in terms of the distribution of dentists, geographical and socio-economic conditions.

The clinics Vindeln, Tärnaby, Sorsele, Vilhelmina, Storuman are situated in the less populated part of Västerbotten where there are less dentists. The clinics Lycksele-Stenbergska, City Skellefteå, Umeå-Ersboda, Umeå-NUS are all situated near cities with more dentists.

The data included in the study was extracted by the authors, from patients' medical journals who had received treatment in the selected clinics and had the diagnosis code 3051, indicating a disease in the pulp or/and the periapical tissues.

An Excel-document containing all treatments coded 3051 in Västerbotten from January 2015 to August 2020 was kindly provided by Folk tandvården region Västerbotten. The file contained treatments, all with a unique number. The treatments were ordered clinic-wise and 40 patients were randomly selected from each of the clinics. In total, 360 patients were included in the study. The total amount of treatments in the different clinics is presented in table 1.

A number of 51 cases were excluded that did not meet the request of the study. The exclusion criteria were treatments lacking debiting code in 400- or 500 series, cases where it was not possible to find the chosen treatment and codes that could not be found in the journal were also excluded. Furthermore, all cases with treated wisdom teeth were excluded since they are usually not endodontically treated within the Swedish dentistry. One case was excluded based on the suspicion that the patient was entitled to only acute treatments, since this is probably affecting the choice of treatment.

The following data was extracted from the patient’s journals in the T4 database: sex and age, total number of teeth including wisdom teeth, the treated tooth, x-ray images, sex of responsible dentist, cause of the treatment and description of case.

When analyzing the treatments, a decision was settled by the authors, whether the chosen treatment was the most suitable one or if it was considered questionable. An
individual judgement was made for every case. If a tooth was extracted or received endodontic treatment, it was settled whether there was a more suitable treatment option available. This analysis was based only on available data, X-ray images and the general case description. The prognosis, possibility for endodontic treatment, the periodontal status as well as prosthetics and the patient’s wishes were taken into consideration.

In order to calibrate, 20 randomly selected cases were discussed with the tutor. When presented with cases where the chosen treatment was questioned, these cases were discussed until consensus was reached in the group.

**Ethical reflection**

In order to make this study, it was necessary to use patient journals to collect information. This kind of method implies that patient data is examined and there is always a risk that unnoticed diseases could be detected. It is also important that patients’ data is kept from those unauthorized and that individual patients and dentists are not distinguishable.

For this study, an approval was obtained from Region Västerbotten to access patients’ journals and extract data. The ethical committee at the Department of Odontology, Umeå university, approved this study and its execution.

**Literature search**

The literature search was executed by looking for books about endodontics in the medical library and the tutor searched for suitable articles on PubMed with the terms: “endodontic treatment vs extraction”, “decision-making”, “endodontic treatment” and “extraction”.
Results

In total, 360 patients were included in the study, 51 of these were later excluded, resulting in a total of 309 patients. The distribution of the treatments established that in total, 151 teeth were endodontically treated, 138 extracted and there were 20 acute endodontic treatments without any further information. The distribution is illustrated in figure 1 and 2.

Distribution of cases
A number of 95% (295) of the analyzed cases were considered receiving the most suitable treatment while in 5% (14) of the cases, the chosen treatment was considered to be questionable. Of these 14 cases, 11 teeth were extracted and three were endodontically treated. The 11 extracted teeth were considered savable and possible to treat endodontically based on the information provided by the journal. The three endodontically treated teeth were thought to have received a questionable treatment, explained by a doubtful prognosis of the tooth or lack of diagnosis information in the journals.

Distribution of treatment in clinics
The distribution of treatment choices varied when comparing the different clinics and is presented in figure 3. In Tärnaby and Sorsele the majority of treatments were endodontic treatments and in Storuman and Ersboda the majority were extractions. No trends in treatment choices could be observed based on geographical location.

Reasons for extractions
The most common reason for an extraction was lack of tooth substance. The second most common reason for an extraction was based on the patient’s request. Other reasons for extractions were periodontal disease, fractures, complication with endodontically treatment, external resorption and unknown reasons. See figure 4. For instance, in Vilhelmina and Storuman, the most common reason for an extraction was on the patient’s request, while in Ersboda, Vindeln and Skellefteå the most common reason was lack of tooth substance. See figure 5.

Summary of results
Since the cohort was too small, no conclusions could be drawn considering questionable treatments and no trends could be established considering this matter.
However, it was confirmed that dentists in Västerbotten generally make suitable treatment choices (95%).
Discussion

In this study, it was examined whether dentists in the county of Västerbotten, Sweden, made suitable therapy choices when faced with teeth with endodontic diseases. This was executed by analyzing data from patient’s medical journals and deciding whether the chosen treatment was motivated or if considered questionable.

Distribution of cases
A number of 95% of all treatments analyzed were found to be the most suitable ones, that implies that dentists generally make good treatment choices in Västerbotten. The data presented in the result indicated that the number of cases that had a motivated treatment were 295. The number of questionable treatments were 14. This implies that the cohort is too small for any statistical correlation to be drawn to explain the reason for a dentist to choose a questionable treatment.

Trends
It is not possible to draw any conclusions regarding why a questionable treatment is chosen. Considering the 14 cases interpret as having received a questionable treatment and the factors analyzed such as tooth number, number of teeth, age, sex of the patient/dentist, no significant trends could be noted when compared to the whole group. Therefore, in relation to our aim, it is not possible to find any common factors regarding the patients who received a treatment less indicated since the cohort is too small.

Another important aspect concerning the patients who received a questionable treatment, is that there can be information concerning the cases that is not stated in the journals. This information can be important for the case and might change the assessment. When evaluating the cases, the analysis is based on the given information. If one were to talk to the dentist and the patient in person, there might be more information that makes the treatments more indicated. Taking this in consideration, it underlines the importance of good journal assessment.

Distribution between clinics
In Ersboda the results showed that 56% of the treatments coded with 3051 were extractions. Out of these extraction cases, 50% were due to lack of tooth substance. All extractions were considered to be correct, but it is interesting to ask why these
teeth get in such bad condition, that extraction therapy was unavoidable. In Vilhelmina, 47% of the extractions were on the patient’s request. Why the patient requests an extraction can be explained by many factors and is discussed further down.

Some clinics in Västerbotten such as Skellefteå, report long queues (Ehlin, 2019). What this is accounted to can have many explanations. Even though Västerbotten has 156 dentists (Socialstyrelsen, 2021), it is not stated how much they work clinically. Some might be in the research field or have other reasons not to work full-time clinically. Therefore, the number of dentists might be skew.

Reasons for extractions - lack of tooth substance.
As presented in the results, the most common reason to why a tooth was extracted was due to lack of tooth substance and the second most common reason was an extraction on the patient’s request. Even though the majority of the treatments were shown to be indicated and the dentists made the right treatment choices, it is important to ask why the rightful treatments were needed in the first place? Why a tooth ends up lacking tooth substance is not easy to understand, one can guess it is due to a previous or ongoing caries disease. According to a study by Passarelli et al. from 2020, the most common reason for an extraction, is due to caries disease.

As mentioned in the introduction, dental clinics in Sweden are facing problems with lack of dentists, long queues, prioritizing child patients, leading to problems in calling in their adult patients for regular checkups. Can long queues contribute to the fact that damages occur and then stays unnoticed for a long time until toothache appears?

Another reason that might affect the patients’ will to visit the dentist is dental fear, this is reported in an article by Svensson from 2020. Such behavior might lead to disease progression and as an effect loss of tooth substance because of caries. Those patients might hesitate to visit a dentist and avoid treatment for a long time, resulting in irreversible damage and impossibility to save the tooth.

An aging population might also be a factor that contributes to the amount of lost tooth substance, people live longer and teeth are kept in the dentition for a longer time. It is important that the teeth are kept as long as possible but sometimes it
reaches a point where the tooth has been treated so many times that there is barely anything left of it.

*Reasons for extraction - Request*

When looking at the patient group who requests extractions, it is sometimes shown in the journals that the patient is doing so, due to an economic factor and that is something you as a dentist cannot argue with. The price is higher for endodontic treatments compared to an extraction and especially if the prognosis is uncertain, patients with a limited budget have no other choice than to extract the tooth. On the other hand, it is more common that it is not stated why a tooth is extracted, it is simply stated that he/she wishes it with no further explanation.

Another factor that might affect the choice of treatment is the way the dentist presents the options, as stated in an article by Kelly, Aengus, Rajagopal and Sandhya from 2020. As a caregiver it is possible to affect the choice of the patient by presenting the different options in a certain way, letting your values and state of mind affect how it is presented. This can be done unconsciously as well as intentionally, affecting the patient greatly since dentists are the professionals with knowledge that the patient trusts while making the decision.

A dentist makes multiple decisions every day and when faced with the choice of an endodontic treatment vs an extraction, the decision can be a challenge and this fact is noted in an article by Edrees Sayed et al, from 2021.

Another affecting factor is the state the patient is in, if they are in a lot of pain or discomfort, or if they suffer from dental fear, this can affect their judgement, making them ask for the quickest solution. It is in that situation important for the dentist to inform the patient about all the possible alternatives in order to give him or her the best possible treatment. The fastest solution isn't always the best, an extraction creates other problems, such as a possible need for an extent prosthetic treatment for establishing a good function/esthetic in the future, preserving the natural teeth is always best.

*Sources of error*

Possible errors include the human factor; miscalculations, wrong interpretation of the description or information being missed in journals. These errors were minimized
by discussing difficult cases in group and by calibrating cases. Through discussion, consensus was reached together in the group.

Some of the journals contain limited information and some information might be missing. The lack of data in some journals and the fact that the clinical picture of the teeth is missing, can contribute to a wrong interpretation of the case. As discussed before, there can be information that only the dentist and the patient know that can change this matter. The size of the cohort might have an impact on the result of this study. It would be interesting to see if a bigger cohort would affect the outcome and if any other conclusions could be drawn.

It is of great interest for the dental professionals to prevent extractions and endodontic treatment from happening and that the patient can have a healthy mouth all through life. This study exemplifies that our dentists generally are good at making good decisions but are standing in front of an even greater problem, preventing the patients from getting sick in the first place.

**Conclusion**
Our conclusion is that generally, dentists in the county Västerbotten make adequate therapy decisions. Furthermore, it was not possible to draw any conclusions regarding if the examined factors affect treatment choices, since the cohort was too small.

**Acknowledgement**
We would like to thank all those who contributed in any way to this paper. A special thanks goes out to our amazing tutor Majid Ebrahimi who contributed with his time, knowledge as well as support in every given aspect of this paper. We would also like to thank Ulf Söderström, Martin Burström, Lars Sjödin and Tuomo Hellström who contributed with valuable information to this study. We would also like to thank region Västerbotten for supporting this study.
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6. Försäkringskassan, Tandvårdsstöd, date missing https://www.forsakringskassan.se/privatpers/tandvard/tandvardsstod (2021-04-30)


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**Table 1.** Number of treatments with the diagnosis code 3051 between January 2015-August 2020 in different clinics.
Figures

Figure 1. Distribution of cases. *Questionable: Other treatments could be more suitable.
Figure 2. Distribution of analyzed treatments in percent.
Figure 3. Distribution of different treatments in different clinics
Figure 4. Reasons for extractions.
Figure 5. Reasons for extractions in different clinics.