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Subjective and objective perception of orthodontic treatment need: a systematic review

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SUMMARY The aim of this work was to investigate the published evidence on the comparison of self-perception and diagnosis of orthodontic treatment need. A search of Cochrane Library, MEDLINE, Scopus databases, and archives of two orthodontic journals was carried out from January 1966 to August 2011 by the two authors using Medical Subject Heading terms. Studies that investigated solely either self-perception of orthodontic need by laypersons or assessment of orthodontic need by professionals were excluded from the data analysis. The methodological soundness of each study and the aggregate level of evidence were evaluated according to predetermined criteria. Moderate level of evidence, the relatively highest grade, was assigned to 9.1 per cent of the 22 studies, finally included in the data analysis. The overall evidence level provided by the evaluated publications was rated as limited. However, the existing body of evidence indicated a highly variable association between self-perception of orthodontic treatment need and orthodontist's assessment. Future controlled studies with well-defined samples and common assessment methodology will clarify further the relationship between perception of treatment need by laypersons and orthodontists and enhance international comparison and development of health care strategies.

Introduction

While the orthodontist prioritizes function and occlusion in consultation, the patient might perceive other factors to be equally important to initiate treatment (Josefsson *et al.*, 2009). Interestingly, a proportion as high as 80 per cent of the individuals that attend orthodontic practices disregard structural or functional consideration (Baldwin, 1980). Shaw *et al.* (1991) observed that some referred patients refuse orthodontics for professionally perceived handicapping malocclusions, while others are keen on undergoing treatment for minor deviations. Apparently, the demarcation between acceptable and unacceptable occlusion is largely dependent upon idiosyncratic judgement (O' Brien *et al.*, 2006).

The latest developed occlusal indices (OIs; Brook and Shaw, 1989; Jenny *et al.*, 1991; Espeland *et al.*, 1992; Richmond *et al.,* 1992; Daniels and Richmond, 2000) have been used to quantify malocclusion severity and orthodontic need in an objective manner. Experience with their use in Europe suggests that they have a useful role in resource allocation and planning and better uniformity in patient identification and referral (Shaw *et al.*, 1995).

Undoubtedly, the relationship between specialized evaluation and self-perception of treatment need is of great interest for dental health planners and decision makers. As the ultimate goal of a health service is to meet the public needs, professional measurements can be supplemented by and related to individual's self-perception of occlusion and need for treatment (Stenvik *et al.*, 1997).

The aim of the present study was to systematically review the orthodontic literature on the relation between self-perception of treatment need and orthodontic expertise, both based on validated registration methods.

Materials and methods

Search strategy

The Cochrane Library (www.thecochranelibrary.com), MEDLINE (www.ncbi.nlm.nih.gov/pubmed), and Scopus (www.scopus.com) databases were searched by the two authors from January 1966 to August 2011 using the comprehensive Medical Subject Heading terms: 'Self Concept' AND 'Health Services Needs and Demand' AND 'Orthodontics, Corrective'. Additionally, the electronic archives of two high-ranking orthodontic journals, the *European Journal of Orthodontics* and *Angle Orthodontist*, were searched to collect relevant articles.

At the first stage of the selection, titles and abstracts were screened to identify duplicates and articles appearing repeatedly. Studies including self-perception of orthodontic need by laypersons or objective assessment of orthodontic need by professionals and not a comparison were excluded

from this review. This led to a set of possibly eligible studies for which the full-text needed to be viewed. In cases that either subjective or objective evaluation data were not thoroughly documented, the respective publications were excluded. Conclusively, the reference lists of all suitable records were examined to minimize information leakage.

Data extraction and quality assessment

From each study included in the review, specific data were extracted: author, year of publication, sample size, gender distribution, age, assessment methods, and country of origin.

The soundness of procedures and statistics of each study was evaluated, and studies were graded with scores of A–C (ranging from high to low level of evidence) according to a previously validated grading system (Bondemark *et al.*, 2007; Joss-Vassalli *et al.*, 2010):

1. Grade A—high level of evidence (all criteria should be met):
   (a) Randomized clinical study or a prospective study with a well-defined control group.
   (b) Defined diagnosis and endpoints.
   (c) Diagnostic reliability tests and reproducibility tests described.
   (d) Blinded outcome assessment.
2. Grade B—moderate level of evidence (all criteria should be met):
   (a) Cohort study or retrospective case series with defined control or reference group.
   (b) Defined diagnosis and endpoints.
   (c) Diagnostic reliability tests and reproducibility tests described.
3. Grade C—low level of evidence (one or more of the criteria should be met):
   (a) Large attrition.
   (b) Unclear diagnosis and endpoints.
   (c) Poorly defined patient material.

Both authors assessed the methodological soundness of the reviewed articles simultaneously and any conflict was resolved by discussion to reach consensus. The final level of evidence indicated by the total of the reviewed studies was determined according to the protocol employed by Bondemark *et al.* (2007) and originated from the Centre for Reviews and Disseminations (2001).

1. Level 1—strong level of evidence: at least two studies assessed with 'grade A'.
2. Level 2—moderate level of evidence: one study with 'grade A' and at least two studies with 'grade B'.
3. Level 3—limited level of evidence: at least two studies with level 'grade B'.
4. Level 4—inconclusive level of evidence: fewer than two studies with 'grade B'.

Results

The literature search resulted in 116 articles. A detailed overview of the selection process is presented by the PRISMA flow diagram (Moher *et al.*, 2009; Figure 1). A total of 22 suitable studies were finally considered for the purposes of this review (Table 1).

Fifteen of the treatment need perceptive studies were conducted on children and adolescents samples, while seven studies in young adults. The perception of parents regarding the orthodontic treatment of own child was concurrently recorded in six articles. In almost 78 per cent of the reviewed studies, subjective need and demand for orthodontic treatment were evaluated by means of a structured questionnaire addressing attitude towards malocclusion and orthodontics in combination with an OI or not. In 18 of 22 studies, the professionals utilized the components of the Index of Orthodontic Treatment Need (IOTN) to determine treatment need. Interestingly enough in two articles (Tang and So, 1995; Ngom *et al.*, 2007), the examiners based their assessment on an additional classification system, i.e. the OI and the Index of Complexity, Outcome and Need (ICON). In three of the reviewed papers (Espeland *et al.*, 1993; Ng'ang'a *et al.*, 1997; Stenvik *et al.*, 1997), the Need for Orthodontic Treatment Index was applied, while one author (Marques *et al.*, 2009) assessed treatment need by using the Dental Aesthetic Index.

To enable inter-study comparison, we summarized the data that represented definitive treatment need in spite of the registration method used by the authors (Table 2). In general, the results indicated a highly variable association between self-perception of definitive orthodontic treatment need and orthodontist's point of view, between children and adult groups, and in studies of university students and adults of unknown educational background. Inconsistency in results was also evident among children, parents, and specialists (Table 3). Orthodontists tended to define higher treatment need with either component of IOTN in comparison to self-assessment of laypersons based on the Aesthetic Component (AC). On the contrary, children recorded higher percentages of definitive treatment need when their responses to questionnaires were evaluated against examiners AC scores. Lower percentages of definitive treatment need were self-conceived by adults in either questionnaire or AC of IOTN-based studies in comparison to IOTN–Dental Health Component scoring by specialists.

Regarding the sample selection, demographic or socio-economic measures to represent the general population were described in 10 articles. This was not the case in studies that investigated perceived needs of university students (Tang and So, 1995; Bernabé and Flores-Mir, 2006; Chu *et al.*, 2009), military men (Soh and Sandham, 2004), and individuals attending public health services

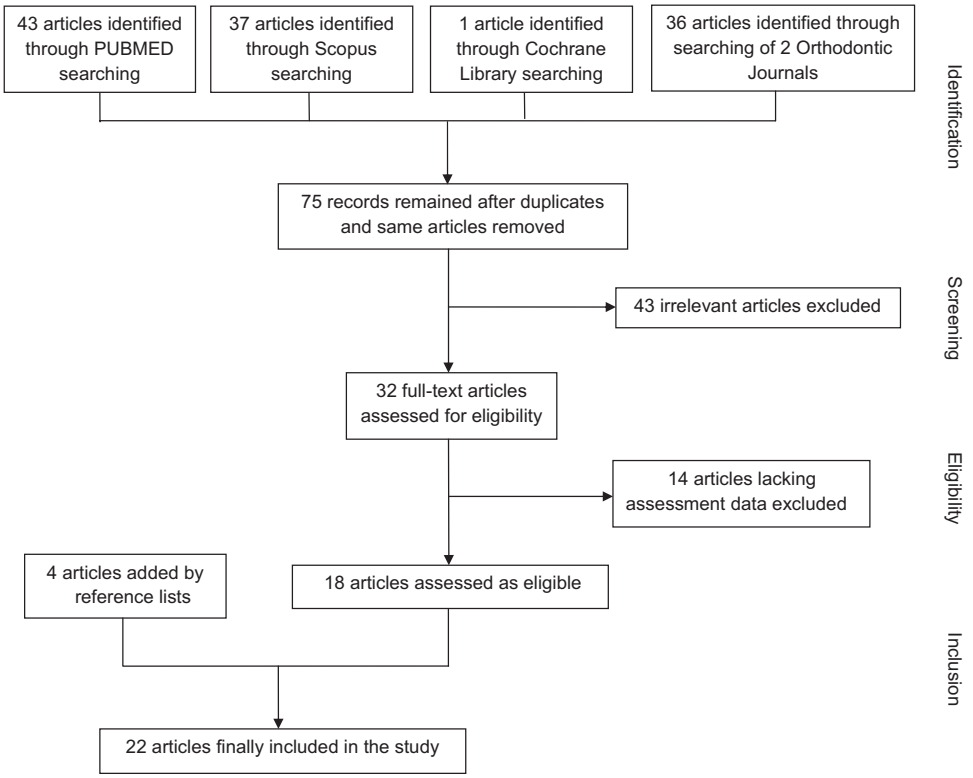

Figure 1 PRISMA flow diagram of the selection process.

Table 1 Summarized data of studies included in the review. n/m, not mentioned; IOTN, Index of Orthodontic Treatment Need; AC, Aesthetic Component; DHC, Dental Health Component; NOTI, Need for Orthodontic Treatment Index; DAI, Dental Aesthetic Index; OI, Occlusal Index.

Study	*N* (females, males)	Age (years)	Subjective assessment	Objective assessment	Country
Al-Sarheed *et al.* (2003)	287 (165, 122)	11–16	IOTN (AC)	IOTN (AC and DHC)	Saudi Arabia
Bernabé and Flores-Mir (2006)	281 (124, 157)	18.1 ± 1.6	IOTN (AC)	IOTN (DHC)	Peru
Birkeland *et al.* (1996)	359 (183, 176)	10.6	IOTN (AC) and questionnaire	IOTN (AC and DHC)	Norway
Chew and Aw (2002)	257 (137, 120)	12 ± 2.4	Questionnaire	IOTN (DHC)	Singapore
Christopherson *et al.* (2009)	1566 (825, 741)	9.37 ± 0.961	IOTN (AC) and questionnaire	IOTN (DHC)	USA
Chu *et al.* (2009)	240 (127, 113)	21 ± 2	Questionnaire	IOTN (DHC)	Hong Kong
Dias and Gleiser (2010)	407 (216, 191)	9–12	IOTN (AC) and questionnaire	IOTN (AC and DHC)	Brazil
Espeland *et al.* (1993)	94 (48, 46)	17.6	Questionnaire	NOTI	Norway
Grzywacz (2003)	84 (42, 42)	12	IOTN (AC), questionnaire	IOTN (AC)	Poland
Hamdan (2004)	103 (65, 38)	15.3 ± 3.8	IOTN (AC)	IOTN (AC and DHC)	Jordan
Hassan (2006)	743 (n/m, n/m)	17–24	IOTN (AC)	IOTN (DHC)	Saudi Arabia
Holmes (1992)	955 (452, 503)	12.54 ± 0.27	IOTN (AC)	IOTN (AC and DHC)	UK
Josefsson *et al.* (2009)	379 (188, 191)	12–13	Questionnaire	IOTN (DHC)	Sweden
Kerosuo *et al.* (2004)	139 (70, 69)	15.3 ± 1.08	Questionnaire	IOTN (AC and DHC)	Kuwait
Mandall *et al.* (2005)	325(169, 156)	11–12	IOTN (AC)	IOTN (AC and DHC)	UK
Marques *et al.* (2009)	333 (183, 150)	14–18	Questionnaire	DAI	Brazil
Mugonzibwa *et al.* (2004)	386 (201, 185)	9–18	Questionnaire	IOTN (AC and DHC)	Tanzania
Ng'ang'a *et al.* (1997)	919 (451, 468)	14.1	Questionnaire	NOTI	Kenya
Ngom *et al.* (2007)	665 (338, 327)	12–13	IOTN (AC) and questionnaire	ICON and IOTN (AC and DHC)	Senegal
Soh and Sandham (2004)	339 (0, 339)	17–22	IOTN (AC) and questionnaire	IOTN (AC and DHC)	Singapore
Stenvik *et al.* (1997)	80 (55, 25)	20.7	Questionnaire	NOTI	Norway
Tang and So (1995)	105 (54, 51)	19.75	Questionnaire	OI and IOTN (DHC)	Hong Kong

(Espeland *et al.*, 1993; Chew and Aw, 2002; Hamdan, 2004; Hassan, 2006). Estimation of the sample size was made in three publications (Christopherson *et al.*, 2009; Chu *et al.*, 2009; Marques *et al.*, 2009), whereas the power of the samples in the residual studies was questionable. No information about the gender distribution was given by Hamdan (2004), while one study group comprised entirely adult males (Soh and Sandham, 2004). Age details of the

Table 2 Percentages of subjects identified with definitive treatment need according to the used assessment methods in the reviewed studies. SG1, study group of visual impaired children; SG2, study group of hearing impaired children; IOTN, Index of Orthodontic Treatment Need; AC, Aesthetic Component; DHC, Dental Health Component; NOTI, Need for Orthodontic Treatment Index; DAI, Dental Aesthetic Index; ICON, Index of Complexity, Outcome and Need; OI, Occlusal Index.

Study	Subjective assessment		Objective assessment		
	Questionnaire (%)	IOTN (AC 8–10; %)	IOTN (AC 8–10; %)	IOTN (DHC 4–5; %)	Other indices (%)
Al-Sarheed *et al.* (2003) (SG1)		43	16.8	11.7	
Al-Sarheed *et al.* (2003) (SG2)		5.3	5.3	13.5	
Bernabé and Flores-Mir (2006)		1.8		29.9	
Birkeland *et al.* (1996)	36.8	9	7.7	26.1	
Chew and Aw (2002)	74			73.1	
Christopherson *et al.* (2009)	46.9	16.7		17.1	
Chu *et al.* (2009)	28			33	
Dias and Gleiser (2010)	38.1	5.1	11.3	34.2	
Espeland *et al.* (1993)	16				39.4 (NOTI A–B)
Grzywacz (2003)	58.3	0	2.4		
Hamdan (2004)		16.7	21	71	
Hassan (2006)		16.1		71.6	
Holmes (1992)	27.6	4.2	4.9		
Josefsson *et al.* (2009)	22.3		43.9		
Kerosuo *et al.* (2004)	34.6		1.5	28.6	
Mandall *et al.* (2005)		2.7	19.4		
Marques *et al.* (2009)	78.6				23.8 (DAI ≥ 31)
Mugonzibwa *et al.* (2004)	38		11	22	
Ng'ang'a *et al.* (1997)	33				29 (NOTI A–B)
Ngom *et al.* (2007)	23.8	3.2	8.7	42.6	44.1 (ICON ≥ 43)
Soh and Sandham (2004)	8.8	3.5	29.2	50.1	
Stenvik *et al.* (1997)	28.7				1.2 (NOTI A–B)
Tang and So (1995)	23.8			54.3	26.6 (7.1 ≤ OI ≤16)

Table 3 Percentages of children identified with definitive need of treatment by themselves, parents, and orthodontists. DHC, Dental Health Component; IOTN, Index of Orthodontic Treatment Need.

Study	Children (questionnaires; %)	Parents (questionnaires; %)	Orthodontist (IOTN–DHC; %)
Birkeland *et al.* (1996)	36.8	47.7	26.1
Chew and Aw (2002)	74	83	73.1
Dias and Gleiser (2010)	38.1	67.3	34.2
Hamdan (2004)	16.7*	17*	71
Marques *et al.* (2009)	78.6	73.6	23.8**
Ngom *et al.* (2007)	3.2*	2.9*	42.6

*IOTN–AC.
**DAI.

participants were not also fully reported for all samples. Sufficient statistic tests to check examiners performance were carried out in half studies (Holmes, 1992; Ng'ang'a *et al.*, 1997; Grzywacz, 2003; Kerosuo *et al.*, 2004; Mandall *et al.*, 2005; Bernabé and Flores-Mir, 2006; Hassan, 2006; Christopherson *et al.*, 2009; Josefsson *et al.*, 2009; Marques *et al.*, 2009; Dias and Gleiser, 2010). Finally, blinding procedures were described merely in an investigation on first-year university students (Tang and So, 1995).

Nonetheless, the results of the reviewed articles should be interpreted with caution. Overall, the evidence level of the total of the studies was considered to be limited (level 3). The research standards of 20 studies were evaluated to have low value of evidence (grade C). Only two study designs included control group (Espeland *et al.*, 1993; Al-Sarheed *et al.*, 2003) and graded to provide moderate level of evidence (grade B). Al-Sarheed *et al.* (2003) investigated self-perception and need for orthodontic treatment in young sensory (visual and hearing) impaired children attending special schools. In the second controlled study of Espeland *et al.* (1993), the orthodontic concern of orthodontically untreated young adults living in areas with different treatment frequency was examined.

Discussion

This study was conducted to appraise the current scientific evidence on subjective and objective orthodontic treatment

need. The evaluation of the research standards and methods of the reviewed studies according to well-established guidelines revealed the limited level of evidence. Hence, assumptions rather than reliable conclusions can be made about the association between professional and self-assessment treatment need.

In the two highest graded investigations, as the analysis of methodological quality showed, we observed a clear difference in treatment need assessment between laypersons and specialists. More than twice as many hearing impaired children (Al-Sarheed *et al.*, 2003) and young adults in a region with a low uptake of orthodontic therapy (Espeland *et al.*, 1993) were diagnosed than conceived themselves requiring orthodontics. The conflicting IOTN–AC scores of the visually handicapped children might be attributed on the history details of the sensory impairment.

The vast majority of studies under review were conducted on children and adolescents samples. It appears that in the questionnaire-centred studies, children self-perceived higher treatment need than it was professionally assessed on aesthetic grounds. The demand for orthodontic treatment, however, is difficult to assess in children, and it will considerably change with increase in age (Chu *et al.*, 2009). On the contrary, in young adults whose facial growth is completed, the features of malocclusion are fully expressed. Consciousness of body image increases during childhood and adolescence and renders young adults a relevant age group for the study of personal dental appearance perception (Espeland and Stenvik, 1991b). We witnessed that the adult samples persistently underestimated the definitive treatment need as it was determined in terms of dental health.

With regard to the influence of educational status, highly educated individuals have been so far identified to be more aware of the malalignment of their teeth (Shaw *et al.*, 1975; Helm *et al.*, 1983). Academic people may also have higher standards for dental appearance and aesthetics (Onyeaso and Sanu, 2005). In our review, three studies (Tang and So, 1995; Bernabé and Flores-Mir, 2006; Chu *et al.*, 2009) that recruited university students presented contradictory results for self-perceived and normative orthodontic treatment need.

Parents concern about the dentofacial aesthetics of their children regardless of the population studied has been stressed by a number of publications (Gosney, 1986; Pietilä and Pietilä, 1996; Coyne *et al.*, 1999). We could not detect any patterns in how parents conceive their own child's need for treatment in six relevant studies (Table 3).

Regarding the sampling design, subjects with orthodontic treatment experience were excluded in three studies. The rationale behind this might be the fact that former orthodontic patients have been found to be more aware of malocclusion than untreated individuals (Tuominen and Tuominen, 1994). Notwithstanding, this decision did not affect the level of unmet treatment need, it might have reduced the overall assessment of treatment need in the population under examination. Espeland and Stenvik (1991a) showed no significant differences in perception of occlusion in treated and untreated groups and proposed that both should be included to examine how the service meets the needs of the public. It can be also the case that treated subjects may still exhibit impaired aesthetics and residual treatment need.

A major discrepancy encountered in this review was the differentiation in selected assessment methods that impeded the possibility of direct comparison. In 16 studies, questionnaires were applied solely or in addition to the AC for assessing subjective orthodontic treatment need. An answer to a specific question was selected as representing individual self-perceived orthodontic treatment need (Table 4). However, according to Birkeland *et al.* (1996), it is difficult to validate questionnaires used for such purposes because differences in question wording and response option will affect the results. It can be anticipated that diverse scales and starting points in the response alternatives may have a certain impact on the participant replies. To eliminate wastage through completed or defaced forms,

Table 4 Evaluation of self-perception of orthodontic treatment need in questionnaire-based studies.

Study	Question	Response
Chew and Au (2002)	Do you think you need to wear braces?	No, definitely not. No, I don't think so. Yes, I think so. Yes, definitely so.
Holmes (1992)	Do you think your teeth need straightening?	Definitely no. Probably no. Don't know. Probably yes. Definitely yes.
Josefsson *et al.* (2009)	Do you think that you need a brace today?	Yes/uncertain/no
Kerosuo *et al.* (2004)	Do you think that you are in need for orthodontic treatment?	Yes/no/I don't know
Mugonzibwa *et al.* (2004)	Do you need orthodontic treatment?	Yes/no/I don't know
Ngom *et al.* 2007	Do you feel your teeth need such a treatment (to straighten teeth)?	Yes/no/don't know
Soh and Sandham (2004)	Do you think you need to wear braces?	Yes/no/not sure

several investigators (Holmes, 1992; Espeland *et al.*, 1993; Stenvik *et al.*, 1997; Hamdan, 2004; Bernabé and Flores-Mir, 2006; Christopherson *et al.*, 2009; Chu *et al.*, 2009; Dias and Gleiser, 2010) preferred to use face-to-face interviews. Nevertheless, face-to-face interviews risk the introduction of bias since respondents may distort their answers in order to make a more favourable impression on the interviewer, giving the most socially acceptable response to questions rather than a genuine answer. The competence of non-specialists (Christopherson *et al.*, 2009; Josefsson *et al.*, 2009) to perform interviews or address possible queries may also raise an issue about the study protocol.

IOTN appeared to be the most popular quantification method, and especially the AC of IOTN was used in 59.1 and 50 per cent for subjective and objective evaluation, respectively. It has been described as more realistic indicator of a child's self-perception of their dental attractiveness than a questionnaire since it may be less prone to bias (Holmes, 1992). On the other hand, some children find the concept behind the AC difficult to comprehend and fail to select a photograph out of the 10 intraoral frontal photo series, which best presented their degree of dental attractiveness. This holds true for specific morphological traits that are not represented in the scale. The frontal intraoral photographs as bi-dimensional representations of three-dimensional shapes might be also expected to reduce conspicuousness of anterior irregularities and the prominence of overjet problems (Sherlock *et al.*, 2008). The OIs adopted by the reviewed studies for objective assessment of treatment need also present certain disadvantages. Lack of weightings, non-inclusion of common morphological traits, time-consuming scoring procedures, failure to discriminate small occlusal variations, or facial attractiveness implications have been recognized by several authors (Stenvik *et al.*, 1997; Fox and Chapple, 2004; Onyeaso and Sanu, 2005). As a consequence, rating of occlusal irregularities of concern to patients may be incorrect or overlooked.

A substantive number of papers engaged a single examiner to carry out the treatment need assessment. Two (Espeland *et al.*, 1993; Tang and So, 1995; Stenvik *et al.*, 1997; Chew and Aw, 2002; Kerosuo *et al.*, 2004; Hassan, 2006) or even eight examiners (Christopherson *et al.*, 2009) were involved in the study model scoring or clinical examination in the rest of the articles. Generally, experienced specialists participated in the reviewed studies; however, calibration measures were considered in a limited number of them (Espeland *et al.*, 1993; Birkeland *et al.*, 1996; Al-Sarheed *et al.*, 2003; Hamdan, 2004; Christopherson *et al.*, 2009). There is also a tendency for the orthodontist to be more critical on dental health grounds because of his greater knowledge of occlusion and experience with likely treatment outcome (Otuyemi and Noar, 1996). In a recent comparative study of dental students, residents, and orthodontists (Kuroda *et al.*, 2010), perceived needs for orthodontic treatment for maxillary protrusion changed with increasing experience and skills in dentistry and orthodontics. Finally, certain variations, in perception of treatment need, can be found between orthodontist and dentists worldwide (Spalj *et al.*, 2010) and should be taken into account in results interpretation. These differences are basically related to country of origin of specialists and payment method (Richmond and Daniels, 1998).

The heterogeneity in selected malocclusion and treatment need registration methods and the characteristics of the samples (age groups, educational background, parent inclusion, and orthodontic history exclusion) are matters that should be addressed by future researchers. A compact study protocol will prevent further division of the total studies into smaller subgroups and provide conclusive evidence.

Conclusions

No evidence-based conclusions could be drawn regarding the relation between subjective and objective treatment need due to the limited scientific value of the studies. Based on the results of the available studies, a high variability in the treatment need perception among laypersons and specialists was identified. Further comparative studies with adequately defined samples, rigid assessment protocols will improve our understanding on perceived needs in orthodontics and promote planning of health services.

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