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Perception of and Attitudes on Malocclusion: A Literature Review

Cover Page Footnote

I wish to thank my teachers : Johnson Hsin-Chung Cheng, Bolormaa Sainbayar and Ganjargal Ganburged for their help and support.

Perception and Attitudes on Malocclusion: A Literature Review

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ABSTRACT

Purpose: This study aimed to review published evidence on the perception of and attitude on malocclusion and to examine existing assessment tools and influencing factors.

Methods: PubMed, Cochrane Library, and Scopus databases, as well as electronic archives of the *European Journal of Orthodontics*, *American Journal of Orthodontics and Dentofacial Orthopedics*, and *Angle Orthodontist*, were searched to collect articles that compared perception differences between dental professionals and laypeople. Articles that investigated perceptions of dental professionals were excluded.

Results: The literature search identified 94 articles. A total of 31 suitable studies from 1970 to 2019 were finally considered in the review. Moreover, 65% of the reviewed studies used the Index of Orthodontic Treatment Need (IOTN) as a tool to determine perception of malocclusion; 29% of the studies were conducted in Europe, while only 9.6% were conducted in south and southeastern Asia. In addition, 25.8% of included studies investigated adult and adolescent subjects. Age and gender were the factors that most influenced perception of malocclusion.

Conclusion: The Aesthetic Component-IOTN is an effective tool to assess perception of malocclusion. However, modification or combination of indexes might help obtain better results. Gender and age were significant factors influencing perception of malocclusion. *Taiwanese Journal of Orthodontics* 2021;33(3):102–110

Keywords: Perception; Self-perception; Attitude; Malocclusion

1. INTRODUCTION

Perception is the awareness of the elements of the environment through physical sensation. By contrast, attitude is an individual's inclined state of mind regarding a value, and it is precipitated through a responsive expression towards oneself, a person, a thing, a place, or an event. Perception and attitudes on malocclusion are one of the important aspects in the orthodontic field.¹ A professional orthodontist estimates occlusion and function in treatment planning and consultation, while the patient might perceive other factors to be important to start the treatment.² As the ultimate goal of a health services 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.³ Numerous studies have evaluated these needs over the years; however, each study presented different opinions and results.⁴ Professional orthodontists are seen to have a more precise view of malocclusion, but the lay person perceives the same malocclusion as not requiring treatment.⁵ Conversely, in some studies, lay subjects overestimate their pretreatment dental appearance more than specialists.^{6,7}

Normal occlusion was introduced as early as the eighteenth century by John Hunter.⁸ The concept of malocclusion classification increased over 200 years,

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and many studies have been performed. It was first reported by Ackerman and Profit in 1969.⁸ In 1889, Edward Hartley Angle developed the concept that an ideal occlusion occurs if the mesiobuccal cusp of the maxillary first molar rests in the buccal groove of the mandibular first molar and if the rest of the teeth in the arch are aligned.⁸ The publication of the Angle classification in 1899 was a milestone in the development of orthodontics, not only to classify malocclusions, but also to include the first simple and clear definition of normal occlusion of the natural dentition.

Malocclusion is defined by orthodontists as a multifactorial problem with no specific cause.⁹ Assessing occlusion is important because malocclusion, defined as an improper alignment of the jaws and teeth, can interfere with dental–oral function, impair dental–facial aesthetics, and affect self-esteem.¹⁰ Over the years, besides Angle's classification, several alternatives have been developed.^{11,12} Currently, the World Health Organization (WHO) included malocclusion under Handicapping Dentofacial Anomaly, defined as an anomaly that causes disfigurement, impedes function, and requires treatment “if the disfigurement or functional defect was likely to be an obstacle to the patient's physical or emotional well-being” and estimated malocclusions as the third most prevalent oral health problem.^{13,14}

Malocclusion assessment indexes have been developed to take into consideration the perceived dental appearance from the individual's perspective in addition to the normative need determined by orthodontists.^{15,16} However, each assessment has its limitations.

Factors such as the self-perception of dental appearance, gender, age, desire to look attractive, and self-esteem are related to the self-perception and attitude of a lay person.^{17,18} Furthermore, gender, socio-economic background and age have been suggested as factors affecting the self-perception.¹⁹ Thus, this study aimed to present a review of published evidence on the perception of and attitude on malocclusion, to examine existing assessment tools, and to determine factors influencing layperson's perception of dental appearance.

2. MATERIAL AND METHODS

2.1. Study design

Guidelines of the Preferred Reporting Items for Systematic Review and Meta-analysis were followed in this study.²⁰

2.2. Search strategy

The search strategy was carried out to include three categories of headings “perception on malocclusion”, “perception and attitude on malocclusion” and “perception assessment on malocclusion”. All publications written in English were included. Databases of PubMed, Cochrane Library, and Scopus were searched for articles that meet the criteria for the review. Additionally, electronic archives of the *European Journal of Orthodontics*, *American Journal of Orthodontics and Dentofacial Orthopedics*, and *Angle Orthodontist* were searched to further collect related articles.

2.3. Inclusion and exclusion criteria

Articles that investigated perceptions of dental professionals were excluded from the review. Studies that compared perception differences between dental professionals and lay persons were included.

2.4. Data extraction

The following data were extracted: authors, publication date, published journals, country of the study, sample size, age of the subjects, study design, and affecting factors.

3. RESULTS

Initially by search of electronic databases resulted in total of 249 articles, after scanning and reading of titles of the studies, literature review resulted in 94 articles. After removal of duplicates, 69 suitable studies were retrieved. Abstracts were selected according to the inclusion criteria; 44 articles were eligible for full-text evaluation (Figure 1).

A total of 31 suitable studies from 1970 to 2019 were finally considered for this review (Figure 1). Assessments, perception of and attitude on malocclusion and factors that influence lay person's perception of dental appearance were summarized. In this study, 65% of the studies used the Index of Orthodontic Treatment Need (IOTN), approximately 20% used the Oral Aesthetic Subjective Impact Scale (OASIS), and 16.1% used the Dental Aesthetic Index (DAI) as tools to determine perception of malocclusion. Results of this study can present expectations rather than reliable conclusions about the difference in treatment perception between specialists and laypeople (Table 1).

This study reveals that of 31 suitable studies, 58% shows significance difference between specialist

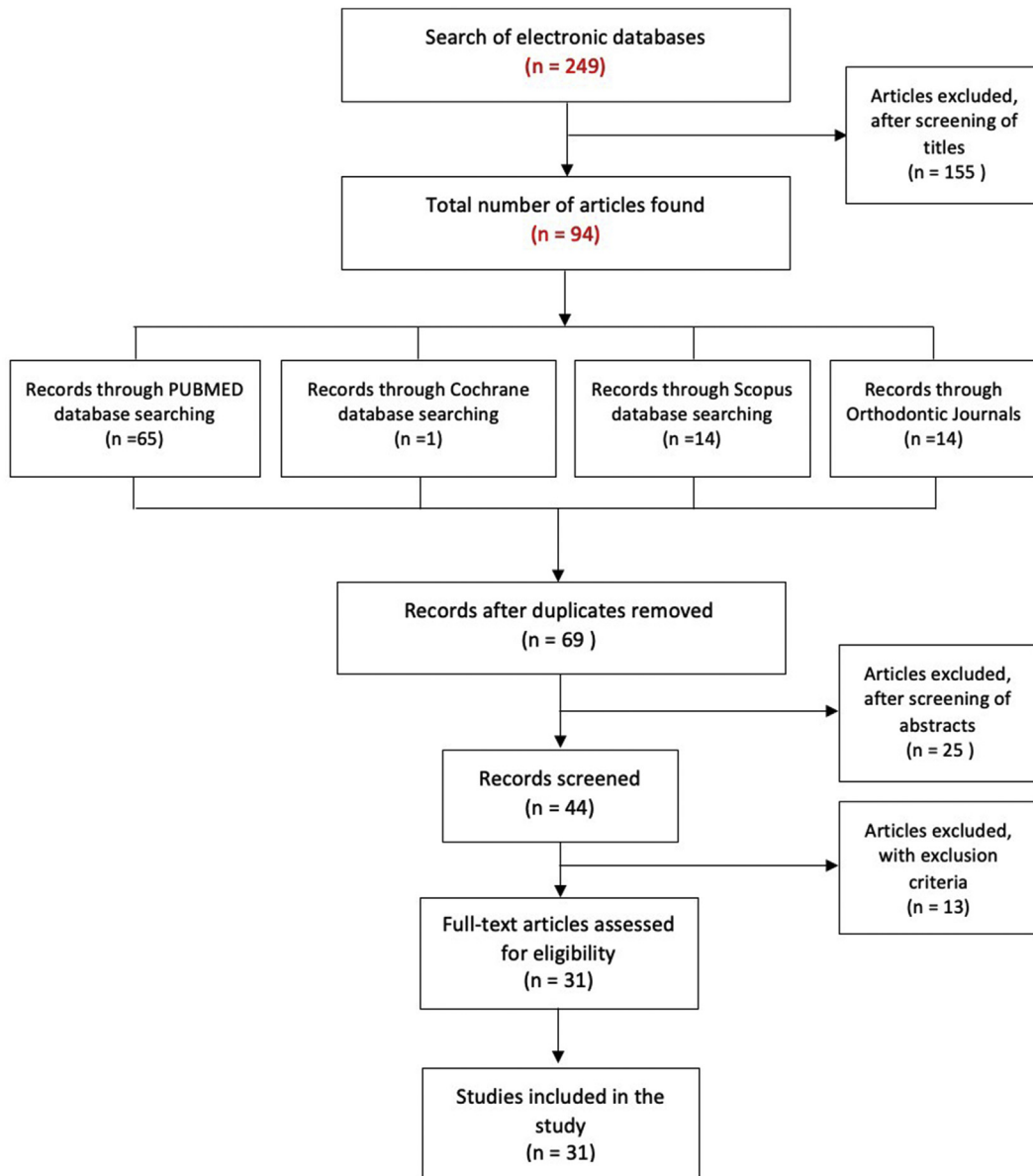


Figure 1. PRISMA flow diagram of the selection process.

and laypeople, while the study by Chu et al.²¹ revealed no significant difference and another study²² showed 84.5% agreement between researchers and subjects. Moreover, four studies used their own assessment of perception rather than a standardized index. Reichmuth²³ and Horowitz¹⁹ used drawings, Zheng²⁴ used six frontal intraoral photos, while Mugonzibwa¹ made modifications to the IOTN. The most examined and contradicting affecting factors were age and gender. Most (29%) of the studies were conducted in Europe, while 9.6% were conducted in south and southeastern Asia. In addition, 74.2% of included studies examined children.

3.1. Assessment of malocclusion

Correction of malocclusion may become the main reason for orthodontic treatment. Moreover, orthodontic treatment need and motivation have been one of the main reasons for the development of many dental appearance indices.^{15,25-27} The aim of such indices is to allow patients with the greatest need to receive orthodontic treatment, and patients with little need for treatment can be assured to receive treatment. Information on assessments is summarized in Table 1.

OASIS is the index that determines subjects' perception of and attitude on malocclusion. OASIS

Table 1. Summarized data of studies and assessments used in the review.

Study	Year	Publication	Country	Number of subjects	Age	Assessments	Significance (p)
Horowitz et al.	1970	96 th APHA	USA	759	9-14	Drawings	
Ann Holmes	1992	BJOO	UK	955	12	IOTN AC; IOTN DHC	<0.001**
Birkeland et al.	1996	AJO-DO	Norway	359	10.6	GSE; IOTN AC; IOTN DHC	25% of agreement
Stenvik et al.	1996	CDOE	Norway	123	18-35	NOTI	
Stenvik et al.	1997	EJO	Norway	386	12-20	NOTI	
Kerosuo et al.	2000	JOO	Finland	281	18-19	IOTN AC; IOTN DHC	45% of agreement
Mandall et al.	2000	EJO	UK	434	14-15	OASIS; IOTN AC; IOTN DHC	54% of agreement
Yeh et al.	2000	AJO-DO	USA	50	11-14	DAI; IOTN AC; IOTN DHC	<.05*
Chew et al.	2002	CDOE	Singapore	257	12	IOTN DHC	
Izabela Grywacz	2003	EJO	Poland	84	12	IOTN AC	84.5% of agreement
Mugonzibwa et al.	2004	AJO-DO	Tanzania	386	9-18	IOTN AC; IOTN DHC	
Hamdan et al.	2004	EJO	Jordan	103	15.3	18 photos IOTN AC; IOTN DHC	<0.05*
Flores-Mir er al.	2004	BJOO	Peru	780	1 st year students	IOTN AC; OASIS; VAS	<0.001**
Reichmuth et al.	2005	AJO-DO	USA	150	7-12	Drawings	
Alhajja et al.	2005	EJO	Jordan	1404	13-17	IOTN AC	
Hassan et al.	2005	BMC	Saudi Arabia	743	17-24	IOTN AC; IOTN DHC	<0.001**
Ajayi et al.	2006	BMC	Nigeria	120	10-12	WHO-FDI	
Bernabe et al.	2006	AO	Peru	630	freshmen	SCAN; OASIS	
Albarakati et al.	2007	PODJ	Saudi Arabia	371	12-16; >16	IOTN AC	<0.05*; 7.6% of agreement
Christopherson et al.	2009	AJO-DO	USA	1566	8-11	IOTN	<0.001**; r = -0.177)
Chu et al.	2009	OHPD	Hong Kong	240	18-27	IOTN DHC	>0.05
Marques et al.	2009	BMC	Brazil	403	14-18	OASIS; DAI	
Hamamci et al.	2009	EJO	Turkey	841	17-26	DAI	<0.001**
Badran et al.	2010	EJO	Jordan	410	14-16	GSE; IOTN AC; IOTN DHC	<0.01* r = 0.387
Dias et al.	2010	JOS	Brazil	407	9-12	IOTN AC; IOTN DHC	k = 0.0159
Danaei et al.	2010	EJO	Iran	900	12-15	DAI	Sig*
Claudino et al.	2013	BMC	Brazil	138	18-21	DAI; OASIS	<0.001**
Ghijsselings et al.	2014	EJO	Belgium	386	11-16	IOTN AC; IOTN DHC; OASIS	<0.001** (r = 0.37)
Siddiqui et al.	2014	SDJ	Pakistan	121	16-25	IOTN AC; IOTN DHC	<0.001**r = 0.516 k = 0.339
Zheng et al.	2018	SMJ	China	116	10-12	6 dental anterior dental photographs	

(continued on next page)

Table 1. (continued)

Study	Year	Publication	Country	Number of subjects	Age	Assessments	Significance (p)
Raghavan	2019	EJO	India	80	11-19	PIDAQ; SWLS; IOTN AC	<0.05*

Sig, significant; APHA, Annual Meeting of the American Public Health Association; BJOO, British Journal of Orthodontics; AJO-DO, American Journal of Orthodontics and Dentofacial Orthopedics; CDOE, Community Dental and Oral Epidemiology; EJO, European Journal of Orthodontics; JOO, Journal of Orofacial Orthopedics; BMC, Bio Med Central - Head & Face Medicine; AO, The Angle Orthodontist; PODJ, Pakistan Oral & Dental Journal; OHPD, Oral Health Prevention Dentistry; JOS, Journal of Oral Science; SDJ, The Saudi Dental Journal; SMJ, Saudi Medical Journal; GSE, Global Negative Self-evaluation Scale; IOTN, Index of Orthodontic Treatment Need; AC, Aesthetic Component; DHC, Dental Health Component; NOTI, Need for Orthodontic Treatment Need; OASIS, Oral Aesthetic Subjective Impact Scale; SCAN, Standardized Continuum of Aesthetic Need; DAI, Dental Aesthetic Index; PIDAQ, Psycho-social Impact of Dental Aesthetics Questionnaire; SWLS, Satisfaction with Life Scale; VAS, visual analog scale.

was developed by a Mandal et al in 1999.²⁸ It consists of five questions regarding concerns on self-perceived oral appearance. OASIS aims to assess self-perception of dental aesthetics: the higher the final score, the more likely a person has a greater negative perception of dental appearance.²⁸ However, this index involves questions that are difficult to understand for children and teenagers aged <12 years.²⁹

DAI is the next broadly used assessment.³⁰ DAI was developed in the United States and integrated by WHO in 1989 as an international index. This assessment connects objective measures of occlusal morphology with the ratings of social acceptability for those occlusal features.³¹ DAI assists dentists and public health programmers to determine which patients should be referred to an orthodontist. DAI can indicate the severity of malocclusion and can determine the level of orthodontic treatment needs, but does not assess occlusal traits such as deep overbite, buccal cross-bite, and severity of arch length. DAI links the clinical and aesthetic components mathematically to produce a single score.³²

Standardized Continuum of Aesthetic Need (SCAN) was described by Ruth Evans and William Shaw in 1986.³³ The index is arranged from the least to the most attractive dentition. As dataset for scale calibration, photographs of 1000 12-year-old subjects were provided, and six lay judges independently recorded their grading on a 10-cm visual analog scale anchored at each end, with description as very attractive and very unattractive. Ten cases, separated by equal intervals through the measured range, were abstracted to provide illustrations for a scale, representing a wide range of dental attractiveness.³³ When professionals were using the scale, consistency was reached, and an agreement between both parents and patients were higher.³³ However, this index has poor ability to represent dentofacial imbalance in the anteroposterior plane,

and photographs of 12-year-old samples still had transitional dentitions. However, SCAN was very simple to use in everyday practice as well as in epidemiological studies.

IOTN is a mostly used method of defining the severity of occlusion and defines the priority of treatment need. The IOTN was initially utilized by Swedish Dental Health Board and introduced by Brook and Shaw in 1989, and they initially called it the Index of Orthodontic Treatment Priority; later, it was renamed to IOTN.¹⁵ The index has an aesthetic component (AC) and a dental component (DHC).^{15,33} The accuracy of the index has been tested by several authors.^{16,34} Draker et al. found the IOTN to be the most accurate index (98%) in contrast to (DAI).³⁵ However, IOTN-AC only concerns the frontal view of occlusion and has limitations on identifying malocclusions, such as reverse overjet, open bite, and diastema. Moreover, IOTN-AC requires modifications for use in people with impaired sensory function (vision and hearing).

AC-IOTN assesses the aesthetic aspects of the malocclusion and was a modification of the SCAN index developed by Evans and Shaw in 1987.³³ The SCAN scale is arranged from the least to the most attractive dentition, while the AC scale is arranged from the most to the least attractive. AC-IOTN consists of scale of 10 color photographs showing different levels of dental attractiveness.

DHC-IOTN was based on the index of treatment priority used by the Swedish Dental Board.²⁵ It has five grades of treatment need and reports the malocclusion using specific traits: cross-bites, displaced contact points, missing or un-erupted teeth, overjet, or overbite.

Need for Orthodontic Treatment Index (NOTI) was initially described and implemented in 1992 by Espeland et al. and is also known as the Norwegian Orthodontic Treatment Index. The index was used by the Norwegian Health Insurance System for

reimbursement of treatment costs, and defined morphological traits have been allocated to four categories of need according to their severity.³⁶ As IOTN was not available for the examination at age 12 years, data from the recordings at age 12 years were applied to determine the NOTI category at that age.

In summary, occlusal indices characterize orthodontic treatment need from a professional orthodontist's perspective. The importance of patients' perceptions and attitudes regarding orthodontic treatment cannot be underrated.³⁷

3.2. Factors that determine the attitude on and perception of malocclusion

Various factors can be used to determine the attitude on and perception of malocclusion. The

most influencing factors are age, gender, ethnicity, socioeconomic background, living environment, orthodontic treatment status, etc.^{17,18} (Table 2).

3.2.1. Age

One of the major influencing factors is an age. In some studies adolescents tended to rate their dentition toward the more attractive. Stenvik and Espeland showed that a reliable self-perception is made by adult subjects.³⁸ By contrast, some authors have reported that the appropriate time is age 12 years when permanent teeth had erupted and orthodontic treatment may commence.³⁹ Most of the reviewed studies concluded that age was the one of the significant factors that influenced self-perception.^{1,40–44} However, some studies have shown that age was not a significant factor.^{19,45,46} According to

Table 2. Factors that determine the attitude and perception of malocclusion.

Factors	Significant		Not significant	
	Reference:	Significance (p)	Reference:	Significance (p)
Age	Mugonzibwa et al.	<0.05*	Horowitz et al.	0.87
	Alhaija et al.	<0.001**	Albarakati et al.	Not Sig
	Ajayi et al.	<0.05*	Dias et al.	>0.05
	Hamamci et al.	Sig*		
	Ghijsselings et al.	<0.001**		
	Raghavan et al.	<0.05*		
	Bernabe et al.	0.049*		
Gender	Kerosuo et al.	<0.01*	Ann Holmes	>0.001
	Izabela Grywacz	<0.05*	Horowitz et al.	0.98
	Alhaija et al.	<0.05*	Stenvik et al.	Not Sig
	Ghijsselings et al.	<0.001**	Chew et al.	Not Sig
	Birkeland et al.	0.07*	Flores-Mir et al.	>0.05
	Mandall et al.	0.014*	Ajayi et al.	Not Sig
			Albarakati et al.	Not Sig
			Chu et al.	0.41
			Badran et al.	Not Sig
			Danaei et al.	Not Sig
		Hamamci et al.	>0.05	
		Dias et al.	>0.05	
		Zheng et al.	>0.05	
		Zheng et al.	>0.05	
		Raghavan	Not Sig	
		Horowitz et al.	Not Sig	
Ethnicity	Reichmuth et al.	<.001**		
	Mandall et al.	0.017*; 0.03*		
Socioeconomic status	Mandall et al.	<0.001**	Mugonzibwa et al.	Not Sig
	Claudino et al.	0.001**	Dias et al.	>0.05
Areas of living	Reichmuth et al.	<.0001**	Raghavan	Not Sig
	Hassan et al.	<0.001**	Alhaija et al.	Not Sig
Treated and Untreated	Bernabe et al.	<0.001**	Kerosuo et al.	Not Sig
	Badran et al.	<0.05*	Flores-Mir et al.	>0.05
Others	Stenvik et al.	<0.01*	Mugonzibwa et al.	Not sig
	Yeh et al.	<0.05*		
	Chew et al.	Sig*		
	Hamdan et al.	Sig*		
	Christopherson et al.	Sig*		
	Marques et al.	<0.05*		
	Badran et al.	<0.001*		

Sig, significant; Not Sig, not significant.

three studies, age was not a significant factor because the age ranged from 9 to 16 years, and children within these ages are equally concerned about their dental appearance.

3.2.2. Gender

Factors such as gender was significant.^{3,19,21,24,41,43,45-51} However, other studies have pointed that female participants tended to rate their dentition as more attractive than did male participants.^{40,50,52} The desire to start orthodontic treatment garnered positive response from girls than from boys.²² However, a significant difference was found between male and female participants in their self-perceived need for treatment.^{22,28,40,42,53,54} As regards the concern of children, no significant gender difference was observed.¹

3.2.3. Ethnicity

Some authors show that perception of malocclusion was least affected by ethnicity.¹⁹ Reichmuth et al. consider of ethnicity as a significant influencing factor.²³ By contrast, some authors concluded that ethnicity did not influence layperson's self-perception.^{19,28} There is few studies consider about ethnicity because majority of studies conducted in Europe and it's difficult to include in study population from many different countries and races.

3.2.4. Socio-economic background

Socio-economic background has been suggested as a factor affecting self-perception of dental appearance; high social class individuals are considered more critical than lower social class individuals.^{19,28,55} However, some studies have shown that social deprivation did not influence a child's and adults orthodontic self-perception.^{1,28,43,46} In a study of Marques et al., 69% of the participants were unable to receive orthodontic treatment because of the high financial costs.⁴⁷ Socio-economic factor has always been one of the important factors to provision of orthodontic treatment and one of the factors that affect perception of and attitude on malocclusion.

3.2.5. Treated and Untreated

Some studies have shown no significant differences in perception of occlusion in the treated and untreated groups.^{38,49,53} However, studies of Badran and Bernabe found significant difference between treated and untreated participants.^{44,50} The perceived social impact of malocclusion was influenced by the opinions of other people. However, the social impact of malocclusion showed moderate to weak correlations.⁵⁰

3.2.6. Others

Results of the reviewed studies revealed that other factors such as motivation to seek treatment, speech, parent's perception, education, occupation, and self-esteem are factors that determine perception of and attitude on malocclusion.^{6,37,38,47}

3.3. Clinical application

Results of the majority of studies suggest that orthodontists do not have the same perception extent as lay people. Thus, patient's self-perception and attitude is important to overall treatment planning. Understanding the aesthetic perceptions of patients allows specialists to meet patients' expectations and eventually improves clinical practice. Better knowledge of a patient improves the design of the treatment plan, enhances communication between orthodontists and patients, and results in better patient compliance. As a result, patients' cooperation will improve. Information about perception of and attitude on malocclusion can affect decision making to orthodontic treatment, continuing education for oral health personnel, and public health programs. Moreover, demographic features such as gender, age, and socioeconomic backgrounds have a significant correlation and association with patient's perception. Therefore, orthodontists should educate patients about factors that have significant correlation with perception of occlusion.

3.4. Further investigation

Other factors, such as culture, race, and economic factors, may play a more significant role in an individual's self-perception, and this needs to be further investigated. Majority of studies were conducted in European population, and there is lack of studies in Asian population. A modification of the IOTN-AC to better reveal patient's evaluation of their self-perception of dental aesthetics should be reviewed¹⁸ because patients with reverse overjet and open bite malocclusions face difficulties when they select one of the 10 photographs of IOTN-AC.⁵⁶ Moreover, IOTN-AC should be modified for application in individuals with impaired sensory (vision and hearing) function. To our knowledge, only one study investigated self-perception of malocclusion in young children in impaired sensory function.⁵⁷

4. CONCLUSIONS

Results of this review reveal that AC-IOTN is an effective tool to assess perception of malocclusion. Moreover, recording of this index takes between 1

and 3 min in majority (65%) of the studies that used IOTN. For instance, combination of the indexes (OASIS) might help increase layperson's perception of and attitude on malocclusion. Gender and age were factors that affect perception of malocclusion, but there might be more other factors.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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Ethical approval

Not required.

Patient consent

Not required.

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