Table 2	Clinical Specifics*
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Esthetics	
Lower facial height and occlusal vertical dimension	
Smile line and facial symmetry	
Tooth form and tooth arrangement	
Function	
Jaw mobility-jaw joint (disc and condyle) and muscle interaction	
Jaw muscle function	
Stable tooth contact position for function	

*Clinical priorities are summarized to emphasize the expectation in knowledge and the global approach to patient care.

Conclusion

Research evidence is not yet available from long-term contemporary clinical outcome studies to specify a particular occlusal design or jaw relationship for optimizing clinical outcomes.

However, in recognition of the above, and within this complex biologic and behavioral framework, and the limits of clinical outcome data, a paradigm shift in available evidence acknowledges that emerging neurophysiologic evidence, based on peripheral and central neuroplasticity, indicates the remarkable accommodation of the masticatory system to subtle and gross changes in the occlusal status.^{1,4}

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Removable Partial Dentures

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Trends: Demographic Changes and Prosthodontics

A continuous decline of tooth loss and complete edentulousness can be observed over the past 30 years, as well as a trend to replace removable partial dentures (RPDs) with fixed prostheses¹ and an increasing number of implants placed. In parallel, there is also an increase in the elderly population of the western world. With regard to a highly reduced dentition or complete edentulousness, a shift to the oldest segment of the population is expected. Caries becomes difficult to control and root caries is a major reason for tooth loss in elderly patients (Fig 1). It is undisputed whether adaptation to removable partial and complete dentures in old age is a favorable solution.

Rather, recent publications suggest that periodontally compromised teeth should be maintained in elderly patients by adequate care.² Natural teeth might have a better prognosis than implants.³ Some clinicians and researchers claim that elderly patients should preferably maintain a natural dentition with 20 teeth at the age of 80 (ie, a shortened dental arch [SDA] concept)⁴ without the need of wearing any removable dentures. Whether this goal can be reached for a broad average of the elderly population has not yet been demonstrated.

Evidence for the Effectiveness of RPDs

So far the level of evidence in the field of RPDs is very low and randomized controlled trials or systematic reviews are missing. In the Cochrane collaboration, six major topics in dentistry are elaborated by systematic reviews, removable prosthodontics not included. While experts claim that RPDs improve chewing function, nutrition, esthetics, occlusal support, and guality of life, this has not been proven on a solid basis.⁵ In fact, it seems that the pleasure of eating is diminished by wearing RPDs and patients with > 20 natural teeth may be healthier. A review comprising over 80 publications⁶ could not identify clear indications for RPDs. RPDs were often delivered to elderly or dependent patients with low general health, low social background, or low education levels. Economic restrictions had the greatest impact on clinical decision-making. Thus, there is some bias in the patient selection for treatment with RPDs and results from studies have to be considered under these auspices.

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Ecologic Aspects

The patient's behavior (oral hygiene), habits (food, smoking), systemic health (medications), genetic disposition, and the normal process of ageing may have an impact on the oral milieu. In the ecologic system of the oral cavity over the years, changes occur that may be complex, multifactorial, not independent from each other, and often result in a cumulative pathologic effect. Such effects like tooth migration and loss, atrophic jaw segments, tooth wear, change of vertical dimension of occlusion, and changes in interarch relationships are an unfavorable basis for providing RPDs. Apart from purely biologic aspects, the selection of strategic teeth and planning of the prosthesis design encompasses a broad synoptic view. The oral ecology itself is often negatively modified by dental restorations and prostheses. In the 1970s and 1980s, various authors found that biologic problems increased with the delivery of RPDs.^{7,8} Otherwise, oral health and prostheses could be maintained in selected patients over a long time period by regular support and hygiene monitoring.⁹ Well-designed prostheses also increased oral health and survival of abutment teeth.¹⁰

A more recent review⁶ came to the conclusion that the long-term use of RPDs was associated with a higher risk of caries and periodontal disease; furthermore, low acceptance of the denture was frequent. A study compared fixed and removable prostheses or no treatment for posterior gaps and found that the failure rate for adjacent teeth (incidence of caries, periodontal and endodontic problems) after 5 years was significantly higher with RPDs.¹¹ Caries close to clasps is frequent.¹² Ageing is a high risk for caries development and many studies have clearly shown that caries is the most frequent age-related problem. Thus, a major problem is the highly compromised structural integrity of many teeth, their unfavorable distribution, and improper position in the jaw. Adequate tooth selection for retention of RPDs becomes difficult (Table 1).

Retention Mechanism of RPDs

In the context of a biophysical and psychosocial model of patient management in dentistry, there may be a danger to disregard technical and biomechanical aspects of prosthodontics. But such a dichotomous view is not helpful and biology and technology should not be regarded as opponents. Technology in the sense of biomechanics, selection of material, and denture design supports the endeavor to maintain the balance of the oral ecology. A broad variety of retention devices—direct and indirect—are available for fixation of removable dentures. The cast metal framework with clasps is probably the most cost-effective solution, but

Table 1 Tooth Selection for Denture Retention

Biologic aspects

- SafeDoubtful
- Not to be maintained hopeless
- Structural integrity
- In which form can we use them as prosthetic abutments?
 Strategic importance

• How many teeth do we need for prosthetic reconstructions? Distribution in the jaw

• Where are they located in the jaw (intermaxillary aspects)?

comparative data are not available. Simple root support with or without cast gold copings and precision attachment is often applied for teeth with improper structural integrity, but the scientific documentation mostly focused on biologic problems (caries, periodontitis, insufficient hygiene) in small patient groups.¹³ A recent study suggested that implants will do better and cast gold root-copings may become obsolete since biologic and technical problems with posts, root fractures, and decementation are frequent.¹⁴ The indication for a combined fixed-removable prosthesis is mostly limited to Kennedy class I and II, preferably without endodontically treated abutment teeth. So far the survival rate seems to be rather low.¹⁵ Telescopic crowns, be it with tooth or implant support, are more popular and more frequently documented in the literature.¹⁶ Both latter solutions provide good esthetics without visible retention devices, high stability, and rigid retention, as compared to the semi-rigid retention of clasps. But there is a higher risk of horizontal fracture of abutment teeth¹⁷ and triangular or quadrangular support is recommended while two single telescopes in Kennedy class I situations, particularly in the maxilla, are obsolete. Today, new technologies with computer-aided design/computer-assisted manufacture fabrication of the primary crowns can be applied, while a cast metal framework is still the standard for all types of removable prostheses.

Overtreatment with RPDs may occur with only a few missing teeth. Posterior missing teeth must not be replaced by RPDs if stable occlusal contacts can be achieved with SDA. There is only weak evidence that temporomandibular joint problems will develop without molar support.

In contrast, providing stable prostheses and proper function with a minimum number of teeth becomes difficult or impossible. In such situations, a proper attribution to the Kennedy classes is no more helpful (Figs 1a and1b). By placement of one or a few implants in strategic positions, triangular or quadrangular support can be reestablished^{18,19} by combined toothimplant retention (Figs 2a and 2b). Thus, a better denture design is achieved and better prognosis for adequate denture function of the RPDs is expected.

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Fig 1a *(left)* Minimal residual dentition with an unfavorable distribution in the arch.

Fig 1b (*right*) Compromised structural integrity with an unfavorable distribution and interarch relationship.

Fig 2a *(left)* Quadrangular support: Two telescopes in the maxillary canines and two implants at the position of the second premolar.

Fig 2b (*right*) Triangular support: Clasp used at the mandibular left first molar, root coping at the left canine, and an implant in the right canine. Dell Bona anchors used at both canine sites.

Oral Health–Related Quality of Life and Patient's Response

It is generally acknowledged that oral health is part of quality of life and this aspect gains more weight in clinical decision-making. But individual constellations, the ethnicity, and social environment may play a great role and significantly influence the patient's expectations and response to dental and prosthodontic treatment.²⁰ Many clinicians know that patients frequently report on problems with RPDs and do not easily accept them. RPDs are often not well accepted, not worn, have a low profile, and are a neglected field of dentistry. Various studies tried to measure the treatment effect by using the OHIP²¹ in its various versions, but so far only few results are available on removable partial dentures. The average range of the OHIP obtained from patients with RPDs resembles that of partially edentulous patients without any treatment.²² A comparison of patients with SDAs who received RPDs or no treatment revealed that the group with RPDs was not more satisfied.²³

However, one study reported that the loss of a single occlusal unit led to a significant increase of the mean OHIP value.²⁴ A positive treatment effect measured by the OHIP and a visual analog scale was observed by improving the quality of the RPDs.²⁵

Summary and Conclusions

On one side, prosthodontic reconstructions compensate for the sequelae of negative changes in the oral cavity; on the other side, they often enhance or accelerate them. As a consequence of negative changes in the oral cavity over time, treatment planning for RPDs becomes highly complex. A set of reliable criteria is necessary for decision-making and problem management.

It appears that the majority of published data on RPDs does not depict high effectiveness of this treatment modality. From a strict point of view of evidence-based dentistry, the level of evidence is low if not missing for RPDs. Randomized controlled trials on RPDs are difficult to design, they are not feasible for some questions due to the complexity of the material, or may remain without clinical relevance. The literature rarely gives information on the denture design, tooth selection, and management of the compromised structural integrity of teeth. So far treatment outcomes with RPDs must be considered under the aspect of bias due to the bias in indication and patient selection for RPDs. Better clinical models should be elaborated with more stringent concepts for providing RPDs. This encompasses: risk analysis and patient assessment, proper indications for maintenance or extraction of teeth, strategic placement of implants, biomechanical aspects, materials, and technology. Although there is a tendency to offer fixed prostheses to our patients, this might change again with demographic changes and with an increase in the ageing population, an increase in their reduced dentition, and low socioeconomic wealth in large parts of the world.

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An Evidence-Based Approach to the Study of the Consequences of Partial Edentulism With and Without Prosthodontic Interventions

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The subject of evidence-based dentistry (EBD) is discussed frequently as a method to ensure appropriate decision-making for patient treatment. Sackett et al¹ describe evidence-based medicine (EBM) as a "conscientious, explicit, and judicious use of best-available evidence when making decisions" regarding the care of patients. The topics of EBD and EBM share a common heritage and mission. Unfortunately, EBD continues to be a misunderstood approach to dental education. Rather than accepting it as a straightforward method to incorporate clinical expertise with best-available evidence, many educators and clinicians appear to consider this approach as a threat to traditional dental therapy.

As part of an international training session for dental educators in EBD methodology, a group of mentors were assigned specific questions that would be addressed using best-available evidence. This evidence was to be identified through reviews of the literature recognizing that there are many approaches to the conduction of a literature review.²

The primary aim of this exercise was to identify different methods of evidence-gathering techniques related to the clinical question of what consequences a patient will face with or without prosthetic intervention for a condition of partial edentulism.

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