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Patient information on treatment alternatives for missing single teeth – Systematic review

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Key words *dental implants, fixed partial dentures, orthodontic space closure, patient information, removable partial dentures*

Aim: This study systematically evaluates existing evidence-based literature covering the topic of patient information about different treatment alternatives for missing single teeth, in order to summarise current evidence.

Material and methods: Three scientific databases – Pubmed, OvidSP and Scopus - were searched for publications up to July 2015, relating to patient information on treatment options for missing single teeth. References of publications and the google scholar database were screened additionally leading to a total of 183 journal articles written in English. Following the selection criteria, 33 articles were included. Twenty-nine questionnaire- based publications were compared by descriptive analysis of six key parameters - awareness of treatment options, source of information, knowledge, attitude to treatment, preference of treatment option and reason for refusal.

Results: Included studies consisted of data from 23,702 responding participants and which were performed in 16 countries. Mean values and standard deviations revealed variations between and within countries. The level of awareness and attitude to treatment in most countries is acceptable. Insufficient knowledge as well as a high demand for knowledge was found. Clinicians are the most important source of information followed by media, family and friends. Dental Implants and FPDs were preferred and high costs would be the major reason for refusal.

Conclusion: Clinicians play an important role in improving awareness and knowledge of patients about treatment alternatives. Non-uniform study designs could lead to variations in results. This systematic review can be considered in further studies, in order to standardise methods using key parameters and a representative study population.

Conflict-of-interest statement: *The authors declare that they have no conflict of interest.*

Introduction

In general, clinicians traditionally focus their effort to preserve and if necessary rehabilitate natural teeth. If conservative treatment strategies fail, tooth extraction can be unavoidable leaving a gap behind. To restore function and aesthetics, the replacement of missing teeth should be considered. Evidence-based medicine builds the foundation of modern dentistry involving oral rehabilitation as its discipline including diagnosis, treatment planning, restoration of tooth defects and replacement of acquired or congenitally missing teeth.

The choice of treatment of single missing teeth underlies different factors including empirical evidence of outcomes of treatment, individual patient

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conditions, access to technology, experience of clinicians and dental technicians as well as economic aspects. Alternatives of treatment of missing single teeth are the use of dental implants (DI), fixed partial dentures (FPD), removable partial dentures (RPD) or orthodontic space closure. Different treatment options come with different advantages and disadvantages. Orthodontic treatment aimed at the closure of gaps requires multidisciplinary planning and might be restricted to specific clinical situations but can also be combined with implant placement. Several studies and systematic reviews show similar failure rates respectively, long-term survival rates of implant therapy including restoration, and FPDs for the treatment of missing single teeth[1,2]. Survival rates of RPDs are lower due to the causes and risks, which come with the ability to be removable. Mechanical failures but also patients not wearing RPDs can lead to a necessary replacement[3].

However, scientific and empirical evidence is not the only thing to consider. Only in combination with patient-oriented methods can optimal treatment be achieved. Clinical experience, education of clinicians, and the disclosure of information to patients are necessary to lead to an increase in different aspects of patients' knowledge about treatment alternatives. Putting patients' well-being and satisfaction at the center of consideration is one of the most important goals to achieve in oral rehabilitation. For clinicians, knowing these factors aims to inform and educate patients to enable self-determined decisions as well as appropriate maintenance and behaviour. If complication rates are reduced that way, it does not only benefit the patient but also the clinician by saving time and resources.

Akagawa et al[4], Zimmer et al[5] and Best HA[6] began researching aspects of patient information in oral rehabilitation. Berge TI[7] was the first who conducted a study expanding the number of participants to 5,000 people of the general population. Response rate amounted to 70.8%. In 2003, Tepper et al[8] extended the scope of earlier research by adding new aspects of patient information to be investigated. Moreover, a representative sample of 1,000 adults in the household was randomly selected from different groups of the general population (age, sex, profession, income and origin) to create a homogenous study population and to enable the separate investigation of these different groups. In the second part of this study, interviewees were questioned about treatment acceptance, satisfaction and economical aspects[9]. Following studies were based on these earlier publications.

At the time of this systematic review, there was no existing publication reviewing literature about patient information on different treatment options of missing single teeth. Investigation of different aspects of patient information could lead to ideas which improve future treatment strategies and the perception of the need for further studies. Hence, the purpose of this study was the systematic evaluation of existing scientific literature covering the topic of different modalities of patient information about different treatment alternatives.

Material and methods

Search strategy

The authors used the following three online databases of scientific literature in the listed order, continuously discarding found duplicates. Each database was searched from its start date to July 2015 and restricted to publications written in English.

I. Pubmed
II. OvidSP, consisting of:
- Ovid MEDLINE(R) In-Process and other Non-Indexed Citations, and Ovid MEDLINE(R) 1946 to Present;
- Embase 1988 to 2015 Week 29;
- EBM Reviews Full Text – Cochrane DSR, ACP Journal Club and DARE;

III. Scopus, consisting of:
- Health Sciences (> 6,800 titles; 100% Medline coverage);
- Life Sciences (> 4,300 titles);
- Physical Sciences (> 7,200 titles);
- Social Sciences and Humanities (> 5,300 titles).

The search term included specific keywords and was built up to reflect different treatment alternatives of single missing teeth and different forms of patient information:

("Dental Implant" OR "Dental Implants" OR "Partial Denture" OR "Orthodontic Space Closure")

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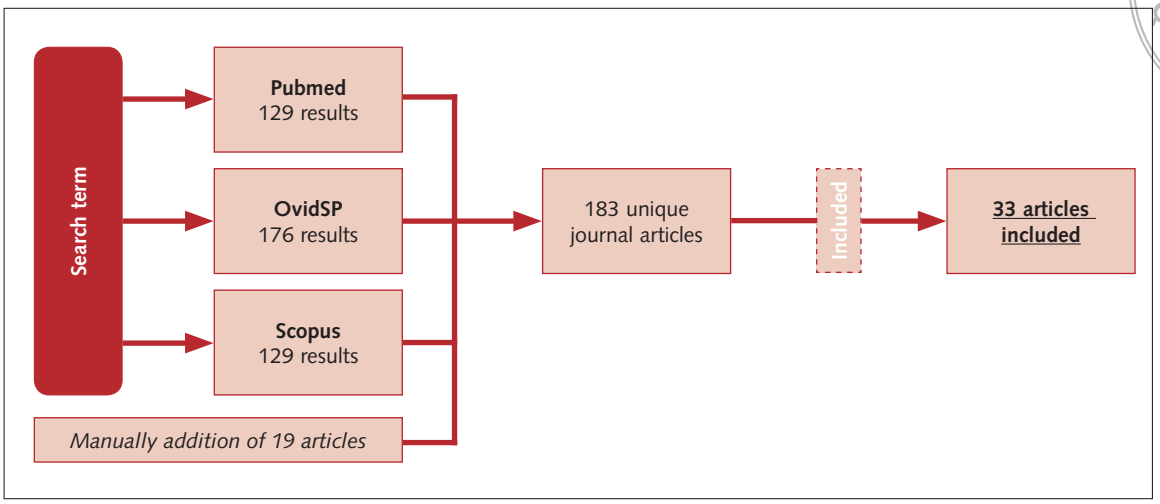

Fig 1 Schematic overview of literature research using three different scientific databases. Literature research was performed by applying a defined search term during the search in three scientific databases and by manually adding literature. One hundred and eighty-three unique journal articles were found and 33 could be finally selected for this systematic review.

AND ("Patient Information" OR "Online Information" OR "Leaflet Information" OR "Informed Consent" OR "Patients' Knowledge" OR "Patients' Awareness" OR "Public Knowledge" OR "Public Awareness")

A Pubmed search revealed 129 findings. Medical Subject Headings (MeSH) combined with keywords were used at first but did not increase the count of results and therefore this search strategy using MeSH terms was rejected. The search term for fixed as well as removable partial dentures could be simplified by searching for 'Partial Denture'. Searching the OvidSP database resulted in 176 results, adding 21 additional journal articles to the Pubmed search results. Finally, when searching the Scopus database, 129 articles were found and an additional 15 articles, which have not been found in the preceding search, were able to be added. By discarding duplicate findings, 434 search results of all three databases could be reduced to 164 unique findings. Screening of reference lists of all eligible publications and the Google Scholar database resulted in an additional 19 publications. Most of these articles were not published in journals listed in previously searched literature databases. Figure 1 shows a schematic overview of the literature research done for this systematic review.

Abstracts of 183 articles were independently screened by the authors to assess which studies met the following selection criteria. Disagreements were resolved through a discussion between the authors.

Selection criteria

Eligibility criteria included:

- Journal article;
- Written in English;
- Studies generated using a search term reflecting aspects of patient information on treatment alternatives of single missing teeth.

Exclusion criteria included:

- Studies not about patient information;
- Studies not about treatment of single missing teeth.

All search results were original journal articles and due to the application of a language filter, they only showed search results written in English and the use of the previously described search term for all publications met the eligibility criteria. One of the publications was a comment and summary[10] of an included study[11] and was therefore excluded. Along with the first exclusion criteria, 69 journal articles had to be excluded. Another 16 findings did not investigate treatment of missing single teeth although they were handling patient information. Sixty-four articles were neither about patient information or about the treatment of single missing teeth. All 19 manually added articles met the selection criteria and were included in this review. In summary, based on the selection criteria, 33 articles were included in this review.

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Analysis

Data were summarised in tables, which included publication year, treatment alternatives, investigational method, sample size and outcome parameters. The following six key parameters were compared and analysed using descriptive statistics: awareness of treatment options, source of information, knowledge, attitude to treatment and preference for treatment options as well as reason for refusal. Outcome parameters were graphically displayed using bar charts sorted by the place of origin. Mean values and standard deviations were calculated for available data.

Results

The literature research resulted in 183 unique journal articles. Thirty-three were finally selected for this systematic review. Studies were performed in 16 different countries, with the majority originally from Asia (20 studies). Sample sizes varied from 109 to 10,000. In total, studies reporting on patient information on treatment alternatives for missing single teeth, contained data of 26,393 participants of which 23,702 responded. Kohli et al[12,13] published two studies using the identical study population which was therefore counted once. The targeted subject group was mainly the public population and dental patients, except Mukatash et al[14] who also included 272 medical staff members as well as 261 subjects from the general population as a control group. Treatment alternatives of missing single teeth included dental implants (33 studies; 23,702 responding participants), RPDs and FPDs (both in seven studies; 2,860 responding participants). Five articles about orthodontic gap closure were amongst the search results. All had to be excluded because they did not investigate any aspect of patient information. As a method of investigation, questionnaires were performed in 29 of these articles; two studies assessed the quality of online information, one study examined information leaflets and one study conducted a retrospective analysis of expert opinions about patient information. These four differing articles were described separately in this review (Table 2). Studies using questionnaires were compared to each other depending on the investigated outcome parameters.

Table 1 enables a quick substantial overview of all included studies, alphabetically sorted by authors, showing the publication year, treatment alternatives, investigational method, sample size and outcome parameters.

Publication dates range from 1988 to July 2015. Figure 2 displays included journal articles grouped by their publication year showing that since 1988 there was a positive trend towards more research in this thematic field. Especially since 2010, there was an increase in publications reaching a maximum of 12 in 2014.

Online information

In recent years, studies about the quality and accuracy of health and medical information available on the internet have shown that many sources provide inadequate information. Ali et al[11] and Jayaratne et al[26] investigated the quality of online patient information regarding dental implants. In 2014, Jayaratne et al[26] assessed the readability of patient-oriented online information on dental implants and found out that the number of words varied widely and that 34 of 39 websites (87.18%) were difficult to read[26]. The same year Ali et al[11] reviewed content and reliability of online information on 30 websites regarding dental implants. Overall, website content quality was low (63%/67% of sites below a mean score of content/reliability) and authors were mainly clinicians (73.3%). Of the clinicians, 86.7% were accredited by a recognised body but only 26.7% were affiliated to a professional/medical institution[11].

Information leaflets

Barber et al[20] analysed 23 patient information leaflets from dental implant companies in the UK in 2015. Word count ranged from 88 to 5,434, the majority of images used were decorative and sources of information was not stated in any of the leaflets. The main emphasis was generally describing treatment and advantages with less information about risks of complications, the relevance of smoking and periodontal disease, failure or disadvantages[20].

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Table 1 Overview of 33 journal articles included in this review in alphabetical order.

Authors	Year	Treatment alternative	Investigational method	Participants / Responder	Outcomes
Akagawa Y et al[4]*	1988	Implant	Questionnaire	358/199	INF, KNO, ATT, REF
Al-Dwairi ZN et al[15]†	2014	Implant	Questionnaire	150 (RPD group)	AWA, INF, KNO, PRE, REF
Alqahtani F et al[16]	2015	Implant	Questionnaire	360/350	AWA, INF, KNO, ATT, REF
Ali S et al[11]	2014	Implant	Online information	N/A	Content, reliability
Al-Johany S et al[17]	2010	Implant, RPD, FPD	Questionnaire	420/379	AWA, INF, KNO, PRE, REF
Amjad F and Aziz S[18]	2014	Implant, RPD, FPD	Questionnaire	240	INF, PRE, REF
Awooda EM et al[19]	2014	Implant	Questionnaire	384	AWA, INF, KNO, REF
Barber J et al[20]	2015	Implant	Information leaflets	N/A	Information, word count devoted to topics, images, claims, sources of information
Berge T[17]	2000	Implant	Questionnaire	5,000/3,445	AWA, ATT, REF
Best HA[6]	1993	Implant	Questionnaire	N/A	AWA
Bhoomika K and Devaraj CG[21]	2015	Implant	Questionnaire	114	AWA, INF, ATT, REF
Chowdhary R et al[22]	2010	Implant	Questionnaire	10,000	AWA, INF, ATT, REF
Faramarzi MS et al[23]	2013	Implant	Questionnaire	150	AWA, INF, KNO, PRE
Gbadebo OS et al[24]	2014	Implant	Questionnaire	220/199	AWA, INF, KNO, ATT, REF
Hussain M et al[25]	2015	Implant, RPD, FPD	Questionnaire	201	AWA
Jayaratne YS et al[26]	2014	Implant	Online information	N/A	Readability grade level
Kohli S et al[12]	2014	Implant	Questionnaire	1,500/1,013	AWA, INF, ATT, REF
Kohli S et al[13]	2014	Implant	Questionnaire	1,500/1,013	AWA, KNO, ATT
Mukatash GN et al[14] ‡	2010	Implant, RPD, FPD	Questionnaire	612/533 (Total)	AWA, INF, PRE
Ozcakir Tomruk C et al[27]	2014	Implant	Questionnaire	527	AWA, INF, KNO
Pommer B et al[28]	2011	Implant	Questionnaire	1,000	AWA, INF, KNO, ATT, REF
Pragati K and Mayank K[29]	2010	Implant	Questionnaire	200	AWA, INF, ATT, REF
Raj N et al[30]	2014	Implant, RPD, FPD	Questionnaire	300/249	AWA, ATT, PRE
Ravi Kumar C et al[31]	2011	Implant, RPD, FPD	Questionnaire	600/535	AWA, INF, KNO, ATT, REF
Rustemeyer J and Bremerich A[32]	2007	Implant	Questionnaire	400/315	INF
Saha A et al[33]	2013	Implant	Questionnaire	550/483	AWA, INF, KNO, ATT, REF
Satpathy AP et al[34]	2011	Implant, RPD, FPD	Questionnaire	723	AWA, INF, KNO, ATT, REF
Shah RJ et al[35]	2014	Implant	Questionnaire	300	AWA, INF, ATT, REF
Strietzel FP[36]	2003	Implant	Retrospective Analysis of Expert Opinions	N/A	Inadequate patient information, significant associations
Suprakash B et al[37]	2013	Implant	Questionnaire	500/440	AWA, INF, KNO, ATT, REF
Szymanska I et al[38]	2014	Implant	Questionnaire	464	INF
Tepper G et al[39]	2003	Implant	Questionnaire	1,000	AWA, INF, KNO, ATT, REF
Zimmer CM et al[5]	1992	Implant	Questionnaire	120/109	AWA, INF, ATT

Outcomes: awareness of treatment options (AWA), source of information (INF), knowledge (KNO), attitude to treatment (ATT), preference for treatment option (PRE) and reason for refusal (REF).

* This study also includes patients with complete dentures (not numerically specified).

† This study includes data of 300 patients, 150 complete denture and 150 removable denture wearers. Due to the fact this review only includes publication about the treatment of missing single teeth, only the RPD group was considered.

‡ Responding participants of this study consisted of 272 (para-) medical staff and 261 people from the general population.

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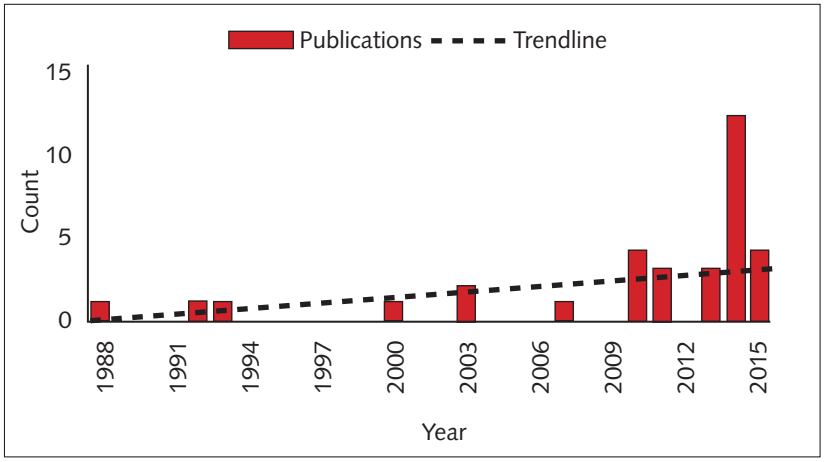

Fig 2 Count of included publications per year from 1988 to July 2015. The first included study was published in 1988. In 2010, the count of publications started to increase to a maximum of 12 published studies in 2014. Few publications before 2010 are the cause for a low upward slope of the trend line.

Expert opinions on patient information

In 28 implant treatment cases, Strietzel[40] analysed expert opinions reports about patient information prior to implant-prosthetic treatment in 2003. The report revealed that in 57% of all cases, general patient information was inadequate. Additionally, a lack of information about complications, treatment risks, cost and alternatives were also found. Diagnostic mistakes were significantly associated with inadequate information about complications that occurred. Insufficient pretreatment of the patient (prosthetic and periodontal) was associated with deficient information about implant and periodontal maintenance as well as insufficient oral hygiene status[40].

The remaining 29 studies using questionnaires as an investigational method were compared and specific study parameters (awareness, sources of information, level of knowledge, attitude to treatment alternatives, preferences for treatment alternatives and reasons for refusal) were analysed. Sorted by the place of investigation, the majority was originally from Asia (20 studies), especially from India where nine studies have been conducted starting in 2010.

Awareness, sources of information, and knowledge

A fundamental aspect of patient information is the awareness of different treatment alternatives of missing single teeth[25], including publications consisting of information about awareness of treatment or treatment options[24], the sources of information the study participants relied on and the knowledge deficiency level or the demand of knowledge of the participants, which was investigated by 15 studies. Table 3 shows a detailed summary with the resulting relative proportion of participants.

Awareness of implants as treatment for missing single teeth was investigated most frequently (25 studies). Interviewees were asked about their awareness about FPDs and RPDs only in 12 studies. Overall, 50.1% ± 24.3% were aware of the implant option, 62.3% ± 22.6% and 54.6% ± 14.3% of the participants were informed about FPDs and RPDs, respectively, as treatment possibilities for missing single teeth. Results of relative proportions are shown in Figure 3.

If people are informed about existing treatment alternatives, it is interesting to know which source of information led to their knowledge. Figure 4 shows that the most common source of information was

Table 2 Overview of four included studies investigating specific topics of patient information in oral rehabilitation and using different investigational methods.

Authors	Year	Treatment alternative	Investigational method	Outcomes
Ali S et al[11]	2014	Implant	Online information	Content, reliability
Barber J et al[20]	2015	Implant	Information leaflets	Information, word count devoted to topics, images, claims, sources of information
Jayaratne YS et al[26]	2014	Implant	Online information	Readability grade level
Strietzel FP[36]	2003	Implant	Retrospective Analysis of Expert Opinions	Inadequate patient information, significant associations

The listed four studies, investigated specific topics about patient information on treatment for missing single teeth. Study outcome parameters give an insight about the investigational focus.

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Table 3 Summary of 29 included studies using questionnaires – awareness, sources of information and level of knowledge.

Place of origin of study	Authors	Year	Awareness (%)			Sources of information (%)	Insufficient / Demand for Knowledge (%)
			DI	FPD	RPD	C/M/FF/P	
Australia (New South Wales)	Best HA[6]	1993	64.0	-	-	-	-
Austria							
Nationwide	Pommer B et al[28]	2011	79.0	91.0	45.0	74.0/26.0/30.0/-	-
Nationwide	Tepper G et al[39]	2003	72.0	89.0	57.0	68.0/23.0/22.0/-	42.0 / -
Germany (Bremen)	Rustemeyer J and Bremerich A[32]	2007	-	-	-	41.0/38.3/15.0/-	-
India							
Nationwide	Chowdhary R et al[22]	2010	23.2	-	-	74.1/9.6/-/16.4	-
Ahmedabad	Shah RJ et al[35]	2014	41.3	-	-	69.4/21.0/9.7/-	-
Bhubaneswar & Cuttack	Satpathy AP et al[34]	2011	15.9	46.9	48.6	45.0/31.5/28.1/-	55.3 / 89.4
Chattisgarh	Saha A et al[33]	2013	41.7	-	-	63.2/24.1/12.7/-	- / >50%
Guntur	Suprakash B et al[37]	2013	33.3	-	-	58.4/23.3/18.3/-	- / 70.0
Jaipur	Bhoomika K and Devaraj CG[21]	2015	40.4	-	-	25.4/8.8/6.1/-	-
Jaipur	Pragati K and Mayank K[29]	2010	38.0	-	-	55.2/15.7/-/28.9	-
Khammam	Ravi Kumar C et al[31]	2011	4.8	50.0	37.6	38.3/24.3/28.5/-	- / 85.7
Songadh & Amargadh	Raj N et al[30]	2014	10.8	80.4	43.6	-	-
Iran (Tabriz)	Faramarzi MS et al[23]	2013	60.0	-	-	42.0/22.0/34.0/2.0	70.7 / -
Japan (Hiroshima)	Akagawa Y et al[4]	1988	-	-	-	20.0/62.0/18.0/-	87.0 / -
Jordan							
Amman	Mukatash GN et al[14]	2010	68.7	71.5	54.4	44.7/35.½1.1/-	-
Irbid	Al-Dwairi ZN et al[15]	2014	68.7	-	-	38.9/18.1/58.3/-	62.0, 80.7 / - (general, placement)
Malaysia							
Nationwide	Kohli S et al[12]	2014	76.2	43.0	55.0	53.6/74.¾5.3/33.5	-
Nationwide	Kohli S et al[13]	2014	76.2	-	-	-	65.4 / -
Nigeria (Ibadan)	Gbadebo OS et al[24]	2014	28.9	18.1	50.3	68.0/29.0/-/-	61.4 / 61.8
Norway (Nationwide)	Berge T[17]	2000	70.1	-	-	-	-
Pakistan							
Karachi	Hussain M et al[25]	2015	5.5	60.6	77.0	-	-
Lahore	Amjad F and Aziz S[18]	2014	-	-	-	42.5/9.8/33.8/-	13.6 / -
Poland (Tomaszòw Mazowiecki)	Szymanska I et al[38]	2014	-	-	-	38.4/29.3/32.3/-	-
Saudi Arabia							
Alkharj	Alqahtani F et al[16]	2015	77.7	-	-	23.1/32.3/28.0/16.6	- / 82.8
Riyadh	Al-Johany S et al[17]	2010	66.4	79.4	67.9	28.3/-/31.5/-	49.8 / 82.4
Sudan (Khartoum)	Awooda EM et al[19]	2014	68.5	83.3	83.3	26.0/18.0/27.9/-	27.1, 53.1 / 93.2 (general, placement)
Turkey (Istanbul)	Ozcakir Tomruk C et al[27]	2014	43.5	34.9	34.9	44.5/31.6/17.3/-	47.5 / 68.3
USA (Rochester, MN)	Zimmer CM et al[5]	1992	77.0	-	-	17.0/35.0/35.0/-	-

This table includes 29 questionnaire studies sorted by the place of origin. Resulting relative proportions of study participants about awareness, sources of information and level of knowledge are summarised in this table.

Awareness: dental implants (DI), fixed partial dentures (FPD), removable partial dentures (RPD).

Sources of information: clinician (C), media (M), family and friends (FF) and other patients (P).

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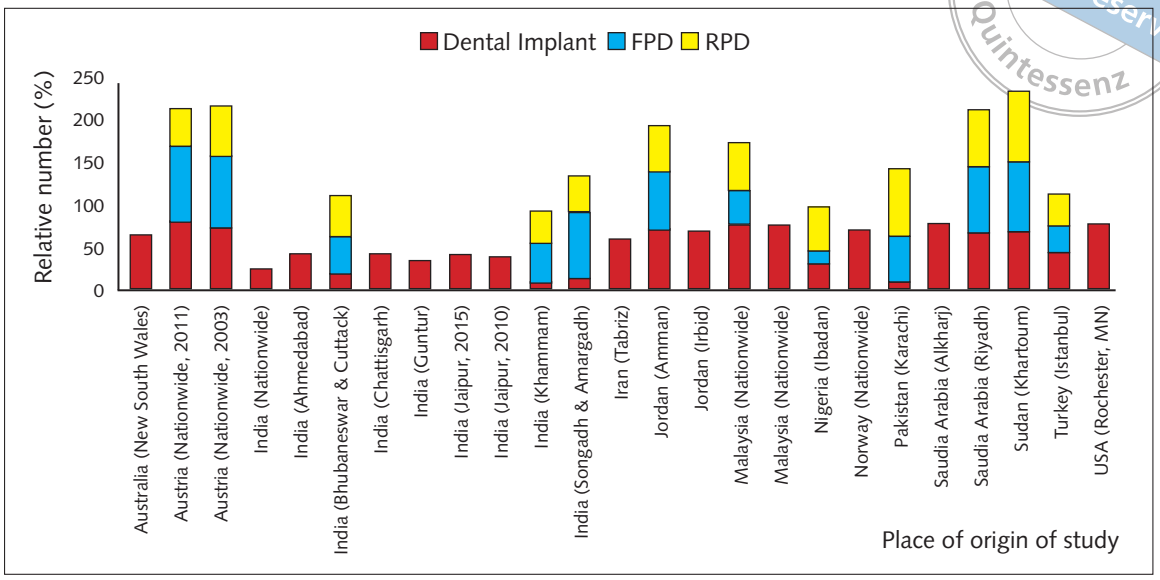

Fig 3 Awareness about treatment alternatives of missing single teeth. In 25 studies, the awareness of participants regarding dental implants as treatment options of missing teeth was investigated. Another 12 studies additionally asked about the awareness of FPDs and RPDs.

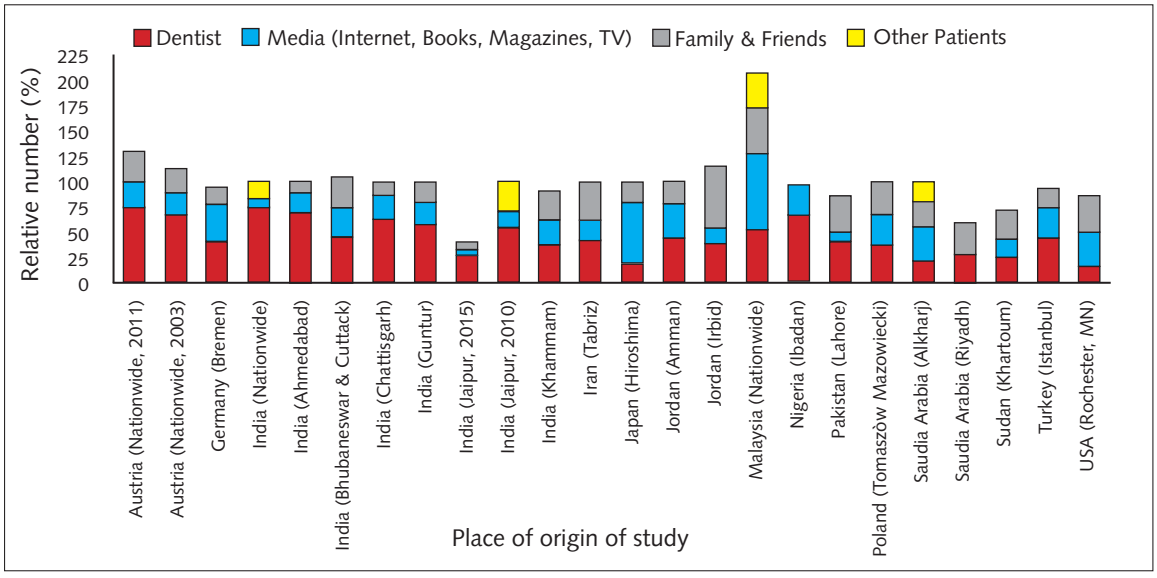

Fig 4 Sources of information about treatment alternatives of missing single teeth. In 24 included publications, interviewees were questioned about their sources of information. Sources could be the clinician, media (e.g. websites on the internet, books, magazines and TV) , their family members and friends or other patients who already received the same treatment.

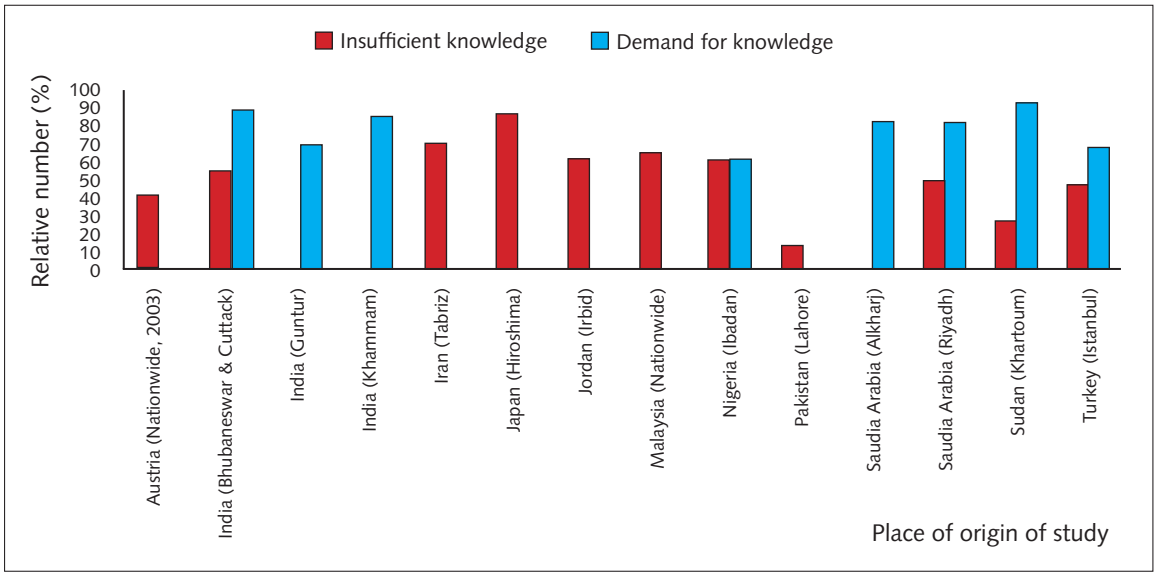

Fig 5 Knowledge of treatment alternatives of missing single teeth. In only less than half (14 of 29) of the included publications using questionnaires as an investigational method, the deficiency level of knowledge (11 studies) or the demand for knowledge (8 studies) about the different treatment options was investigated.

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their clinician and or specialist in 45.8% ± 17.2%, followed by the media in 27.9% ± 14.9%, and by friends and family members in 26.3% ± 11.8%. In 19.5% ± 11.0% of the cases, participants obtained their information from other patients.

Eleven studies investigated the deficiency level of knowledge about treatment options (mostly implants) of missing single teeth by asking basic questions (function, durability and placement). In eight studies, participants were able to assess the demand for knowledge. Figure 5 shows that 52.9% ± 19.5% answered the basic knowledge questions insufficiently while 78.3% ± 10.8% stated their need for better knowledge.

Attitude to treatment alternatives, preferences for treatment alternatives and reasons for refusal

People form their opinion or choice of treatment by their individual knowledge. Information about peoples' attitude to treatment options can give an insight about deficits in knowledge. Additionally, it would be interesting to know which treatment alternatives are preferred. If patients refuse specific treatments, the analysis of information about the reasons for refusal is essential. Table 4 summarises results of these three outcome parameters.

Figure 6 shows participants' attitude towards oral implants which was investigated in 18 studies. Three of them additionally questioned the attitude towards FPDs and RPDs as a treatment option. The mean and standard deviation of attitude towards implants were 46.8% ± 23.2%. The attitude to FPDs and RPDs were stated equally with 34.5% ± 9.2%. The results of attitude towards implants were shown to be very heterogeneous, ranging from 14.8% to 80.5%, whereas the attitude to FPDs and RPDs did not vary a lot.

Study participants in six investigations were asked about their preferences for a specific treatment option. Figure 7 shows that dental implants were preferred by 44.5% ± 26.8%, FPDs by 56.2% ± 18.9% and RPDs by 17.1% ± 11.2% of study participants.

Participants were asked in 18 of the performed studies why they would refuse the treatment for replacing a missing single tooth. High costs were most often the major reason (52.6% ± 25.4%) which can be seen in Figure 8. Secondly, possible risks and side effects (27.7% ± 15.3%) as well as fear of treatment (25.1% ± 10.0%) and subjectively less knowledge (27.6% ± 11.7%) were the following reasons for refusal. A long duration of the treatment procedure as well as time restraints of the participants were reasons in 19.4% ± 8.8%.

Discussion

Findings of Ali et al[11] and Jayaratne et al[26], who investigated online information, suggested that there is a need for improvement in the online information about oral implants. Results of Barber et al[20] showed that a clinician should accompany patient information leaflets provided by dental implant companies to give all necessary information, facilitating informed consent. Risks of complications, the relevance of smoking and periodontal disease, and failure or disadvantages were often not described in leaflets. Significant associations revealed by Strietzel[40] suggested that optimisation of pretreatment information of patients as well as during the treatment and maintenance phase would be important.

Analysis of 29 questionnaires revealed large variations of results between studies conducted in different countries and within the same country. Publications from India stated contradictory results on attitude to treatment alternatives, which was the same as studies performed in Jordan, where results about peoples' preferences of treatment were different between two cities. One cause could be differing study designs. Sample sizes varied between 109 and 10,000 study participants. Questionnaire designs were not concordant by including different questions about basic knowledge, which could lead to different results. Due to the density of publications in the last few years, Figures 3 to 8 were sorted by the place of origin. Otherwise, it would have been interesting to see differences in publications with large time intervals in between repetition. In 2011, Pommer et al[41] repeatedly performed the study by Tepper et al[8] from 8 years before, revealing slightly better results, in terms of awareness of dental implants and the increased use of different sources of information.

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Table 4 Summary of 29 included studies using questionnaires – attitude to treatment alternatives, preferences for treatment alternatives and reasons for refusal.

Place of origin of study	Authors	Year	Attitude to treatment alternatives (%)			Preferences for treatment (%)			Reasons for refusal (%)
			DI	FPD	RPD	DI	FPD	RPD	Cost / Time / Risk / Fear / Knowledge
Australia (New South Wales)	Best HA[6]	1993	-	-	-	-	-	-	-
Austria									
Nationwide	Pommer B et al[28]	2011	-	-	-	-	-	-	83.0/16.0/53.0/-/-
Nationwide	Tepper G et al[39]	2003	-	-	-	-	-	-	76.0/15.0/34.0/-/-
Germany (Bremen)	Rustemeyer J and Bremerich A[32]	2007	-	-	-	-	-	-	-
India									
Nationwide	Chowdhary R et al[22]	2010	24.2	-	-	-	-	-	85.0/-/-/-/15.0
Ahmedabad	Shah RJ et al[35]	2014	45.3	-	-	-	-	-	78.5/-/-/21.5/-
Bhubaneswar & Cuttack	Satpathy AP et al[34]	2011	71.6	28.4	28.4	-	-	-	58.8/26.¼4.0/-/-
Chattisgarh	Saha A et al[33]	2013	14.8	-	-	-	-	-	35.2/14.3/10.3/21.7/-
Guntur	Suprakash B et al[37]	2013	16.0	-	-	-	-	-	27.8/15.6/11.3/18.4/-
Jaipur	Bhoomika K and Devaraj CG[21]	2015	18.4	-	-	-	-	-	75.3/-/-/-/-
Jaipur	Pragati K and Mayank K[29]	2010	29.0	-	-	-	-	-	61.1/-/19.6/-/18.7
Khammam	Ravi Kumar C et al[31]	2011	72.5	27.5	27.5	-	-	-	57.2/19.3/33.6/-/-
Songadh & Amargadh	Raj N et al[30]	2014	47.5	47.5	47.5	88.9	66.2	37.6	-
Iran (Tabriz)	Faramarzi MS et al[23]	2013	-	-	-	42.6	-	-	-
Japan (Hiroshima)	Akagawa Y et al[4]	1988	47.0	-	-	-	-	-	31/-/-/40/-
Jordan									
Amman	Mukatash GN et al[14]	2010	-	-	-	44.3	33.2	16.3	-
Irbid	Al-Dwairi ZN et al[15]	2014	-	-	-	27.3	65.3	14.7	5.3/-/6.6/14.6/-
Malaysia									
Nationwide	Kohli S et al[12]	2014	80.5	-	-	-	-	-	81.8/20.1/30.2/-/28.3
Nationwide	Kohli S et al[13]	2014	80.5	-	-	-	-	-	-
Nigeria (Ibadan)	Gbadebo OS et al[24]	2014	22.6	-	-	-	-	-	9.0/-/-/-/46.2
Norway (Nationwide)	Berge TI[7]	2000	56.7	-	-	-	-	-	M>>FF>P
Pakistan									
Karachi	Hussain M et al[25]	2015	-	-	-	-	-	-	-
Lahore	Amjad F and Aziz S[18]	2014	-	-	-	2.5	81.3	13.6	30.0/25.0/-/-/12.5
Poland (Tomaszòw Mazowiecki)	Szymanska I et al[38]	2014	-	-	-	-	-	-	-
Saudi Arabia									
Alkharj	Alqahtani F et al[16]	2015	74.4	-	-	-	-	-	51.2/-/-/29.0/-
Riyadh	Al-Johany S et al[17]	2010	-	-	-	61.5	35.2	3.3	70.7/38.8/46.7/41.4/34.3
Sudan (Khartoum)	Awooda EM et al[19]	2014	-	-	-	-	-	-	29.1/3.8/15.2/13.9/38.0
Turkey (Istanbul)	Ozcakir Tomruk C et al[27]	2014	-	-	-	-	-	-	-
USA (Rochester, MN)	Zimmer CM et al[5]	1992	47.0	-	-	-	-	-	-

This table includes 29 questionnaire studies sorted by the place of origin. Resulting relative proportions of study participants about attitude, preferences and reasons for refusal are summarised in this table. Attitude to treatment & preference for treatment: dental implants (DI), fixed partial dentures (FPD), removable partial dentures (RPD).

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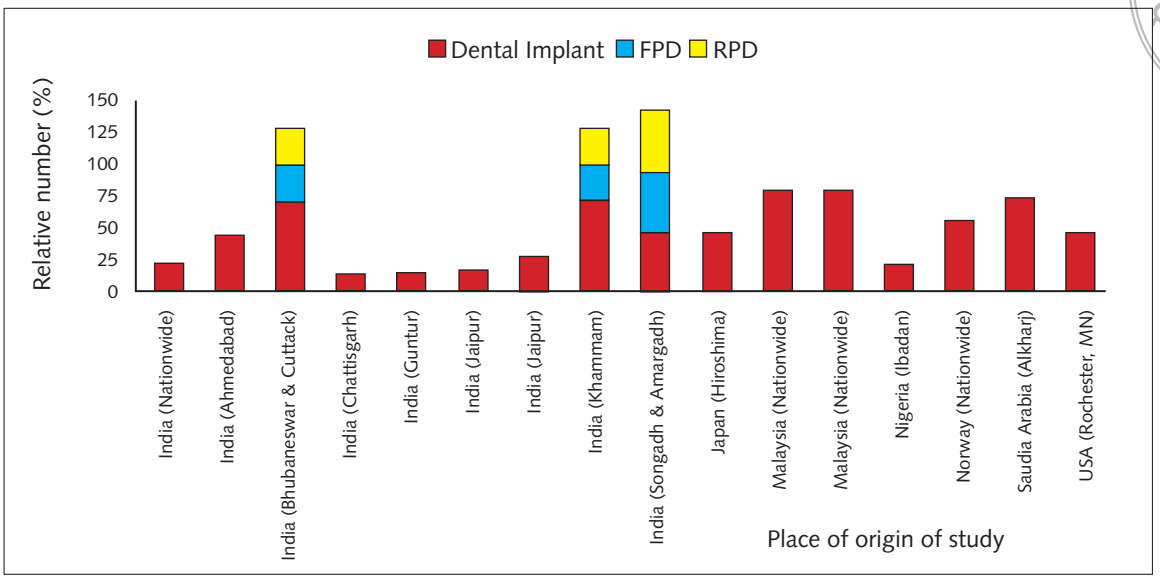

Fig 6 Attitude to treatment alternatives of missing single teeth. In 16 publications, attitude to dental implants, and three additional studies about FPDs and RPDs as treatment for a missing single tooth were investigated.

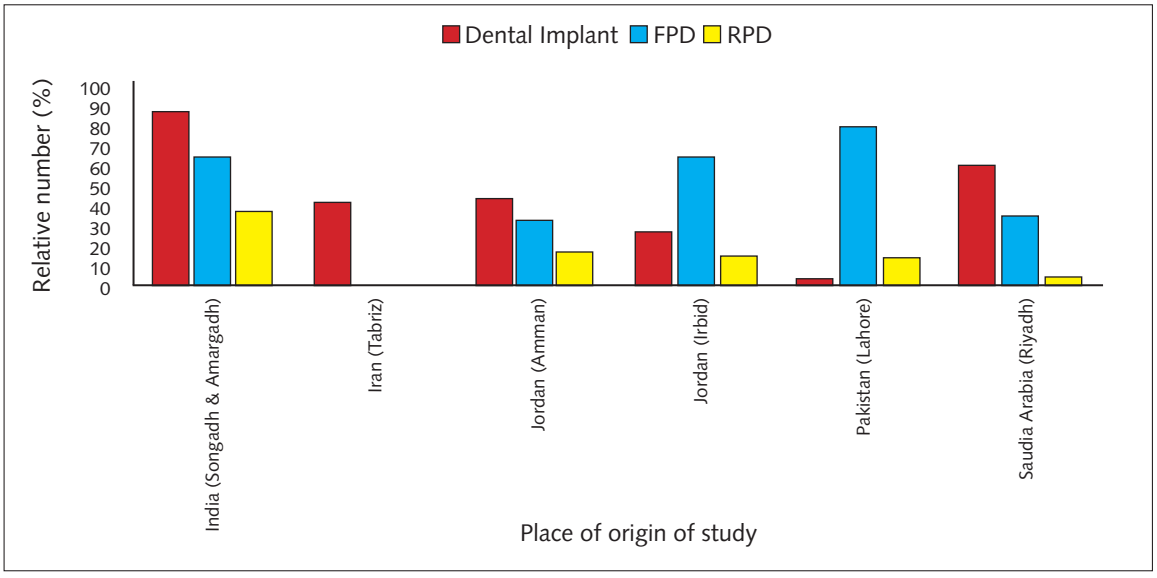

Fig 7 Preferences for treatment alternatives of missing single teeth. Only six studies contained information about preferences of treatment options of study participants. All of them have been conducted in middle and West Asia.

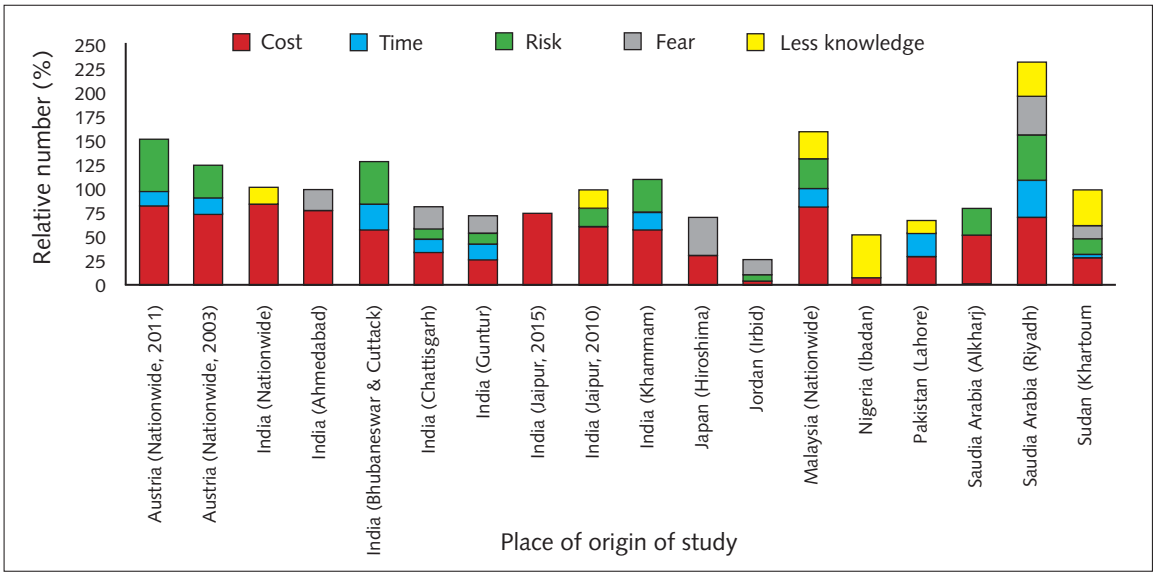

Fig 8 Reasons for refusal of treatment of missing single teeth. Eighteen included studies asked participating interviewees about their possible reason to refuse the treatment to replace a missing single tooth. Cost, time of the participants, as well as the duration of the procedure, risks and side effects, fear and the feeling of having too little knowledge about the treatment were possible options.

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Selection and sampling bias

Additionally, non-randomisation of the study population lead to dissimilar age groups and education levels of the sample to be investigated. A difference in previous experience and knowledge could lead to different results. Therefore, it would be important to create balanced subgroups, at least sorted by age and education level to prevent a sampling bias. Sample sizes should be large enough to represent the public population[8]. As already mentioned, only five articles about orthodontic gap closure were among the primary search results, which had to be excluded because they did not investigate any aspects of patient information. Due to a small range of indications for treatment of missing single teeth by orthodontic gap closure, it can be difficult to perform a study about this topic. However, this finding leads to a demand for further studies.

Awareness, sources of information and knowledge

In general, awareness of FPDs and RPDs is acceptable. In more developed countries dental implant awareness reached values up to 79%. Studies performed in India, Pakistan and Nigeria show results below the mean dental implant awareness. Clinicians were by far the most important source of information for treatment alternatives of missing single teeth. The media and family and friends play important roles evenly in patient information. Only every fifth participant gained knowledge from other patients' experiences. An important finding of this review is the high deficiency level of knowledge and an even higher percentage of demand for knowledge.

Attitude to treatment alternatives, preferences for treatment alternatives and reasons for refusal

A positive attitude towards implants was higher than for FPDs and RPDs. Nevertheless, the results of this attitude varies in a wide range (14.8% to 80.5%), whereas the attitude to FPDs and RPDs did not vary a lot, which may have been caused by the low number of studies which asked about it (three), in comparison to 16 publications investigating attitude to dental implants.

Study participants who had a positive attitude to treatment alternatives for missing single teeth preferred implants and FPDs to RPDs. If treatment was refused, high cost was the major reason in every second participant. One third were afraid of the treatment or feared possible risks and side effects. Only every fifth interviewee criticised the long duration of the treatment or stated their personal time constraints.

Conclusion

Non-uniform study designs of used questionnaires could be cause for variations in resultant outcome parameters. By consideration of this systematic review, further studies can standardise methods by using key parameters and a representative study population (size and randomization). Clinicians as the major source of information for patients are responsible for improving patient education about treatment alternatives. Results revealed a high demand for knowledge of patients. The high subjective and objective need for information shows a clear challenge for national and international organisations affiliated with oral rehabilitation and dental implants such as the European Association for Osseointegration (EAO), the Academy of Osseointegration (AO) and the Foundation for Oral Rehabilitation (FOR). It is their responsibility to develop and deliver state-of-the-art information about oral implants to the public in order to enhance awareness, attitude and preference for dental implant therapy in the general population.

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