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Factors influencing prosthodontic decision-making among general dentists

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يتعرض صنع القرار السريري لمتغيرات تعود جزئياً لبعض العوامل التي تعود للطبيب نفسه والتي تتعرض إليها وبشكل خاص الاستعاضة الصناعية. وسبب هذه المتغيرات غير مفهوم وقد تتاثر بعوامل عديدة تربوية أو ثقافية أو اقليمية. هدفت هذه الدراسة إلى محاولة فهم أفضل للعوامل المتعلقة بطبيب الأسنان بالنسبة لصنع القرار السريري وذلك بين أطباء الأسنان العامين في مدينة الرياض وذلك من خلال تقييم مدى اهتمامهم بمعطيات كل حالة استعاضة صناعية. تم توزيع استبيان لحوالي ٢٢٨ من أطباء الأسنان في القطاعين العام والخاص. بلغ مستوى الاستجابة ١٣٧ (٦٠٪). جرى تعريف الحالات على النحو التالي: (١) تيجان او ترميمات بلاستيكية. (٢) جهاز جزئي ثابت أو متحرك. (٣) جهاز جزئي ثابت أو تعويض بغرسة مفردة. (٤) الرغبة لتعويض فقد خلفي مفرد أو عدم تعويضه. لوحظ، بشكل عام، وجود اختلافاً كبيراً في الاستجابة الفردية لمختلف عناصر الحالة. أعطيت الأهمية الكبرى، في كافة الحالات، للإنذار المرضي والنتائج التجميلية النهائية. كما أعطيت الأهمية أيضا لبعض العوامل التقنية والحيوية في بعض الحالات الخاصة. أما الأهمية الأقل فقد أعطيت لعامل الوقت وعدد الزيارات وذلك في كافة الحالات. لوحظ بعض الاختلافات المهمة في الاستجابة فيما يتعلق بالجنس والجنسية وقطاع العمل. و بتحليل العوامل باستعمال المكونات الأساسية وجد أنه من الممكن التقليل من عناصر كل حالة مرضية إلى مابين ٣-٥ عوامل أساسية مكونة والتي تفسر مابين ٥٩٪ - ٧٠٪ من المتغيرات. جرى تفسير العوامل بشكل أوسع كعامل الحالة السنية السريرية، والزمن وتأثير المريض والمحصلة النهائية والصحة العامة والعوائق غير السنية. ومع امكانية وجود بعض الحلول الشائعة في بعض الحالات الخاصة إلا أنها تبقى خاصة ومميزة للحالة. تؤكد النتائج وجهة النظر على أن صنع قرار العلاج بالاستعاضة الصناعية ذو أبعاد متعددة، وهو عبارة عن عملية تتضمن مجالا أوسعا من العوامل المذكورة ولذلك فهناك حاجة للمزيد من البحث العلمي لزيادة فهمنا للعوامل المبررة.

Variations in clinical decision-making may, in part, be due to dentist-related factors. The aim of this study was to examine the role of dentist-related factors in the process of decision-making in a prosthodontic context, by evaluating the importance that general dentists attach to a series of listed criteria in typical clinical settings. A questionnaire was distributed to 228 dentists, of whom 137 completed it, giving a response rate of 60%. Four clinical categories, or Paper Patient Cases (PPC), representing choices between treatment options, were defined: (1) crown or plastic restoration, (2) fixed or removable partial denture, (3) fixed partial denture or single tooth implant restoration, (4) the choice to replace or not to replace a single missing posterior tooth. A visual analogue scale (VAS) was used to grade responses. There were generally large variations in the individual responses to various items, but smaller variations among genders and working sectors. Greatest importance was given to prognosis and aesthetics of final result across all situations, and less importance to time for treatment and number of visits. In factor analysis, items in each PPC could be reduced to between 3 and 5 principal component factors, which explained between 59% and 70% of the variances. The reduced factors broadly encompassed 'clinical dental status', 'time', 'patient influence', 'outcome', 'general health', and 'non-dental treatment barriers'. While some common explanations could be seen across some of the PPCs, there were also factors which were unique to a given PPC, suggesting that decision-making in prosthodontics could be regarded as a multi-dimensional process involving a wider range of factors than those included here.

Introduction

It is widely acknowledged that, when faced with a clinical situation requiring intervention, dentists differ in their choice of treatment.[1] Variations in diagnoses and treatment decisions occur equally when dentists are asked to examine extracted teeth or radiographs.[2-4] The reasons for these variations are not well understood. This has led to a perception that clinical decisions tend to be made in an implicit, intuitive way, and that dentists do not share a common decision-making process.[5] Even though dental education is based on scientific knowledge and acquired clinical experience, it is possible that variations in clinical decision-making are also influenced by individual preferences and styles.[6] For this reason, it has been suggested that decision-making might not be easily amenable to structured characterization, and may be best described as an art rather than a science.[7]

In many clinical situations, almost any one of a number of possible treatments could be suitable according to well-established clinical principles and practice. Therefore, the way in which the dentist evaluates the available information in a given situation plays an important role in the decision-making process. Although the process is undoubtedly very complex, involving many influential factors, which may be both patient- and dentist-related, the mechanisms involved in the selection, evaluation and application of information remain unclear. If there is to be less of the apparent subjectivity affecting the process, then the mechanisms underlying diagnostic

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thinking should be better understood.[8]

Investigations into decision-making have focussed on empirical theories, which seek to understand the continuous process culminating in actual decisions, or on normative theories, which seek to define how decisions *should* be made by prescribing norms. Normative theories have been presented in many reports.[6,9,10] Until recently, there have been few studies on empirical decision-making,[11,12] which reflects the inherent difficulties of carrying out such research.

In view of its ever-broadening scope, brought about by many new and improved materials and techniques, prosthodontic decision-making is becoming increasingly challenging. The role of more informed, and more litigious patients at the individual level, as well as greater demands for cost-effectiveness of dental health care by funding authorities at the societal level, add to the complexities.[11] Recent Swedish studies[13-16] found large individual variations among dentists regarding their ranking of patient-related criteria when deciding treatment in hypothetical clinical scenarios, so-called Paper Patient Cases (PPC).

Studies have shown that variations in treatment decisions,[4] and treatment patterns,[17,18] occur between, as well as within countries. Recently, following a questionnaire survey among general dentists in Riyadh, associations between the reported time spent on prosthodontics, and a number of dentist-related factors were reported,[19] and confirmed the aforementioned variations in treatment patterns. The aim of the present study was to expand our previous investigation[19] to specific clinical situations. Using factor analysis, we investigated the relative importance that dentists assigned to various patient-related items that might be associated with treatment decisions for four clinical situations in which a choice between two feasible treatments were offered.

Materials and Methods

The selection and composition of the study population of general dentists, has been previously described.[19] Convenience sampling was applied in a broad attempt to represent relevant sub-groups of the total dental workforce, including those from the different working sectors, viz. government (GS) and private sectors (PS), and secondly from across all the different districts of the city.

A total of 228 dentists were surveyed, with 137 returning completed questionnaires, yielding a response rate of 60%. The study population of 137 general dentists was fairly evenly divided with regard to gender (47% males, 53% females), nationality (46% Saudis, 54% non-Saudis), and working sector (49% PS, 51% GS). The mean age of the group was 33 years (range 22 to 63).

The construction, validation, distribution and collection of the questionnaire have been previously described.[19] In summary, it was based on one used in a previous survey of prosthodontic decision-making among Swedish general dentists,[13] but adapted to the local situation in some respects. The questionnaire comprised three parts, the results of the first two parts having been previously reported.[19] The third part used a PPC technique, which described four typical prosthodontic situations involving treatment choices, as follows:

PPC1 - The choice to treat a lesion such as a cusp fracture on a maxillary premolar with a crown or an amalgam/composite restoration.

PPC2 - The choice to provide a patient with a fixed partial denture (FPD) or a removable partial denture (RPD), both options being technically possible.

PPC3 - The choice to replace a single missing tooth in the maxillary anterior region with a conventional FPD or a single tooth implant restoration.

PPC4 - The choice to replace or not to replace a single missing mandibular molar.

A series of items relating to clinical decision-making for each of the cases was given (Tables 1-4). A visual analogue scale (VAS) response technique was used, with alternatives coded in 8 equidistant steps, ranging from unimportant (1) to decisively important (8). Clarification of certain key aspects of the methods used, for example the VAS, was given. In structuring the questions for each of the PPCs, it was important to prevent a feeling among respondents that their clinical judgement was being questioned or their responses directed. Thus, preceding the questions, there was an orientation to the exercise, and reassurance that there were no right or wrong answers, the only objective being to record dentists' spontaneous reactions. This could be interpreted as reflecting dentists' *own* views, and not a view that they felt was the prevailing, correct one.

Data were first analysed in contingency tables. Means and standard deviations of the VAS scores were calculated and differences evaluated with the *t* test for gender, nationality, and working sector. The responses to the PPC questions were analysed using principal components analysis

Table 1. Percentage distribution of VAS responses, and means and standard deviations of total group, and difference between means with respect to gender, nationality and working sector, in PPC1 (choice between crown and amalgam / composite restoration) (*n* =137)

Item	1	2	3	4	5	6	7	8	Mean VAS	SD	Mean diff. M/F	Mean diff. Sa/NSa	Mean diff. PS/GS
Patient's age	11	6	9	5	15	15	13	26	5.4	2.4	-0.1	-0.2	0.3
Patient's general health	6	2	13	7	17	20	9	26	5.5	2.1	-0.5	0.6	-0.5
Patient's wishes	2	2	4	9	11	23	25	26	6.2	1.7	-0.03	0.1	-0.1
Remaining tooth structure	0	0	0	2	2	3	20	73	7.6	0.8	0.0	0.1	-0.1
Technical difficulty	2	3	2	5	17	19	20	31	6.3	1.7	-0.4	0.9**	-0.8**
Prognosis	0	1	0	1	3	7	26	64	7.5	0.9	-0.2	0.1	0.1
Marginal bone level	2	2	4	7	8	13	20	45	6.7	1.8	-0.4	0.9**	-0.7**
Pulp status	0	0	0	3	10	14	16	58	7.3	1.2	-0.5*	0.4	-0.2
Experience with procedure	0	2	2	4	12	13	21	46	6.8	1.5	-0.1	-0.1	-0.2
Oral hygiene	1	2	3	4	7	18	18	47	6.8	1.5	-0.5*	0.7**	-0.6*
Time required for treatment	10	8	10	14	15	12	15	15	4.9	2.2	-0.1	0.7***	-1.9***
Number of visits needed	9	12	10	12	15	13	15	14	4.8	2.2	-0.1	1.7***	-1.8***
Aesthetics of final result	0	0	2	2	2	19	27	49	7.2	1.1	-0.3	0.2	-0.1
Patient's financial status	1	1	2	5	12	18	23	38	6.6	1.5	-0.5	0.5*	-0.4

PPC1 = Paper patient case 1; VAS = Visual analogue scale; VAS code: 1 = unimportant, 8 = decisively important;
Sa = Saudi, NSa = Non-Saudi; PS = private sector, GS = government sector
P<0.05*, 0.01**, 0.001***

Table 2. Percentage distribution of VAS responses, and means and standard deviations of total group, and difference between means with respect to gender, nationality and working sector, in PPC2 (choice between FPD and RPD) (*n* =137)

Item	1	2	3	4	5	6	7	8	Mean VAS	SD	Mean diff. M/F	Mean diff. Sa/NSa	Mean diff. PS/GS
Patient's age	2	2	4	5	4	14	20	49	6.8	1.7	-0.4	0.4	-0.3
Patient's general health	3	2	4	10	7	19	23	33	6.3	1.8	-0.2	0.3	-0.2
Patient's wishes	0	0	0	11	10	18	25	37	6.7	1.4	0.2	-0.2	-0.1
Technical difficulty	0	2	2	10	15	18	27	28	6.4	1.5	-0.6*	0.2	-0.2
Marginal bone level	0	2	1	5	12	9	23	47	6.9	1.5	-0.5*	0.4	-0.6*
Abutment condition	0	2	0	1	4	12	19	64	7.4	1.1	-0.3	0.0	-0.2
Oral hygiene	0	2	1	2	6	9	24	57	7.2	1.2	-0.3	0.0	-0.4
Experience with procedure	1	2	2	4	11	18	24	38	6.7	1.5	-0.2	-0.1	-0.1
Time required for treatment	8	10	8	8	9	14	23	20	5.3	2.3	-0.4	1.3***	-1.3***
Number of visits needed	10	10	7	7	15	15	18	19	5.2	2.3	-0.7	1.3***	-1.4***
Prognosis	0	0	1	2	2	9	32	55	7.3	1.0	-0.1	0.1	-0.1
Aesthetics of final result	0	0	3	1	2	7	30	58	7.3	1.1	-0.2	0.1	-0.1
Patient's comfort	0	2	0	2	8	16	17	56	7.1	1.3	-0.3	0.0	-0.3
Patient's financial status	0	1	1	6	15	14	21	41	6.7	1.4	-0.1	0.2	-0.3

PPC2 = Paper patient case 2; VAS = Visual analogue scale; VAS code: 1 = unimportant, 8 = decisively important;
Sa = Saudi, NSa = Non-Saudi; PS = private sector, GS = government sector
P<0.05*, 0.01**, 0.001***

Table 3. Percentage distribution of VAS responses, and means and standard deviations of total group, and difference between means with respect to gender, nationality and working sector, in PPC3 (choice between FPD and single tooth implant) (*n* =137)

Item	1	2	3	4	5	6	7	8	Mean VAS	SD	Mean diff. M/F	Mean diff. Sa/NSa	Mean diff. PS/GS
Patient's age	3	2	4	8	9	10	19	45	6.5	1.9	-.0.1	0.4	-0.4
Patient's general health	2	0	2	7	8	15	18	48	6.8	1.6	-0.1	0.2	-0.3
Patient's wishes	1	0	2	4	10	15	26	42	6.9	1.3	0.3	-0.1	-0.2
Technical difficulty	2	1	3	4	12	20	22	37	6.6	1.6	-0.4	0.4	-0.5
Caries in adjacent teeth	1	1	3	7	13	15	24	37	6.5	1.6	0.4	-0.1	-0.1
Pulp status of adjacent teeth	4	4	2	4	12	15	23	39	6.4	1.9	-0.1	0.0	-0.1
Bone level of adjacent teeth	0	1	3	4	11	11	18	52	6.9	1.5	-0.6	0.4	-0.6*
Oral hygiene	0	1	2	3	7	9	26	53	7.1	1.3	-0.3	0.5*	-0.6**
Experience with procedure	0	0	3	6	15	9	20	47	6.8	1.5	-0.2	0.0	-0.3
Time required for treatment	7	8	12	7	13	8	20	24	5.4	2.3	-0.3	1.2**	-1.3**
Number of visits needed	7	10	10	5	16	11	19	22	5.3	2.3	-0.5	1.4***	-1.6***
Prognosis	0	0	2	2	2	4	27	65	7.5	0.9	-0.3	0.2	-0.2
Aesthetics of final result	0	0	2	2	1	7	28	61	7.4	1.0	-0.1	0.0	-0.2
Patient's comfort	0	0	1	2	13	12	15	57	7.1	1.2	-0.1	0.0	-0.4
	0	1	0	5	10	18	18	50	6.9	1.3	-0.1	0.0	-0.1

PPC3 = Paper patient case 3; VAS = Visual analogue scale; VAS code: 1 = unimportant, 8 = decisively important;
Sa = Saudi, NSa = Non-Saudi; PS = private sector, GS = government sector
P<0.05*, 0.01**, 0.001***

(PCA), a standard psychometric method to assess common variation between attitude questions.[20] Thus, a large number of variables, in our case each set of PPC *items*, were reduced to fewer *factors* which showed internal homogeneity. For each PPC, the number of factors was determined after inspection of scree plots and by the Kaiser criteria. Items with communality of < 0.4 were excluded in the final factor analysis. The factors were rotated by the Varimax method to maximize the total variance explanation retaining the dimensionality of factors. All statistical analyses were performed on an IBM Personal Computer using SPSS 10.

Results

Relative frequencies of VAS responses to the four sets of PPC questions appear in Tables 1-4. The tables also list means and standard deviations, indicating wide individual variations in responses to most questions. High importance, with low variations were recorded for prognosis in all PPC cases (SD, 0.9-1.1), and for aesthetics of final result (SD, 1.0-1.1) in the first 3 PPCs. Items consistently regarded as less important were time required for treatment and number of visits required, but with wide individual variations (SD, 2.2-2.3). In specific situations, great importance, and with relatively small individual variations, were observed for remaining tooth structure in PPC1, abutment condition in PPC2, oral hygiene in PPC3, and presence of opposing tooth and occlusal stability in PPC4.

Bivariate analysis revealed some significant differences in responses related to gender, nationality and working sector (Tables 1-4). In all PPCs, the most significant differences were observed in time required for treatment and number of visits required, for which Saudi and GS dentists consistently scored the items higher (P<0.01 or P<0.001).

In the factor analysis, none of the items in any of the PPCs had a communality of < 0.4, and thus all were included in the final factor analyses (Tables 5-8). From the analyses, the items judged by dentists as important in their treatment choices, could be condensed into between 3 and 5 dimensions, or

Table 4. Percentage distribution of VAS responses, and means and standard deviations of total group, and difference between means with respect to gender, nationality and working sector, in PPC4 (choice between replacing or not replacing a single missing lower posterior tooth) (*n* =137)

Item	1	2	3	4	5	6	7	8	Mean VAS	SD	Mean diff. M/F	Mean diff. Sa/NSa	Mean diff. PS/GS
Patient's age	8	0	6	6	7	20	19	35	6.1	2.1	-0.1	-0.6	-0.3
Patient's general health	2	1	3	12	7	18	24	33	6.4	1.7	-0.3	0.2	-0.3
Patient's wishes	3	1	1	7	11	19	26	34	6.5	1.6	0.4	-0.1	-0.2
Technical difficulty	2	0	3	10	17	15	21	32	6.3	1.7	-0.2	0.2	0.0
Occlusal stability	1	0	1	2	4	15	26	53	7.2	1.2	-0.2	0.1	-0.3
Chewing ability	2	0	3	1	7	11	26	52	7.1	1.4	-0.4	0.4	-0.1
Speech	29	8	7	5	7	15	10	20	4.4	2.8	-0.7	0.1	-1.4**
Integrity of the arch	1	2	3	4	13	21	19	37	6.5	1.5	-0.4	0.1	0.0
Experience with procedure	0	0	3	5	19	20	23	30	6.5	1.4	0.1	-0.1	-0.1
Oral hygiene	0	1	2	5	9	10	24	50	7.0	1.4	-0.4	0.6**	-0.9***
Number of visits needed	9	8	12	8	17	15	12	19	5.0	2.3	-0.6	1.3***	-1.3***
Prognosis	0	0	2	2	3	9	30	55	7.3	1.1	-0.3	0.4	-0.2
Time required for treatment	9	11	10	6	18	12	13	21	5.1	2.3	-0.5	1.1**	-1.3***
Patient's financial status	0	0	0	8	20	14	21	37	6.6	1.4	-0.1	0.1	-0.1
Presence of opposing tooth	0	0	0	2	5	12	25	56	7.3	1.0	0.0	0.1	-0.2
	0	0	1	2	9	16	15	58	7.2	1.2	0.0	0.3	-0.3

PPC4 = Paper patient case 4; VAS = Visual analogue scale; VAS code: 1 = unimportant, 8 = decisively important;
Sa = Saudi, NSa = Non-Saudi; PS = private sector, GS = government sector
P<0.05*, 0.01**, 0.001***

factors, which captured most of the variation. Variance explanations of between 59% and 70% were obtained. In interpreting the data, it should be kept in mind that the order of the factors reflects only their variance explanation, not their substantive interpretation.

There was no common explanatory pattern across all of the PPCs, even though some factors showed remarkable cross-case similarity in dimensionality. For all four PPCs, a 'time' dimension was fairly consistently identifiable (Tables 5-8), except that in PPC3 and PPC4 some other general items were also included in the factor. Other factors, identified as 'outcome', 'general health', 'clinical dental status', 'patient influence', and 'non-dental treatment barriers', showed less cross-case consistency.

Discussion

Notwithstanding the limitations of the convenience sampling, the purpose here was to explore the mechanisms underlying diagnostic thinking and treatment planning. The approach used was to see whether patterns could be observed in the way dentists *say* they evaluate a list of issues in defined clinical consultation contexts. It was not the intention here to define what clinicians *ought* to be doing,[21] nor whether what they say conforms to a given norm.[22]

The PPC technique has been applied in studies on decision-making in general dentistry in the US,[11,12] and in prosthodontics (amongst general dentists) in Sweden,[13-16] with the conclusion that it is a useful research instrument for such purposes. By replicating the clinical situations used in the latter studies, but with the addition of a fourth clinical situation, direct comparisons of the present findings with the Swedish results could be made. In general terms, the present results support the view that dentists from different countries differ in terms of their stated criteria for making treatment choices.[4]

This can be clarified by a further discussion of the results. Although there were similarly wide individual variations amongst Riyadh and Swedish dentists in their evaluations of the importance of various patient-related factors, there were some

Table 5. Varimax rotated factor analysis of PPC1 (crown vs amalgam/composite restoration)

Item	Factor 1 (clinical dental status)	Factor 2 (time)	Factor 3 (general health)	Factor 4 (patient influence)	Factor 5 (non-dental treatment barriers)	Communality (h^2)
Pulp status (no. 8)	**0.78**					0.65
Marginal bone level (no. 7)	**0.67**					0.71
Prognosis of treatment (no. 6)	**0.69**					0.64
Remaining tooth structure (no. 4)	**0.60**				0.49	0.66
Experience with procedure (no. 9)	**0.57**					0.51
Technical difficulty (no. 5)	**0.49**	0.45				0.56
Number of visits required (no. 12)		**0.91**				0.87
Time required for treatment (no. 11)		**0.89**				0.86
Patient's age (no. 1)			**0.87**			0.77
Patient's general health (no. 2)			**0.78**			0.71
Patient's wishes (no. 3)				**0.80**		0.66
Aesthetics of final result (no. 13)	0.31			**0.66**		0.62
Oral hygiene (no. 10)	0.36		0.48	**0.55**		0.72
Patient's financial status (no. 14)					**0.82**	0.82
Eigenvalue	4.68	1.66	1.26	1.14	1.03	
Variance explanation (%)	33.39	11.89	9.00	8.13	7.33	

Total variance explanation: 70%

differences between the two groups. In Riyadh, prognosis and aesthetics of final result were highly ranked in each of the first three PPCs. This is perhaps a reflection of the increasing emphasis on the aesthetic outcome of dental treatment. For the same clinical situations, Swedes scored patient's wish and prognosis consistently high.[13-16] The Riyadh group considered patient's wish relatively less important, but not unimportant.

There were a number of case-specific items, mainly technical in nature, which were also considered important by Riyadh dentists. This was so in the cases of the FPD vs RPD (PPC2) and the crown vs restoration (PPC1) choices. In the case of FPD vs single tooth implant (PPC3), dentists considered adjacent teeth with restorations as important. In the case of replacing vs not replacing a single missing molar (PPC4), the presence of an opposing tooth was considered most important by our group. This is a commonly held clinical view, but one which lacks strong scientific support.[23] Other traditional concerns such as functional needs and arch integrity ranked lower, and could be seen as evidence for a growing awareness among dentists that not all teeth distal to the premolars must always be replaced.[24,25]

Time required for treatment and number of visits needed ranked lowest, or close to lowest, in all situations. Individual variations within these items were also wide, which may not be surprising given the influence of practice profile on such a factor.[26] Indeed, GS dentists attached significantly more importance to this factor than PS dentists. It is not clear why GS dentists should be more time-bound, although it could be speculated that the work-load is higher on account of a free GS service. Time-related factors were also ranked significantly higher amongst the Saudi subset than the non-Saudis. If, as seems likely, Saudis make up most of the GS workforce and non-Saudis the PS, then the two findings would not be contradictory. Gender differences were hardly evident, except weakly for a few items.

Clearly, an important consideration in any treatment decision is the patient's treatment need. The focus of the study being an evaluation of

Table 6. Varimax rotated factor analysis of PPC2 (FPD vs RPD)

Item	Factor 1 (clinical dental status)	Factor 2 (outcome)	Factor 3 (time)	Factor 4 (general health)	Communality (h^2)
Prognosis of treatment (no. 11)	**0.75**				0.61
Aesthetics of final result (no. 12)	**0.75**				0.67
Patient's financial status (no. 14)	**0.74**				0.62
Patient's comfort (no. 13)	**0.59**	0.44			0.64
Technical difficulty (no. 4)		**0.76**			0.64
Oral hygiene (no. 7)		**0.70**			0.62
Experience with procedure (no. 8)		**0.63**	0.40		0.62
Patient's wishes (no. 3)		**0.63**		-0.37	0.67
Abutment condition (no. 6)	0.60	**0.50**			0.72
Marginal bone level (no. 5)	0.44	**0.49**			0.61
Time required for treatment (no. 9)			**0.91**		0.92
Number of visits required (no. 10)			**0.89**		0.89
Patient's age (no. 1)				**0.81**	0.73
Patient's general health (no. 2)				**0.67**	0.66
Eigenvalue	5.91	1.40	1.26	1.03	
Variance explanation (%)	42.21	10.00	9.00	7.38	

Total variance explanation: 69%

dentist-related factors, the patient need factor was intentionally not included in the questionnaire, except indirectly through some of the items relating to the case. The large individual variations in dentists' responses to given items should not automatically be interpreted as being indicative of equivalent variations in treatment, even though such variations are known to be large.[4] The scoring of an item as important by one clinician, and unimportant by another, does not mean that two opposite treatment decisions will result. In the totality of the clinical situation, the same treatment decision could well arise, due to a complex interaction of many decision-making factors. Explanations for such questions are, of course, outside the scope of questionnaire techniques.

Nevertheless, the PPC method appeared to work well for the present purpose of detecting variations in the factors considered by dentists when deciding treatment. Although the factor analysis differed in its ability to condense dentists' judgements into consistent dimensions for the different PPCs, the solutions for the first 2 cases were quite consistent, with 5 and 4 factors capturing 70% and 69% of the variation, respectively (Tables 5 and 6). In a Swedish study, data reduction by principal components analysis was not possible in the case of crown vs restoration, which was ascribed by the authors to the complexity of prosthodontic decision-making,[14] even though an earlier pilot study by the same authors had produced a stable model in factor analysis.[13] This, as with our result, supports the concept that only a few basic factors might influence decisions.[27] On the other hand, even though the FPD vs implant and replacement vs non-replacement items were similarly reducible into factors (Tables 7 and 8), with high variance explanations, their interpretation as specific characteristics was not consistent. This presents an apparent dichotomy, since factors other than those represented in the PPCs may be influential in the choices made. For example, in PPC3, the decision may have been largely theoretical since in practice most dentists would not have been confronted with this decision. Thus it may be that the decision-making approach is easier to resolve into a few factors when not subject to actual hands-on clinical experience in the treatment option. And in PPC4, with patient factors deliberately unspecified (to avoid leading respondents to a particular answer), many different perceptions of the

Table 7. Varimax rotated factor analysis of PPC3 (FPD vs single tooth implant)

Item	Factor 1 'outcome'	Factor 2 'time'	Factor 3 'clinical dental status'	Communality (h^2)
Aesthetics of final result (no. 13)	**0.83**			0.72
Patient's comfort (no. 14)	**0.73**			0.72
Prognosis of treatment (no. 12)	**0.72**			0.60
Patient's financial status (no. 15)	**0.63**			0.47
Patient's wishes (no. 3)	**0.58**			0.45
Experience with procedure (no. 9)	**0.45**		0.39	0.50
Time required for treatment (no. 10)		**0.84**		0.77
Number of visits required (no. 11)		**0.81**		0.75
Patient's age (no. 1)		**0.73**		0.60
Patient's general health (no. 2)		**0.68**		0.52
Caries in adjacent teeth (no. 5)			**0.85**	0.75
Pulp status of adjacent teeth (no. 6)			**0.81**	0.67
Bone level of adjacent teeth (no. 7)			**0.70**	0.63
Oral hygiene (no. 8)			**0.53**	0.45
Technical difficulty (no. 4)			**0.40**	0.28
Eigenvalue	5.99	1.48	1.38	
Variance explanation (%)	39.94	9.89	9.20	

Total variance explanation: 59%

situation could arise, and with it a theoretically correct response.

Conclusions

From the range of findings in this study, it appears that prosthodontic decision-making is a multi-dimensional process, much of which remains only poorly understood.

1. Although considerable individual variations in responses to the various decision-making items were seen, differences, on a group basis (gender, working sector), were smaller.
2. Comparisons of the present findings with similarly conducted investigations elsewhere, reveal both similarities and differences, which further highlight the complexity of the decision-making process.
3. A deeper understanding of the influences on decision-making is vital if clinicians are to recognize that they often make the 'best' choices for a given patient, rather than one which is 'right', according to levels of disease alone.
4. Further research into the influences on dentists' treatment decisions, perhaps cognitive psychological aspects, is required.

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Table 8. Varimax rotated factor analysis of PPC4 (replacing vs not replacing single missing posterior tooth)

Item	Factor 1 (outcome)	Factor 2 (time)	Factor 3 (general health)	Factor 4 (patient influence)	Communality (h^2)
Chewing ability (no. 6)	**0.80**				0.74
Occlusal stability (no. 5)	**0.80**				0.65
Presence of opposing tooth (no. 15)	**0.70**				0.62
Prognosis (no. 12)	**0.65**				0.52
Presence of distal abutment (no. 16)	**0.63**				0.63
Number of visits required (no. 11)		**0.88**			0.83
Time required for treatment (no. 13)		**0.86**			0.84
Speech (no. 7)		**0.60**			0.50
Oral hygiene (no. 10)	0.38	**0.40**	0.38		0.48
Patient's age (no. 1)			**0.83**		0.74
Patient's general health (no. 2)			**0.81**		0.75
Integrity of the arch (no. 8)	0.47	0.35	**0.45**		0.51
Patient's wishes (no. 3)				**0.77**	0.65
Patient's financial status (no. 14)				**0.60**	0.48
Experience with procedure (no. 9)		0.54		**0.58**	0.69
Technical difficulty (no. 4)				**0.48**	0.49
Eigenvalue	6.01	1.55	1.35	1.11	
Variance explanation (%)	38.12	9.69	8.46	6.94	

Total variance explanation: 63%

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