

A questionnaire instrument to assess clinical decision-making in prosthodontics among general practitioners

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There are great variations in dentists' choice of treatment. The aim of this study was to evaluate a Patient Paper Case (PPC) technique to investigate such variation, adjusted for prosthodontics. The questionnaire was sent to all 131 general practitioners (GP) in the Public Dental Service in Örebro County and to all 100 GPs in private practice in Skaraborg County, Sweden, with 81% responding. There were three PPC questions, concerning 1) crown therapy or amalgam/composite filling, 2) fixed or removable partial denture, 3) fixed partial denture or single implant restoration. Respondents were asked to assess 13 or 14 items concerning the patient, dental conditions, and own skills. There was great variation in responses. In factor analysis four factors were found to capture between 54% and 60% of the variance of the items. They were interpreted as a time factor, a patient subjective factor, a clinical factor, and finally, for the PPC 1 and 2, a general health factor. The Swedish insurance regulations of single implant therapy, mandatory caries/filling-free, and vital adjacent teeth were reflected in the factor solution of PPC 3. It is concluded that the PPC method is feasible and useful in studies of clinical decision-making in prosthodontics.

□ *Dentist-patient relations; dentures; factor analysis; Patient Paper Case; treatment variation*

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There are great variations in dentists' choice of treatment, especially in prosthodontics (1–3). Little is known, however, about causal factors behind these variations in dental practice. In a review in 1992 it was concluded that, 'The extent to which variation in dentists' detection of caries, evaluation of existing restorations, and identification of damaged teeth are associated with characteristics of the dentist, the practice and the patient is completely unknown' (4). A recent study of general practitioners in public dental service in Sweden found that three variables were significantly associated with the quantity of performed fixed prosthodontics: general prosthodontic activity at the clinic, male sex of the dentist, and (inversely) time in the profession (5).

A study of patient records of American dentists found no connections between choice of treatment and technical factors, clinic activity, patient incomes, or the age of dentists. The study concluded that the large variation between individual dentists primarily was due to 'style' and individual preferences (6). However, there are only a few examples of available research instruments that could capture such individual preferences among dentists. A main line in the efforts to develop such instruments is the so-called PPC technique (Paper Patient Cases) (7, 8). There is, to our knowledge, only one example of such a technique that has been applied

in dentistry (9). It led to successful and interesting results, but it was not specifically geared for decision-making in prosthodontics.

The aim of this paper was to evaluate a PPC technique for investigation of decision-making in prosthodontics. The technique was developed and tested in a pilot study. The objective of this paper is therefore limited to assessing the technique psychometrically and evaluating its possibilities for use in future larger studies representative of the population of dentists as a whole.

Materials and methods

A mail questionnaire was issued during October 1994 to 231 dentists in 2 Swedish counties, Örebro and Skaraborg. The questionnaire was sent to all 131 general practitioners (GPs) in the Public Dental Service in Örebro, and to all 100 GPs in private practice in Skaraborg (about half of the Swedish dentists are publicly employed). The subjects were requested to complete and return the questionnaire as soon as possible. Those who had not responded within 2 weeks received a reminder. After that, no further efforts were made to get additional responses. The number of respondents was 187, yielding an overall response rate

of 81%. There were 109 responses in Örebro County (83%) and 78 in Skaraborg (78%). There was no available information enabling analysis of non-responding dentists. Failure among responding dentists to answer single questions, internal non-response, was negligible (<1%).

The questionnaire contained three PPC questions about prosthodontic treatment situations, all using the VAS (visual analog scale) response technique. An important consideration, when formulating the questions, was to prevent the responding dentists from feeling that their clinical judgement was questioned or controlled. Accordingly, there were instructions immediately preceding the questions:

‘An often used method to find different dentists’ treatment profiles is to start from concrete treatment situations. One asks different dentists to assess which importance he or she allots to various factors in his or her own choices. There is no right or wrong, and we have tried to choose such situations in which one really can have different opinions. We ask for *your own* opinion of each single factor, also considering the other ones. Please indicate your opinion about the relative importance of the various factors with a mark on the scale, on which the distance from the end points should mirror the relative importance you want to allot to the factor.’

The response items used VAS ranging from ‘Unimportant’ to ‘Absolutely decisive’. A mid-point was indicated on each scale.

The first treatment situation was as follows:

1. ‘You encounter the choice to treat a lesion, such as a cusp fracture, on a premolar in the maxilla with an artificial crown or with an amalgam/composite filling. How do you assess the following factors?’

The following factors were given as response items: Age of patient; patient’s general health; patient’s wishes; remaining tooth substance; technical difficulty of

therapy; prognosis of treatment; marginal bone level; pulp status—vital or non-vital tooth; poor oral hygiene—gingivitis; own experience with artificial crown therapy; time required for treatment; number of visits necessary for treatment; esthetics of final result.

The second treatment situation was as follows:

2. ‘You encounter the choice to treat a patient with a fixed partial denture or a removable partial denture, both solutions being technically possible. How do you assess the following factors?’

The following factors were given as response items: Patient’s age; patient’s general health; patient’s wishes; technical difficulty of therapy; marginal bone level; condition of possible abutments; poor oral hygiene—gingivitis; your own experience with the different treatments; time required for treatment; number of visits necessary for treatment; prognosis of treatment; esthetics of final result; expected patient comfort.

The third treatment situation was as follows:

3. ‘You encounter the choice to treat a single missing tooth in the front maxillary region with a conventional fixed partial denture or a single implant restoration. How do you assess the following factors?’

The following factors were given as response items: Patient’s age; patient’s general health; patient’s wishes; technical difficulty of therapy; caries or fillings in adjacent teeth; bone level of adjacent teeth; pulp status of neighboring teeth; poor oral hygiene—gingivitis; your own experience with the therapies; time required for treatment; number of visits necessary for treatment; prognosis of treatment; esthetics of final result; expected patient comfort.

The questionnaire began with the three PPC questions. Besides those, there was a question battery about general attitudes towards patients and several questions about type of dental clinic and level of prosthodontic activity, profiles of patient groups, and so forth. The questionnaire ended with a series of questions concern-

Table 1. Percentages of responses on the choice between artificial crown or filling (PPC 1)

Item	VAS response code: 1 = unimportant to 8 = absolutely decisive								n	Mean	s
	1	2	3	4	5	6	7	8			
Patient’s age	21	17	8	11	23	10	9	3	187	3.7	2.1
Patient’s general health	7	14	7	11	22	20	13	5	186	4.7	2.0
Patient’s wishes	0	0	0	2	4	20	35	39	187	7.0	1.0
Remaining substance	1	2	2	5	17	17	36	21	186	6.3	1.5
Technical difficulty	23	17	12	8	16	10	10	4	186	3.7	2.2
Prognosis of treatment	0	1	0	3	9	17	35	35	187	6.9	1.2
Marginal bone level	1	5	3	12	25	25	19	10	186	5.6	1.5
Pulp status	17	16	8	11	16	14	12	6	186	4.2	2.2
Oral hygiene	4	9	9	10	28	19	14	8	187	5.0	1.8
Experience with therapy	13	7	4	11	20	18	17	10	186	4.9	2.2
Time for treatment	46	22	11	8	9	3	1	2	187	2.3	1.7
No. of visits	45	23	9	9	8	4	2	1	187	2.4	1.7
Esthetics of final result	0	0	2	8	16	26	33	15	187	6.3	1.2

PPC = Paper Patient Cases; VAS = visual analog score.

Table 2. Percentages of responses on the choice between fixed partial denture and removable partial denture (PPC 2)

Item	VAS response code: 1 = unimportant to 8 = absolutely decisive								n	Mean	s
	1	2	3	4	5	6	7	8			
Patient's age	20	12	7	10	17	17	9	8	187	4.1	2.3
Patient's general health	4	10	4	12	24	21	15	11	185	5.2	1.9
Patient's wishes	0	0	1	2	4	17	29	48	187	7.2	1.0
Technical difficulty	22	17	12	16	15	8	8	3	186	3.5	2.1
Marginal bone level	0	2	2	7	25	28	25	11	187	6.0	1.3
Abutment condition	0	0	1	2	6	20	35	36	187	7.0	1.1
Oral hygiene	3	4	7	9	23	27	16	13	186	5.5	1.7
Experience with therapy	7	8	3	9	20	22	21	11	186	5.3	2.0
Time for treatment	41	24	11	12	9	2	1	1	187	2.3	1.5
No. of visits	41	26	11	11	9	1	1	1	187	2.3	1.5
Prognosis	0	0	0	1	5	16	37	41	187	7.1	0.9
Esthetics of final result	0	1	1	5	19	23	35	16	187	6.3	1.2
Patient comfort	0	0	1	1	5	17	48	29	187	7.0	0.9

PPC = Paper Patient Cases; VAS = visual analog scale.

ing the questionnaire itself. There were questions about meaningfulness, relevance, and clarity of the different items.

The responses to the PPC questions were analyzed in principal components analysis, a standard psychometric method to assess common variation between attitude questions. In the tables, factor loadings, eigenvalues, and communalities are stated. A factor loading expresses the proportion of the variation in a single item that is explained by a single factor. It can vary between -1 and 1. Eigenvalues should be greater than 1 for a factor to be considered, but this requirement can be modified after factual judgement of the importance of a factor. The communality, varying between 0 and 1, can be interpreted to express how much variation in the single item that is explained by the combined factors. The VAS responses were coded into eight equidistant categories. The distributions over categories were

examined as to mean and dispersion. The number of principal components, factors, was determined after inspection of scree plots and by the Kaiser criterion (10). The factors were rotated by the varimax method to maximize the total variance explanation retaining the pattern of factors. All statistical analyses were done in SPSS.

Results

For inspection of distributions and discriminatory ability, the relative frequencies of responses to the three questions were calculated and are shown in Tables 1-3. The means and standard deviations are given.

There was considerable dispersion of responses on most items, as can be seen from the standard deviations. The tables show obvious differences between dentists as to

Table 3. Percentages of responses on the choice between fixed partial dentures and single implant (PPC 3)

Item	VAS response code: 1 = unimportant to 8 = absolutely decisive								n	Mean	s
	1	2	3	4	5	6	7	8			
Patient's age	5	7	3	8	14	15	24	24	186	5.8	2.1
Patient's general health	2	5	3	7	15	28	23	17	184	5.9	1.7
Patient's wishes	1	0	1	2	10	20	28	37	186	6.8	1.3
Technical difficulty	15	19	8	12	19	9	11	7	182	4.1	2.2
Caries in adjacent teeth	1	1	2	3	6	19	36	32	185	6.7	1.4
Bone level of adj. teeth	0	1	0	4	11	26	37	21	185	6.6	1.2
Pulp status of adj. teeth	4	4	4	7	19	24	25	13	182	5.6	1.8
Oral hygiene	5	4	5	10	21	23	23	10	186	5.4	1.8
Experience with therapy	8	8	4	12	20	20	19	9	182	5.1	2.0
Time for treatment	37	19	13	10	11	4	3	2	184	2.7	1.8
No. of visits	38	24	10	10	12	3	2	0	184	2.5	1.7
Prognosis	0	0	1	2	4	15	38	39	185	7.0	1.2
Esthetics of final result	1	1	2	2	10	22	35	29	186	6.7	1.3
Patient comfort	0	0	1	2	6	18	42	31	185	6.9	1.1

PPC = Paper Patient Cases; VAS = visual analog score.

Table 4. Varimax rotated principal components analysis of PPC 1, artificial crown or filling. Factor loadings ≥ 0.30

Item	Factor no.				Communi- nality
	1	2	3	4	
Experience with therapy	0.47	0.39			0.40
Time for treatment	0.84				0.75
No. of visits	0.86				0.75
Remaining substance		0.59			0.39
Technical difficulty	0.32	0.60			0.49
Oral hygiene		0.44	0.43		0.39
Marginal bone level		0.44	0.37		0.39
Pulp status		0.65			0.46
Patient's age			0.78		0.62
Patient's general health			0.84		0.74
Patient's wishes		-0.31		0.69	0.59
Prognosis	-0.39	0.32			0.61
Esthetics of final result				0.71	0.53
Eigenvalue	2.78	1.90	1.26	1.17	

Total variance explanation: 55%.
PPC = Paper Patient Cases.

their assessment of the importance of the various factors.

The lowest dispersions were found concerning the importance of patient wishes and comfort (s , 0.9–1.3). Most of the dentists allotted great importance to that factor for all three cases, and for prognosis when choosing between fixed partial denture and removable partial denture (s , 0.9). The greatest differences of opinions were consistently found with regard to the importance of technical difficulty and own experience with the therapy (s , 2.0–2.2), whereas the means show that those factors on average were given rather low importance. With some differences of opinion, the time for treatment and the number of necessary visits were clearly allotted the least importance for all three cases.

The degree of variation was considered adequate for a principal components analysis. It was done separately on the responses of each case. The results are given in Tables 4–6, where only component loadings ≥ 0.30 are presented, to simplify interpretation. For all three cases solutions with four factors gave interpretable results and satisfactory variance explanations. The analyses thus showed that in all three PPC cases, the judgments of the dentists could be condensed into four dimensions, capturing most of the variation. There were similarities, but also some differences, concerning the response patterns of the three cases.

In interpretation of the tables, it should be borne in mind that the order of the factors reflects only their variance explanation ability, not their substantial interpretation. A certain factor number can thus vary between analyses. The point of interpretation is to ascertain which items tend to belong to a factor, rather than to consider the order of factors. For all three PPC cases, it was thus obvious that the items time required for treatment and number of visits consistently belonged

Table 5. Varimax rotated principal components analysis of PPC 2, fixed partial or removable partial dentures. Factor loadings ≥ 0.30

Item	Factor no.				Communi- nality
	1	2	3	4	
Time for treatment	0.91				0.85
No. of visits	0.90				0.85
Experience with therapy	0.42				0.25
Technical difficulty	0.51		0.38		0.44
Marginal bone level		0.64	0.34		0.54
Abutment condition		0.84			0.72
Oral hygiene		0.47	0.45		0.52
Prognosis		0.66		0.41	0.63
Patient's age				0.86	0.78
Patient's general health		0.32	0.71		0.63
Patient's wishes					0.53
Esthetics of final result					0.73
Patient comfort					0.80
Eigenvalue	3.14	2.09	1.60	0.99	

Total variance explanation: 60%.
PPC = Paper Patient Cases.

to a common factor, although it was the first factor in Tables 4 and 5 and the third factor in Table 6. The factor was interpreted as a 'time factor'.

The item esthetics of final result was further consistently connected to the items patient's wishes, and patient's comfort, and, for PPC 3, with prognosis, forming the first factor in Tables 4 and 5 and the fourth factor in Table 6. It was interpreted as a 'patient subjective factor'.

Factor 2 in all three tables was interpreted to indicate the assessment of general dental status as a foundation for clinical judgment, although the items loading on the factor varied somewhat. Still, the items abutment condition, remaining tooth substance, marginal bone level, and oral hygiene loaded consistently on this factor. It was interpreted as a 'clinical factor'.

The greatest inconsistency between the three cases concerned the two items about patient age and health. They were joined in factor 3 in PPC 1 and 2 but included among the clinical factors in PPC 3. The factor was interpreted as a 'general health factor' in the first two cases. No consistent interpretation of the two items was possible for PPC 3.

Discussion

Studies of clinical decision-making in dentistry are naturally often performed with the intention of using the results as guidance in clinical situations. According to McCreery & Truelove (11, 12), the study of clinical decision-making 'provides a common model on which to base dental practice and thus promotes standardization of care and treatment'. Our goal here was strictly confined to description and psychometric evaluation,

Table 6. Principal components analysis of PPC 3, fixed partial dentures or implant. Factor loadings ≥ 0.30

Item	Factor no.				Communality
	1	2	3	4	
Prognosis	0.81				0.71
Esthetics of final result	0.74				0.60
Patient's comfort	0.86				0.79
Patient's wishes	0.58				0.44
Patient's age		0.55			0.32
Patient's general health		0.71			0.59
Bone level of adj. teeth		0.58		0.41	0.53
Oral hygiene		0.58			0.42
Experience with therapy		0.50			0.42
Technical difficulty		0.54	0.40		0.50
Time for treatment			0.94		0.92
No. of visits			0.93		0.88
Caries in adjacent teeth				0.80	0.64
Pulp status of adj. teeth				0.78	0.63
Eigenvalue	3.57	1.97	1.71	1.14	

Total variance explanation: 60%.

PPC = Paper Patient Cases.

without any ambition to evaluate what should be good clinical practice. We have no immediate application assumptions, and the study is part of a project to find and assess which factors actually affect decision-making, not which ones *should* affect it.

The results were on the whole satisfactory for this purpose. Eighty-one per cent of the dentists in the study population responded to the questionnaire after only one reminder, which we regard as a good result and also as a test of the general credibility and usefulness of the questionnaire. Internal non-response was less than 1% on most questions, also an indicator of the functionality of the questionnaire.

The discriminatory ability of the PPC questions was satisfactory from a psychometric viewpoint, although the degree of variation maybe disturbingly large for anyone entertaining ideas of homogeneity and consistency in dental care. For the first PPC case (artificial crown or filling) there were responses covering all 8 VAS categories for 10 of 13 items. For the second PPC case (FPD or RPD) all categories were used for 7 of 13 items, and for the 3rd PPC case (FPD or implant) all categories were used for 10 of 14 items.

There is, of course, a link between decision-making and the patient's treatment need. That was, however, not included in the questionnaire, other than the need situations covered by the PPC cases, which of course cannot cover all details and individual nuances of the patients. The great variations between dentists in their assessments of importance cannot immediately be interpreted as actual variations in treatment, although such variations are large according to other studies (1-4, 13). In this context, if a dentist, for example, considers

the patient's age as unimportant, this does not mean a preference for an artificial crown or a filling. A factor that for one dentist speaks in favor of a particular therapy may not do so for another dentist, although they eventually may make the same decisions. The varying salience of the different decision-making factors may lead to actual treatment variations, but that is outside the scope of this paper, and probably outside the scope of questionnaire methods.

With this in mind, the PPC method worked well psychometrically in the present case and should be useful in questionnaire studies aiming at detecting variations in what factors are considered by large populations of dentists. The factor analysis was clear-cut and interpretable. It was remarkable that such similar solutions were obtained for all three PPC cases. The difference in the third case, in which the items caries in adjacent teeth and pulp status of adjacent teeth formed a separate factor, we interpret to reflect a special regulation in the Swedish dental insurance system of implant therapy, as caries-free and vital adjacent teeth are mandatory for reimbursement of implant treatment to replace a single missing tooth.

We conclude, therefore, that the PPC method is feasible and useful in studies of decision-making in prosthodontics. In future research we shall use the method in analysis of decision-making in prosthodontics in Sweden, with the ambition to find a basis for generalizing knowledge about factors forming the preferences and styles of generally practicing dentists.

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