



Scottish Needs Assessment Report
Dental Implants

March 2004

*"We will never have all we need.
Expectation will always exceed
capacity. The NHS will always be
changing, growing and improving -
it will always appear inadequate".*

Aneuryn Bevin, 1948

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EXECUTIVE SUMMARY

Dental implants replace a missing tooth, or teeth, by imbedding a supportive structure in the upper or lower jaw upon which a dental prosthesis is placed.

The use of a dental implant is an invaluable method of creating support for a dental prosthesis, particularly when natural bone support is absent or insufficient to support conventional prostheses. In some instances it may be necessary to combine the insertion of a dental implant(s) with bone grafting.

Dental implants in certain clinical situations may be the sole means by which a complete denture can be made functional. This is the most common clinical presentation requiring dental implants.

Dental implants may be an appropriate adjunct in the treatment of hypodontia and in the replacement of individual teeth lost through trauma or localised disease when no other teeth have been restored or are carious. There are, however, alternative conventional treatment options. The relative benefits of each treatment have not been rigorously compared in randomised controlled trials over a minimum follow-up period of 10 years.

Whilst the majority of dental implants successfully integrate with bone, smoking of tobacco products may cause failure of osseointegration. Mechanical failures of implants are uncommon.

The maintenance of high standards of oral hygiene is essential to the long-term success of any dental implant.

The success of a final prosthesis is dependent upon thorough pre-operative assessment and planning of the positioning of the implant(s), the skill of the surgeon in placing the implant, the skill of the clinician in designing the dental prosthesis and the skill of the technician in constructing the prosthesis.

Dental implants are themselves expensive to manufacture, require specialised surgical instrumentation and require specialised surgical expertise for their insertion. Consequently,

the surgical aspects of dental implant provision should be limited to those trained clinicians who are experienced in their insertion. It is essential that the surgical and restorative clinicians (if different) work as a team to ensure optimal benefit.

Any prosthesis which is supported by a dental implant(s) should be maintained by a suitably experienced clinician throughout the life of the implant.

Whilst many scientific publications exist about various designs of dental implants, it is advisable that long term success and survival data for a minimum of 10 years are available to assist practitioners in selecting the appropriate implant for the specific clinical needs of individual patients.

The high costs together with limited economic evaluation and long term benefits of dental implants preclude routine provision within the NHS in Scotland.

INTRODUCTION

A dental implant is a means of replacing a missing tooth, or teeth, by imbedding a supportive structure in the upper or lower jaw upon which is placed a dental prosthesis (Figures 1 and 2). Dental implants can be used to help support structures which restore function and appearance for example, when tissue has been lost following resection of tumours.

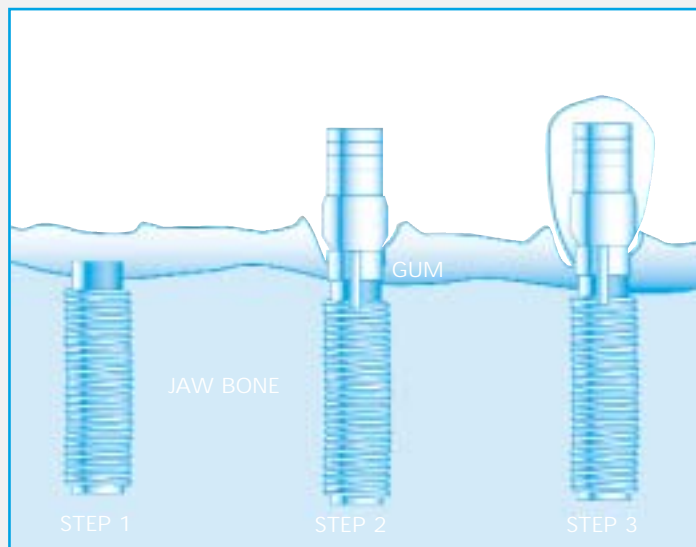


Figure 1.
Diagrammatic representation
of dental implant insertion



Figure 2.
Diagrammatic representation of
dental implant supported lower
denture

The placement of dental implants is most commonly practiced in other countries of the world where dental services are mostly provided in the private sector. Dental implants are not available in the NHS General Dental Service. Their use is confined to the Hospital Dental Service and to private providers of dental services.

As patients' treatment expectations rise and awareness of dental implants increases, combined with an increasing move to private dental practice, the likelihood is that increasing demands will be made for dental implants in Scotland.

The Health Plan for Scotland¹ acknowledged that standards of health care are uneven, with a "postcode" lottery of care across Scotland. It aimed to enable NHS Boards and Trusts together, across Scotland, to make the decisions regarding the delivery of NHS services in their area. It also recognised that these decisions are to be made in the context of national clinical and service standards.

This report aims to review the current provision of dental implants in Scotland, to consider the respective merits of alternative treatment options and to make recommendations in the light of its conclusions.

The scope of this report will therefore concentrate on describing the various uses and indications for implants, identifying the need for them within the constraints of the available data. It will make recommendations on the appropriateness of their use within the NHS in Scotland.

The report will take the form of a focussed needs assessment approach², investigating in some depth the specific provision of dental implant services. It will use both routine available data and information collected specifically for this needs assessment. Although this needs assessment focuses on dental implants, alternative interventions will also be considered.

Ultimately, this report should help guide NHS Boards in priority decisions regarding the provision of dental implants in their area, allowing this to be carried out on an even playing field throughout Scotland.

LITERATURE REVIEW

This section aims to review the scientific literature on dental implants and to assess the evidence base and effectiveness from both public health and economic effectiveness points of view.

SYSTEMATIC REVIEWS

An electronic search of the MEDLINE database using the key word 'dental implants' identified 12,903 publications between June 1966 and August 2003. In the past decade alone, there have been 6,441 publications, with 2,269 since 2000.

The Cochrane Library Database has 12 systematic reviews and holds 355 publications on the Cochrane Register of Controlled Clinical Trials. Unfortunately the systematic reviews published are unable to cover the primary question for this Needs Assessment: that is, whether there is any evidence to suggest that dental implants are more successful or cost-effective than conventional prosthetic techniques. The reviews published to date cover: surgical techniques for placing dental implants^{3,4}; bone augmentation techniques⁵; different times for loading dental implants⁶; bone augmentation procedures pre-dental implants for severely deficient edentulous maxilla⁷; antibiotics to prevent complications following dental implants⁸; pre-prosthetic surgery versus dental implants⁹; maintaining and re-establishing healthy tissues around dental implants¹⁰; hyperbaric oxygen therapy for irradiated patients who require dental implants¹¹; and different types of dental implants¹².

The overwhelming conclusion from these reviews is that there is limited evidence from which conclusions could be drawn regarding one technique over another and there is a need for more randomised controlled trials (RCTs) of better quality and simple design conforming to the CONSORT guidelines¹³.

While the reviews to date have focussed on clinical questions, there remains a need for broader economic and effectiveness questions to be addressed at the community or population level. However, the Cochrane Library has two registered protocols for reviews currently underway which could assist in this regard^{14,15} although it is unlikely, with the nature and quality of the RCTs registered on the Cochrane Library, that definitive conclusions regarding the effectiveness of dental implants over conventional treatments could be drawn.

The Cochrane Library also holds a Database of Abstracts of Reviews of Effectiveness (DARE), which contains critical assessments and structured abstracts of quality-assessed reviews on dental implants available. These have concluded that:

- in the short term the survival rates of implants in partially edentulous jaws are comparable with the survival rates in completely edentulous jaws¹⁶;
- additional RCTs and/or follow-up studies are needed before final conclusions can be drawn about the long-term safety and efficacy of certain augmentation materials in sinus grafting¹⁷;
- at 10 years, less than 15% of fixed partial dentures supported by dental implants were removed or in need of replacement but at 15 years nearly one third were removed or in need of replacement and less than 5% of the implant abutments were removed at 10 years¹⁸;
- a review of the literature pertaining to patient-based assessments of the outcomes of implant therapy concluded that further research is needed using RCTs of broad patient groups treated in a variety of clinical settings¹⁹.

With regard to single-tooth restorations supported by dental implants one systematic review is published and this found acceptable short-term survival of four years for the implant, but crown complications were common²⁰.

The Health Technology Assessment (HTA) database contained four abstracts of dental implant research, one of which has been published²¹. This review, commissioned by the French Ministry of Health in 1993, concluded that the treatment of a complete edentulous mandible by means of certain osseointegrated implants had demonstrated its long-term efficacy, however the treatment of partial and single tooth loss, a more recent application, requires a longer follow-up, and that further studies of the safety and efficacy of oral implantology are therefore essential. It recommends a minimum follow-up of ten years. It also suggests that the creation of a data bank and clinical trial registry would be useful. The Cochrane Library has since taken on this role.

ECONOMIC EVALUATIONS

A search of the NHS Economic Evaluation database (NHS EED) yielded only four research papers. Only one of these satisfied the necessary criteria to be considered an economic evaluation by the reviewer and none contained long run information. This suggests that future research should be directed towards providing information on both the long run cost and effectiveness of dental implants.

NEEDS ASSESSMENT REVIEWS

The general need of a population has been subjectively assessed in Sweden. This study showed a greater perceived or felt need (assessed by being "expressed") in the population in those who had better dental health²².

One review showed that, in most cases, dental implants will produce a better outcome than the best alternative technology but this improvement will only come at greater cost²³.

In a recent survey conducted in 1999 in the UK, of those clinicians who had provided dental implants, there was a range of between 2 and 150 cases treated per year²⁴. Half of all restorative consultants had provided no implant-retained restorations in the previous twelve months. Those consultants involved with implant work reported that cases of denture intolerance made up a significant proportion of their case mix and 88% reported working with oral surgeons as part of an implant team.

More recently extensive reviews of patient expectations, satisfaction and behaviour related to implant dentistry have been undertaken^{19,25,26}. This provides a multifactorial model for outcome assessments relating to: longevity/survival; physiological impact; psychological impact; and economic impact. Although the number of available studies is limited, most show a high level of patient satisfaction compared with alternative treatment options.

CLINICAL GUIDELINES

The Dental Faculty of the Royal College of Surgeons of England in their National Guidelines²⁷ for selecting appropriate patients to receive dental implants identify but do not rank the priorities for dental implants within the NHS. Guidelines produced by the British Association of Oral and Maxillofacial Surgeons²⁸ deal with the surgical aspects of dental implant placement. The British Society for the Study of Prosthetic Dentistry guidelines²⁹ review the restorative management regarding dental implants. These guidelines state that no single aetiological factor for failure has been generally identified²⁹: failures are attributed to poor surgical technique, host factors that impair healing (medical problems, lifestyle factors e.g. smoking), poor bone quality, peri-implant infections (peri-implantitis), poor prosthesis/restorative design (and traumatic loading conditions)³⁰. Ageing in itself, however, has been shown not to affect osseointegration³¹. At present outcome measurement of dental implant success is mostly limited to implant/prosthesis survival, to the exclusion of other potential outcome measurements e.g. quality of life, psycho-social effects, and cost-benefit analysis³². However, recently there has been increasing evidence to show that quality of life can be improved when dental implants are compared with conventional treatments³³.

CONCLUSION

To date, there have been no randomised controlled trials that compare the respective outcomes of alternative treatments and dental implants. Assessment of relative cost-effectiveness of different solutions to particular clinical presentations is at present only hypothetical. Varying case selection criteria and varying products complicate the pooling of multi-centre data.

CURRENT DENTAL IMPLANT ACTIVITY IN SCOTLAND

This section describes the primary research undertaken for this report into current dental implant activity in Scotland. Currently there are no reliable data routinely collected on a national basis on current and historic dental implant activity.

ORAL AND MAXILLOFACIAL UNITS

Oral and Maxillo-facial Surgery Units in Scotland were asked to complete a questionnaire about their implant activity. Seven units in Scotland currently perform implant surgery and each of these units has an implant team that includes a restorative practitioner. Only one unit considered that there were no constraints on their provision of dental implants whilst six units reported that they believed that their service was constrained by limited budgets and that their service needed to be expanded to meet identified needs. Three units reported that oral cancer was the single most common reason that required implant provision and two units stated that complete denture difficulties were their most common reason for implant provision. Trauma cases were the second and the third most frequent reason for providing implants in two and three units respectively. The responses in part reflected the case mix of the respective units. It was noted that those units which do not provide an implant service refer patients to alternative units for implant treatment. Only the units who perform implant surgery ranked conditions in priority order. Oral cancer cases were the first priority followed by trauma cases. Four units which do not currently have an implant service expressed a need to develop a service.

NHS GENERAL DENTAL SERVICE

At present dental implants are not included in the range of treatments provided in the General Dental Service in the UK.

NON-NHS DENTAL PRACTICE

It has not been possible to quantify dental implant activity in private dental practice.

CRITERIA FOR SUCCESS/FAILURE

CONTRAINDICATIONS AND RISK FACTORS

In virtually all situations, dental implants are one of several options available to the patient. Since the implant option involves at least one surgical phase, considerable time and costs, it is clearly in the interest of the patient, dentist and involved third parties that the treatment outcome is successful for all concerned. The surgical procedure is not without risk of complications which may have long-term consequences. Success cannot be guaranteed. Certain aspects of patients' medical and dental histories may contraindicate the use of dental implants. These are described in current guidelines ^{27,28,29}.

IN A SUCCESSFUL OUTCOME, THE DENTAL IMPLANT:

- Does not cause allergic, toxic or gross infectious reactions either locally or systematically
- Offers anchorage to a functional prosthesis
- Does not show signs of fracture or bending
- Does not show mobility when individually tested
- Does not show any signs of peri-implant radiolucency on an intra-oral radiograph

INDICATIONS OF FAILURE OF IMPLANTS:

- Non-integration of implant with bone
- Progressive loss of bone following successful osseointegration as diagnosed clinically and radiographically may occur (and is not necessarily bone related), however, unless excessive, some degree of bone loss is acceptable. Various authors have reported progressive bone loss^{34,35,36}. Poor oral hygiene and/or occlusal overload are likely to be associated with a higher incidence of complications and failure.
- An osseointegrated implant may in some instance fail to meet patients' expectations with regard to aesthetics and phonetics.

Careful patient selection by experienced clinicians and appropriate work-up including patient education can greatly influence the short term and long term success rates.

NEED AND PRIORITY

Figure 3 is a diagrammatic representation of need for dental implants and the priority for the provision of treatment presented as a continuum or range with multi-dimensions. The priority ranking is the considered subjective opinion of the authors of this report. The clinical needs and priorities will be discussed in turn and recommendations are collated together in the conclusions and recommendation section.

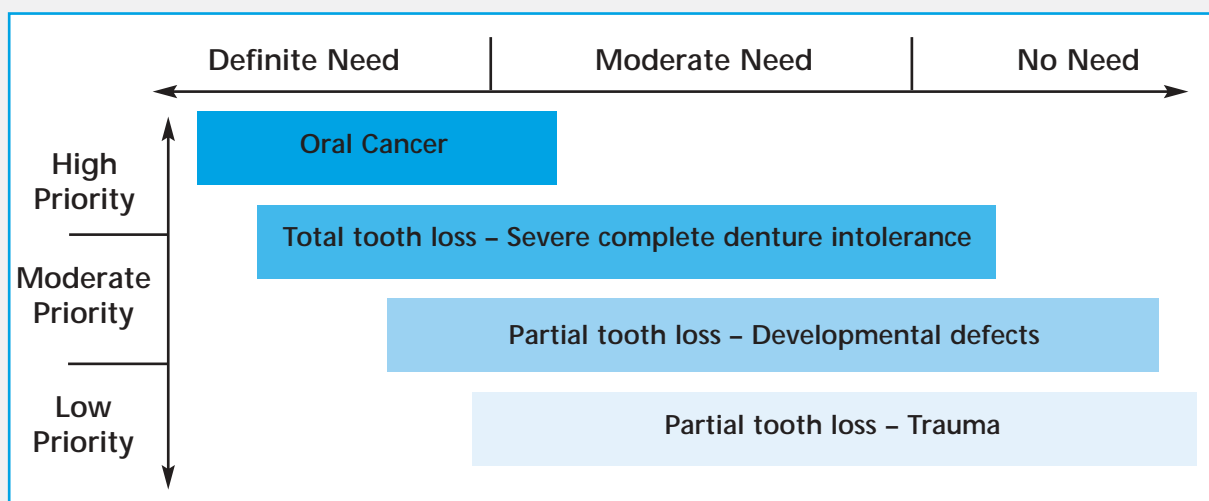


Figure 3: Continuum of need and priority

ORAL CANCER

Patients with oral cancer who have had jaw resection are a high priority group to receive dental implants on the NHS. It does not follow, however, that all such patients have the same need for dental implants nor that all such patients would wish to undergo the procedure.

Generally, the larger the defect following surgery, the greater the requirement for additional support from dental implants for reconstruction. However, many factors should be considered including: lower jaw defects are more suited to dental implant supported prostheses than defects in the upper jaw where implants may not necessarily improve the retention/function³⁷ of the prosthesis.

Appendix 3 displays the frequency of jaw resection in Scotland by Health Board during the periods 1997/98, 1998/99 and 1999/2000.

Special consideration should also be given in each case to oral health, systemic considerations, irradiation exposure, alternative treatments, life expectancy (prognosis) and patient wishes before placing dental implants.

TOTAL TOOTH LOSS

It has been reported that a significant proportion of patients receiving dental implants in Scotland have previously experienced severe difficulties when wearing conventional complete dentures. However, the availability of dental implants to assist in the restoration of edentulous mouths is uneven across Scotland.

In 1972 the level of total tooth loss among the Scottish adult population was 44%. This had dropped to 26% in 1988 and to 18% in 1998. The expectation is that fewer than 10% of adults up to the age of 55 years will have lost all their teeth by 2008. Indeed the target in Scotland for the 45-54 year cohort in 2010 is that fewer than 5% will have lost all of their natural teeth. It is anticipated that as the prevalence of edentulousness decreases so will the prevalence of intractable complete denture intolerance. Moreover, in 1998, 33% of edentulous adults had problems speaking clearly, eating or drinking with their dentures. This pattern does not seem to have changed since 1988³⁸.

An atrophic residual alveolar ridge may cause difficulty in wearing a complete denture (particularly, the lower denture if atrophy of the lower ridge is severe). The dimensions of the alveolar ridge can be assessed objectively³⁹. Those with the most severe bone loss (grades V and VI) will have the greatest difficulty wearing a complete denture.

PARTIAL TOOTH LOSS

Traditional partial dentures or traditional and resin-bonded bridges can adequately restore lost teeth. Moreover, the optimum aesthetic outcome may be better achieved by using such traditional techniques.

However, valid clinical justifications for an implant-retained prosthetic restoration would be the avoidance of the preparation of intact tooth surfaces for the construction of a bridge, or where the indications for traditional prostheses are not met.

DEVELOPMENTAL TOOTH DEFECTS

Developmental tooth defects generally manifest in young people. These can range from a few permanent malformed teeth to a few developmentally missing teeth. In the most severe cases the few permanent and malformed teeth provide poor, if any, retention for conventional fixed or removable prosthesis in which case implant-supported restorations, when placed following completion of growth of the facial skeleton, can provide the necessary support to restore the adult dentition.

DEVELOPMENTAL BONE DEFECTS

Patients with a cleft palate have been successfully treated with dental implants⁴⁰ to replace missing teeth. The prerequisite, however, is that there must be sufficient bone into which to place the implant. If the cleft alveolus has been repaired, implants should be placed in the graft area with caution due to the higher failure rate. In these cases traditional treatment should be pursued in preference. However, patent/unrepaired clefts should be managed as for patients with oral cancer, in that they should be considered to be high priority with need for dental implant-supported prostheses.

TRAUMA

The case for dental implants in the treatment of patients who have suffered trauma and tooth loss is complex and multi-dimensional; each case should be treated on its own merit.

The need for dental implants to replace teeth lost due to trauma depends upon the extent of bone damage and the number of teeth lost. The likelihood of further trauma must also be considered before implant therapy is commenced.

PREVENTION STRATEGIES

The most common reasons for tooth loss are uncontrolled dental caries and destructive periodontal disease.

PRIMARY PREVENTION

Dental caries is a preventable disease and its prevalence can be reduced through positive changes in individuals' lifestyles and through environmental change e.g. provision of optimally fluoridated water.

Periodontal disease in many instances can be avoided or constrained by patients' personal behaviour. Regular effective toothbrushing and inter-dental cleaning can reduce the damaging effects of oral bacteria upon the supporting structures of the natural dentition. It is known that the smoking of tobacco products is associated with more rapid advance of periodontal disease. A reduction in the proportion of the population who smoke could reduce the progression of periodontal disease in some individuals.

The treatment of invasive oral cancer can involve ablative surgery of the head and neck resulting in extensive loss of dental and oral tissues. It is known that smoking and the excessive consumption of alcohol are causative factors in oral cancer.

Teeth may be damaged or lost as a result of physical trauma. Most frequently this results from accidental damage occasioned through sporting and recreational activities but may also result from physical violence. The appropriate use of well constructed mouthguards during sporting activities and full face protection in motor sports and motorcycling will reduce the extent of damage to the teeth and facial skeleton. Moderation in the consumption of alcohol can reduce the incidence of alcohol-related violence.

SECONDARY PREVENTION

Secondary prevention strategies should include appropriate and thorough planning, and stabilisation of current oral diseases. All reasonable effort should be made to restore damaged and diseased teeth and their supporting structures using conventional methods. The use of conventional bridges and conventional dentures are frequently the most appropriate and most cost-effective methods of replacing missing teeth. Resin-bonded bridges have the

advantage that they require minimal preparation of the teeth immediately adjacent to the missing tooth but are seldom appropriate when two or more adjacent teeth are missing. However, any restoration that impedes the normal access of tooth cleaning devices does have the potential to place the compromised tooth at risk of disease.

TERTIARY PREVENTION

Patients who have one or more dental implants must maintain optimum standards of oral hygiene to reduce the incidence of peri-implant inflammation and bone loss around the implant. Tobacco smoking has been shown to be associated with increased failure of osseointegration and tobacco smokers may suffer more rapid bone loss around any implant if the smoking habit is continued. Appropriate smoking cessation advice should be given.

Patients who have implants in the anterior region of the mouth should be aware that they have a particular need to wear protective appliances if they continue to participate in risk activities e.g. contact sports, cycling etc.

Implant supported restorations require regular review to ensure that they are well maintained by the patients and that they are managed by clinicians who are sufficiently experienced and competent in the maintenance of implant restorations. The after-care regime should include appropriate oral and prosthesis hygiene instruction.

MODEL OF EFFECTIVE CARE

The surgical and restorative procedures are skilled and complex. The evaluation process and sequence of prospective procedures is variable, extensive and time-consuming. Professional consensus supports the view that the planning stage is the most important, with proper assessment being crucial to the selection of appropriate patients, ultimate effectiveness, and the reputation of the intervention. It must be noted, however, that, in the first instance, attempts to solve tooth loss problems by conventional means should be attempted or such options should, at least, be explored. It is also recognised that dental implants should, at least, be delivered by a multidisciplinary team.

MULTI-DISCIPLINARY TEAM APPROACH

(i) Consultant clinic assessment

Joint clinical assessment: appropriate trained specialists.

Thorough work-up including appropriate special investigations including referrals if necessary, leading to treatment plan consensus.

Clear open communication pathways for referral if required to:

- Clinical psychologist/Psychiatrist
- Speech therapist
- Anaesthetist
- Medical colleagues

(ii) Suitably trained technical support

Dental/oral and maxillofacial technicians

(iii) Suitably trained hygienist

Pre- and post- implant placement.

Professional dental cleaning, oral hygiene instruction/after-care instruction, smoking cessation counselling.

(iv) Suitably trained nursing assistance

ECONOMICS

This section reports some evidence on the costs and benefits of dental implants.

The introduction of dental implants as a treatment option for certain patients has clear benefit to the recipients but also confers a large financial burden on the payer. This generates a requirement for a Cost-Effectiveness Analysis (CEA)⁴¹. An exhaustive CEA would consist of a comparison of the lifetime costs and benefits of the treatment options for particular clinical presentations. Some of these benefits and costs are detailed below.

BENEFITS

A number of clinically related outcome measures are available^{32,42}. Measuring longevity is important because additional treatment (and the discounted benefits and costs it confers) is a significant component of any CEA. Whilst the current evidence does not evaluate this issue accurately⁴³, some evidence is available. Over a three year period, relining and remaking of implant supported overdentures was necessary in 40% and 21% of cases, respectively. A recent systematic review of single-tooth implant supported restorations (SIRs)³⁰ found that the success rate (survival rate) of the implant was 98% after four years, while the survival rate of the restoration was 86%. In addition, a meta-analysis¹⁸ of the survival of fixed partial dentures (FPDs) – an alternative treatment to SIRs – found that after four years more than 95% of FPDs were not removed nor had they technically failed (thus necessitating replacement); and approximately 3% of abutment teeth were lost.

Other clinically related outcome measures, including bite force and the degree of alveolar bone resorption, provide further evidence of the benefits of implant supported prostheses (ISPs) relative to conventional prostheses (CPs)^{44,45}.

PATIENT-BASED OUTCOMES

In addition to the potential benefits of ISPs over CPs in terms of clinically measured outcomes, there is a whole raft of evidence that supports the patient perceived benefits of ISPs relative to CPs^{46,47,48}. However, interpreting this evidence should be conducted with some caution because patients who find they are constantly dissatisfied with CPs may self-select for implant treatment⁴⁹. Controlling for this self-selection would require a fully prospective randomised controlled trial (RCT). Unfortunately, in a recent review of patient-based outcomes of implant

therapy¹⁹ only 3 of the 19 studies included were RCTs. One of these RCTs demonstrated that patients prefer ISPs to CPs over a number of dimensions of satisfaction after one year post-placement⁵⁰. This RCT⁵⁰ showed that there was no difference in satisfaction measures between the groups prior to treatment, but a significant difference post-treatment: on a scale of 1 to 10, the overall satisfaction ratings for ISPs and CPs were 8.37 and 6.58 respectively.

COSTS

The total costs of ISPs consist of initial placement costs and the discounted future costs of re-treatment. At the time of writing, only two papers^{45,51} explicitly included cost data on implants. Both are concerned only with implants placed to support full dentures and neither study provides reliable estimates of the expected future costs of treatment. Tables 1 and 2 in Appendix 5 provide some details.

To provide an indication of the cost of placing dental implants in Scotland the working group collected some cost information on the placement of certain types of implants and their conventional alternative via an 'expert panel' (Appendix 4). Whilst these data clearly have some limitations they are at least suggestive of the order of magnitude of the cost of implant treatment in Scotland.

CONCLUSION

The driver behind all economic evaluations is the concept of opportunity cost⁵². The opportunity cost of implant treatment is the oral health benefits forgone of conventional treatments. The evidence presented in this report suggests these opportunity costs are large. Therefore, the decision policy makers must address is whether the obvious benefits of implant treatments are worthwhile. Naturally, this requires good quality – and, in particular, long-term – evidence. At present this is not available.

CONCLUSIONS

This report concludes, in the context of limited resources available and insufficient information on costs and benefits, that dental implants cannot be justified for wide-spread routine use within the NHS in Scotland.

Furthermore, decisions as to the prioritisation and allocation of health care resources have to be made regarding the continuing provision and availability of dental implants on the NHS.

There is limited published literature which addresses the economic evaluation and effectiveness of dental implants. Specifically, there is a lack of evidence based research into the comparative effectiveness of dental implants compared to conventional treatments. However, there is more research into techniques, materials and clinical outcomes.

In addition, there is a dearth of well-designed, long term, prospective randomised controlled trials (RCTs) with which to inform an economic analysis of dental implants.

At present there is inequitable access to dental implant services throughout Scotland, as not all patients who need them are offered them.

Improvements in the quality of life of patients can be achieved with the use of dental implants. However, the costs associated with dental implants and the complexities of this form of treatment mean that they have to be used appropriately.

Dental implants have the potential to help to provide a functional dentition in cases of severe and disfiguring dental and oral pathology, particularly in patients with oral cancer and developmental tooth defects.

RECOMMENDATIONS

1. Dental implants should be made available as a reconstructive treatment for all patients with oral cancer where there is a clinical need and when no alternative treatment is appropriate.
2. For patients with developmental tooth defects and multiple traumatic tooth loss dental implants should be made available as a reconstructive treatment option when alternative conventional treatment is inappropriate.
3. NHS Scotland should develop a programme to ensure that dental implant treatment is made available throughout Scotland for all adult patients who cannot wear complete dentures because of severe atrophy of the alveolar ridges but who are capable of maintaining adequate standards of oral hygiene.
4. Dental implants should only be provided within the NHS in Scotland by trained specialists working in multidisciplinary teams in secondary care settings.
5. All specialists who provide dental implants should maintain a data bank of cases to allow long-term follow-up. Standardised records (clinical, radiographic and photographic) should be maintained and shared with successive clinicians to ensure appropriate continuing care.
6. A co-ordinated national programme of audit and research should be developed, to include:
 - A long-run assessment of the cost and effectiveness of dental implants and appropriate alternative treatments.
 - Further research should be undertaken to predict the incidence of severe alveolar ridge atrophy, to identify its likely causes and to determine if the early provision of dental implants in selected cases may be the most cost-effective method of reducing the prevalence of complete denture intolerance in the adult population.

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APPENDICES

APPENDIX 1: DEFINITIONS

DENTAL IMPLANTS

A dental implant consists of an infrastructure of alloplastic material (usually Titanium) surgically placed into the jaw bone. Following successful healing (osseointegration) this provides the infrastructure onto which a prosthesis superstructure) can be secured. Osseointegrated dental implants are a relatively recent development, with Branemark presenting the first 10 year results of research into titanium implant osseointegration in only 1977.

Dental Implants contribute to the restoration of oral function (eating, speaking, swallowing and smiling) and facial appearance. They can aid the relief of discomfort, and improve psychological and emotional well-being.

OSSEOINTEGRATION

Healing whereby the implant is directly connected with the bone creating a solid bond.

CONVENTIONAL TREATMENTS

Missing teeth and supporting tissues have traditionally been replaced with dentures or bridges. Bridges frequently require preparation of adjacent teeth.

PRE-PROSTHETIC SURGERY

Regarded as conventional surgical techniques to prepare or improve the quantity and form of oral mucosa/bone as supporting structures for a prosthesis. In many instances superseded by or now incorporating more dental implant techniques.

NEED

Need in the context of this assessment implies the medical definition ("normative need"), i.e. need for the clinical intervention. This will inevitably give the report a professional focus. Application to the population will have to come from realising the need of the population in terms of the "unmet need" - being the difference between the services deemed necessary to deal with defined health problems and the actual service received or available.

TECHNICAL EFFICIENCY

In terms of allocating resources, using the most cost-effective system to achieve desired outcome.

ALLOCATIVE EFFICIENCY

Allocating resources away from cost-ineffective systems to cost-effective systems; taking into account the greatest need and benefit.

OPPORTUNITY COST

The cost of using resources for a certain purpose, measured by the benefits forgone by not using them in their best alternative use.

APPENDIX 2: DATA ON VARIOUS SYSTEMS

The lack of consistently used criteria makes it difficult to compare the relative success rates of the commercially available systems. The first European Workshop of Periodontology (1993) recommended that at least five year data should be available. The 3rd European Workshop of Periodontology (1999) offers extensive criteria that implant systems should meet. These recommend that there should be less than 2mm of bone loss, when measured radiographically, over the first five years of loading, with the majority of any bone loss occurring in the first year. At the time of writing, the following systems meet these criteria:

Nobel Biocare
ITI
IMZ
Implant Innovations
Astra

APPENDICES

APPENDIX 3:

PATIENTS DISCHARGED FOLLOWING A JAW RESECTION OPERATION IN SCOTLAND BY NHS BOARD OF RESIDENCE AND FINANCIAL YEAR

Time period: April 1997 to March 2000

SOURCE: SMR01

NHS BOARD NAME	97/98	98/99	99/00
Greater Glasgow	16	32	23
Lothian	14	20	18
Lanarkshire	9	13	10
Argyll and Clyde	11	4	10
Fife	7	9	9
Grampian	4	9	12
Highland	8	6	4
Ayrshire and Arran	8	6	3
Tayside	7	5	5
Forth Valley	4	2	6
Borders	3	1	2
Dumfries and Galloway	2	1	1
Shetland	1	1	0
Total	94	109	103

APPENDIX 4:

COMPARISON OF THE COSTS OF DENTAL IMPLANTS SUPPORTED DENTURES VS CONVENTIONAL DENTURES IN A SECONDARY CARE SETTING IN SCOTLAND (CALCULATED IN 2000).

Table A.1

The cost of providing full upper denture and dental implant supported lower completed lower denture.

SC	Senior Clinician
DN	Dental Nurse
RAD	Radiographer
DPT	Dental Panoramic Tomograph
Lat Ceph	Lateral Cephalometric Radiograph
SLT	Senior Lab Technician

X-ray material costs assumed zero

Process	Input	Units	Time (mins.)	Cost per unit	Total cost
Consultation	SC	1	20	0.55399	11.0798
	DN	1	20	0.11395	2.279
Radiography	DPT	1			
	RAD	1	10	0.23633	2.3633
Combined implant clinic	SC	3	30	0.55399	49.8591
	DN	1	30	0.11395	3.4185
Radiography	DPT				
	Lat Ceph				
	RAD	1	20	0.23633	4.7266
Prosthetics clinics for new full dentures	SC	1	150	0.55399	83.0985
	DN	1	150	0.11395	17.0925
	Impression materials	2		1	2
	Sterile instrument trays	5		9	45
Prosthetic Lab for new full dentures	SLT	1	510	0.1824	93.024
	Materials				20
Pre-op assessment	SC	1	20	0.55399	11.0798
	DN	1	20	0.11395	2.279
Operation- 2 implants	SC	1	90	0.55399	49.8591
	DN	1	90	0.11395	10.2555
	Implants	2		165	330
	Drill	0.16 6		120	20
	Sterile trays	3		46.66	140
	Consumables				20
Post-op review	SC	1	20	0.55399	11.0798
	DN	1	20	0.11395	2.279
Review	SC	1	10	0.55399	5.5399
	DN	1	10	0.11395	1.1395
Prosthetic Review	SC	1	20	0.55399	11.0798
	DN	1	20	0.11395	2.279
Radiography	DPT/ 2 peri-apical				
	RAD	1	15	0.23633	3.54495
Prosthetic clinic for conversion of lower denture	SC	1	60	0.55399	33.2394
	DN	1	60	0.11395	6.837
	Abutments	2		60	120
	Impression materials	1		2	2
Prosthetic Lab for denture conversion	SLT	1	60	0.1824	10.944
	Impression pins	2		10	20
	Matrix	2		25	50
Prosthetic clinic fit	SC	1	30	0.55399	16.6197
	DN	1	30	0.11395	3.4185
Prosthetic clinic reviews	SC	1	30	0.55399	16.6197
	DN	1	30	0.11395	3.4185
Total Cost					1237.454

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Table A.2
The cost of providing conventional full upper and lower dentures

Process	Input	Units	Time (mins.)	Cost per unit	Total cost
Consultation	SC	1	20	0.55399	11.0798
	DN	1	20	0.11395	2.279
Radiography	DPT	1			
	RAD	1	10	0.23633	2.3633
Prosthetics clinics for new full dentures	SC	1	150	0.55399	83.0985
	DN	1	150	0.11395	17.0925
	Impression materials	2		1	2
	Sterile instrument trays	5		9	45
Prosthetic Lab for new full dentures	SLT	1	510	0.1824	93.024
	Materials				20
Total					275.9371

APPENDIX 5:

THE ESTIMATED COST OF ISP AND CP IMPLANT TREATMENT FOR FIXED (USING 5 IMPLANTS) AND REMOVABLE (USING 2 IMPLANTS)^{45,51}

Study	Duration	Perspective	Results	
			Treatment	Cost index
Van der Wijk et al. (1998) ⁵¹	First year of treatment including follow up	Provider	Complete dentures	1 ^A
			Complete dentures ^B	3
			Permucosal implants	3
			Transmandibular implants	7

Study	Duration	Perspective	Results ^C		
			Treatment	Cost index	
MacEntee and Walton (1998) ⁴⁵	12 years	Provider		1 year	12 years ^D
			Conventional denture	1 ^E	3
			Removable ISP	7	14
			Fixed ISP	17	27

^A The cost of new dentures is \$1205 (1994 \$ US)

^B With pre-prosthetic surgery.

^C It is not clear whether these are \$US or \$Can. Furthermore it is not clear whether future costs have been discounted to their present value. These estimates should therefore be interpreted with caution.

^D Estimated.

^E The total cost for conventional dentures is \$750 (1996).

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