

Prosthetic Rehabilitation of Partially Dentate or Edentulous Patients

A Systematic Review

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Summary and Conclusions of the SBU Report:

Prosthetic Rehabilitation of Partially Dentate or Edentulous Patients

A Systematic Review

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Project Group:

Susanna Axelsson (Assistant Project Director)	Kickan Håkanson (Project Assistant) Torsten Jemt	Gunilla Nordenram Anders Norlund (Health Economy)
Thomas Davidson (Health Economy)	Therese Kedebring (Project Assistant)	Karin Sunnegårdh- Grönberg
Göran Gynther	Ulf Lekholm	Sofia Tranæus
Gert Helgesson (Ethics)	Jonas Lindblom (Literature Search)	(Assistant Project Director)
Margareta Hultin	Krister Nilner	Madeleine Rohlin (Chair)

Scientific Reviewers:

Anders Anell	Carina Källestål
Anders Johansson	Elisabeth Nyström

English Translation: Joan Bevenius Carrick, Transodont

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Adult patients with varying severity of tooth loss can be rehabilitated by different types of fixed or removable constructions which are retained by the remaining natural teeth or dental implants, or in cases of edentulism, are supported directly by the oral mucosa.

The Report is a basis for national guidelines for dental care by The National Board of Health and Welfare.

Conclusions

- ❑ With tooth loss there is an associated deterioration in quality of life. Life becomes restricted – the existence of many people with tooth loss is characterized by loss of self-esteem, lower social status and deterioration in function.
- ❑ Treatment of tooth loss is very important for those afflicted. In several ways, receiving treatment for tooth loss signifies a return to normal lifestyle and improved quality of life.
- ❑ Patients with single tooth loss can be rehabilitated by tooth-supported bridges, resin-bonded bridges or implant-supported crowns. The five-year survival rate¹ for crowns and implants is over 90 percent.
- ❑ For patients with more extensive tooth loss, rehabilitation can be achieved by bridgework supported by the natural teeth or implants, or alternatively with a removable partial denture. Around 95 percent of implant bridges can be expected to survive for 5–10 years.

¹ survival = the crown or bridge is retained in place and functional.

- ❑ Patients with edentulism, or maxillary or mandibular edentulism respectively, can be rehabilitated with complete dentures supported by the oral mucosa, or implant-supported constructions. Implant-retained bridge constructions have a five-year survival rate of over 90 percent. For mandibular overdentures, over 90 percent of constructions remain after five years.
- ❑ There is an insufficient scientific basis on which to determine which of these treatment methods gives the best results in terms of aesthetics and function, or is the most cost-effective.
- ❑ A survey of established practice by dentists shows that rehabilitation of patients who have lost teeth is today mainly in the form of fixed tooth- or implant-retained prostheses. It is estimated that for the year 2007, implants comprised around 18 percent of the support for fixed constructions.

SBU's summary

Background and aims

The severity of loss can vary, from a single tooth to the entire dentition. It is a relatively long time since edentulism was accepted as a natural part of ageing. Today only a few people are edentulous, whereas there are still relatively many people with one or more missing teeth. In the middle of the 1960's, 23 percent of the Swedish population over 16 years of age was edentulous. However, in the ensuing 40 years there have been immense changes, particularly among the very elderly. In Gothenburg, the proportion of edentulous 70 year-olds declined from 56 percent in 1983 to 7 percent in 2003. The most common causes of tooth loss are the oral diseases dental caries and periodontal disease.

Poor oral health can signify social or financial problems. People who are more or less edentulous or have a removable denture can have a negative perception of themselves and feel different from others. The afflicted individuals often have a poorer quality of life and poorer function. Loss of teeth can be likened to an amputation, and gaps in the teeth are perceived as physical imperfections, like missing body parts.

Today, there are three main methods for replacing lost teeth:

1. A removable denture, which the patient can insert or remove,

2. A bridge retained by the natural teeth abutting the gap and which bears the replacement teeth,
3. Implants which are anchored in the jawbone and support a removable denture or fixed tooth-replacements.

Combinations of these methods are also used.

The aim of this report was to evaluate the scientific support for the following questions:

- How do people perceive losing their teeth and living with varying degrees of tooth loss?
- How do people respond to rehabilitation of this condition?
- How is perceived oral quality of life influenced by rehabilitation of tooth loss of varying severity?
- What effects do the currently available methods of rehabilitation have after 5, 10 and 15 years?
- How effective is immediate loading of dental implants compared with conventional treatment, which requires an interval for healing of the implant in the jawbone before loading?
- What complications, risks, and side effects are associated with the methods investigated?
- How cost-effective are the different methods?
- What is the present distribution of the different treatment methods in the population?

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 a thorough and systematic methodology, by which all literature relevant to the question being addressed is searched in available databases. Every study included is scrutinized for quality and tabulated according to a specially designed method.

The scrutiny comprises evaluation of the relevance of the studies to the subject and methodological qualities – study design, internal validity (reasonable protection from systematic errors), analysis of results, statistical power and generalisability.

The quality of studies using qualitative methods was scrutinized according to a special protocol. The results of the selected studies were merged in a secondary qualitative analysis. In the initial analysis, data from the studies were sorted under several themes, which were presented as synthesized results. Quality evaluation of the articles on health economics was undertaken as a joint effort between a medical expert and a health economist. On the basis of the scientific background, the results were then graded according to the evidence.

Evidence-graded results

Patients' perceptions

The qualitative studies selected for inclusion, i.e. studies which applied qualitative analytical methods to document individual, personal experiences of losing teeth, were based on interviews with people of different age, categories and cultures and diverse social backgrounds. Regardless of the context, the experience of losing teeth appears to have common characteristics which can be broadly interpreted as loss of quality of life. Rehabilitation of tooth loss signifies not only restoration of oral function; the patient also regains the prerequisite conditions for participating in social

activities again, just as prior to tooth loss. Specific improvements are described, such as enjoyment of food, clarity of speech and attractive facial expression.

- There is scientific support to show that loss of teeth leads to reduced self-esteem, lower social status and poorer function. People cope with this loss in various ways.
- There is scientific support to show that after receiving treatment for tooth loss, people experience increased self-esteem and improved function.
- Studies which apply quantitative methodology to evaluate oral quality of life constitute a relatively new research field. To date there are few high quality studies of treatment outcomes.

Single tooth loss

Single tooth loss can be treated by a tooth-retained bridge, a resin-bonded retained bridge or an implant-retained crown. For a follow-up period of five years, the survival of implant-retained crown constructions is over 90 percent and the risk of bone loss (>2mm) around the implant is small. With respect to implant-supported crowns for treatment of single tooth loss, there is at present no scientific basis on which to compare the effectiveness of this method with a tooth-retained bridge or a bridge retained to the abutment teeth by the adhesive technique.

Tooth-retained bridges

Comparison of treatment methods, construction survival, risks and side effects

- For assessing the effect of tooth-retained bridges for treatment of single tooth loss, no studies meeting the inclusion criteria were identified.

- For assessing the five year survival rate, complications, risks and side effects of treatment of single tooth loss, no studies meeting the inclusion criteria were identified.

Resin-bonded-retained bridges

Comparison of treatment methods, construction survival, risks and side effects

- For assessing the effects of the resin-bonded-retained bridges for treatment of single tooth loss, no studies meeting the inclusion criteria were identified.
- For assessing survival, complications, risks and side effects of treatment of single tooth loss treated by resin-bonded-retained bridges, no studies were identified which met the inclusion criteria and had a follow-up time of at least five years.

Implant-supported single crowns

Comparison of treatment methods

- For comparing the effects of the tooth-retained bridge, the resin-bonded bridge or the implant-retained crown for treatment of single tooth loss, no studies which met the inclusion criteria were identified.

Survival of the construction

- There is limited scientific support to show that the five-year survival rate of implant-retained crowns is over 90 percent (⊕⊕○○).

Complications, risks and side effects

- There is limited scientific support to show that after treatment of single tooth loss by implant-retained crowns, survival of the implant, after follow-up of at least five years, is almost 100 percent. The risk for marginal bone loss (>2mm) is less than 5 percent (⊕⊕○○).

- For treatment of single tooth loss with implant-retained crowns, the scientific basis is insufficient to assess aesthetic results or the risk of aesthetic failure after at least five years' follow-up (⊕○○○).

More extensive tooth loss

Patients with more extensive tooth loss can be treated with tooth- or implant-supported bridges. Around 95 percent of implant-supported bridges can be expected to survive after 5–10 years. There is however, no scientific basis on which to assess the survival rate of tooth-retained bridges. Patients with more extensive tooth loss can also be rehabilitated with removable partial dentures. However it cannot be stated with certainty how long such constructions last. Although this form of treatment has been used for a long time, there are few high quality studies in this field.

Tooth-supported overdentures respectively removable partial dentures supported by tooth and oral mucosa

- No studies meeting the inclusion criteria were identified on which to assess the effect of tooth-supported overdentures or removable partial dentures supported by tooth and oral mucosa, respectively. Nor is there any scientific basis on which to assess the outcome of these treatment methods with respect to survival time, frequency of occurrence of complications and side effects.

Tooth-retained bridges

Comparison of treatment methods and survival of the construction

- No studies meeting the inclusion criteria could be identified on which to assess the effect of treatment with tooth-retained bridges. Nor was it possible to assess the survival rate of the constructions.

Complications, risks and side effects

- No studies meeting the inclusion criteria could be identified on which to assess the occurrence of complications. Certain types of complications and side effects are however reported in some studies. The complications are usually related to different events, i.e. sometimes presented as a total number, sometimes in relation to extracted abutment teeth and sometimes to the total number of failed bridge constructions. Nor is there any scientific basis on which to assess the risks and side effects of the treatment method.

Implant-retained bridges

Comparison of treatment methods

- No studies meeting the inclusion criteria were identified for assessing the effect of treatment with implant-retained bridges.

Construction survival

- For implant-retained bridges, there is limited scientific support that the survival rate of original constructions is 95 percent after five years and 94 percent after ten years (⊕⊕○○).

Complications, risks and side effects

- There is limited scientific support that for implant-retained bridges, implant survival is 97 percent after five years and 93 percent after ten years (⊕⊕○○). The scientific basis is insufficient for assessing other complications (⊕○○○).

Edentulism

Patients who are edentulous or have an edentulous maxilla or mandible can be treated with complete dentures or implant-supported bridge constructions. Five-year follow-up shows that implant-supported bridge constructions are retained in over 90

percent of cases. The reported complications are minor, such as material fractures which are easily managed.

Total edentulism

Comparison of treatment methods, construction survival, complications, risks and side effects

- No studies meeting the inclusion criteria could be identified for assessing the effectiveness of the different treatment methods, construction survival, or complications, risks and side effects in the treatment of totally edentulous patients.

Maxillary edentulism

Comparison of treatment methods

- No studies meeting the inclusion criteria could be identified for assessing the effectiveness of different treatment methods for maxillary edentulism.

Construction survival

- There is limited scientific support to show that the survival of an implant-supported bridge is 95 percent after five and ten years respectively (⊕⊕○○).
- There is limited scientific support that survival of an implant-supported bridge of titanium is equal to that of a cast gold alloy construction at observation times of five and ten years respectively (⊕⊕○○).
- No studies meeting the inclusion criteria could be identified for assessing the number of implants necessary for survival of implant-supported bridges, or for evaluating different implant systems and different retention elements used in implant-supported overdentures.



Complications, risks and side effects

- No studies meeting the inclusion criteria could be identified on which to assess complications, risks and side effects associated with treatment by dentures supported by the oral mucosa or implant-supported overdentures.
- There is limited scientific support to show that in patients treated for maxillary edentulism by implant-supported bridges, 70 of 1 000 implants are at risk of failing after five and ten years respectively (⊕⊕○○).
- There is an insufficient scientific basis on which to assess other complications, which are mainly technical in nature and comprise fractures and wear of the construction material (⊕○○○).

Mandibular edentulism

Comparison of treatment methods

- The scientific basis is insufficient to show that an implant-supported overdenture is more likely to function better than a denture supported by the oral mucosa. No studies meeting the inclusion criteria could be identified for comparing implant-supported bridges and other treatment methods (⊕○○○).

Construction survival

- There is limited scientific support to show that the survival rate of implant-supported overdentures is 93 percent after five and eight years respectively (⊕⊕○○).
- There is limited scientific support that treatment with an implant-supported bridge has a survival rate of 97 percent after ten years. For patients treated for mandibular edentulism,

survival of a titanium implant-supported bridges after five and ten years respectively, equals that of gold-alloy constructions (⊕⊕○○).

- No studies meeting the inclusion criteria could be identified for assessing the number of implants necessary for the survival of implant-supported constructions or for assessing various implant systems and various retention elements used in implant-supported overdentures.

Complications, risks and side effects

- There is limited scientific support that the risk of complications is low for treatment with implant-supported overdentures after five and eight years respectively. There is a risk that 12 out of 1 000 implants in implant-supported overdentures may fail after five years. The corresponding figure after eight years is 17 out of 1 000. Other complications of a technical nature comprise fracture or wear of components which retain overdentures (⊕⊕○○).
- There is limited scientific support showing a low risk of complications and side effects associated with implant-supported bridges after ten years. The risk of failure of an implant in the implant-supported bridge is low (2 of 1 000 implants). Other complications are mainly technical in nature, comprising fractures in and wear of the construction material. In these studies there are no reports of complications in the form of nerve damage (⊕⊕○○).

Immediate loading of implants

Immediate loading of implants anchored in the jawbone refers to the attachment of the dental suprastructure to the implants within three weeks of surgical installation. The original implant procedures required that the implant had to be allowed to osseointegrate (become firmly bonded to the bone tissue) before being loaded with the dental suprastructure. If immediate loading of the implant is successful, the overall treatment time and the number of treatment sessions is markedly reduced compared with the traditional method.

Single tooth loss

- The scientific basis is insufficient for assessing whether, in treatment of single tooth loss, the survival of a construction after immediate loading of the implants is comparable with loading only after the implant has integrated into the jawbone (⊕○○○). No studies meeting the inclusion criteria could be identified for assessing treatment complications, risks and side effects.

More extensive tooth loss and edentulism

- No studies meeting the inclusion criteria could be identified for assessing whether immediate loading is effective in treatment of patients with more extensive tooth loss and edentulous patients. Nor could any studies be identified for assessing treatment complications, risks and side effects.

Ethical and social aspects

The literature overview clearly showed that much of the research conducted in the field of tooth loss is of unacceptable quality. For example, some studies currently being conducted as clinical follow-up prospective studies, evaluating immediate loading of

dental implants, comprise few subjects and very brief follow-up times. The ethics of such research is questionable, because the studies have limited prospects of providing reliable information.

The absence of research into certain issues should also be noted. Groups which are overlooked include - among others – the chronically ill, patients with special dental care needs and those with dementia or mental disabilities. For the sake of equity, it is important that research also addresses issues relevant to the dental needs of disadvantaged groups in society.

With respect to diagnosis and treatment of patients with tooth loss, the issues of both autonomy and the right to information are highly relevant: what aspects of their dental treatment is it appropriate that the patients themselves should decide? What information should the dentist provide to the patient – should any information be withheld? In a situation where there is insufficient scientific evidence available about the expected benefit of different treatment alternatives, it is difficult for the clinician to provide the patient with information in a way that offers a reliable basis on which to make a decision. A greater understanding of the effects of different treatment methods, both positive and negative, improves the clinician's potential to provide information to patients and in turn the patients' ability to assess treatment alternatives.

Dental care in Sweden is financed differently from other medical care. There is a high cost threshold for dental care procedures, by which more complicated treatment such as dentures, bridges and implants is subsidized by the government. The fact that adult patients still have to pay for most of their dental care affects access to treatment. While the subsidies lower the threshold for those who can afford to avail themselves of the more advanced and expensive dental care, the implication is that those who are already disadvantaged are least able to derive any benefit from the subsidies.

Health economics aspects

None of the studies which included health economics analyses were conducted in Sweden. The studies also vary with respect to study design and to which treatment methods were investigated. Therefore there is no means of drawing conclusions about the cost effectiveness of different treatment methods.

For many years, dental care in Sweden has been financed by three parties: the state, the county councils and the patients, the latter in the form of patient fees. As seen in the survey of established dental practice, the data indicate that the National Health Insurance regulations clearly influence demand for and provision of dental rehabilitation treatment.

Survey of established practice

As part of the project, a survey was conducted of established practice with respect to prosthetic dental treatment. During the decade from 1989 to 2009, several reforms to the dental benefit scheme were introduced, with subsequent changes to the levels of reimbursement. In this context, there was a need to investigate more closely whether, and if so how, these reforms have influenced established practice.

In order to do this, data were extracted from three of the National Health Insurance databases for reimbursement for dental treatment: Pre-Plomben (pre-filling) Plomben (filling) and the current database Tandem (the tooth). The data were analysed with respect to the patients' sex, age, county of residence and whether treatment was provided by the private or public sectors. Information was also extracted about different prosthetic treatments and combinations of these.

The results showed i.a. the following:

- Prosthetic rehabilitation of patients with tooth loss is currently mainly in the form of fixed tooth- or implant-retained prostheses. It is estimated that in the year 2007, implants for supporting crowns and bridges comprised around 18 percent of registered abutments.
- Registered prosthetic treatment is considered to be relatively evenly distributed between the sexes and regionally throughout the country and is provided largely by the private dental sector. The proportions of registered dental prosthetic patients are similar for urbanized counties and the less populous counties.
- A drastic change occurred in the proportional distribution of treatment between older and younger patients (+/- 65 years) in the population during the year immediately after the introduction of subsidized dental care in July 2008. This implies that the National Health Insurance system and the regulations governing dental and pharmaceutical benefits clearly influence demand for and provision of restorative dentistry.

Gaps in knowledge and directions for future research

Our knowledge of many of the treatment methods intended to replace lost teeth is based on follow-up of a single treatment method. There is a great dearth of studies which compare different treatment methods. Study results must be presented primarily at individual patient and construction level and take into account the influence of individual variations on treatment outcome. Greater emphasis on patient satisfaction with the treatment outcome will also be required in future studies.

The following areas of great clinical significance have therefore been identified as particularly important for future research:

- Studies are required of different patient groups; patient recruitment and the criteria by which patients are selected for treatment should be well-described.
- There is a need for studies comparing different methods of treating patients with varying severity of tooth loss. Future studies should be conducted in the form of prospective multicentre studies in order to evaluate whether the methods are independent of individual clinicians and clinical settings.
- Because of the limited scientific basis for assessing long-term outcomes of treatment methods, there is a need for studies with observation periods of five years or longer.
- There is a need for studies which analyse treatment outcomes, in different patient groups and different methods, from various perspectives and with well-defined questions and effect measures. It is particularly important to analyse the treatment outcome from the patient's perspective, especially in patients with chronic disease or disabled patients and among the very elderly. Moreover there is a need for studies which explore such aspects as indications for various treatment alternatives.
- Little is known about the cost-effectiveness of methods used to treat patients with tooth loss. There is therefore a great need for studies which disclose the benefits and costs of different treatment methods from the health economic perspective. Moreover, there is a need for epidemiological studies of the population's oral health, in order to estimate the need for treatment resources and to analyse the effects of the allocated

resources. This would be facilitated by the creation of a national register with quality indicators.

- There is insufficient analysis of financial aspects of rehabilitation of patients with tooth loss. The question of patients' willingness to pay for such treatment also needs to be addressed. Thus there is a need for studies in this field, preferably within the context of various systems for financing dental care.

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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.

Prosthetic Rehabilitation of Partially Dentate or Edentulous Patients

SBU's report on Prosthetic Rehabilitation of Partially Dentate or Edentulous Patients 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 Technology Assessment in Health Care).

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.