

Prosthodontics for the elderly patient – a Scandinavian approach*

Protetyka ukierunkowana na pacjentów w podeszłym wieku – podejście skandynawskie*

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Summary

The main purpose of this paper is to discuss the need for replacing missing teeth in the elderly and indicate some of the special treatment dilemmas that may be present in this group. No incontrovertible definition exists as to what constitutes an adequate oral function. However, there seems to be a consensus in the dental literature that acceptable oral function can be obtained by means of «The Shortened Dental Arch Concept», even in severely reduced dentitions as is frequently found in the elderly.

Among matters also discussed in this paper are: what is meant by “elderly”, how a patient’s true prosthodontic need is uncovered, possible obstacles to optimal treatment, the use of simplified methods and materials, prosthodontic treatment when oral diseases cannot be completely controlled, repair or renewal of prosthesis, the choice of fixed or removable restoration, implants for the elderly and future perspectives.

Streszczenie

Głównym celem pracy jest omówienie konieczności uzupełnienia brakujących zębów u osób w podeszłym wieku i wskazanie niektórych specyficznych problemów leczniczych, które mogą występować w tej grupie pacjentów. Nie istnieje jednoznaczna definicja czynnika determinującego prawidłową funkcję jamy ustnej. Jakkolwiek, wydaje się, że w literaturze stomatologicznej istnieje zgodność opinii odnośnie możliwości osiągnięcia akceptowalnej funkcji narządu żucia za pomocą „konceptu skróconego łuku zębowego” (The Shortened Dental Arch Concept) nawet w przypadku istotnego ubytku uzębienia, co często zdarza się u pacjentów w starszym wieku.

* Uzyskano zgodę na przedruk artykułu.

In brief

1. No scientific standards exist as to what constitutes acceptable oral function.
2. Reduced dentitions without anterior gaps may still provide satisfactory function.
3. Small fixed dental prostheses have superior functional qualities and need not necessarily cost more than partial removable dental prostheses.
4. An individually patient centred treatment is focused.

Introduction

This paper is a revised and adapted version of an article under the larger theme “Gerodontology” that was published simultaneously in 2017 in the dental journals of the Nordic countries Denmark, Finland, Norway and Sweden.¹⁻⁴

Prosthetic problems for elderly patients are rather universal. These may be associated with general health issues or be of a biophysical nature, like mastication, occlusion etc. Oftentimes possible problems are associated with “softer” aspects, such as subjective patient and socio-economic factors. The latter may be more important than the former, and have been the subject of much research in recent years. Regrettably, this research has provided limited clinical guidance. Nonetheless, treatment problems must somehow be managed by the dentist. The aim of this paper does not purport to provide ultimate answers on how to overcome the difficulties, but rather to present and discuss some of the more important issues and treatment dilemmas for this group of patients. Hopefully it will function as an eye-opener to clinicians and health planners alike.

Fundamental considerations

Why is it difficult to decide if missing teeth should be replaced?

The main focus of this paper is to discuss

the need for replacement of missing teeth in the elderly. The object of any dental treatment is to maintain or even improve oral function. When teeth are missing, prosthodontics restore oral functions such as mastication, speech, appearance and oral comfort. What is an acceptable level for these functions, is rather poorly defined for the average and even more so for the elderly patient, as there are no well-founded criteria regarding the need to replace teeth. Also, oral function has lately been increasingly related to oral health related quality of life (OHRQoL). The present task therefore poses a number of challenging questions. Some of these may seem simple and easily answered, but several uncertainties exist.

Because of the lack of a generally accepted definition among professionals as to what constitutes an oral handicap, the objective need for tooth replacement is unclear both on a population and individual level. For that reason, the subjective need may be over- or under-estimated, resulting in inadequate or inappropriate treatment solutions.

Tradition, culture, mentors’ opinions, education, legal aspects in claim investigations about what is “generally accepted treatment standards” etc. all influence clinicians and care planners more than we care to admit.

What is the role and effect of public guidelines?

Traditional “thinking” about prosthodontics and decision making still pervades official guidelines and regulations. Nordic official definitions as to what constitutes adequate oral function are remarkable similar in publications by the Norwegian Health Authority⁵ and a Swedish regional guideline.⁶ They emphasize the importance of an oral function that satisfies the need for acceptable mastication and social function. Interestingly, the Norwegian one adds the concept of an “aesthetic zone” and the “patient’s opinion” into the equation, while the Swedish definition requires that the

treatment should “significantly increase the patient’s ability to eat and speak and provide a substantially elevated quality of life and well-being”.

These guidelines and requirements have very low precision and offer little practical advice in the individual case. Still, to varying extents, they implicitly or explicitly tend to favour simple and inexpensive treatments in order to satisfy the above minimal requirements. Thus, they significantly influence decisions in clinical dentistry and add stress to both dentist and patient.

How many teeth do the elderly need for a satisfactory oral function?

The introduction by Käyser⁷ in the 1970-ies of “The Shortened Dental Arch Concept” (SDA), known by many clinicians as the premolar–occlusion, represented a paradigm shift in prosthodontics. It was emphasised that “treatment goals can be limited and still satisfy patients’ demand by using a problem-solving approach”. This was contrary to the traditional philosophy in which a theoretical complete ideal dentition was pursued. It took many years before SDA reached its present near universal theoretical acceptance. Despite this, the SDA concept is still not widely practised.^{8,9}

The SDA, considered to be relevant for patients aged 40-80, provides in general terms a suboptimal but acceptable functionality. Käyser⁷ also suggested the Extremely Shortened Dental Arch Concept (ESDA), for patients 70-100 years of age, which provides a minimal but still individually acceptable functional level. As a consequence of the SDA and ESDA treatment philosophies, it may currently be considered less professional to over-treat than under-treat when replacing missing teeth; especially in older patients that are often not cognisant of their real needs.

What is meant by “elderly” and what is our target group?

“Elderly” is an elusive concept. Most dentists would consider a healthy, fit and active person aged 80 or over as any other patient and provide the generally accepted treatment option for adults. What happens in the future if conditions suddenly change, as is not unusual in this age group? Different patients exhibiting different conditions, may in fact appropriately receive anything from no to quite extensive treatment. Thus, in an ailing 80-year-old with a reduced dentition, temporary fillings, temporary relining (tissue conditioner) or just oral health care can be adequate treatment.

Space does not allow a full discussion of all possible aspects of replacement of missing teeth and necessary maintenance in the heterogeneous “elderly” group. Our main focus will therefore be on elderly who are usually treated by general practitioners, as opposed to institutionalised patients who may require more specialised care. We will present some questions that we hope could be usefully discussed among care givers and care planners. Although we may not be able to give complete answers, we hope that the questions themselves and the ensuing discussion will contribute as eye openers.

Conclusion

Understanding what constitutes necessary and reasonable treatment for the elderly patient is essential and requires a very high level of knowledge, empathy and patient centred respect. No simple and reliable test exists, even though aspects related to OHRQoL have been subject to increasing research during the last decade. The application of evidence based dentistry, a very popular guideline nowadays, seems to be of little or no use in such basic, but also complex diagnostics.

Clinical consideration

How can the elderly's real need to restore missing teeth be uncovered?

The following aspects are usually relevant: Patients can hardly be expected to express their real need and how it may be satisfied without a full understanding of possible treatment options. These are determined by the dentist after a thorough clinical examination. In the subsequent dialogue between patient and dentist, all such options, with relevant advantages, disadvantages, financial consequences, risks and prognoses need to be discussed and explained. However, the dialogue does not have to be more extensive or complicated than necessary for its purpose.

Many elderly regard the dentist as an authority figure, whose concept of optimal prosthodontic treatment based on the dentist's superior knowledge and experience may be difficult to challenge. However, usually several treatments are possible, and it is advisable that the dentist's preference is not presented so strongly that the patient's subjective need becomes obfuscated.

Relevant to this discussion is that the requirements of the elderly may be less demanding than those of younger patients, and deviate significantly from more "objective" optimal treatments suggested by the dentist. In contrast, a few patients may insist on restorations that are not in accordance with generally accepted standards. In the latter case, if the patient is adamant, the advice is to refrain from treatment, because the dentist carries the legal and moral responsibility for any treatment provided.

Only after deliberations like those mentioned above, the patient is able to give "informed consent" to the chosen treatment as specified by law and ethics. Informed consent by frail elderly persons may be complicated by declining mental ability. Tiredness,

reduced hearing or early dementia may cause communication problems that may be reduced with the assistance of a family member or an emphatic friend. If dentist and patient have had a longstanding professional contact the decision-making is greatly simplified.

What may be obstacles to optimal treatment of elderly?

Of particular prosthodontic interest in this respect is the reduced ability by some elderly to endure long-lasting and multiple appointments - particularly associated with complex treatments. The lack of endurance may be related to general failing health and somatic diseases, but also to reduced mental stamina or other psychosocial circumstances. Even when this problem does not apply, conditions like shaking or rigidity or reduced muscular function in patients with motor afflictions or conditions that preclude prolonged periods of sitting still in a dental chair, may denote insurmountable obstacles for complex treatments.

Elderly patients use dental services less than younger adults even though their treatment needs are more complex.¹⁰ Furthermore, the cost of prosthodontic treatment and the level of public funding may influence the use of oral health care services for elderly,¹¹ the choice of preferred prosthetic treatment¹² and thus OHRQoL.¹³ Public funding for dental treatment differs widely between countries. All Nordic countries have some degree of public funding for dental treatment, but the systems and regulations differ significantly.^{14,15} In Denmark, Finland and Norway, prosthodontic treatment, with some exceptions, is not reimbursed, whereas in Sweden almost all kinds of prosthetic treatment, including the use of implants, are publicly reimbursement to a significant degree.

When are simplified methods and materials justifiable?

There are numerous types of simplified methods and materials that may be indicated for elderly on specific indications. Examples are composite crowns – as opposed to conventional crowns, fibre reinforced fixed dental prostheses (FDPs) (also called bridges) – as opposed to conventional FDPs, or resin bonded FDPs. Their advantages are that they can be accomplished in shorter and fewer appointments and at a lower cost compared with conventional methods. Composite crowns may perhaps not last as long as conventional crowns, but are still acceptable in suitable cases. Fibre reinforced bonded FDPs are shown to have reasonable longevity as demonstrated in multicentre studies,^{16,17} and in suitable cases are certainly preferable to partial removable denture prostheses (PRDPs). Resin bonded FDPs with prepared mechanical retention have demonstrated longevity comparable to conventional FDPs.¹⁸

Simple acrylic PRDPs with wrought wire retentive clasps (as opposed to PRDPs with metal framework) are always contra-indicated, except as temporary restorations, because of convincing documentation as long ago as the mid 1950ies that long-term use causes irreversible harm to oral tissues, reduced function and poorer prognosis of the remaining dentition.¹⁹

Patients with problems like those described in the previous paragraph may be particularly likely to be treated with simplified methods and materials. Regrettably, unacceptable restorations like acrylic PRDPs are too often used in the elderly indiscriminately because they are inexpensive, expedient and may seem to satisfy short-term needs. Considering the dire consequences on oral tissues and loss of OHRQoL, in some cases such dentures may even be more expensive than alternative treatments. Furthermore, to make use of ESDAs may not infrequently be the best treatment strategy

for the target group if it satisfies the limited subjective need of the patient. Even if it does not, nothing is ever lost by employing ESDA. Thereby time is gained and an extension of the dental arch by whatever means can always be implemented later if indicated.

What about prosthodontic treatment when oral diseases cannot be completely controlled?

Infected teeth or retained roots and other conditions that cause pain and acute infection, must always be resolved before prosthodontic treatment. However, elderly may also have an increased risk of root caries, periodontitis, stomatitis or peri-implantitis that can be quite resistant to treatment. These conditions may be successfully treated in the short term and prophylactic measures implemented. Still, in this age group they often relapse, due to factors like hyposalivation, reduced host resistance and sometimes inability and reluctance of the elderly to carry out adequate oral hygiene regimen. If the ideal, that oral tissues should be free from disease before restorative treatments are undertaken, is strictly adhered to, a significant proportion of this group would not be able to enjoy the benefits of restorations with corresponding loss of OHRQoL. Compromising this ideal should never be made lightly, but must be justified after careful consideration of each individual case.

Examples of the dilemmas such problems pose in regard to prosthodontics are apical pathology with no subjective symptoms, slowly developing periodontitis or treatment resistant stomatitis. A necessary condition for undertaking prosthodontics is then that possible harmful consequences are considered to take too long to be of major importance compared with the advantages gained with a restoration.

In all such cases a professional maintenance regimen needs to be implemented. This must be individualized and controlled so that failure of the patient to attend is recognized. Then the

patient should be routinely, and if necessary, repeatedly contacted. If unsuccessful, contact with family members or guardians may be attempted.

If the above measures are not implemented, the short-term benefits in the frail elderly may rapidly be offset by adverse effects. Whether or not to undertake prosthodontic treatments under these conditions pose difficult ethical and professional dilemmas for the dentist.

Repair or renewal of existing prostheses?

Maintenance of existing restorations in the elderly may be equally and sometimes even more important for preserving oral function than constructing new ones. To this end, the need for regular, systematic recalls and implementing measures when needed cannot be stressed enough. This is particularly important in regard to PRDPs due to their potential for tissue harm.

When problems do occur, deciding whether to repair, adjust, renew or leave well alone is difficult. Adapting to new prostheses may be problematic for an elderly person, particularly if the intervention alters the denture's external shape. However, some interventions are less risky than others: repairing fractured retention clasp arms of an PRDP, replacing fractured denture teeth and repairing a fractured acrylic base if the fragments can be accurately positioned or extending the denture when a natural tooth is lost, certainly fall within this category. Fractures of an acrylic denture base caused by material fatigue – typically in the midline of a complete removable dental prosthesis (CRDP), should not be repaired because such defects inevitably recur. Then a rebasing or a new denture is the treatment of choice.

Relines of PRDPs or CRDPs may extend the lifetime of the dentures. With PRDPs, relines should only be attempted if the general fit of the metal framework is acceptable and all metal components are functioning.

Unfortunately, patients must manage without removable dentures during laboratory assisted repairs, although the time needed to carry them out may be reduced by careful preplanning. If the alternative to repair is making a new denture, the patient has to decide whether this disadvantage is worth the cost and possible adaptation problems incurred in having a new one made.

If an existing denture must be remade, it may be an advantage to make use of the duplicate denture technique in which internal and external surfaces of the existing denture are replicated,²⁰ which is then used as a basis when constructing a new one. This method hopefully reduces the risk of rejection. Also, the original denture is intact and can be reinserted if the patient cannot adapt to the new one.

Mechanical breakdowns of FDPs are rare. A possible exception is broken facings, which can mostly be polished or repaired with composites. The most common causes of failure of fixed constructions are root caries or periodontal breakdowns of the abutments. Consequently, prophylactic measures are of crucial importance for maintaining FDPs in function. If the abutments have fractured or the retention of the FDP is lost on one or more abutments, repairs are usually technically very complicated, impractical or impossible to perform. Then, a new appliance has to be fabricated or the existing one shortened.

How can the need for repairs of fixed restorations be minimised?

In the reduced dentitions in SDA or ESDA the biting and chewing forces load fewer teeth than in dentitions with more teeth. The resulting heavy loading on remaining teeth and abutments necessitates adequate dimensioning of the metal constructions. Also, strong retention needs to be carefully considered. Night guards may counteract some of the problems.

The increased risk of root fracture of

endodontically treated abutments with posts and cores is reduced by furnishing such teeth with solid ferrules embracing the root. Endodontic treatment through a crown is sometimes necessary, but this procedure reduces the strength of the dentin core with resulting high risk of loss of retention or fracture of tooth substance. Minimal entrance to pulpal chamber and root canal should be sought in order to reduce these risks. Insertion of a post in such cases, which could perhaps be considered after such root canal treatment, may in fact further reduce the mechanical strength of the tooth.

Fixed or removable – a key question

As intimated earlier, in guidelines for public funding, including those that exist in UK and Nordic countries, FDPs are still, implicitly or explicitly, considered an exclusive, expensive and “unnecessary” treatment. The preferred alternative, no doubt mainly for economic reasons, is PRDPs. This preference is also shared by many colleagues and health care planners who claim that FDPs are more expensive, technically challenging and difficult to keep clean. However, compared with FDPs, PRDPs substantially add a risk of mechanical damage to gingival tissues, plaque retention and dental caries (Fig. 1).²¹⁻²³ It has also been reported that up to 40 % of PRDPs are rejected by the patients soon after insertion, indicating a low patient acceptance and reduced OHRQoL of such constructions.²⁴ Furthermore, it has recently been shown that patients prefer to have missing teeth replaced by FDPs” rather than by a removable appliance.²⁵

If the SDA and ESDA concepts are followed, gaps in the anterior dentition are often small. These are more adequately closed with FDPs, which are mostly easy to produce, carry a minimal risk of harmful consequences and are better accepted than PRDPs. An implant supported crown may also suffice to close the gap. In suitable cases the use of a simple two-unit



Fig. 1. PRDPs and caries. *The use of PRDPs is associated with increased plaque accumulation and caries risk as seen in this patient. Establishing and maintaining optimal oral hygiene through a systematic regimen of recalls and supportive therapy must be implemented.*

cantilever FDPs (one abutment/one pontic) can be justified (Fig 2), even when used to extend the dental arch posteriorly, as documented in prosthetic literature.^{21,22,26,27} A similar distal extension can also be accomplished with an implant supported crown. Such treatment may be especially valuable for the elderly who have retained natural teeth to a high age and who may experience great problems adapting to an PRDP with a resulting reduced OHRQoL.

Furthermore, keeping in mind the SDA and ESDA concepts, the laboratory cost and clinical time required in order to restore such a dentition by means of an FDP may sometimes be equal to or lower than a high quality PRDP counterpart, which requires much time for construction, clinical adjustments and follow-up (Fig. 3).^{27,28} This was demonstrated in a recent Irish study²⁹ where laboratory costs were 38% higher for the PRDP than the FDP. Also, initial clinical visits, follow-up appointments and total clinical time were on average 48% higher for the PRDP group. The FDP patients had an average of just 2.6 replaced in order to satisfy the SDA requirement whereas the PRDP replaced 6.3 teeth. The added teeth of the



Fig. 2. Short FDPs. Severe periodontitis treated for 30 years. Patient now 85 years old. Mandibular FDP 23 years old. FDP²² 23 18 years old. FDP 15¹⁴ 13 4 years old. Existing post and core with cervical gold collar of 15 retained and used for retention of the three-unit FDP. Maxillary FDPs in cobalt chromium and porcelain. Resin bonded. A – frontal aspect. B – lateral aspect, patient's right. C – lateral aspect, patient's left. D – palatal aspect. E – two-unit and three-unit FDPs.

PRDPs were a consequence of the construction, had little therapeutic value and did not enhance the OHRQoL as shown in a large multicentre study.³⁰

A practical example of the small difference in production cost between FDP and PRDP is presented in Fig. 2, which depicts an elderly patient who had been successfully treated for advanced periodontitis. The restorative

alternatives for the maxilla were PRDP with cast framework or two minor FDPs. The latter treatment was chosen because of its more favourable effect on OHRQoL and reduced risk of adverse periodontal response.

A comparison of dental laboratory costs shown in Table 1, indicates that, at least in a representative large Nordic laboratory, the cost of the fixed solution was only about 10%



Fig. 3. Improper and proper PRDP constructions. A, B – patient 66 years old. Has had maxillary CRDP and mandibular PRDP for many years. Present dentures one-year-old. Maxillary denture keeps falling down; mandibular PRDP hurts. Gingival trauma because the construction is too close to soft tissues. C, D – patient 91 years old. Mandibular PRDP 15 years old. No gingival trauma, no relining/rebasing during these years. Denture still stable and functional until patient dies aged 96.

higher than the removable alternative, an almost negligible difference. True, such comparisons of costs may be difficult to generalise, as the total cost for the patient may be influenced by price culture, funding system **etc.** However, this aspect should at least be considered before the treatment plan is finalized. The type of metal framework retained PRDP that was used for economic calculation is demonstrated in Fig. 4. This patient has a similar dentition to the one in Fig. 3 for whom the calculations were made.

Based on the above, it can be argued that the current preference for PRDPs, has resulted in a longstanding overproduction of such appliances.²⁶ The reduced risk for tissue injuries, less demanding long-term maintenance,

long-term success, patients' preference and improved OHRQoL, strongly suggest a more liberal use of FDPs – particularly when restoring minor gaps in the anterior region. The type of crown for retaining a fixed restoration is in this context of lesser importance.

Implants for the elderly?

A complex or unsatisfactory prosthetic treatment may be changed to a simple and effective one by the use of implants. The construction will then be technically safer, have better oral function and may easily improve OHRQoL in an elderly patient. One cost-effective example for patients unsatisfied with their mandibular complete denture is the

Table 1. A comparison of laboratory costs between a cobalt-chromium PRDP and two small FDPs for the patient shown in Fig. 3. Laboratory costs (in PLN) calculated by a Swedish dental laboratory and updated for May 2018. The PRDP is constructed according to a “hygienic” regimen^{27,28} with a metal palatal plate, two metal backings, two pontics and two gold wire clasps. See also patient in Fig. 4 with a similar PRDP. The three-unit resin-bonded FDP includes one full metal-ceramic crown and one partial crown; the two-unit FDP includes one resin-bonded partial crown (Fig. 2).

Partial removable dental prosthesis	Cost (PLN)	Fixed dental prosthesis	Cost (PLN)
Basic	2165	Restoring ^{22 23}	1579
2 metal backings	291		
2 composite pontics	426	Restoring ^{15 14 13}	2368
2 gold wire clasps incl. soldering	415		
Total	3297	Total	3947



Fig. 4. An example of a PRDP constructed according to a “hygienic regimen”^{27, 28} in another patient than the one used for calculation of costs in table 1. A – frontal aspect. B – palatal aspect.

insertion of two implants with ball attachments retaining an overdenture.³¹ Age as such does not affect implant survival.^{32,33} However, there may be surgical, medical, psychological and financial aspects that limit the use of implants, particularly in frail patients.

Future perspectives

The present rate of edentulousness varies between UK and some Nordic countries. Regardless, despite the fact that the proportion of elderly in the population will increase in the coming years, epidemiologic data suggest that the number of edentulous elderly will decrease.

A substantial number of elderly will still, for various reasons, have missing teeth, also in the anterior region, and be in need of tooth replacements. Furthermore, a large number of patients needing prosthetic treatment will be in the older age groups and many of these will have general diseases and use multiple medications. This may influence choice and implementation of prosthetic treatment and will require increased knowledge and understanding by clinicians. Hopefully, a better understanding of OHRQoL will permeate the planning process. Research and teaching need to change rapidly to meet these requirements.

References

1. Berg E, Isidor F, Öwall B: Prosthodontics for the elderly patient. *Nor Tannlegefor Tid* (Norwegian Dental Journal) 2017; 127: 120-126.
2. Berg E, Isidor F, Öwall B: Prosthodontics for the elderly patient. *Tandlægebladet* (Danish Dental Journal) 2017; 121: 28-35.
3. Berg E, Isidor F, Öwall B: Protetik för den äldre patienten. (Prosthodontics for the elderly patient). *Tandläkartidningen* (Swedish Dental Journal) 2017; 109: 60-68.
4. Berg E, Isidor F, Öwall B: Läkhan potilaan proteettinen hoito. (Prosthodontics for the elderly patient). *Suomen Hammaslääkärilehti* (Finnish Dental Journal) 2017; 29: 30-37.
5. God klinisk praksis i tannhelsetjenesten. En veileder i bruk av faglig skjønn ved nødvendig tannbehandling. (Good clinical practice in the dental care service. Guidelines in professional assessment of necessary dental treatment). HelseDirektoratet (Norwegian Department of Health), YS-1589, p 8.
6. Regelverk Tandvårdsreform 1999/2013. Region Skåne Tandvårdsstöd. Mål och inriktning för nödvändig tandvård. (Guidelines for dental care reform 1999/2013. The Skåne region dental care funding. Aims and direction for necessary dental care). Sweden.
7. Käyser AF: Teeth, tooth loss and prosthetic appliances, pp 35-47. In *Prosthodontics. Principles and management strategies*. Eds Öwall B, Käyser AF, Carlsson GE. London: Mosby-Wolfe 1996. ISBN 0 7234 20467.
8. Kanno T, Carlsson GE: A review of the shortened dental arch concept focusing on the work by the Käyser/Nijmegen group. *J Oral Rehabil* 2006; 33: 850-862.
9. Korduner EK, Collin Bagewitz I, Vult von Steyern P, Wolf E: The shortened dental arch concept from the perspective of Swedish general practitioners: a qualitative study. *Swed Dent J* 2016; 40: 1-11.
10. Widström E, Augustdottir H, Byrkjeflot LI, Pälvärinne R, Christensen LB: Systems for provision of oral health care in the Nordic countries. *Tandlægebladet* (Danish Dental Journal) 2015; 119: 702-711.
11. Raittio E, Kiiskinen U, Helminen S, Aromaa A, Suominen AL: Dental attendance among adult Finns after a major oral health care reform. *Community Dent Oral Epidemiol* 2014; 42: 591-602.
12. Pillai RS, Mathur VP, Jain V, Shah N, Kalra S, Kumar P, Dey AB: Association between dental prosthesis need, nutritional status and quality of life of elderly subjects. *Qual Life Res* 2015; 24: 2863-2871.
13. Raittio E, Lahti S, Kiiskinen U, Helminen S, Aromaa A, Suominen AL: Inequality in oral health-related quality of life before and after a major subsidization reform. *Eur J Oral Sci* 2015; 123: 267-275.
14. Palmqvist S, Söderfeldt B, Vigild M: Influence of dental care systems on dental status. A comparison between two countries with different systems but similar living standards. *Community Dent Health* 2001; 18: 16-19.
15. Holt C: Brugen af og betaling for tandpleje i Danmark, Sverige og Norge. (The use of and payment for dental care in Denmark, Sweden and Norway). *Nor Tannlegeforen Tid* (Norwegian dental Journal) 2013; 123: 12-18.
16. Van Heuman CC, van Dijken JW, Tanner J, Pikaar R, Lassila LV, Creugers NH, Vallittu PK, Kreulen CM: Five-year survival of 3 unit fiber-reinforced composite fixed partial dentures in the anterior area. *Dent Mater* 2009; 25: 820-827.
17. Van Heuman CC, Tanner J, van Dijken JW, Pikaar R, Lassila LV, Creugers NH, Vallittu PK, Kreulen CM: Five-year survival of 3 unit fiber-reinforced composite fixed partial dentures in the posterior area. *Dent Mater* 2010; 26: 137-142.
18. El-Mowafy O, Sendi P: Markov models in dentistry: application to resin-bonded bridges

- and review of the literature. *Expert Rev Pharmacoecon Outcomes Res* 2012; 12: 623-629.
19. *Koivumaa KK*: Changes in periodontal tissues and supporting structures connected with partial dentures. Thesis. Suomen Hammasläkäriseuran Toimituksia (Proceedings of the Finnish Dental Society) 1956; 52 suppl. 1
 20. *Lindquist TJ, Ettinger RL*: Patient management and decision making in the complete denture fabrication using a duplicate denture: A clinical report. *J Prosthet Dent* 1999; 82: 499-503.
 21. *Budtz-Jørgensen E, 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.
 22. *Jepson NJ, Moynihan PJ, Kelly PJ, Watson GW, Thomason JM*: Caries incidence following restoration of shortened lower dental arches in a randomized controlled trial. *Br Dent J* 2001; 191: 140-144.
 23. *Kern M*: RBFDP. Resin-bonded fixed dental prostheses. Quintessence Publishing Co Inc. ISBN 9781786980205.
 24. *Riber E, Öwall B*: Patienters anvendelse af fremstillede delproteser. (Patients usage of removable partial dentures) *Tandlægebladet (Danish Dental Journal)* 1998; 102: 936-940.
 25. *Cronin M, Meaney S, Jepson NJ, Allen PF*: A qualitative study of trends in patient preferences for the management of the partially dentate state. *Gerodontology*. 2009; 26: 137-142.
 26. *Jepson NJ, Allen PF*: Short and sticky options in the treatment of the partially dentate patient. *Br Dent J* 1999; 187: 646-652.
 27. *Öwall B, Budtz-Jørgensen E, Davenport J, Mushimoto E, Palmqvist S, Renner R, Sofou A, Wöstmann B*: Removable partial denture design: A need to focus on hygienic principles? *Int J Prosthodont* 2002; 15: 371-378.
 28. *Jepson NJ*: Removable partial dentures. (Quintessentials of dental practice 18). Quintessence Publishing Co Ltd. London 2004. ISBN 1850970750.
 29. *McKenna G, Allen PF, Woods N, O'Mahony D, DaMata C, Cronin M, Normand CA*: Preliminary report of the cost-effectiveness of tooth replacement strategies for partially dentate elders. *Gerodontology* 2013; 30: 207-213.
 30. *Wolfart S, Müller F, Gerß J, Heyedcke G, Marré B, Böning K, Wöstmann B, Kern M, Mundt T, Hannak W, Brückner J, Passia N, Jahn F, Hartmann S, Stark H, Richter EJ, Gernet W, Luthardt RG, Walter MH*: The randomized shortened dental arch study: oral health-related quality of life. *Clin Oral Investig* 2014; 18: 525-533
 31. *Gjengedal H, Berg E, Grønningsæter AG, Dahl L, Malde MK, Bøe OE, Trovik TA*: The influence of relining or implant retaining existing mandibular dentures on health-related quality of life: a 2-year randomized study of dissatisfied edentulous patients. *Int J Prosthodont* 2013; 26: 68-78.
 32. *Park JC, Baek WS, Choi SH, Cho KS & Jung UW*: Long-term outcomes of dental implants placed in elderly patients: a retrospective clinical and radiographic analysis. *Clin Oral Implants Res* 2016 doi: 10.1111/clr.12780.
 33. *Heydecke G, Boudrias P, Awad MA, de Albuquerque RF, Lund JP & Feine JS*: Within-subject comparisons of maxillary fixed and removable implant prostheses: Patient satisfaction and choice of prosthesis. *Clin Oral Implants Res* 2003; 14: 125-130.
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