Eur. J. Prosthodont. Rest. Dent., Vol.16, No. 1, pp 24-34
Printed in Great Britain

The Evidence Base for Current Practices in Prosthodontics

Claire L. Harwood *

This paper is based on the winning entry for the BSSPD Heraeus Kulzer undergraduate essay prize 2006

Abstract - *An aging population means the number of edentulous and partially dentate patients is rising. The multiplicity of treatments makes treatment choice challenging, emphasising the need for evidence-based prosthodontics. This review examines the evidence-base for current prosthodontic practices within removable and fixed domains by drawing on evidence from randomised controlled trials. Consideration is also given to the role of systematic reviews and observational studies. The increasing number of prosthodontic randomised controlled trials, especially in commercially attractive topics such as denture hygiene and implants, is highlighted. What is needed to advance the evidence-base within prosthodontics is also examined.*

KEY WORDS: Evidence-based; dentistry; prosthodontics; denture/partial, complete; prosthesis/removable, fixed

INTRODUCTION

Evidence-based medicine[1,2] embodies the philosophy that treatment should be based on best available research. The broader concept, evidence-based practice[3,4], relates clinical expertise, patient choice and available research. A 'hierarchy of evidence' considers the quality of evidence[5,6] (Fig. 1). Randomised controlled trials (RCTs) are the 'gold standard'[7], while systematic review (SR) represents a higher level. Dentistry has embraced this evidence–based approach[8] and is supported by resources such as an internet-based 'Centre for Evidence-based Dentistry'[9], journals devoted to evidence-based practice[10,11] and the Cochrane Oral Health Group[12].

Prosthodontics is concerned with the replacement of missing teeth[13] in either removable or fixed domains; implantology is considered an adjunct[14]. An aging population means the number of edentulous and partially dentate patients is rising[15]. The wealth of treatments makes treatment choice challenging[16] and highlights the need for evidence-based prosthodontics[17]. Drawing on RCTs cited previously[18], and others identified in further literature searches, this review will examine the evidence-base for current prosthodontic practices within removable and fixed domains. While the quality of the individual studies cited will not be assessed, the strengths and weaknesses of the design of RCTs, SRs and observational studies will be considered. Finally, what is needed to advance the evidence-base will be discussed.

The Evidence Base for Current Practices

MEDLINE was searched for English language 'prosthodontic' articles published between 1966 and 2005 (Fig. 2). Limiting to RCTs yielded 955 articles. An earlier, narrowly defined, search found 91 English language, prosthodontic, RCTs between 1966 and 2000[18]. The summary was updated, adding articles published between 2001 and 2005 using similar categories (Figs. 3a and b). MEDLINE searches only identify ~80% of published RCTs[19], however, the increasing number of prosthodontic RCTs is clear (Fig. 3a). Notably, commercially attractive topics such as denture hygiene and implants, dominate the literature.

To restore or not to restore

Tooth replacement must be justified in terms of patient needs, demands and motivation, as well as maintenance of oral function. Withholding active treatment may be indicated if problems outweigh the benefits[20]. A functional, but reduced dentition may not require treatment. The shortened dental arch (SDA) provides adequate oral function with reduced occluding pairs of posterior teeth[21,22] and is common as molars are most affected by dental disease[23,24]. However, despite 95% of dentists agreeing with the concept, the SDA was utilized in <10% of cases[25]. Twenty teeth can satisfy most criteria for a stable occlusion and functionality[26,27]. Only one RCT shows no difference in oral-health-related quality-of-life between a SDA and a removable partial denture (RPD)[28]. Even this study did not use a natural SDA: missing anteriors and premolars were replaced by fixed prostheses, but molars were not replaced, and low sample size might 'muddy' the result. SDAs can be restored with removable or fixed prostheses[29]. In a series of RCTs, resin-bonded fixed partial dentures (RBFPDs) gave improved patient satisfaction[30] and a lower incidence of caries[31] but did not improve diet[32] compared to RPDs.

No active treatment should always be considered as an option to posterior tooth replacement and clinical criteria should be developed to inform this decision. If restoration is indicated, evidence suggests that RBFPDs are more efficacious than RPDs.

* BSc, BDS, PhD

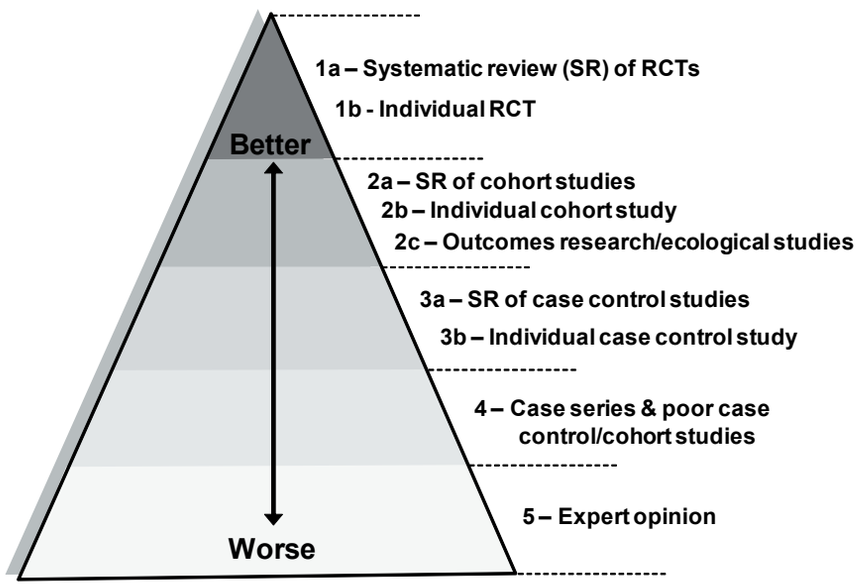

Figure 1. *Hierarchy of evidence. Systematic Review = literature review to appraise/synthesise all high quality research evidence on a specific question. RCT (Randomised Controlled Trial) = group of patients randomised into experimental and control groups and followed-up for outcomes of interest. Cohort Study = two groups of patients, exposed/not exposed to factors, and followed forward for outcomes of interest. Case control study = previous exposure to a risk factor is compared between cases and control groups of patients. Case-series = report on a series of patients with an outcome of interest (no control group).*

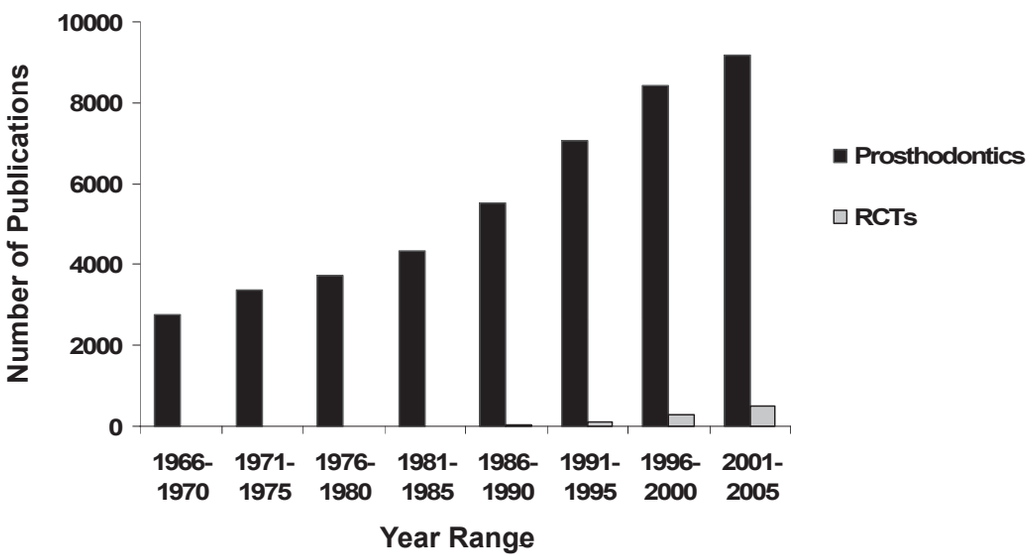

Figure 2. *The number of English language publications, according to a MEDLINE search, containing the term "prosthodontics" and publications containing "prosthodontics" limited to randomised controlled trials (RCTs) in 5-year ranges from 1966. At the end of 2005, 44,338 "prosthodontic" publications and 955 "RCTs" had been published.*

Removable Prostheses

Denture construction

Two RCTs[33,34-41], one spanning 20-years[34-41], found no difference between construction methods using varying articulation techniques to establish occlusion in terms of bone loss and number of adjustment appointments. Another RCT found no major difference in patient satisfaction, comfort and function between a 'traditional' and 'simple' method, supporting the use of simple techniques, which are easier to master and reduce time and costs compared to traditional techniques taught to undergraduates[42]. An RCT has indicated that positioning teeth in the neutral zone improves comfort and speech in complete dentures[43]. Scientific methods for determining tooth position are lacking: anatomical landmarks are 'handed-down' but can be unreliable[44]. One RCT shows the relationship between intercondylar-width and the width between the canine and molar in each arch can be used to position canines and first molars[44]. Clearly more RCTs on denture construction are needed to identify constructions techniques and tooth arrangements that improve dentures.

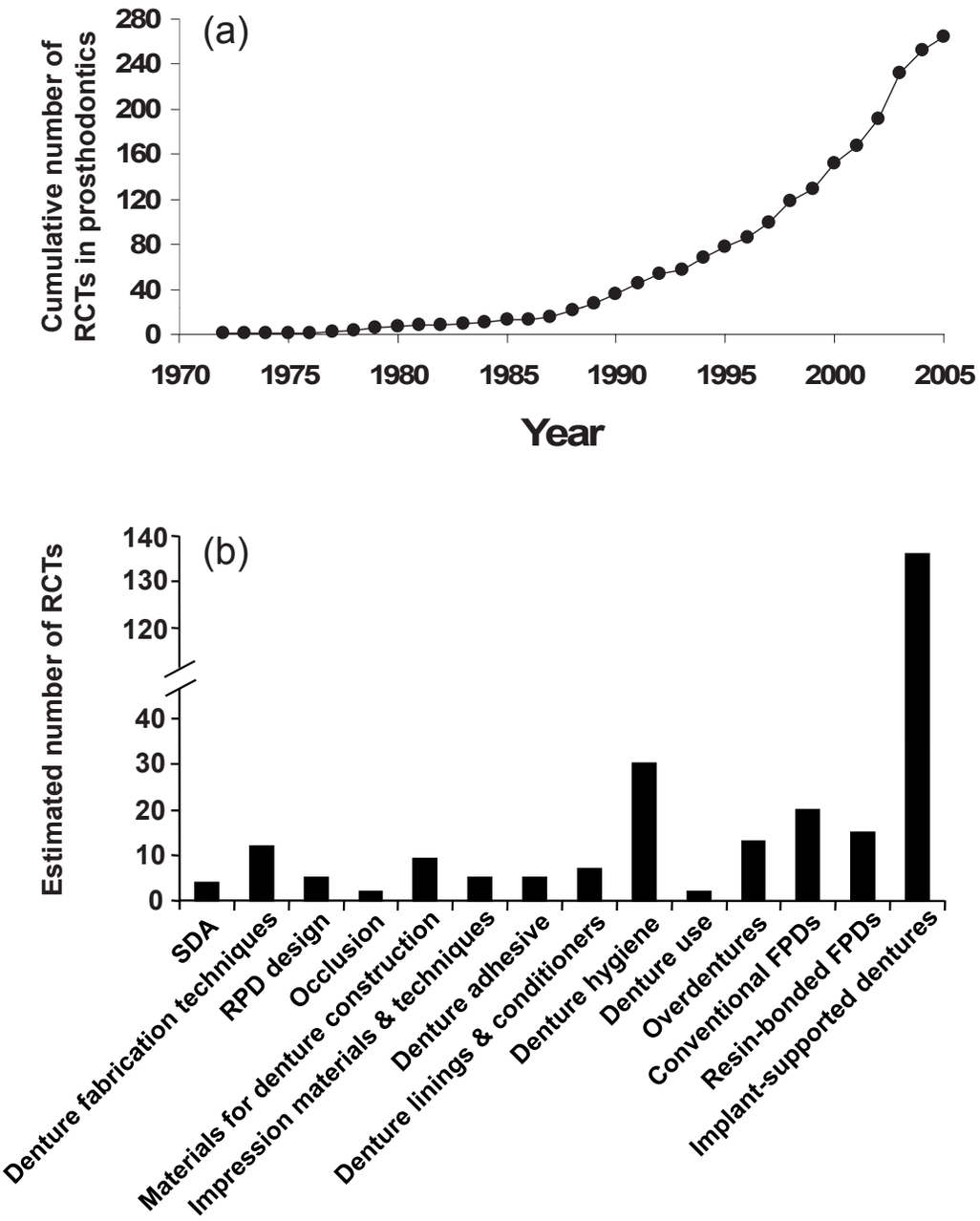

Figure 3. *Randomised-controlled trials (RCTs) reporting within the discipline of Prosthodontics. RCTs used are those are cited in a previous publication (1966-2000)18 and from a further MEDLINE search (2001-2005) carried out by the author. (a) The cumulative number RCTs published between 1966 and 2005. (b) The number of RCTs reporting within various categories within the prosthodontic domains defined in Fig. 3.*

RPD design

The primary purpose of an RPD must be to preserve the remaining dentition[45], but they can increase periodontal problems, caries and bone resorption[46]. Only five RCTs focus on these problems. A crossover study found no difference between minor connector design in abutment mobility and plaque accumulation after 19 weeks[47]. Patients preferred the design that exerted a tilting force on the abutment tooth, increasing retention and minimising tooth mobility. There was no significant difference in success rate, maintenance, periodontal health, caries incidence or masticatory performance between two different RPD designs showing that a well-constructed RPD using abutment teeth with good bone support, together with regular review, is a satisfactory treatment modality[48,49]. In contrast, gingival inflammation was increased with a lingual plate compared to a cingulum bar major connector[50]. Another RCT showed that a resilient-layer, distal extension RPD reduced ridge resorption compared to conventional RPDs, recommending this design[51].

The burden of oral disease, alveolar bone reduction and patient satisfaction with different RPD designs should be investigated across the range of Kennedy's classification[52] while taking into account variables such as patient attitudes towards dentures and oral health.

Occlusion

The patient's occlusal requirements must be considered to ensure denture stability and centralize forces on the ridge to reduce bone resorption[53]. Strong evidence is lacking for much of complete denture occlusion[54]. No RCTs compare the two main occlusal concepts: Balanced occlusion and balanced articulation. It is recommended after balanced occlusion is established, a 1-2mm area of balanced articulation is created around this position[55] to provide stability at rest and during ruminatory movements. Canine guidance (CG) is not usually associated with complete dentures due to instability and loss of retention during eccentric movements, however, it reduces muscle activity and alveolar bone resorption[56]. A recent RCT found that complete denture patients quickly adapt to CG, achieving better chewing ability and mandibular denture retention compared to balanced occlusion[57]. Despite low patient number and dropouts on follow-up, this success suggests it merits further investigation.

Cuspal anatomy affects occlusion, stability, function and the aesthetics of complete dentures. Four types of posterior tooth-moulds are available[58]. Moulds are generally based on conjecture and subjective evidence. Only one RCT compares occlusal schemes[59] and, because of possible bias[60], provides only weak evidence of patient preference for teeth with cusps over cuspless teeth and fails to identify a superior mould. A RCT is being undertaken to address the efficacy of three posterior moulds[60].

Materials used for the construction of dentures

Nine RCTs address the increasing range of denture materials. Compression-moulded acrylic denture bases and artificial teeth are most widely used, but are subject to processing shrinkage and expansion due to water absorption. A 5-year RCT showed similar, clinically acceptable, dimensional changes in conventional and rapid heat-cured acrylic maxillary dentures[61]. Injection-moulding may reduce dimensional inaccuracies[62]. Two similar RCTs showed no difference in denture adaptation between conventional and injection-packed bases[63], and no difference between heat or microwave polymerisation in conventional and injection-packed bases[64]. Thus, there is no evidence that injection-moulding has advantages over compression moulding.

Many alloys are used for fabricating removable prostheses: cobalt-chromium (Co-Cr) is most widely used, but may corrode and cause allergic reactions. Titanium is resistant to corrosion and more biocompatible. One RCT concluded that titanium bases were most suitable for dentures subject to high mechanical stresses and patients hypersensitive to other materials[65]. Another found similar two-year success rates in Co-Cr and titanium RPDs but increased failure of titanium RPDs before one-year, possibly due to lower rigidity[66].

Softer resin teeth have largely replaced ceramic teeth, causing less wear of natural teeth and improved bonding to denture bases, but they tend to wear. Modified-resin teeth are more wear resistant[67]. No difference in wear was found between different commercially available modified-resin teeth[68-70]. There is a lack of data on the comparative efficacy of old and new materials, possible toxicity of materials leaching from acrylics and patient responses to new alloys[71]. This means clinicians must largely reply on tradition and experience to choose which to use.

Impression materials and techniques

Five RCTs focus on impression materials and techniques, only two compared materials. A similar number of adjustments were required using fluid wax and polysulphide rubber[72]. Unfortunately, fluid wax is not commonly used. 75% of patients preferred RPDs made using alginate compared to condensation-cured silicone impressions[73]. Surfactant was found to improve the surface quality of polyvinyl siloxane impressions[74]. The altered-cast technique[75], widely taught but rarely used in practice, reduces the support differential for a distal extension saddle, obtaining a compressive impression while imitating functional loading[76]. One RCT concluded it has no significant advantage over the one-piece cast, provided the master impression is completely extended[77]. Alginate is generally chosen for ease of use and low cost, however, zinc-oxide-eugenol (ZOE) is sometimes preferred for definitive complete denture impressions. There is little evidence to support this. Indeed, in a recent RCT, ZOE was least favoured of three impression materials[78]. Thus, few data discriminate between impression materials and techniques.

Denture adhesives

Dentists generally reject the use of denture adhesives; however, loose dentures mean they are widely used by patients. From five RCTs, three indicated patients favoured adhesives, citing improved retention and chewing ability[79-81], another RCT reported reduced breath odour[82]. Adhesives contain cytotoxic substances[83], or may have toxic effects with continuous use. Further clinical evidence about their use, efficacy and toxicity of adhesives is sorely needed.

Denture linings and conditioners

As the population ages, patients with atrophic mandibles will increase, increasing the need for resilient liners[84]. One RCT found no difference in compliance between two liners after 6-months wear[85] and another showed similar levels of fungal growth between liners[86,87]. There was no difference in patient satisfaction between a resilient liner and acrylic resin, however, the resilient liner was preferred[84], providing some evidence of efficacy from the viewpoint of the patient. Notably, there were significant differences in *in vitro* and *in vivo* leaching of plasticizers between two different soft linings[88]. A denture reline is indicated when there is a defect in the impression surface. Choice of reline material has largely been based on clinician preference. One RCT found no difference in comfort, fit or integrity between three hard chairside reline materials, however, 'Tokuso Rebase' showed superior stain-resistance, colour stability and durability[89]. Tissue conditioners are used over relatively long periods. A RCT showed coatings improve their life-span, with 'Permaseal'-coated conditioners remaining the softest after four weeks[90].

Linings and conditioners are widely used in prosthodontics. Clinical studies considering outcomes such as efficacy, longevity, comparative benefits and the effects of low-dose exposure to components of these materials are lacking.

Denture hygiene

The growth of microorganisms on dentures potentially threatens patient health, particularly the elderly[91]. Denture hygiene is important for health, aesthetics and the prevention of candidosis[92,93]. Many RCTs focus on this topic[94-123]. While no single cleaning technique is supported, mechanical cleaning alone has been found to be inadequate. There is a pressing need for more studies focusing on the development of effective preventive programmes and cleaning methods.

Denture use

Prognosis of complete denture therapy relies on a patient's ability to adapt, which depends on age, treatment burden, co-morbidity, expectations and other factors. Two RCTs looked at denture use. A behaviour-rating scale was found to be a useful predictor of elderly patients' ability to adapt to dentures when comparing relined *versus* new dentures[124]. A consistency-graded diet during adjustment to complete dentures improved adaptation, reducing mucosal ulceration and soreness[125]. However, the value of both studies suffered due to low patient numbers and high dropout rates. Further research identifying the problems associated with adjusting to removable prostheses and the factors determining their acceptance and success is needed. In addition, to compare studies, universal criteria for assessing denture success should be developed.

Conventional overdentures

Roots are retained under dentures in an attempt to counter alveolar bone loss[126]. 13 RCTs study overdentures. A RCT showed bone loss after one-year to be 50% less with immediate mandibular overdentures compared to immediate complete dentures, but no significant difference in additional bone loss was apparent after two-years[127]. While the reduced bone loss indicates overdenture therapy, the 4.5 year abutment condition was disappointing[128]. Patient satisfaction with overdentures was high and any variance was related to denture quality and preconceived attitudes towards dentures[129,130]. Sealing the abutment root canal and protecting the abutment from caries is paramount. While no superior sealing material has been identified, glass-ionomer reduced caries, possibly due to fluoride release[131]. There is evidence that abutments can also be protected by topical fluoride[132,133], fluoride containing resins[134] and fluoride-releasing restorative materials[135]. Daily application of topical fluoride was more effective than weekly[133] but relies on patient compliance. Chlorhexidine and chlorhexidine-fluoride gels also reduce plaque accumulation, gingival bleeding[136] and maintain periodontal health[137], but chlorhexidine must be applied daily to maintain its effect[136]. In contrast, autopolymerising resins and fluoride-releasing materials are not patient-dependent. Two RCTs show chlorhexidine-fluoride gel reduces caries and suppresses microbes better than fluoride gel[138,139]. Although overdentures reduce bone loss, their success depends on root health. More data on sealing materials and protective agents are needed.

Fixed prostheses

Conventional fixed partial dentures (FPDs)

FPDs are an alternative to RPDs but are expensive and can damage tooth-tissue. 20 RCTs were identified. Two found similar 5-year success of FPDs (80%) and RPDs but RPDs required more follow-up treatment, supporting the use of FPDs[140,141]. Recent SRs of cohort-studies calculated pooled FPD success rates of 71-87% and up to 90% survival. The most common causes of failure were caries, loss of abutments and loss of retention[142]. FPD success depends on the materials and bonding systems, marginal fit, abutment condition, ridge form, oral hygiene, extent of tooth preparation and other factors[143]. Two RCTs show no difference in abutment prognosis whether zinc-phosphate or glass-ionomer cement was used[144,145]. Others showed that, while lower quality noble alloys can be used, some tarnish and show surface changes[146,147], and cheaper alloys have poorer outcomes[148]: Titanium-alloys have increased metal-ceramic failure compared to gold[149]. Metallic taste is generally not a problem[150] and plaque-scores are similar for different alloys[151]. A RCT evaluating temporary FPD resins found they were clinically reliable, however, light-cured resins had greater polymerisation shrinkage and all resins suffered from increased plaque adherence[152]. Adjunct chlorhexidine mouthrinse reduced plaque levels associated with FPDs[153,154]. A RCT comparing two soft tissue augmentation procedures for correcting alveolar ridge defects prior to FPD placement revealed significantly greater tissue gain with a subepithelial connective tissue graft[155].

Demands for stronger, more aesthetic FPDs and advances in materials and technology have led to new fabrication methods, high-strength all-ceramic and less destructive fibre-reinforced FPDs. RCTs have evaluated several of these new FPDs and, although there are some problems, most show clinical viability[156-162].

Resin bonded FPDs (RBFPDs)

RBFPDs offer a conservative, cheaper option to conventional FPDs. They were introduced relatively recently[163] and have since been improved[143]. 15 RCTs were identified. RBFPDs perform as successfully as conventional FPDs[164,165] but with reduced longevity: 5-7 year survival rate is 75%[166]. Several risk factors have been identified[167]. Location in the mouth greatly influences durability[168]. Survival is higher for anterior than posterior RBFPDs[169-171], and is better in the maxilla[167,169,170,172,173]. Debonding of RBFPDs, generally due to poor retention, is the most common cause of failure. Although many can be successfully rebonded, retreatment is less successful, especially in the mandible[173,174]. Improved bonding systems have been developed[175]. No difference was found between brands[171-174,176], but some are more aesthetic, easier to use[176] and influence rebonding[173]. Etched retainers[170], alloy surface treatments[177] and grooved tooth preparations[173,178,179] improve retention and RBFPD longevity, increasing success for less-experienced clinicians[178].

Biological or technical failure affects the longevity of fixed prostheses. Most studies are retrospective, so identifying a cause of failure is difficult and complex. FPD systems are continually improving, although long-term studies are few. Long-term, comparative RCTs are required to evaluate, for patient and treatment-based outcomes, conventional fixed prostheses, and new systems with improved materials, bonding, retention (especially in the posterior mandible) and better aesthetics.

Implant-supported dentures

136 RCTs relating to implant-supported dentures (ISD) were identified. Due to the large number only a selection of these RCTs is discussed below. ISD's are increasing in popularity, particularly a mandibular implant-supported overdenture (ISO) supported by two implants opposed by a complete conventional denture[180]. It is superior to conventional treatments[181-189] with improved stability, increased bite force, decreased denture pain[190], improved masticatory performance[191] and confers improved quality-of-life[192]. While attachment type does not influence bite force[193], a bar-clip is more successful than a ball attachment[194-196]. However, ISOs are only an option if their cost is reasonable. There is little difference in total time, number of visits[180] and cost[197] of implant-supported *versus* conventional dentures. Although professional maintenance is paramount, the time needed is similar between implant systems[198]. The cost of providing and maintaining ISOs is not as large as expected. Together with compelling evidence for superior performance, this has led to a consensus statement that conventional dentures are not the most appropriate treatment for an edentulous mandible and a two-implant-overdenture should be made available[199,200].

In the NHS, implants may be considered for edentulous and partially dentate patients with severe denture intolerance, to prevent severe alveolar bone loss or to preserve remaining healthy teeth[201]. However, as only appropriately trained clinicians should place implants, they are largely restricted to hospitals. Most NHS hospitals in the UK lack funding for implants so they are rarely offered. Further, older patients have minimal expectations and are reluctant to undergo surgery[202]: >36% of older patients refused free implants[203].

Problems And Deficiencies In The Prosthodontic Evidence Base

Although increasing, the number of RCTs in the prosthodontics literature remains small (~2% of studies relating to prosthodontics, Fig. 2). To evaluate interventions, RCT quality has been appraised. Between 1966-2000 few complied with established guidelines[18], such as CONSORT (Consolidated Standards of Reporting Trials)[204,205]. It was suggested this indicates a lack of knowledge about common prosthodontic procedures, specifically: use of alloys, cements and the differences between impression materials[18]. A catalogue of prosthodontic RCTs is currently being compiled in the USA[206] and should be extended internationally.

RCTs

Although RCTs are regarded as 'gold standard', they are not without problems. They often employ ideal conditions which may not address a therapy's effectiveness in practice. They may be hampered by ethical considerations or exclusion of certain groups[207]. While they should be long-term (10-20 years) and multi-centred, maintaining patient numbers throughout a long-term study can be difficult as most prosthodontic patients are elderly. They may be confounded by patient variables, e.g. ridge form, patient tolerance, oral anatomy, medical history, age, periodontal status, Kennedy classification. Long term studies may be complicated by changes in the participating centres and clinical teams, availability of funding and changes in research policy etc. RCTs are also expensive and difficult to blind.

SRs in Prosthodontics

SRs of RCTs re-analyse data from multiple studies (meta-analysis) to draw definitive conclusions. However, historical data may be subject to bias[207]. An inventory of prosthodontic SRs has been compiled[208]. Of thirteen studies synthesising pooled data, only one used included RCTs alone. Positively, there was close agreement of two pairs of reviews on the same subject, one pair addressing FPD longevity, the other, single-tooth implant survival. They concluded that, while SR has penetrated prosthodontics, providing some prognostic evidence, the lack of RCTs limits their use in defining best practice. It is generally accepted that the most authoritative SRs are published by the Cochrane Library, nevertheless, even these can be improved[209,210]. The Cochrane Oral Health Group's[12] SRs on 'Interventions for Replacing Missing Teeth' are likely to inform future RCTs, SRs and therapies in prosthodontics. The Cochrane Collaboration has developed guidelines for the including studies in a SR[211]. Other guidelines are also available (QUORUM – Quality of Reporting Meta-Analyses[205]). Future prosthodontic reviews should adopt these recommendations[208].

The role of observational studies

The prosthodontic literature contains a wealth of observational studies[212] that would be wasteful to abandon. Observational studies focus on effectiveness using data from existing databases, cross-sectional studies, case series, case-control or cohort designs, or designs with historical controls[213]. Conditions are generally close to everyday practice, making them clinically useful. They may yield unanticipated results often undetected by RCTs due to restricted numbers, and may address issues that would be unethical to test with an RCT. However, they lack randomisation and bias is difficult to identify. Therefore, they do not provide definitive evidence for recommending therapies. SR and meta-analysis of observational studies is controversial[213]. However, within prosthodontics, observational studies represent a large body of data that should not be ignored, not least because they can be used to shape more carefully designed RCTs. It is also noteworthy that many successful treatments have been developed without RCTs, e.g. osseointegrated-implants[214]. TREND (Transparent Reporting of Evaluations with Non-Randomised Designs)[215] and MOOSE (Meta-Analysis of Observational Studies in Epidemiology)[213] guidelines explicitly aim to improve reporting of non-randomised interventions. Adoption of these guidelines in prosthodontics will greatly increase the value of future studies and should be promoted through editorial and peer review processes.

The Future of Evidence-Based Prosthodontics

EBP is becoming established within prosthodontics[18] and, as the literature expands, high-quality research should be encouraged[216]. EBP should be introduced early in the dental curriculum and students should be encouraged to consider the evidence underlying treatments. An in-

creasingly litigious society, as well as increased patient awareness and wider availability of information, increases the need for evidence that treatments are based on best practice. A catalogue of RCTs will be vital. Research findings must be accessible and disseminated efficiently. The immediacy of research must also be addressed; the rates of discovery and publication must keep pace. The trend for on-line submission and advance publication will help address this problem. Structured abstracts and headers indicating study type help the clinician identify pertinent articles, and should be adopted by more journals. The lack of RCTs and SRs in prosthodontics must be addressed. This is only possible with a substantial research effort and adequate funding.

CONCLUSIONS AND RECOMMENDATIONS

The increasing emphasis on EBP underlines the pressing need for high-quality clinical studies. While it is encouraging that the number of RCTs in prosthodontics is increasing, coverage of the field is patchy and concentrated on commercially important areas. This review has identified areas where more research is needed. Many treatment modalities have been 'handed-down' and, while they have stood the test of time, sound evidence, by modern standards, is often lacking. Few studies use the strongest research designs and methodological weaknesses mean that many of these cannot provide sufficiently robust evidence to inform treatments. Research is lacking for both removable and fixed prosthodontics. There is a lack of high-quality evidence for many common procedures, including the choice of impression and denture base materials. Few clinical studies compare different treatment options for similar tooth loss scenarios and these studies are often of poor quality. However, it is noteworthy that some prosthodontics practices have robustly stood the test of time. Revisiting these areas may be wasteful when other areas demand more immediate investigation.

The future of evidence-based prosthodontics depends, not only on how well the research is executed, but also on its interpretation and its relevance to dental practice. Future progress relies on high-quality clinical studies; judicious and timely reporting of these studies and frequent, high-quality reviews of the growing evidence-base. The adoption of evidence-based approaches in practice is also dependent on funding. Best practice is often not the most economical option. Finally, there needs to be an appreciation throughout the profession of the different levels of evidence and the necessity for EBP, and that this philosophy should be introduced as early as possible in dental education.

ACKNOWLEDGEMENTS

The original version of this manuscript was awarded the BSSPD Heraeus Kulzer essay prize 2006. The author would like to extend thanks to the BSSPD and Heraeus Kultzer for this award. The author would also like to thank Dr I.S. Young, Mr P.J. Farrelly, Dr A.J. Preston and Prof. C.C. Youngson for their support and constructive comments.

ADDRESS FOR CORRESPONDENCE

Claire L. Harwood, University of Liverpool, School of Dental Studies, Liverpool Dental School, Pembroke Place, Liverpool, L3 5PS. UK. E-mail: charwood@liverpool.ac.uk

REFERENCES

1. Guyatt, G. Evidence-based medicine *ACP J. Club*, 1991; **A-16**:114.
2. Sackett, D.L., Rosenburg, W.M.C., Gray, J.A.M., Haynes, R.B., and Richardson, W.S. Evidence-based medicine: what it is and what it isn't. *Br. Med. J.*, 1996; **312**:71-72.
3. Dawes, M., Summerskill, W., Glasziou, P., et al. Sicily Statement on evidence-based practice. *BMC Med. Educ.*, 2005; **5**:1.
4. Clarkson, J., Harrison, J.E., Ismail, A.I., Needleman, I., and Worthington, H. Editors. Evidence based dentistry for effective practice. Martin Dunitz, Taylor Francis Group. London and New York, 2003.
5. Canadian Task Force in the Periodic Health Examination. The periodic health examination. *CMAJ*, 1979; **121**:1193-1254.
6. http://www.cebm.net/
7. Sutherland, S. Evidence-based dentistry: Part IV. Research design and levels of evidence. *J. Can. Dent. Assoc.* 2001; **67**:375-378.
8. Richards, D., and Lawrence, A. Evidence based dentistry. *Br. Dent. J.* 1995; **179**:270-273.
9. http://www.cebd.org/
10. *Evidence-Based Dentistry*. Nature Publishing Group.
11. *Journal of Evidence Based Dental Practice*. Mosby, Inc.
12. http://www.cochrane-oral.man.ac.uk/
13. Jokstad, A., Orstavik, J., and Ramstad, T. A definition of prosthetic dentistry. *Int. J. Prosthodont.* 1998; **11**:295-301.
14. Phoenix, R.D., Cagna, D.R., and DeFreest, C.F. Stewart's Clinical Removable Prosthodontics 3rd Edition. Quintessence Publishing Co., Inc., 2003.
15. Steele, J., Treasure, E., Pitts, N.B., Morris, J., and Bradnock, G. Total tooth loss in the United Kingdom in 1998 and implications for the future. *Br. Dent. J.* 2000; **189**:598-603.
16. Jokstad, A. Prosthodontics 21: towards a new era? *Evid. Based Dent.* 2002; **3**:2-4.
17. McGivney, G.P. Editorial: Evidence-based dentistry article series. *J. Prosthet. Dent.* 2000; **83**:11-12.
18. Jokstad, A., Esposito, M., Coulthard, P., and Worthington, H.V. The reporting of randomized controlled trials in prosthodontics. *Int. J. Prosthodont.* 2002; **15**:230-242.
19. Dickersin, K., Chan, S., Chalmers, T.C., Sacks, H.S., and Smith, H. Publication bias and clinical trials. *Controlled Clin. Trials* 1987; **8**:343-353.
20. Davenport, J.C., Basker, R.M., Heath, J.R., Ralph, J.P., and Glantz, P.O. Removable partial dentures. 1. Need and demand for treatment. *Br. Dent. J.* 2000; **189**:364-368.
21. Käyser, A.F. Shortened dental arches and oral function. *J. Oral Rehabil.* 1981; **8**:457-462.
22. Käyser, A.F. Limited treatment goals – shortened dental arches. *Periodontol. 2000* 1994; **4**:7-14.
23. Nunn, J., Morris, J., Pine, C., Pitts, N.B., Bradnock, G., and Steele, J. The condition of teeth in the UK in 1998 and implications for the future. *Br. Dent. J.* 2000; **189**:639-644.
24. Chase, R., and Low, S.B. Survival characteristics of periodontally involved teeth: a 40 year study. *J. Periodontol.* 1993; **64**:701.
25. Witter, D.J., Allen, P.F., Wilson, N.H.F., and Käyser, A.F. Dentists' attitudes to the shortened dental arch concept. *J. Oral Rehabil.* 1997; **24**:143-147.
26. Witter, D.J., De Haan, A.J.F., Käyser, A.F., and van Rossum, G.M.J.M. A 6-year follow-up study of oral function in shortened dental arches. Part I: occlusal stability. *J. Oral Rehabil.* 1994; **21**:113-125.
27. Witter, D.J., De Haan, A.J.F., Käyser, A.F., and van Rossum, G.M.J.M. A 6-year follow-up study of oral function in shortened dental arches. Part II: craniomandibular dysfunction and oral discomfort. *J. Oral Rehabil.* 1994; **21**:353-366.
28. Wolfart, S., Heydeke, G., Luthardt, R.G., et al. Effects of prosthetic treatment for the shortened dental arches on oral health-related quality of life, self-reports of pain and jaw disability: results from the pilot phase of a randomized multicentre trial. *J. Oral Rehabil.* 2005; **32**:815-822.
29. Armellini, D., and von Fraunhofer, J.A. The shortened dental arch: A review of the literature. *J. Prosthet. Dent.* 2004; **92**:531-535.

30. Jepson, N., Allen, F., Moynihan, P., Kelly, P., and Thomason, M. Patient satisfaction following restoration of shortened mandibular dental arches in a randomized controlled trial. *Int. J. Prosthodont.* 2003; **16**:409-414.
31. Jepson, N.J., Moynihan, P.J., Kelly, P.J., Watson, G.W., and Thomason, J.M. Caries incidence following restoration of shortened lower dental arches in a randomized controlled trial. *Br. Dent. J.* 2001; **191**:140-144.
32. Moynihan, P.J., Butler, T.J., Thomason, J.M., and Jepson, N.J. Nutrient intake in partially dentate patients: the effect of prosthetic rehabilitation. *J. Dent.* 2000; **28**:557-563.
33. Lutes, M.R., Henderson, D., Ellinger, C.W., et al. Denture modification during adjustment phase of complete denture service. *J. Prosthet. Dent.* 1972; 28:572-579.
34. Ellinger, C.W., Somes, G.W., Nicol, B.R., Unger, J.W., and Wesley, R.C. Patient responses to variations in denture techniques Part III: Five-year subjective evaluation. *J. Prosthet. Dent.* 1979; **42**:127-130.
35. Ellinger, C.W., Wesley, R.C., Abadi, B.J., and Armentrout, T.M. Patient responses to variations in denture technique. Part VII. Twenty-year patient status. *J. Prosthet. Dent.* 1989; **62**:45-48.
36. Nicol, B.R., Somes, G.W., Ellinger, C.W., Unger, J.W., and Fuhrman, J. Patient responses to variations in denture techniques Part II: five year cephalometric evaluation. *J. Prosthet. Dent.* 1979; **41**:368-372.
37. Tuncay, O.C., Thomson, S., Abadi, B., and Ellinger, C. Cephalometric evaluation of the changes in patients wearing complete dentures: A ten-year longitudinal study. *J. Prosthet. Dent.* 1984; **51**:169-180.
38. Wesley, R.C., Ellinger, C.W., and Somes, G.W. Patient responses to variations in denture techniques Part VI: Mastication of peanuts and carrots. *J. Prosthet. Dent.* 1984; **51**:467-469.
39. Sabes, W.R., Ellinger, C.W., Tucker, S.R., Somes, G.W., Unger, J.W., and Fuhrman, J. Patient responses to variations in denture techniques Part V: Microscopic response of the oral mucosa. *J. Prosthet. Dent.* 1981; **45**:11-13.
40. Brehm, T.W., and Abadi, B.J. Patient responses to variations in denture techniques Part IV: Residual ridge resorption – cast evaluation. *J. Prosthet. Dent.* 1980; **44**:491-494.
41. Douglass, J.B., Meader, L., Kaplan, A., and Ellinger, C.W. Cephalometric evaluation of the changes in patients wearing complete dentures: a 20-year study. *J. Prosthet. Dent.* 1993; **69**:270-275.
42. Kawai, Y., Murakami, H., Shariati, B., et al. Do traditional techniques produce better conventional complete dentures than simplified techniques? *J. Dent.* 2005; **33**:659-668.
43. Fahmy, F.M., and Kharat, D.U. A study of the importance of the neutral zone in complete dentures. *J. Prosthet. Dent.* 1990; **64**:459-462.
44. Keshvad, A., Winstanley, R.B., and Hooshmand, T. Intercondylar width as a guide to setting up complete denture teeth. *J. Oral Rehabil.* 2000; **27**:217-226.
45. DeVan, M.M. The nature of partial denture foundations: Suggestions for its preservation. *J. Prosthet. Dent.* 1952; **2**:210-218.
46. Davenport, J.C., Basker, R.M., Heath, J.R., Ralph, J.P., and Glantz, P.O. The removable partial denture equation. *Br. Dent. J.* 2000; **189**:414-424.
47. Hosman, H.J. Influence of clasp design of distal extension removable partial dentures on the periodontium of the abutment teeth. *Int. J. Prosthodont.* 1990; **3**:256-265.
48. Kapur, K.K., Deupree, R., Dent, R.J., and Hasse, A.L. A randomized control trial of two basic removable partial denture designs. Part I: Comparisons of five-year success rates and periodontal health. *J. Prosthet. Dent.* 1994; **72**:268-282.
49. Kapur, K.K., Garrett, N.R., Dent, R.J., and Hasse, A.L. A randomized control trial of two basic removable partial denture designs. Part II: Comparisons of masticatory scores. *J. Prosthet. Dent.* 1997; **78**:15-21.
50. McHenry, K.R., Johansson, O.E., and Christersson, L.A. The effect of removable partial denture framework design on gingival inflammation: a clinical model. *J. Prosthet. Dent.* 1992; **68**:799-803.
51. elCharkawi, H.G., and elMahdy, A.S. The effect of resilient layer and occlusal reactive complete dentures on the residual alveolar ridge. *J. Prosthet. Dent.* 1988; **59**:598-602.
52. Kennedy, E. Partial denture construction. *Dent. Items Interest* 1928; **1**:308.
53. McCord, J.F., and Grant, A.A. A Clinical Guide to Complete Denture Prosthetics. London: *British Dental Journal*, 2000.
54. Carlsson, G. Facts and fallacies: An evidence base for complete dentures. *Dent. Update* 2006; **33**:134-142
55. Basker, R.M., and Davenport, J.C. Prosthetic Treatment of the Edentulous Patient. Munksgaard: Blackwell, 2002.
56. Miralles, R., Bull, R., Manns, A., and Roman, E. Influence of balanced occlusion and canine guidance on electromyographic activity of elevator muscles in complete denture wearers. *J. Prosthet. Dent.* 1989; **61**:494-498.
57. Peroz, I., Leuenberg, A., Haustein, I., and Lang, K.P. Comparison between balanced occlusion and canine guidance in complete denture wearers – a clinical, randomized trial. *Quintessence Int.* 2003; **34**:607-612.
58. Lang, B.R. Complete denture occlusion. *Dent. Clin. North Am.* 1996; **40**:85-101.
59. Clough, H.E., Knodle, J.M., Leeper, S.H., Pudwill, M.L., and Taylor, D.T. A comparison of lingualised occlusion and monoplane occlusion in complete dentures. *J. Prosthet. Dent.* 1983; **50**:176-179.
60. Sutton, A.F., Glenny, A.M., and McCord, J.F. Interventions for replacing missing teeth: denture chewing surface designs in edentulous people. The Cochrane Database of Systematic Reviews 2002, Issue 1. Art. No.: CD004941.pub2. DOI: 10.1002/14651858.CD004941.pub2.
61. Polychronakis, N., Yannikakis, S., and Zissis, A. A clinical 5-year longitudinal study in the dimensional changes of complete maxillary dentures. *Int. J. Prosthodont.* 2003; **16**:78-81.
62. Pryor, W.J. Injection moulding of plastics for dentures. *J. Am. Dent. Assoc.* 1942; **29**:1400-1408.
63. Haug, S.P., Duke, P., Dixon, S.E., Menegotto, L.D., Zentz, R.R., and Moore, B.K. A pilot clinical evaluation of a new injection denture base system. *Comp. Contin. Educ. Dent.* 2001; **22**:847-852.
64. Keenan, P.L., Radford, D.R., and Clark RK. Dimensional change in complete dentures fabricated by injection molding and microwave processing. *J. Prosthet. Dent.* 2003; **89**:37-44.
65. Da Silva, L., Martinez, A., Rilo, B., and Santana, U. Titanium for removable denture bases. *J. Oral Rehabil.* 2000; **27**:131-135.
66. Au, A.R., Lechner, S.K., Thomas, C.J., Mori, T., and Chung, P. Titianium for removable partial dentures (III): 2-year clinical follow-up in an undergraduate programme. *J. Oral Rehabil.* 2000; **27**:979-985.
67. Ogle, R.E., David, L.J., and Ortman, H.R. Clinical wear study of a new tooth material: Part II. *J. Prosthet. Dent.* 1985; **54**:67-75.
68. Lindquist, T.J., Ogle, R.E., and Davis, E.L. Twelve-month results of a clinical wear study of three artificial tooth materials. *J. Prosthet. Dent.* 1995; **74**:156-161.
69. Jooste, C., Geerts, G., and Adams, L. Comparison of the clinical abrasion resistance of six commercially available denture teeth. *J. Prosthet. Dent.* 1997; **77**:23-27.
70. Ogle, R.E., and Davis, E.L. Clinical wear study of three commercially available artificial tooth materials: thirty-six month results. *J. Prosthet. Dent.* 1998; **79**:145-151.
71. Campbell, S.D. Biological compatibility of prosthodontic materials. *Int. J. Prosthodont.* 2003; **16(Suppl)**:52-54.
72. Firtell, D.N., and Koumjian, J.H. Mandibular complete denture impression with fluid wax or polysulfide rubber: a comparative study. *J. Prosthet. Dent.* 1992; **67**:801-804.
73. Hochman, N., and Yaniv, O. Comparative clinical evaluation of removable partial dentures made from impressions with different materials. *Compend. Contin. Educ. Dent.* 1998; **19**:204-206.
74. Millar, B.J., Dunne, S.M., and Robinson, P.B. An in vivo study of a clinical surfactant used with polyvinyl siloxane impression materials *Quintessence Int.* 1996; **27**:707-709.
75. Applegate, O.C. Essentials of Removable Partial Denture Prostheses. Philadelphia: WB Sanders Co., 1954; 166-194.
76. Davenport, J.C., Basker, R.M., Heath, J.R., Ralph, J.P., and Glantz, P.O. A Clinical Guide to Removable Partial Dentures. London: *British Dental Journal*, 2000.
77. Frank, R.P., Brudvik, J.S., and Noonan, C.J. Clinical outcome of the altered cast impression procedure compared with use of a one-piece cast. *J. Prosthet. Dent.* 2004; **91**:468-476.
78. McCord, J.F., McNally, L.M., Smith, P.W., and Grey, N.J. Does the nature of the impression material influence the outcome of (mandibular) complete dentures? *Eur. J. Prosthodont. Restor. Dent.* 2005; **13**:105-108.
79. Berg, E. A clinical comparison of four denture adhesives. *Int. J. Prosthodont.* 1991; **4**:449-56.
80. Kelsey, C.C. Lang, B.R., and Wang, R.F. Examining patients' responses about the effectiveness of five denture adhesive pastes. *J. Am. Dent. Assoc.* 1997; **128**:1532-1538.
81. Uysal, H., Altay, O.T., Alparslan, N., and Bilge, A. Comparison of four different denture cushion adhesives – a subjective study. *J. Oral Rehabil.* 1998; **25**:209-213.

82. Myatt, G.J., Hunt, S.A., Barlow, A.P., Winston, J.L., Bordas, A., and Maaytah, M.E. A clinical study to assess the breath protection efficacy of denture adhesive. *J. Contemp. Dent. Prac.* 2002; **3**:1-9.
83. Zhao, K., Cheng, X-R., Chao, Y-L., Li, Z-A. and Han, G-L. Laboratory evaluation of a new denture adhesive. *Dent. Materials* 2004; **20**:419-424.
84. Kimoto, S., Kitamura, M., Kodaira, M., et al. Randomised controlled clinical trial on satisfaction with resilient denture liners among edentulous patients. *Int. J. Prosthodont.* 2004; **17**:236-240.
85. Villar, A., Pesun, I.J., Brosky, M.E., et al. Clinical evaluation of resilient denture liners. Part 1: Compliance and color evaluation. *J. Prosthodont.* 2003; **12**:82-89.
86. Graham, B.S., Jones, D.W., Burke, J., and Thompson, J.P. In vivo fungal presence and growth on two resilient denture liners. *J. Prosthet. Dent.* 1991; **65**:528-532.
87. Brosky, M.E., Pesun, I.J., Morrison, B., Hodges, J.S., Lai, J.H., and Liljemark, W. Clinical evaluation of resilient denture liners. Part 2: Candida counts and speciation. *J. Prosthodont.* 2003; **12**:162-167.
88. Graham, B.S., Jones, D.W., and Sutow, E.J. An in vivo and in vitro study of the loss of plasticizer from soft polymer-gel material. *J. Dent. Res.* 1991; **70**:870-873.
89. Haywood, J., Basker, R.M., Watson, C.J., and Wood, D.J. A comparison of three hard chairside denture reline materials. Part 1. Clinical evaluation. *Euro. J. Prosthodont.* Rest. Dent. 2003; **11**:157-163.
90. Malmstrom, H.S., Mehta, N., Sanchez, R., and Moss ME. The effect of two different coatings on the surface integrity and softness of a tissue conditioner. *J. Prosthet. Dent.* 2002; **87**:153-157.
91. Shay, K. Denture hygiene: a review and update. *J. Contemp. Dent. Prac.* 2000; **1**:28-41.
92. Soames, J.V., and Southam, J.C. Oral Pathology 3rd Edition. Oxford University Press, 2003.
93. Green, S.L. Anaerobic pleuro-pulmonary infections. *Postgrad. Med.* 1979; **65**:62-66.
94. Vanzeveren, C., D'Hoore, W., and Bercy, P. Influence of removable partial denture on periodontal indices and microbiological status. *J. Oral Rehabil.* 2002; **29**:232-239.
95. Budtz-Jorgenesen, E., Mojon, P., Rentsch, A., and Deslauriers, N. Effects of an oral health program on the occurrence of oral candidosis in a long-term care facility. *Community Dent. Oral Epidemiol.* 2000; **28**:141-149.
96. Bellomo, F., de Preus, F., Chung, J.P., Julien, N., Budtz-Jorgensen, E., and Muller, F. The advantages of occupational therapy in oral hygiene measures for institutionalised elderly adults. *Gerodontology* 2005; **22**:24-31.
97. Ambjornsen, E., and Rise, J. The effect of verbal information and demonstration on denture hygiene in elderly people. *Acta Odontol. Scand.* 1985; **43**:19-24.
98. Nikawa, H., Hamada, T., Yamashiro, H., and Kumagai, H. A review of in vitro and in vivo methods to evaluate the efficacy of denture cleansers. *Int. J. Prosthodont.* 1999; **12**:153-159.
99. Sheen, S.R., and Harrison, A. Assessment of plaque prevention on dentures using an experimental cleanser. *J. Prosthet. Dent.* 2000; **84**:594-601.
100. Dills, S.S., Olshan, A.M., Goldner, S., and Brogdon, C. Comparison of antimicrobial capability of an abrasive paste and chemical-soak denture cleansers. *J. Prosthet. Dent.* 1988; **60**:467-470.
101. Chan, E.C., Iugovaz, I., Siboo, R., et al. Comparison of two popular methods for removal and killing of bacteria from dentures. *J. Can. Dent. Assoc.* 1991; **57**:937-939.
102. McCabe, J.F., Murray, I.D., and Kelly, P.J. The efficacy of denture cleansers. *Eur. J. Prosthodont. Restor. Dent.* 1995; **3**:203-207.
103. Budtz-Jorgensen, E. Prevention of denture plaque formation by enzyme denture cleanser. *J. Biol. Buccale* 1977; **5**:239-244.
104. Budtz-Jorgensen, E. A 3 Months' study of enzymes as denture cleansers. *J. Oral Rehabil.* 1978; **5**:35-39.
105. Gornitsky, M., Paradis, I., Landaverde, G., Malo, A.M., and Velly, A.M. A clinical and microbiological evaluation of denture cleansers for geriatric patients in long-term care institutions. *J. Can. Dent. Assoc.* 2002; **68**:39-45.
106. Budtz-Jorgensen, E., and Milton Knudsen, A. Chlorhexidine gel and Steradent employed in cleaning dentures. *Acta Odontol. Scand.* 1978; **36**:83-87.
107. Weitz, M., Brownstein, C., and Deasy, M. Effect of a twice daily 0.12% chlorhexidine rinse on the oral health of a geriatric population. *Clin. Prev. Dent.* 1992; **14**:9-13.
108. Mahonen, K., Virtanen, K., and Larmas, M. The effect of prosthesis disinfection on salivary microbe levels. *J. Oral Rehabil.* 1998; **25**:304-310.
109. DePaulo, L.G., Minah, G.E., Elias, S.A., Eastwood, G.W., and Walters, R.A. Clinical and microbial evaluation of treatment regimens to reduce denture stomatitis. *Int. J. Prosthodont.* 1990; **3**:369-374.
110. Schwartz, I.S., Young, J.M., and Berrong, J.M. The effect of Listerine on denture microbial flora and denture stomatitis. *Int. J. Prosthodont.* 1988; **1**:153-158.
111. Banting, D.W., Greenhorn, P.A., and McMinn, J.G. Effectiveness of a topical regimen for the treatment of oral candidiasis in older, chronically ill, institutionalized adults. *J. Can. Dent. Assoc.* 1995; **61**:199-200.
112. Johnson, G.H., Taylor, T.D., and Heid, D.W. Clinical evaluation of a nystatin pastille for treatment of denture-related oral candidosis. *J. Prosthet. Dent.* 1989; **61**:699-703.
113. Budtz-Jorgensen, E., and Carlino, P. A miconazole lacquer in the treatment of Candida-associated denture stomatitis. *Mycoses* 1994; 37:131-135.
114. Konsberg, R., and Axell, T. Treatment of Candida-infected denture stomatitis with a miconazole lacquer. *Oral Surg. Oral Med. Oral Pathol.* 1994; **78**:306-311.
115. Parvinen, T., Kokko, J., and Yli-Urpo, A. Miconazole lacquer compared with gel in the treatment of denture stomatitis. *Scand. J. Dent. Res.* 1994; **102**:361-366.
116. Budtz-Jorgensen, E., Holmstrup, P., and Krogh, P. Fluconazole in the treatment of Candida-associated denture stomatitis. *Antimicrob. Agents Chemopther.* 1988; **32**:1859-1863.
117. Bissell, V., Felix, D.H., and Wray, D. Comparative trial of fluconazole and amphotericin in the treatment of denture stomatitis. *Oral Surg. Oral Med. Oral Pathol.* 1993; **76**:35-39.
118. Cross, L.J., Bagg, J., and Aitchison, T.C. Efficacy of the cyclodextrin liquid form of itraconazole in the treatment of denture stomatitis: comparison with itraconazole capsules. *Antimicrob. Agents Chemother.* 2000; **44**:425-527.
119. Cross, L.J., Bagg, J., Oliver, D., and Warnock, D. Serum itraconazole concentrations and clinical responses in Candida-associated denture stomatitis patients treated with itraconazole solution and itraconazole capsules. *J. Antimicrob. Chemother.* 2000; **45**:95-99.
120. Koray, M., Ak, G., Kurklu, E., et al. Fluconazole and/or hexitidine for management of oral candidiasis associated with denture-induced stomatitis. *Oral. Dis.* 2005; **11**:309-313.
121. Banting, D.W., and Hill, S.A. Microwave disinfection of dentures for the treatment of oral candidiasis. *Spec. Care Dentist.* 2001; **21**:4-8.
122. Vasconcelos, L.C., Sampaio, M.C., Sampaio, F.C., and Higino, J.S. Use of Punica granatum as an antifungal agent against candidosis associated with denture stomatitis. *Mycoses* 2003; **46**:192-196.
123. Maver-Biscanin, M., Mravak-Stipetic, M., Jerolimov, V., and Biscanin, A. Fungicidal effect of laser diode irradiation in patients with denture stomatitis. *Lasers Surg. Med.* 2004; **35**:259-262.
124. de Baat, C., Kalk, W., Felling, A.J., and van't Hof, M.A. Elderly people's adaptability to complete denture therapy: usability of a geriatric behaviour-rating scale as a predictor. *J. Dent.* 1995; **23**:151-155.
125. Cleary, T.J., Hunter, L., Blunt-Emerson, M., and Hutton, J.E. The effect of diet on the bearing mucosa during adjustment to new complete dentures: a pilot study. *J. Prosthet. Dent.* 1997; **78**:479-485.
126. Millar, P.A. Complete dentures supported by natural teeth. *J. Prosthet. Dent.* 1958; **8**:924-928.
127. van Waas, M.A., Jonkman, R.E., Kalk, W., van't Hof, M.A., Plooij, J., and Van Os, J.H. Differences two years after tooth extraction in mandibular bone reduction in patients treated with immediate overdentures or with immediate complete dentures. *J. Dent. Res.* 1993; **72**:1001-1004.
128. van Waas, M.A., Kalk, W., van Zetten, B.L., and Van Os, J.H. Treatment results with immediate overdentures: an evaluation of 4.5 years. *J. Prosthet. Dent.* 1996; **76**:153-157.
129. Jonkman, R.E., van Waas, M.A., and Kalk, W. Satisfaction with complete immediate dentures and complete immediate overdentures. A 1 year survey. *J. Oral Rehabil.* 1995; **22**:791-796.
130. Jonkman, R.E., van Waas, M.A., van't Hof, M.A., and Kalk, W. An analysis of patient satisfaction with complete immediate (over)dentures. *J. Dent.* 1997; **25**:107-111.
131. Keltjens, H.M., Creugers, T.J., van't Hof, M.A., and Creugers, H.N. A 4-year clinical study on amalgam, resin composite and resin modified glass ionomer cement restorations in overdenture abutments. *J. Dent.* 1999; **27**:551-555.

132. Ettinger, R.L., Ahmad, R., and Wefel, J.S. Effect of fluoride concentrations on overdenture abutments. *Am. J. Dent.* 1992; **5**:199-202.
133. Hong, L., Ettinger, R.L., Watkin, C.A., and Wefel, J.S. In vitro evaluation of fluoride varnish on overdenture abutments. *J. Prosthet. Dent.* 2003; **89**:28-36.
134. Yamada, T., and Nokubi, T. Clinical observations of noncoping overdenture abutments protected by tannin-fluoride preparation. *J. Prosthet. Dent.* 1997; **78**:315-319.
135. Ikebe, K., Ettinger, R.L., and Wefel, J.S. In vitro evaluation of fluoride releasing restorative material for sealing the root canals of overdenture abutments. *Int. J. Prosthodont.* 2001; **14**:556-562.
136. Keltjens, H.M., Creugers, T.J., Schaeken, M.J., and Van der Hoeven, J.S. Effects of chlorhexidine-containing gel and varnish on abutment teeth in patients with overdentures. *J. Dent. Res.* 1992; **71**:1582-1586.
137. Keltjens, H.M., Creugers, T.J., Schaeken, M.J., Van der Hoeven, J.S., and Hendriks, J.C. Effects of chlorhexidine gel on periodontal health of abutment teeth in patients with overdentures. *Clin. Oral Implants Res.* 1991; **2**: 71-74.
138. Keltjens, H.M., Creugers, T.J., Schaeken, M.J., and Van der Hoeven, J.S. Microbial aspects of preventive regimes in patients with overdentures. *J. Dent. Res.* 1987; **66**:1579-1582.
139. Keltjens, H.M., Creugers, T.J., Schaeken, M.J., Van der Hoeven, J.S., and Hendriks, J.C. Caries control in overdenture patients: 18-month evaluation on fluoride and chlorhexidine therapies. *Caries Res.* 1990; **24**:371-375.
140. Isidor, F., and Budtz-Jorgensen, E. Periodontal conditions following treatment with distally extending cantilever bridges or removable partial dentures in elderly patients. A 5-year study. *J. Prosthet. Dent.* 1990; **61**:21-26.
141. Budtz-Jorgensen, E., and Isidor, F. A 5-year longitudinal study of cantilevered fixed partial dentures compared with removable partial dentures in a geriatric population. *J. Prosthet. Dent.* 1990; **64**:42-47.
142. Tan, K., Pjetursson, B.E., Lang, N.P., and Chan, E.S.Y. A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years III. Conventional FPDs. *Clin. Oral Impl. Res.* 2004; **15**:654-666.
143. Schillingburg, H.T., Hobo, S., Whitsett, L.D., Jacobi, R., and Brackett, S.E. Fundamentals of fixed prosthodontics 3rd Edition. Quintessence Publishing Co, Inc., 1997.
144. Kern, M., Kleimeier, B., Schaler, H.G., and Strub, J.R. Clinical comparison of post-operative sensitivity for a glass ionomer and a zinc phosphate luting cement. *J. Prosthet. Dent.* 1996; **75**:159-162.
145. Jokstad, A., and Mjor, I.A. Ten years' clinical evaluation of three luting cements. *J. Dent.* 1996; **24**:309-315.
146. Bessing, C., Lundqvist, P., and Tillstrom, B. A clinical comparison of alternative alloys. *Acta Odontol. Scand.* 1988; **46**:207-217.
147. Bessing, C., Lundqvist, P., and Tillstrom, B. A 3-year clinical study of alternative to high noble dental casting alloys type 3. *Acta Odontol. Scand.* 1990; **48**:319-325.
148. Anderson, R.J., Janes, G.R., Sabella, L.R., and Morris, H.F. Comparisons of the performance on prosthodontic criteria of several alternative alloys used for fixed crowns and partial denture restorations: Department of Veterans Affairs Cooperative Studies project 147. *J. Prosthet. Dent.* 1993; **69**:1-8.
149. Walter, M., Reppel, P.D., Boning, K., and Freemeyer, W.B. Six-year follow-up of titanium and high-gold porcelain-fused-to-metal fixed partial dentures. *J. Oral Rehabil.* 1999; **26**:91-96.
150. Morris, H.F. Veterans Administration Cooperative Studies Project No. 147: association of metallic taste with metal ceramic alloys. *J. Prosthet. Dent.* 1990; **62**:124-129.
151. Morris, H.F. Veterans Administration Cooperative Studies Project No. 147: Part VIII: Plaque accumulation on metal ceramic restorations cast from noble and nickel based alloys. A five-year report. *J. Prosthet. Dent.* 1989; **61**:543-9.
152. Luthardt, R.G., Stossel, M., Hinz, M., and Vollandt. R. Clinical performance and periodontal outcome of temporary crowns and fixed partial dentures: A randomized clinical trial. *J. Prosthet. Dent.* 2000; **83**:32-39.
153. Sorensen, J.A., Doherty, F.M., Newman, M.G., and Flemmig, T.F. Gingival enhancement in fixed prosthodontics. Part I. Clinical findings. *J. Prosthet. Dent.* 1991; **65**:100-107.
154. Flemmig, T.F. Sorensen, J.A., Newman, M.G., and Nachnani, S. Gingival enhancement in fixed prosthodontics. Part II. Microbiologic findings. *J. Prosthet. Dent.* 1991; **65**:365-372.
155. Studer, S.P., Lehner, C., Bucher, A., and Scharer, P. Soft tissue correction of a single-tooth pontic space: a comparative volume assessment. *J. Prosthet. Dent.* 2000; **83**:402-411.
156. Chai, J., McGivney, G.P., Munoz, C.A., and Rubenstein, J.E. A multicenter longitudinal clinical trial of a new system for restorations. *J. Prosthet. Dent.* 1997; **77**:1-11.
157. Chitmongkolsuk, S., Heydecke, G., Stappert, C., and Strub, J.R. Fracture strength of all-ceramic lithium disilicate and porcelain-fused-to-metal bridges for molar replacement after dynamic loading. *Eur. J. Prosthodont. Rest. Dent.* 2002; **10**:15-22.
158. Olsson, K.G., Furst, B., Andersson, B., and Carlsson, G.E. A long-term retrospective and clinical follow-up study of In-Ceram Alumina FPDs. *Int. J. Prosthodont.* 2003; **16**:150-156.
159. Song, H.Y., Yi, Y.J., Cho, L.R., and Park, D.Y. Effects of two preparation designs and pontic distance on bending and fracture strength of fibre reinforced composite inlay fixed partial dentures. *J. Prosthet. Dent.* 2003; **90**:347-353.
160. Wolfart, S., Wegner, S.M., Al-Halabi, A., and Kern, M. Clinical evaluation of marginal fit of a new experimental all-ceramic system before and after cementation. *Int. J. Prosthodont.* 2003; **16**:587-592.
161. Esquivel-Upshaw, J.F., Anusavice, K.J., Young, H., Jones, J., and Gibbs, C. Clinical performance of a Lithia disilicate-based core ceramic for three-unit posterior FPDs. *Int. J. Prosthodont.* 2004; **17**:469-475.
162. Reich, S., Wichmann, M., Nkenke, E., and Proeschel, P. Clinical fit of all-ceramic three-unit fixed partial dentures, generated with three different CAD/CAM systems. *Eur. J. Oral Sci.* 2005; **113**:174-179.
163. Rochette, A.L. Attachment of a splint to enamel of lower anterior teeth. *J. Prosthet. Dent.* 1973; **30**:418-423.
164. Chan, A.W., and Barnes, I.E. A prospective study of cantilever-resin bonded bridges: an initial report. *Aust. Dent. J.* 2000; **45**:31-36.
165. Jiang, T., Hong, W., and Zhang, Q. Two-year clinical trial of resin-bonded fixed partial dentures incorporating novel attachments. *Int. J. Prosthodont.* 2005; **18**:225-231.
166. Creugers, N.H., Snoek, P.A., van't Hof, M.A., and Käyser, A.F. Clinical performance of resin-bonded bridges: a 5-year prospective study. I. Design of the study and influence of experimental variables. *J. Oral Rehabil.* 1989; **16**:427-436.
167. Kellett, M., Verzijden, C.W., Smith, G.A., and Creugers, N.H. A multicentred clinical study on posterior resin-bonded bridges: the 'Manchester trial'. *J. Dent.* 1994; **22**:208-212.
168. Creugers, N.H., de Kanter, R.J., Verzijden, C.W., and van't Hof, M.A. Risk factors and multiple failures in posterior resin-bonded bridges in a 5-year multi-practice clinical trial. *J. Dent.* 1998; **26**:397-402.
169. Creugers, N.H., Snoek, P.A., van't Hof, M.A., and Käyser A.F. Clinical performance of resin-bonded bridges: a 5-year prospective study. II. The influence of patient-dependent variables. *J. Oral Rehabil.* 1989; **16**:521-527.
170. Creugers, N.H., Käyser, A.F., and van't Hof, M.A. A seven-and-a-half year survival study of resin-bonded bridges. *J. Dent. Res.* 1992; **71**:1822-1825.
171. Creugers, N.H., de Kanter, R.J., and van't Hof, M.A. Long-term survival data from a clinical trial on resin-bonded bridges. *J. Dent.* 1997; **25**:239-242.
172. Verzijden, C.W., Creugers, N.H., and Mulder, J. A multi-practice clinical study on posterior resin-bonded bridges: a 2.5-year interim report. *J. Dent. Res.* 1994; **73**:529-535.
173. de Kanter, R.J., Creugers, N.H., Verzijden, C.W., and van't Hof, M.A. A 5-year multi-practice clinical study on posterior resin-bonded bridges. *J. Dent. Res.* 1998; **77**:609-614.
174. Creugers, N.H., Snoek, P.A., van't Hof, M.A., and Käyser, A.F. Clinical performance of resin-bonded bridges: a 5-year prospective study. Part III. Failure characteristics and survival after rebonding. *J. Oral Rehabil.* 1990; **17**:179-186.
175. el-Mowafy, O., and Rubo, M.H. Resin-bonded fixed partial dentures – A literature review with presentation of a novel approach. *Int. J. Prosthodont.* 2000; **13**:460-467.
176. Aboush, Y.E., and Estetah, N. A prospective clinical study of multipurpose adhesive used for the cementation of resin-bonded bridges. *Oper. Dent.* 2001; **26**:540-545.
177. Petrie, C.S., Eick, J.D., Williams, K., and Spencer, P. A comparison of 3 alloy surface treatments for resin-bonded prostheses. *J. Prosthodont.* 2001; **10**:217-223.
178. Simon, J.F., Gartrell, R.G., and Grogono, A. Improved retention of acid-etched fixed partial dentures: a longitudinal study. *J. Prosthet. Dent.* 1992; **68**:611-615.
179. Moschen, I., Berger, P., Falk, M., Horl, R., Horle, M., and Gausch, K. Comparison of resin-bonded prosthesis groove parallelism with the use of four tooth preparation methods. *J. Prosthet. Dent.* 1999; **82**:398-409.

180. Takanashi, Y., Penrod, J.R., Chehade, A., et al. Does a prosthodontist spend more time providing mandibular two-implant overdentures than conventional dentures? *Int. J. Prosthdont.* 2002; **15**:397-403.
181. Boerrigter, E.M., Geertman, M.E., Van Oort, R.P., et al. Patient satisfaction with implant-retained mandibular overdentures. A comparison with new complete dentures not retained by implants – a multicentre randomized clinical trial. *Br. J. Oral Maxillofac. Surg.* 1995; **33**:282-288.
182. Geertman, M.E., Boerrigter, E.M., van't Hof, M.A., et al. Two-centre clinical trial of implant-retained mandibular overdentures versus complete dentures – chewing ability. *Community Dent. Oral Epidemiol.* 1996; **24**:79-84.
183. Fontijin, T.F., Slagter, A.P., van't Hof, M.A., Geertman, M.E., and Kalk, W. Bite forces with mandibular implant-retained overdentures. *J. Dent. Res.* 1999; **77**:1832-1839.
184. Kapur, K.K., Garrett, N.R., Hamada, M.O., et al. A randomized control trial comparing the efficacy of mandibular implant-supported dentures in diabetic patients. Part I: Methodology and clinical outcomes. *J. Prosthet. Dent.* 1998; **79**:555-569.
185. Kapur, K.K., Garrett, N.R., Hamada, M.O., et al. A randomized control trial comparing the efficacy of mandibular implant-supported dentures in diabetic patients. Part III: Comparison of patient satisfaction. *J. Prosthet. Dent.* 1999; **82**:416-427.
186. Awad, M.A., Locker, D., Kernerbitensky, N., and Feine, J.S. Measuring the effect of intraoral implant rehabilitation on health-related quality of life in a randomized controlled clinical trial. *J. Dent. Res.* 2000; **70**:1659-1663.
187. Raghoebar, G.M., Meijer, H.J., Steganga, B., van't Hof, M.A., van Oort, R.P., and Vissink, A. Effectiveness of three treatment modalities for the edentulous mandible. A five-year randomized clinical trial. *Clin. Oral Implants Res.* 2000; **11**:195-201.
188. Raghoebar, G.M., Meijer, H.J., van't Hof, M.A., Steganga, B., and Vissink, A. A randomized prospective clinical trial on the effectiveness of three treatment modalities for patients with lower denture problems. A 10 year follow-up study on patient satisfaction. *Int. J. Oral Maxillofac. Surg.* 2003; **32**:498-503.
189. Visser, A., Raghoebar, G.M., Meijer, H.J., Batenburg, R.H., and Vissink, A. Mandibular overdentures supported by two or four endosseous implants. A 5-year prospective study. *Clin. Oral Implants Res.* 2005; **16**:19-25.
190. Fontijn-Tekamp, F.A., Slagter, A.P., van't Hof, M.A., and Jansen, J.A. Pain and instability during biting with mandibular implant-retained overdentures. *Clin. Oral Implants Res.* 2001; **12**:46-51.
191. Geertman, M.E., Slagter, A.P., van't Hof, M.A., van Waas, M.A., and Kalk, W. Masticatory performance and chewing experience with implant-retained mandibular overdentures. *J. Oral Rehabil.* 1999; **26**:7-13.
192. Heydecke, G., Locker, D., Awad, M.A., Lund, J.P., and Feine, J.S. Oral and general health related quality of life with conventional and implant dentures. *Community Dent. Oral Epidemiol.* 2003; **31**:161-168.
193. van Kampen, F.M., van der Bilt, A., Cune, M.S., and Bosman, F. The influence of various attachment types in mandibular implant-retained overdentures on maximum bite force and EMG. *J. Dent. Res.* 2002; **81**:170-173.
194. Walton, J.N., MacEntee, M.I., and Glick, N. One-year prosthetic outcomes with implant overdentures: a randomized clinical trial. *Int. J. Oral Maxiollofac. Implants* 2002; **17**:391-398.
195. Walton, J.N. A randomized clinical trial comparing two mandibular implant overdenture designs: 3-year prosthetic outcomes using a six-field protocol. *Int. J. Prosthodont.* 2003; **16**:255-260.
196. van Kampen, F., Cune, M., van der Bilt, A., and Bosman, F. Retention and postinsertion maintenance of bar-clip, ball and magnet attachments in mandibular implant overdenture treatment: an in vivo comparison after 3 months of function. *Clin. Oral Implants Res.* 2003; **14**:720-726.
197. Palmqvist, S., Owall, B., and Schou, S. A prospective randomized clinical study comparing implant-supported fixed prostheses and overdentures in the edentulous mandible: prosthodontic production time and costs. *Int. J. Prosthdont.* 2004; **17**:231-235.
198. Watson, G.K., Payne, A.G., Purton, D.G., and Thomson, W.M. Mandibular overdentures: Professional time for prosthodontic maintenance during the first year of service using three different implant systems. *Int. J. Prothodont.* 2002; **15**:379-384.
199. Feine, J.S., Carlsson, G.E., Awad, M.A., et al. The McGill consensus statement on overdentures: Mandibular two-implant overdentures as first choice standard of care for edentulous patients. *Gerodontology* 2002; **19**:3-4.
200. Thomason, J.M. The McGill consensus statement on Overdentures: Mandibular 2-implant overdentures as first choice standard of care for edentulous patients. *Eur. J. Prosthodont. Restor. Dent.* 2002; **10**:95-96
201. Faculty of Dental Surgery. National Clinical Guidelines 1997. Guidelines for selecting appropriate patients to receive treatment with dental implants: Priorities for the NHS. http://www.rcseng.ac.uk/fds/docs/ncg97.pdf
202. Heath, R. Time to go for the end game: Mandibular 2-implant overdentures for older people. *Gerodontology* 2002; **19**:1-2.
203. Walton, J.N., and MacEntree, M.I. Choosing or refusing oral implants: A prospective study of edentulous volunteers for a clinical trial. *Int. J. Prosthodont.* 2005; **18**:483-488
204. Consort Statement website. http://www.consort-statement.org/
205. Needleman, I. Is this good research? Look for CONSORT and QUORUM. *Evid. Based Dent.* 2000; **2**:61-62.
206. Dumbrigue, H.B., Jones, J.S., and Esquivel JF. Developing a register for randomized control trials in Prosthodontics: Results of a search from prosthodontic journals published in the United States. *J. Prosthet. Dent.* 1999; **82**:699-703.
207. Coulter, I.D. Observational studies and evidence-based practice: Can't live with them, can't live without them. *J. Evidence Based Dent. Prac.* 2003; **3**:1-4.
208. Creugers, N.H.J., and Kreulen, C.M. Systematic review of systematic reviews in prosthodontics. *Int. J. Prosthodont.* 2003; **16**:123-127.
209. Olsen, O., Middleton, P., Ezzo, J., et al. Quality of Cochrane reviews: assessment of sample from 1998. *Br. Med. J.* 2001; **323**:829-832.
210. Glenny, A-M., Esposito, M., Coulthard, P., and Worthington, H.V. The assessment of systematic reviews in dentistry. *Eur. J. Oral Sci.* 2003; **111**:85-92.
211. Higgins, J.P.T., and Green, S. Editors. Cochrane Handbook for Systematic Reviews of Interventions 4.2.5 [updated May 2005]. In: The Cochrane Library, Issue 3, 2005. Chichester, UK: John Wiley & Sons, Ltd. http://www.cochrane.org/resources/hanbook/hbook.htm
212. Nishimura, K., Rasool, F., Ferguson, M.B., Sobel, M., and Niederman, R. Benchmarking the clinical prosthetic literature on MEDLINE. *J. Prosthet. Dent.* 2002; **88**:533-541.
213. Stroup, D.F., Berlin, J.A., Morton, S.C., et al. Meta-analysis of observational studies in epidemiology. A proposal for reporting. Meta-analysis of Observational Studies in Epidemiology (MOOSE) group. *J. Am. Med. Assoc.* 2000; **283**:2008-2012.
214. Healy, D., and Lyons, K. Evidence-based practice in dentistry. *N. Z. Dent. J.* 2002; **98**:32-35.
215. Treasure, E. The TREND statement. *Evid. Based Dent.* 2004; **5**:88-91.
216. Carlsson, G.E. Changes in the prosthodontic literature 1966-2042. *J. Can. Dent. Assoc.* 2005; **71**:328.