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Restorative dentistry and restorative materials over the next 20 years: A Delphi survey

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ABSTRACT

Objectives. The aim of this study was to forecast trends in restorative dentistry over the next 20 years and to identify treatment goals and corresponding properties of restorative materials.

Methods. Using the Delphi method, a panel of 3 experts identified 8 key questions, which were sent to experts in restorative and preventive dentistry. In round 1 of this survey, 15 international experts devised a clearer semantic definition of the key questions and the completion of respective items for two additional rounds. In round 2, 125 experts from 35 countries rated the items developed in round 1 using a Likert scale. In round 3, the same 125 experts received the ratings of round 2 and were asked to agree or disagree to these ratings by re-voting on all key questions and items. A total of 105 experts re-voted and finally took part in the complete survey. Among the 8 key questions, two questions were selected for the present report: (Q1) "What will be the future role of restorative treatment?" and (Q6) "What will be the key qualities for clinical success of restorations?" For both questions and the respective items, the experts were asked to evaluate the importance and the feasibility for later calculation of the scientific value (i.e. the opportunity, where opportunity = importance + [importance − feasibility]).

Results. The three items of highest importance for Q1 were "preservation of existing enamel and dentin tissue," "prevention of secondary caries," and "maintenance of the pulp vitality," and for Q6 they were "optimization of adhesion," "biocompatibility," and "minimizing technical sensitivity."

Significance. Bioactivity toward the pulp-dentin complex and prevention of secondary caries were the items generally rated as having the highest opportunity.

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1. Introduction

Over the last 25 years, restorative dentistry has gone through remarkable changes. Generally, caries has declined in industrialized countries. However, caries is not evenly distributed throughout the population but follows a social gradient [1], which can be regarded as one factor that results in a phenomenon described as caries polarization where the majority of carious lesions in a population are found in a small group of individuals (the "caries risk group") [2,3]. In addition, the increasing number of elderly people in industrialized countries leads to special oral health problems. Among others, these problems include those affecting restorative dentistry such as root caries or dental erosion, of which the prevalence in general seems to increase [4,5]. Moreover, other factors such as the level of industrialization, educational status, price levels, and presence of social insurance and reimbursement systems highly influence primary dental healthcare. Over the years, dental materials for restorative dentistry have also gone through remarkable changes. The advent of adhesive dentistry along with resin composite materials enabled not only the establishment of preventive measures such as pit and fissure sealing but also allowed for less invasive and highly esthetic restorations. However, new resin-based composite materials currently provide only incremental developments due to a highly competitive market with the need for relatively short product cycles.

In which way will restorative dentistry in general and restorative materials in particular change in the future? An elucidation of these trends would be helpful for healthcare authorities, education staff at universities, and dental companies in order to set the right framework and to ensure that the abilities of dental students today as well as restorative materials will meet tomorrow's requirements. One possible approach for an elucidation of trends may be reached with a Delphi survey. The Delphi survey is a systematic interactive forecasting and consensus method based on independent input of selected experts. Initially developed during the cold war [6], Delphi surveys have been used for technological forecasting. It is now widely used in fields such as education, business, economics, or social science to reach consensus among experts. The Delphi survey has also been used in dentistry [7] for decision-making in the absence of quantitative scientific data.

The aim of the present study was to forecast trends in restorative dentistry over the next 20 years and to identify treatment goals and corresponding properties of restorative materials with a Delphi survey.

2. Materials and methods

This study was designed as Internet-based (TNS Healthcare, Munich, Germany) Delphi survey in 3 rounds.

A panel of 3 experts (team including one of the authors (M.J.N.) – led by the experienced facilitator M.J.N.) identified 8 key questions (Table 1), which were piloted with a group of 10 dentists working at the University of Cologne, Germany. Upon fine-tuning the 8 key questions, the Internet-based Delphi survey was started with 20 hand-selected international experts in restorative and preventive dentistry (round 1). Selection criteria for these experts were: (i) good command of English, (ii) expertise in operative/preventive dentistry as indicated by publications (PubMed), (iii) expertise demonstrated by publication of literature reviews or monographs, and (iv) personally known to the present authors in a professional capacity. Fifteen experts from 10 countries accepted the invitation and took part in the first round of the Delphi survey. All input received from the experts was based on their personal opinion without any pre-readings or literature recommendations provided by the present authors. The participants received no reimbursement but were offered exclusive access to the results of the study before publication.

Table 1 – The eight key questions (Q1–Q8) identified for the survey. The full questionnaire including all items can be found in the online supplementary material of this publication.

- Q1 What will be the future role of restorative treatment?
- Q2 What are typical patients' needs and how will they change?
- Q3 What is the share of risk groups in your country?
- Q4 Which additional goals compared to traditional restorative therapy should be fulfilled by future technologies or materials to improve the success rate in risk groups?
- Q5 Which properties of a special restorative material are needed to achieve these goals?
- Q6 What will be the key qualities for clinical success of restorations?
- Q7 Which key properties of restorative materials or devices will be required for the treatment of elderly and children?
- Q8 Do you agree with the following statements?

Round 1 resulted in the development of a questionnaire containing clearer semantic definitions of the key questions and the completion of respective items for the two additional rounds.

For round 2, 175 experts were contacted of whom 125 agreed to participate based on their scientific interest in the results without being offered a reimbursement (response rate = 71%). The selection criteria for experts in rounds 2 and 3 were: (i) good command of English, (ii) expertise in operative/preventive dentistry as indicated by publications (PubMed) and (iii) personally known to at least one of the present authors in a professional capacity. The distribution of experts, who covered 35 countries (located in Europe, North and South America, Asia, the Middle East, Australia, New Zealand, and Africa), as well as the experts' specialties are shown in Table 2. The design of the study required that all participants corresponded individually without officially knowing the identity of the other experts, in order to avoid a "bandwagon effect" in their responses.

The experts rated the closed-ended items developed in round 1 for the 8 key questions using a Likert scale (level of agreement 1 [low]–4 [high]). The complete questionnaire can be found in the online supplementary material of this publication.

In round 3, the same 125 experts received the ratings of round 2 and were asked to agree or disagree to these ratings by re-voting on all key questions and respective items. Finally, 105 experts took part in the complete survey (response rate = 84%). Among the 8 key questions, the following 2 questions were