

Methods of Diagnosis and Treatment in Endodontics

A Systematic Review

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Summary and Conclusions of the SBU Report:

Methods of Diagnosis and Treatment in Endodontics

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November 2010

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SBU has evaluated the methods used by dentists to diagnose, prevent and treat inflammation and infection of the dental pulp. Root canal therapy (endodontics) is conducted to ensure healthy conditions in and around teeth, which have been damaged by caries, external trauma or other causes. Despite the overall high standard of dental health in Sweden, root fillings are still common and are expensive items of treatment for both the individual and the society.

The report forms the basis of national guidelines for dental care by The National Board of Health and Welfare.

Conclusions

- ❑ Because of the lack of studies it is not possible to determine which diagnostic methods can disclose whether a vital but injured pulp can be maintained or whether it should be removed and replaced with a root filling. The available research provides limited direction as to what distinguishes a treatable from a non-treatable pulpal inflammation (pulpitis).
- ❑ The effects of different methods used for instrumentation, disinfection and root filling associated with root canal therapy are insufficiently investigated.
- ❑ An investigation of common practice among Swedish dentists shows that great variations exist in treatment strategies and choice of materials. This applies, for example, to the management of the exposed pulp or when a root filling is retreated. An exception is the use of engine driven instrumentation, which to a varying degree are used by almost two-thirds of the dentists.

- ❑ There is a need for prospective studies of root canal therapy, which show how teeth can be preserved in the long-term, without risk of recurrence of symptoms, periradicular inflammation or tooth fracture. The lack of good research in this field clearly indicates that priority should be given to well-planned and carefully conducted clinical studies of methods for diagnosis and treatment of the disease conditions of the pulp.
- ❑ There is a need for a national registry with quality indicators to be applied for follow-up evaluations of pulpal and root canal treatments.

SBU's summary

Background and aims

For many people, toothache resulting from infection of the dental pulp is a cause of severe suffering. The infection often occurs as a result of dental caries. Pulpal infections can also occur in non-carious teeth if cracks or fractures occur, due to external trauma or in heavily restored teeth. The purpose of root canal treatment with root filling of teeth (endodontics) is to prevent and treat pulpal infections and thereby symptoms such as toothache and swelling because of suppuration. The aim of endodontic treatment is a functional and asymptomatic tooth, without signs of residual root canal infection, including loss of bone at the root apex.

The following specific questions were addressed:

- How well can different diagnostic methods determine the condition of the pulp in teeth with different types of injury (caries, trauma, restorative interventions and other causes)?
- How well can different radiographic methods demonstrate loss of bone at the root apex?
- Are there effective methods for treating pulpal inflammation so that the pulp can be preserved when it has been subjected to caries, trauma or other injury?

- How effective are different treatment measures when the pulp is necrotic (dead)?
- How effective are orthograde (root filling through the crown) and retrograde (surgical intervention at the root apex) treatments of root filled teeth showing signs of periapical inflammation (apical periodontitis)?
- How effective are different methods for treatment of acute toothache?
- Can the root filled tooth be restored effectively, with long-term survival of the tooth and the restoration?
- Is there a risk that cases of acute and chronic infection originating in the dental pulp may give rise to pathological conditions in other organs?
- What serious side effects are associated with root canal therapy?
- Which are the most cost-effective methods for diagnosis and treatment of diseases of the dental pulp?

Facts 1 Study Quality and Strength of the Evidence.

Study quality refers to the scientific quality of an individual study and its ability to provide a valid answer to a specific question.

Strength of the evidence refers to a judgment of the total strength of all scientific evidence and its ability to provide a valid answer to a specific question. SBU uses GRADE, an international grading system for scientific evidence. Study design is a key element in the overall judgment of each outcome measure. Other factors that can weaken or strengthen the power of the evidence are study quality, relevance, consistency, transferability, effect size, data precision, risk of publication bias, and other aspects, eg, the dose-response relationship.

Grading the strength of the evidence – four levels:

Strong scientific evidence (⊕⊕⊕⊕). Based on high-quality studies containing no factors that weaken the overall judgment.

Moderately strong scientific evidence (⊕⊕⊕○). Based on high-quality studies containing isolated factors that weaken the overall judgment.

Limited scientific evidence (⊕⊕○○). Based on high- or medium-quality studies containing factors that weaken the overall judgment.

Insufficient scientific evidence (⊕○○○). The evidence base is insufficient when scientific evidence is lacking, quality of available studies is poor, or studies of similar quality are contradictory.

The stronger the evidence, the less likely it is that the results presented will be affected by new research findings within the foreseeable future.

Conclusions

SBU's conclusions represent our overall judgment of benefits, risks, and cost effectiveness.

Method

SBU has developed a thorough and systematic methodology in which all literature relevant to the question under investigation is sought in available databases. Every study included has been scrutinized for quality and tabulated according to a specially designed method. The scrutiny comprised evaluation of the study relevance with regard to the subject matter and the methodological qualities – study design, internal validity (reasonable protection from systematic errors), statistical power and generalisability.

Quality evaluation of the articles on health economics was undertaken as a joint effort between an endodontist and a health economist. The results were subsequently graded on the basis of the quality of the scientific evidence.

The conclusions of the report are based solely on human studies. Experimental studies in laboratory animals and in vitro studies were not included. Study selection was restricted to randomized controlled studies (RCT), controlled clinical studies (CCT) and prospective cohort studies. For assessment of the reliability of different radiographic methods for diagnosis of periapical bone lesions, post-mortem studies were accepted. In the section on serious side-effects and complications associated with root canal therapy, case reports were included.

Evidence-graded results

How well can different diagnostic methods determine the condition of the pulp in teeth with different types of damage (caries, trauma, restorative interventions and other causes)?

The aim of diagnosing the condition of the pulp is to determine whether a damaged pulp can be treated and preserved, or should be removed and replaced with a root filling. The diagnosis is

founded on any presenting symptoms, and the findings made by the dentist during examination. To determine whether the pulp is vital or dead is another important aspect of diagnosis. This is usually done by some form of vitality test. If the radiographic examination shows bone destruction around the root apex then the pulp is probably dead and infected.

Symptoms and clinical signs

- The scientific basis is insufficient to allow determination of whether sensitivity to heat, cold, electrical stimulation or percussion gives reliable information about the condition of the pulp in asymptomatic teeth with deep carious lesions (⊕○○○).
- There is no scientific basis on which to determine whether the presence, nature and duration of toothache offer reliable information about the condition of the pulp.
- There is no scientific basis on which to assess the value of inflammatory markers intended to determine the condition of the pulp in terms of reversible and irreversible pulpitis.
- There is no scientific basis on which to determine the value of markers of inflammation, infection and tissue damage in predicting the outcome of treatment intended to maintain an exposed pulp vital and asymptomatic.

Sensibility and vitality testing

- The scientific basis is insufficient to allow assessment of the reliability of electrical pulp testing to determine whether the pulp is vital or nonvital (⊕○○○).
- The scientific basis is insufficient to allow assessment of the reliability of thermal testing to determine whether the pulp is vital or nonvital (⊕○○○).

- The scientific basis is insufficient to allow assessment of the reliability of methods for measuring pulpal blood circulation to determine whether the pulp is vital or nonvital (⊕○○○).

Toothache and hypersensitivity to cold or heat stimulation and tenderness to percussion do not provide reliable information on the condition of the pulp. In general, there are major shortcomings in the design, the conduct and the reporting of studies on diagnosis. There is also an insufficient basis to allow assessment of the reliability of different tests for determining whether the pulp is vital or not. This applies to both electrical and thermal tests as well as methods used to determine the existence of pulpal blood circulation.

How well can different radiographic techniques reveal loss of periapical bone?

In assessing pulpal condition, radiographic examination is often an important supplement to clinical examination. It is particularly important to detect changes in the bone tissue around the root apex indicative of a severely inflamed or infected pulp. Radiographic examination is also used to evaluate the result of root canal therapy.

There are several radiographic methods for diagnosing bone changes. In recent years conventional film radiography has been superseded by digital radiography. A new method called CBCT (Cone Beam Computed Tomography) or volume tomography has been developed.

Radiographic methods and their reliability in identifying the presence or absence of changes in the periapical tissues

- There is insufficient scientific support, based on in vitro studies, to give an answer to the question as to whether the diagnostic reliability of digital radiography is as high as con-

ventional film radiography in detecting experimental periapical bone destruction (⊕○○○).

- There is insufficient scientific support, based on in vitro studies, to determine whether volume tomography (CBCT) has greater diagnostic reliability than intraoral radiographic techniques in detecting experimental bone destruction (⊕○○○).

Radiographic methods for determining whether changes have occurred over time in the status of the periapical bone tissue

- There is insufficient scientific evidence, based on in vitro studies, to be able to answer the question of whether the subtraction technique has greater diagnostic reliability than conventional techniques in detecting small areas of experimental bone destruction (⊕○○○).

The reliability of radiographic examination for identifying different lesions in the periapical bone tissue (variants of apical periodontitis, periapical cyst, scar tissue healing)

- There is no scientific support, hence no conclusions can be drawn as to the reliability of radiographic examination in identifying various forms of changes in the periapical bone tissue, including cyst formation and healing with scar tissue.

Periapical bone changes and pulpal status

- There is no scientific support, hence no conclusions can be drawn as to the reliability of radiographic examination in providing information about the status of the pulp.

We have insufficient clinical knowledge on the diagnostic reliability of various radiographic methods. Both digital and film radiography have limited ability to demonstrate small experimen-

tal areas of bone destruction but good ability to identify normal conditions. The new method CBCT is more sensitive and discloses more small areas of bone loss in comparison with conventional radiographic techniques. Meanwhile there is insufficient documentation with respect to the diagnostic accuracy of this method. A difficulty encountered in evaluating radiographic methods is that the reference method, which is histological validation, in reality requires post-mortem studies or biopsy using surgical procedures.

Are there effective methods for treating the inflamed pulp so that it can survive following caries, trauma or other injuries?

Depending on the condition of the pulp, and whether it is directly exposed or not, there are two treatment choices. If the pulp is exposed then pulp capping or partial pulpotomy can be considered. Such treatment is relatively uncomplicated as the wound can be covered with an appropriate dressing and sealed and protected by a surface filling. The outcome is then monitored to ensure that no complications such as pulpitis or pulpal necrosis develop. If the pulp is deemed to be irreversibly inflamed, then the alternative is pulpectomy. This procedure is more extensive and means that the pulp is removed and replaced by a root filling.

Treatment of deep carious lesions

- There is limited scientific support for the claim that pulpal exposure occurs twice as frequently during direct, complete caries excavation than during stepwise excavation (⊕⊕○○).
- The scientific basis is insufficient to allow an evaluation of whether there are differences in pulpal survival rates following immediate complete caries excavation and stepwise excavation (⊕○○○).

- The scientific basis is contradictory with respect to healing rates following direct pulp capping when the pulp is exposed during excavation of deep caries. In two studies, the short-term (1–3 years) healing rate was 80–85 percent in asymptomatic teeth. Another study in adults with very deep caries lesions, including patients presenting with toothache, reports a much lower healing rate after a year (33 percent) (⊕○○○).
- There is limited scientific support that preoperative toothache increases the risk of failure of direct pulp capping (⊕⊕○○).
- There is no scientific basis on which to assess the effect of indirect pulp capping, i.e. when the deepest layer of carious dentine is permanently left in situ.
- There is no scientific basis for assessment of which method, indirect pulp capping, stepwise excavation, direct pulp capping, partial pulpal amputation or pulpal amputation gives the most favourable conditions for maintaining the pulp in a vital and asymptomatic condition.
- There is limited scientific evidence that there is no difference between “Mineral Trioxide Aggregate” (MTA) and calcium hydroxide as dressings on exposed vital pulps (⊕⊕○○). There is no scientific evidence on which to assess the effect of other dressings.
- The scientific evidence is insufficient to allow assessment of the significance of age and tooth type on pulpal survival after direct pulp capping (⊕○○○).
- There is no scientific basis on which to assess whether it is more advantageous to preserve the vitality of some or all of the pulp tissue in teeth with deep caries than to undertake a pulpectomy and root filling.



- There is no scientific basis on which to assess the treatment outcome after pulpectomy and root filling.
- The scientific evidence is insufficient to allow assessment of whether the number of treatment sessions is of importance for the outcome of pulpectomy and root filling procedures (⊕○○○).
- There is no scientific basis on which to assess which other factors might be of importance for treatment outcome after pulpectomy and root filling.

Treatment of the traumatically exposed pulp (crown-fracture, crown-root-fracture)

- The scientific basis is insufficient for assessing the effectiveness of direct pulp capping, partial pulpotomy (partial pulp amputation) and pulpotomy (pulp amputation) in maintaining the vitality and function of some or all of the pulp (⊕○○○).
- The scientific basis is insufficient for assessing the prognosis for pulpal survival in teeth with
 - completed root development compared with teeth with incomplete root development,
 - different intervals elapsing between the occurrence of trauma and treatment,
 - crown-fracture compared with crown-root-fracture (⊕○○○).

There are substantial gaps in our knowledge base and the report is unable to offer a clear answer to the question of which method is best for the management of deep carious lesions. Stepwise excavation results in fewer pulpal exposures than direct, complete caries excavation. Whether this results in higher survival rates for the pulp has not been adequately investigated. Still to be unanswe-

red is the important question of which of the methods - indirect pulp capping, direct pulp capping/partial pulpotomy is the most effective treatment for a tooth with deep caries and an inflamed, vital pulp.

In teeth with traumatically exposed pulps, a study shows that the degree of root development and the time elapsing between sustaining the injury and receiving treatment does not influence the outcome of partial pulpotomy. Generalisability to the conventional clinical routines in general practice is uncertain. There is a need for prospective studies. There are few studies which investigate the effects of pulpectomy and root filling.

How effective are different treatment measures when the pulp is necrotic (dead)?

Root canal treatment of a tooth with a necrotic pulp in essence is a treatment of an infection. The aim of the procedures is to achieve an asymptomatic status and regain normal bone structure at the root apex in cases of apical periodontitis. Any symptoms usually subside directly or within a few days. Healing of apical periodontitis, however takes a relatively long time, in some cases several years. This leads to uncertainty in assessing the outcome of treatment.

Instrumentation

- There is no scientific basis on which to assess the influence of different root canal instruments and instrumentation techniques on the outcome of root canal treatment.

Disinfection

- There is no scientific basis on which to assess the influence of various intracanal irrigants and medicaments on the outcome of root canal treatment.

- There is no scientific evidence on which to assess whether calcium hydroxide has any therapeutic effect in root canal treatment.

Root filling material and root filling methods

- There is no scientific basis on which to assess whether any material or any method for root filling gives a better treatment outcome than any other.

Prognostic factors

- There is no scientific basis on which to assess to what extent the microbiological status of the root canal at the time of root filling influences the outcome of root canal treatment.
- There is no scientific basis on which to determine to what extent preoperative status (pulpal necrosis with or without apical periodontitis) influences the outcome of root canal treatment.
- There is no scientific basis on which to determine to what extent the quality of the root filling (length and compactness) influences the outcome of root canal treatment.

Number of treatment sessions

- There is limited scientific evidence to show that there is no clinically important difference in outcomes for teeth with necrotic pulps and apical periodontitis, when endodontic treatment is carried out in one, two or more treatment sessions (⊕⊕○○).

Post-treatment complications

- There is limited scientific evidence that the risk of severe pain and swelling after root canal treatment is 1–15 percent (⊕⊕○○).

- There is no scientific basis for treatment protocols intended to prevent and treat pain and swelling after root canal treatment.
- There are contradictory results on the influence of the number of treatment sessions on the occurrence of post-operative complications after root canal treatment of teeth with necrotic pulps (⊕○○○).

The review of the literature shows that there is no scientific basis on which to draw definite conclusions about the effectiveness of different methods and materials for root canal treatment. Nor is it possible to determine which factors determine the occurrence of post-treatment discomfort, such as pain and swelling.

How effective are different methods of treating acute toothache?

Toothache and facial swelling are common reasons for seeking emergency dental care. Relatively simple measures are then needed to relieve the condition.

- In cases of symptomatic pulpitis or symptomatic apical periodontitis there is no scientific basis on which to assess whether debridement of the pulp chamber is as effective as conventional root canal therapy to achieve relief of symptoms.
- There is no scientific basis on which to assess whether additional treatment such as apical trepanation, analgesics and antibiotics, in combination with or without partial or complete treatment of the root canal system, can relieve the symptoms of acute toothache.

Reviewed studies answer different questions and give no basis for evidence-based conclusions. Thus there is no scientific basis on which to assess the effectiveness of various interventions intended

to relieve acute toothache caused by pulpitis or apical periodontitis. There is also little information available about the effect of different intracanal dressings or other supportive measures intended to relieve or cure acute toothache.

How effective are orthograde (root filling through the dental crown) and retrograde (surgical intervention at the tip of the tooth root) treatments of root filled teeth showing signs of periradicular inflammation (periapical periodontitis)?

In cases of an emerging or persisting periapical lesion there are two methods for retreatment of a root filling. In orthograde revisions, the root canal system is accessed through the tooth crown whereby the old root filling is removed. Following, disinfection procedures a new root filling is inserted. Retrograde retreatment includes surgical intervention to access the root apex.

- There is no scientific basis on which to assess differences in outcome between orthograde and retrograde retreatment.
- There is little or no scientific basis for assessing differences in outcome after using various methods for orthograde or retrograde retreatment (⊕○○○).
- There is no scientific basis on which to assess the effectiveness of various methods for preventing or treating post-operative discomfort after retreatment.

There is no scientific basis on which to assess how effective either treatment form is. Nor is there a basis for an assessment as to whether any method or material used for instrumentation, disinfection and root filling give a better outcome than others for orthograde retreatment. The same applies to retrograde retreatment.

Can the root filled tooth be restored effectively, with long-term survival of the tooth and the restoration?

As well as achieving infection-free and asymptomatic teeth, a further aim of root treatment is the preservation of function of the treated tooth. Thus some form of restoration is necessary. The choice is between crown therapy (with or without post retention) a less complicated filling which only replaces the lost tooth substance.

- There is no scientific basis on which to assess whether a crown is better than a filling in achieving long-term preservation of the tooth.
- There is limited scientific evidence to show that in a short-term perspective of 2–3 years, premolars with little remaining tooth substance, restored with post-retained crowns, have a higher rate of survival, for both the restoration and the tooth, than premolars restored with crowns without post retention (⊕⊕○○).
- There is no scientific basis on which to assess whether post retention itself achieves long-term survival of a root filled tooth.
- There is limited scientific evidence to show that in the short term, premolars with extensive loss of tooth substance and restored with crowns without post retention, run a greater risk of loss of the restoration than teeth with a larger amount of preserved tooth substance (⊕⊕○○).
- There is no scientific basis on which to assess what type of temporary restoration best protects the tooth during or after endodontic treatment.

Is there a risk that cases of acute and chronic infection originating in the dental pulp may give rise to pathological conditions in other organs?

The potential of an association between chronic marginal periodontitis and cardiovascular disease is recognized in numerous reports. Less attention has been given to a corresponding association with disease processes originating in the dental pulp. Case reports in the literature describe the occurrence of more or less serious complications in nearby organs (respiratory tract, brain), due to spread of bacterial infection from the root canals of teeth.

- The scientific basis is insufficient to assess the association between infections of endodontic origin and disease conditions of other organs (⊕○○○).

What serious side effects are associated with root canal therapy?

Although root canal treatment and subsequent root canal filling are intended to be restricted to the root canal system of teeth, adjacent tissues and structures may be injured. While some injuries result in relatively insignificant consequences for the patient, others can lead to more extensive tissue damage and systemic effects.

- Side effects and complications are reported in the form of allergic reactions, nerve damage, inflammatory changes with tissue necrosis and serious infectious conditions as direct sequelae to endodontic treatment, e.g. in conjunction with disinfection and root filling. There is no scientific basis on which to assess the risk and risk factors for the development of such complications.

Ethical aspects

The review by the project group discloses that in all areas there is a lack of reliability and insufficient scientific support to allow firm conclusions to be drawn with respect to a number of issues. In general, reliable support seems to be lacking on the relative value of different methods for diagnosis and treatment. In isolated cases it is not possible even to determine whether the established interventions are better than no intervention at all. This does not mean that there are absolutely no grounds for preferring a certain method to another in everyday clinical practice. For example, methods which expose the patient to great risk should be avoided. Methods, which are particularly expensive, should also be avoided until such time as they are confirmed in scientific studies. Moreover, in the absence of empirical support, diagnostic and treatment methods, which are supported by relevant established theoretical assumptions, should be given preference, over methods, which do not have such a theoretical basis.

Aspects on health economics

Which are the most cost-effective methods for diagnosis and treatment of diseases of the dental pulp?

- There is no scientific basis for assessing cost effectiveness of various methods of treating diseases of the dental pulp.

It has been possible to include empirical health economics studies only in the form of a systematic overview with two empirical studies. The conclusion of this overview is that at present, there is no support in published empirical studies on the cost effectiveness of different methods of endodontic treatment. This does not exclude the likelihood that different methods have a good effect and are cost effective. However, to date this has not been demonstrated in empirical studies of health economics.

Survey of current practice routines

Within the field of endodontics many different methods and treatment philosophies subsist. In recent years there have been important technological advances, among which engine driven instrumentation of root canals has been introduced. Against this background, a survey was conducted to explore how Swedish dentists perceive treatment options in various case situations and which materials and methods they use. A questionnaire was posted to a random selection of 2 012 dentists out of 8 705 dentists practicing in Sweden. The response rate was 80 percent.

The responses to the questionnaire showed the following:

- Mechanical instrumentation is used, at least to some extent, by two-thirds of the responders.
- When a pulpal exposure occurs after caries excavation in a mandibular molar in a 22 year-old patient, a clear majority (>80 percent) choose pulp capping or partial pulpotomy. For a 50 year-old patient with the same condition in a maxillary premolar, about half of the respondents recommend pulpectomy and root filling.
- With respect to the number of treatment sessions usually required for pulpectomy and root filling, more employ two or more treatment sessions than immediate root filling.
- For restoration of a recently root-filled molar with four of the five tooth surfaces missing, the great majority prefers a crown fabricated in the laboratory rather than a composite crown.
- In treating an acute pulpitis in a carious mandibular molar, three out of four dentists debride the pulp chamber.

- In a case with an incomplete filling in the apical portion of the root canal and with obvious radiographic indication of apical periodontitis in an otherwise asymptomatic maxillary incisor (root filling five years old) about 60 percent suggest revision of the root filling. The rest propose re-examination and follow-up after a year. A few respondents consider no action necessary.
- In a similar case, the difference being that the tooth has a post-retained crown and signs of acute apical periodontitis, half propose an apicoectomy. A third would refer the case to an endodontist for assessment and possible treatment. Only a few would remove the crown and undertake orthograde retreatment. A very small minority reported that they would put the patient on antibiotics with a checkup 3–6 months later.
- By far the most commonly used method for root filling is sealer with guttapercha as the core material, while rosin chloroform and gutta-percha is used by fewer than a quarter. Of the available sealers, the most frequently used are AH+ Tubli-Seal and Sealapex.

Need for research

The systematic review of the literature shows that there are many knowledge gaps within this branch of dentistry. There is therefore a need for both randomized studies and prospective observational studies with follow-up, in order to

- evaluate diagnostic methods which with reasonably good certainty can determine the condition of the pulp in teeth afflicted by deep caries, trauma, or other forms of injury
- determine the reliability of digital volume tomography (CBCT) for diagnosis of changes in the periapical bone tissue

- answer the question of whether a pulp exposed by caries or other causes is best treated by measures intended to preserve the pulp, such as pulp capping/partial pulpotomy or pulpectomy and root filling
- improve our knowledge of the importance of specific treatment factors which explain why many endodontic treatments do not achieve an optimal outcome, i.e. develop or have persistent apical periodontitis
- investigate whether modern techniques for instrumentation improve the outcome of root canal therapy
- study whether root filled teeth survive long-term and what factors influence the loss of endodontically treated teeth
- investigate the risk that teeth with persistent but asymptomatic periapical inflammation will result in pain and swelling or that the area of periapical bone destruction will increase in size
- study the risk to general health when teeth with periapical inflammatory processes remain untreated.

Concluding discussion and consequence analysis

This systematic overview discloses extensive shortcomings in the scientific basis underlying methods applied for endodontic diagnosis and treatment.

It is acknowledged that practitioners have lengthy clinical experience of several of the methods and considerable knowledge

from in vitro studies which have tested material and techniques for instrumentation and root filling. Moreover, animal studies have provided a basis for understanding how the pulp and the periapical tissues respond to therapeutic interventions.

There are, however, few clinical studies of high scientific quality. This means that there is only weak scientific support for those measures aimed at restoring healthy conditions in and around teeth with infected pulps.

At the same time it is important to bear in mind that there are important parameters which can influence treatment results but which cannot easily be controlled for in clinical studies. It may be a question of the clinician's (dentist's) experience, meticulousness and skill. It is seldom possible to assess to what extent such factors influence the results of treatment studies or clinical evaluations. It is however, reasonable to assume that in a discipline such as endodontics, these factors are most important, because of the technically complicated nature of many endodontic treatments. This is probably a contributing factor to the great variations in outcomes of endodontic treatment reported in cross-sectional studies. Future research should therefore test treatment protocols which can be standardized as far as possible. Moreover, today there are tools available which can facilitate the technical procedures. Priority should therefore be given to an investigation of the influence on treatment outcomes of increased use of such techniques in everyday general practice.

Because there are no evidence-based conclusions for many of the questions addressed by this systematic review, it is not meaningful to propose changes to conventional clinical routines. Until studies of high quality become available, it would be desirable to reach consensus on guidelines to support endodontic diagnosis and treatment procedures.

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SBU Evaluates Health Care Technology

Below is a brief summary of the mission assigned to SBU by the Swedish Government:

- SBU shall assess healthcare methods by systematically and critically reviewing the underlying scientific evidence.
- SBU shall assess new methods as well as those that are already part of established clinical practice.
- SBU's assessments shall include medical, ethical, social and economic aspects, as well as a description of the potential impact of disseminating the assessed health technologies in clinical practice.
- SBU shall compile, present and disseminate its assessment results such that all parties concerned have the opportunity to take part of them.
- SBU shall conduct informational and educational efforts to promote the application of its assessments to the rational use of available resources in clinical practice, including dental care.
- SBU shall contribute to the development of international co-operation in the field of health technology assessment and serve as a national knowledge centre for the assessment of health technologies.

Methods of Diagnosis and Treatment in Endodontics

SBU's report on Methods of Diagnosis and Treatment in Endodontics builds on a systematic, critical review of the scientific literature in the field.

The report is one in a series of reports published by SBU (Swedish Council on Health Technology Assessment).

This document presents the summary and conclusions of the full report, which has been approved by SBU's Board of Directors and Scientific Advisory Council.