

**THE IMPACT OF MALOCCLUSION ON SELF-
ESTEEM AND ORAL HEALTH RELATED
QUALITY OF LIFE**

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LIST OF ABBREVIATION

CPQ	Child Perception Questionnaire
DAI	Dental Aesthetic Index
DMFT	Decayed, Missing, and Filled Teeth
GNSSES	Global Negative Self Evaluation Scale
ICP	Intercuspal Position
IOTN	Index Of Orthodontic Treatment Need
IOTN AC	Index of Orthodontic Treatment Need- Aesthetic

IOTN DHC Index of Orthodontic Treatment Need- Dental Health Component

MRSM Maktab Rendah Sains MARA

OHIP-14 Oral Health Impact Profile-14

OHRQoL Oral Health Related Quality of Life

RCP Retruded Contact Position

RSES Rosenberg Self-Esteem Score

SD Standard Deviation

TMD Temporomandibular joint Dysfunction

% Percentage

mm millimeter

≥ Less than

IMPAK MALOKLUSI HARGA DIRI DAN KUALITI HIDUP BERKAITAN KESIHATAN ORAL

ABSTRAK

Latar Belakang: Dengan memahami lebih lanjut kesan maloklusi terhadap harga diri dan pelbagai domain pada Kualiti Hidup Berkaitan Kesihatan Oral (OHRoL) seperti fungsi, fizikal, sosial dan psikologi di sekolah kanak-kanak, ia akan membantu dalam merancang rawatan yang realistik, seperti yang diharapkan oleh pesakit.

Matlamat: Untuk menentukan kesan keterukan maloklusi terhadap harga diri dan (OHRQoL) di kalangan pelajar etnik Melayu. Kajian ini juga menilai hubungan keterukan maloklusi dengan harga diri dan (OHRQoL).

Kaedah: Kajian keratan rentas prospektif ini dijalankan ke atas 256 pelajar Melayu berumur 13 hingga 16 tahun. Penilaian harga diri Rosenberg dan soal selidik OHIP-14 digunakan untuk menilai harga diri kanak-kanak dan Kualiti Hidup Berkaitan Kesihatan Oral. Pemeriksaan oral dilakukan menggunakan pengukur IOTN untuk memeriksa keterukan maloklusi. Koefisien korelasi Pearson digunakan untuk menilai hubungan antara keterukan maloklusi, harga diri, dan (OHRQoL). Analisis regresi dilakukan untuk menentukan kesan keparahan maloklusi harga diri dan (OHRQoL).

Keputusan: 139 (55.2%) peserta adalah lelaki dan 113 (44.8%) adalah perempuan. 133 (52.8%) berumur 13-14 tahun dan 119 (47.2) berumur 15-16 tahun. Markah min dan sisihan piawai RSES dan OHIP-14 masing-masing adalah 33.64 ($\pm$ 3.40) dan 9.72 ($\pm$ 8.39). Tidak terdapat perbezaan yang ketara dalam tahap keterukan maloklusi antara lelaki / wanita dan kumpulan umur pelajar ($p < 0.01$). OHIP-14 secara signifikan dan positif dikaitkan dengan

seks, perempuan mempunyai skor kesan yang lebih tinggi daripada lelaki, B adalah 2.413 dengan $p < 0.05$ menunjukkan persamaan signifikan antara seks dan skor OHIP-14, persamaan ini menjadi lebih kuat dalam model multivariat ($B = 2.673$; 95% selang keyakinan [CI], 0.639-4.707; $p < 0.05$). Terdapat persamaan penting antara IOTN-DHC dan OHIP-14, $B = 1.235$ $p < 0.05$.

Kesimpulan: Perempuan menunjukkan lebih banyak kesan negatif terhadap maloklusi pada (OHRQoL) mereka. Korelasi positif yang lemah didapati antara maloklusi dan (OHRQoL). Dalam kajian ini (OHRQoL) pelajar dipengaruhi oleh keterukan maloklusi. Kajian ini memberikan maklumat bahawa kualiti hidup yang rendah dikaitkan dengan keterukan maloklusi.

IMPACT OF MALOCCLUSION ON SELF-ESTEEM AND ORAL HEALTH RELATED QUALITY OF LIFE

ABSTRACT

Background: By further understanding the impact of malocclusion on self-esteem and different domains of Oral Health Related Quality of Life (OHRQoL) such as functional, physical, social and psychological in school children, it will aid in planning a realistic treatment, as expected by patients.

Aim: To determine the impact of the severity of malocclusion on self-esteem and OHRQoL among Malay ethnic students. This study also evaluated the relationship of malocclusion severity with self-esteem and OHRQoL.

Method: This prospective cross-sectional study was conducted on 252 Malay students aged 13 to 16 years old. Rosenberg self-esteem Scale (RSE scale) and Oral Health Impact Profile-14 questionnaires (OHIP-14) were used for assessing the children's self-esteem and OHRQoL respectively. Oral examination was performed by the use of Index of Orthodontic Treatment Need (IOTN) ruler to examine the severity of malocclusion. Pearson correlation coefficient was used to evaluate the relationship between severity of malocclusion, self-esteem, and OHRQoL. Regression analysis was done to determine the effects of the severity of malocclusion on self-esteem and OHRQoL.

Result: 139 (55.2%) of participants were male and 113 (44.8%) were female. 133 (52.8%) aged 13 to 14 and 119 (47.2) were 15 to 16 years old. Mean scores and standard deviation of the RSES and OHIP-14 were 33.64 (± 3.40) and 9.72 (± 8.39) respectively. There was no statistically significant difference in malocclusion severity between male/female and students age group ($p > 0.05$). A weak positive relationship was observed between OHIP-14 and IOTN

DHC ($r = 0.186$; $p < 0.01$). OHIP-14 was significantly and positively associated with sex, females have higher impact scores than males ($B = 2.413$; $p < 0.05$), indicating the significant association between sex and OHIP-14 score. This association became stronger in multivariate model [$B = 2.673$; 95% confidence interval (CI) = 0.639-4.707; $p < 0.05$]. There was a significant association between (IOTN-DHC) and OHIP-14. ($B=1.235$ $p < 0.05$).

Conclusion: Female exhibited more negative impact of malocclusion on their OHRQoL. A weak positive correlation was found between malocclusion and OHRQoL. In the present study the OHRQoL of the students was affected by malocclusion severity. This study provided information that low quality of life was associated with severity of malocclusion.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Even though malocclusion is not considered as a disease and it is not a life-threatening condition, a high demand for treatment can be noticed. Malocclusion is considered an important health issue all over the world (Petersen, 2003). Epidemiological studies of malocclusion reported a high prevalence of this condition in different countries (Thilander & Myrberg, 1973). It seems that malocclusion and orthodontic treatment need become a health care issue and subsequently a quality of life problem (Liu *et al.*, 2009).

Social relationship of people can be adversely affected by their dentation and facial morphology, and severe malocclusion can have a negative impact on self-esteem (Choi *et al.*, 2016). Self-esteem is defined as individual's subjective emotional evaluation of his or her own worth (Hewitt, 2009). According to Rosenberg (1965) individual with high self-esteem has self-respect and consider her or his self a person of worth, is aware of his or her faults and at the mean time appreciate his merit. In contrast lack of self-respect, feeling of being unworthy, inadequate and in severe case being deficient as a person is correspond with low self-esteem (Gray-Little *et al.*, 1997).

Studies on psychological aspect of malocclusion shaded light on the effect of malocclusion and orthodontic treatment on self-esteem of adolescents (Jung, 2010). Even though malocclusion can cause difficulties in maintaining oral hygiene, chewing, swallowing, speech, breathing, and predisposing to oral habits which can result in pain and

discomforts, in majority of cases the key motivator for orthodontic treatment is the cosmetic impairment caused by the malocclusion (Albino *et al.*, 1990).

The concept of OHRQoL is correlated with the impact of oral condition on a person's daily function, well-being, or overall quality of life (Aldrigui *et al.*, 2011). Studies on social, psychological and physical impact of malocclusion on individual's OHRQoL lead to understanding of effects of malocclusion on people's wellbeing. Therefore, the need for orthodontic treatment from patient point of view can also be considered (Masood *et al.*, 2013).

According to O'Brien *et al* (2007) discrepancies can be found regarding need for treatment between patients determined by clinician using the IOTN DHC (Brook & Shaw, 1989) and patient's self-perception about their own teeth using IOTN Aesthetic Component (IOTN AC). Many developed tools for assessing the need for orthodontic treatment are based on functional and dental health reason and they are not able to reflect the main concern of the patient which is aesthetic impairment.

Studies on the impact of malocclusion on self-esteem and OHRQoL have shown controversies. One study found that malocclusion causes low self-esteem in girls (Jung, 2010), while other study found no difference between male and female, also the correlation between need for orthodontic treatment and self-esteem was low (Badran, 2010).

Many studies reported the negative impact of malocclusion on OHRQoL (Choi *et al.*, 2016, Masood *et al.*, 2013). The results of these studies shades light on the importance of patient-based assessment of oral health status and oral health need. Combination of functional based assessment by clinician together with the self perceived need for orthodontic treatment can lead to better outcome.

1.2 Statement of Problem

In Malaysia the prevalence of malocclusion in children who requires treatment is 37.4% among all ethnic groups (Esa *et al.*, 2001). Malocclusion can be one of the causes of dental trauma in children, Grimm *et al* (2004) found a positive association between maxillary overjet and anterior teeth trauma. Malocclusion can also cause conditions such as appearance discrimination, oral function problems such as jaw movement due to muscles disharmony, pain, difficulties in mastication, swallowing, speech, caries and periodontal diseases (Proffit, 2013). All of these factors influence the quality of life of an individual.

Besides all these self-esteem is another variable that can be negatively affected by malocclusion (Badran, 2010). There is little information about impact of malocclusion on self-esteem and (OHRQoL) of school children in Malaysia, and if the use of quality of life measure such as OHIP-14 and self-esteem measure lead to a better understanding of need for treatment which can end up with patient satisfaction.

1.3 Justification of study

Understanding the impact of malocclusion on self-esteem and different domains of OHRQoL such as functional, physical, social and psychological can lead to plan a proper treatment in a good time, this can help in prevention of unfavorable consequences of malocclusion.

Also by acquiring knowledge regarding the impact of malocclusion on individual's perception of body image, orthodontic treatment can be provided as required by the patient, case studies revealed improvement in self-esteem and depressive symptoms in patients after treatment (Nicodemo *et al.*, 2008).

The IOTN DHC which record the treatment priority based on dental health and functional ground can be used to assess the treatment need according to dentist's point of view. But inclusion of patient self-perception of their own need for treatment by using tools such as OHIP-14 and RSE scale can lead to a proper treatment plan which can end up with the patient's satisfaction.

1. 4 Objectives

1. 4 .1 General Objectives

To determine the impact of malocclusion on self-esteem and OHRQoL among 13 to 16 years old school children.

1. 4 .2 Specific Objectives

- 1) To determine the severity of malocclusion, self-esteem and OHRQoL among children aged 13-16 years old.
- 2) To compare the RSES and OHIP-14 score between sex and age groups.
- 3) To compare the RSES and OHIP-14 score according to severity of malocclusion.
- 4) To determine the relationship between malocclusion severity, self-esteem and OHRQoL.
- 5) To determine the effect of malocclusion severity on self-esteem and OHRQoL.

1.5 Research Hypotheses

- 1) There is an association between severity of malocclusion, self- esteem and OHRQoL to sociodemographic data.
- 2) There is a relationship between malocclusion severity, self-esteem and OHRQoL
- 3) Malocclusion severity negatively affects student's self-esteem and OHRQoL.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition and Classification

Occlusion can be defined as intercuspation of upper and lower teeth, and it occurs as a result of interaction between masticatory system which includes teeth, periodontal structures, maxilla and mandible, temporomandibular joint, and related muscles and ligaments (Ramfjord & ASH, 1994).

Angle's Classification (1899) (Figure 2.1) provided a simple description of a normal occlusion as well as different types of malocclusion. He introduced the first upper molar, as the key of occlusion. In which a normal molar relationship was described as, mesiobuccal cusp of upper first molar lies in the buccal groove of lower first molar. If the teeth are positioned in a slight and catenary curve of occlusion line and relationship of molars exists as mentioned above, it is called a normal occlusion. This description is useful until now except in cases of tooth size discrepancy.

Various methods are existed for the classification of malocclusion, and different types of indices are present. According to molar relationship, Angle classified the malocclusion into three classes:

Class I: there is a normal relationship between upper and lower first permanent molars but the occlusion line is changed due to malposition or rotation of some teeth.

Class II: Lower first molar positioned distally to the upper molar and occlusion line does not have any special characteristics.

Class III: Lower first molar positioned mesially to upper first molar, without any special characteristic of occlusal line.

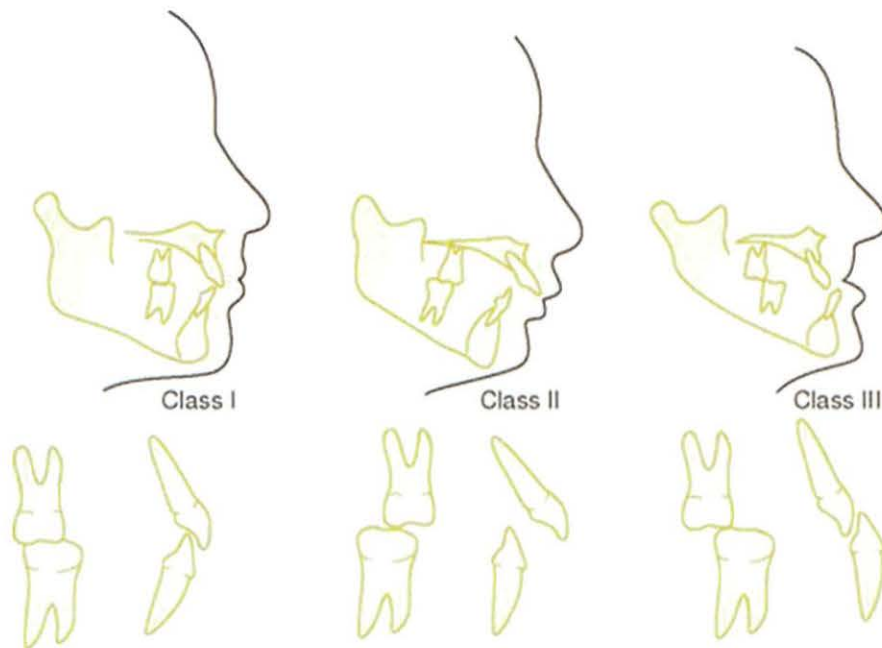


Figure 2.1 Angle Classification of malocclusion (Davis & Cladis, 2016)

Andrews (1972) introduced the six keys which treatment plans based on that:

Molar relationship: The mesiodistal cusp of the upper first permanent molar must lie in buccal groove between mesial and middle cusps of lower first permanent molar. The distal surface of the distobuccal cusp of the upper first permanent molar must be occluded with the mesial surface of the mesiobuccal cusp of the lower second molar.

Crown angulation “tip”: This denotes to the angulation of the long axis of the crown not entire tooth, which is particular for each tooth. The gingival part of the long axis of all crowns were leaning distally to the incisal edge. For the incisors, canine, and premolar the middevelopmental ridge is deemed as long axis. For the molar crown the prominent buccal grove.

Crown inclination: It is the inclination of labiolingual or buccolingual of the long axis of the tooth.

Rotation: There shouldn’t be any rotation.

Space: Teeth must be in tight contact to each other.

Occlusal plan: Spee curve can be vary from flat shape to slight curve.

A method for measurement of occlusal traits was developed by the Federation Dentair International (FDI) commission on classification and statistics for oral conditions (Hassan & Rahimah, 2007). The aim of this classification was to provide a measurement system that could assess the occlusal conditions. This classification includes:

I: Developmental anomalies such as developmentally missing teeth, malformed and supernumerary teeth, missing teeth due to trauma and extraction, over retained deciduous teeth and impacted teeth.

II: Intra-arch assessment including spacing, upper midline diastema, anterior irregularities and crowding.

III) Inter-arch assessment, for posterior openbite, anterior openbite, posterior crossbite, midline deviation, overjet, and overbite with and without soft tissue trauma.

Björk *et al*, (1964) developed a measurement system for evaluation of malocclusion. This Classification commonly is used in epidemiological studies. This Classification includes:

I: Dentation anomalies such as tooth anomalies, abnormal eruption and misalignment of individual teeth.

II) Occlusal anomalies including deviations in the positional relationship between the upper and the lower dental arches in the three planes.

III) Deviation in space conditions such as spacing and crowding of the teeth

For assessment of the malocclusion severity, IOTN that was developed by Brook and Shaw (1989) has been widely used for determining orthodontic treatment need of a patient. This index consisted of two components: IOTN Dental Health Component (DHC) (**Table 2.1**) which evaluates the orthodontic treatment need according to dental health and functional ground and the second component is the IOTN AC (**Figure 2.2**) which records the aesthetic impairment caused by the malocclusion and provide justification for orthodontic treatment need on a psychosocial ground.

Table 2.1: Dental Health Components of Index of Orthodontic Treatment Need**Grades of IOTN-DHC**

Grade 1: No treatment need

Extremely minor malocclusion with contact point displacements of less than 1 mm

Grade 2: Minor anomaly, No treatment need

2.a Overjet > 3.5 mm and ≤ 6 mm (with competent lip closing)

2.b Reverse overjet between 0 and ≤ 1 mm

2.c Anterior or posterior crossbite with 1 mm discrepancy between RCP and ICP

2.d Contact point displacements > 1 mm and ≤ 2 mm

2.e Anterior or posterior open bite > 1 mm and ≤ 2 mm

2.f Increased overbite of ≥ 3.5 mm (without gingival contact)

2.g Class II or Class III occlusion without other anomalies (up to half a premolar width)

Grade 3: Borderline treatment need

3.a Overjet > 3.5 mm and ≤ 6 mm (incompetent lip closing)

3.b Reverse overjet between 1 and ≤ 3.5 mm

3.c Anterior or posterior crossbite with > 1 mm and ≤ 2 mm discrepancy between RCP and ICP

3.d Contact point displacements > 2 mm and ≤ 4 mm

3.e Lateral or anterior open bite > 2 mm and ≤ 4 mm

3.f Deep overbite with gingival contact or contact with palatal mucosa (but without trauma)

Grade 4: Treatment need

4.h Less severe hypodontia requiring prerestorative orthodontics or orthodontic space closure to obviate the need for prosthetic restoration

4.a Overjet > 6 mm and ≤ 9 mm

4.b Reverse overjet > 3.5 mm (without masticatory or speech problems)

4.m Reverse overjet > 1 mm and ≤ 3.5 mm (without masticatory or speech problems)

4.c Anterior or posterior crossbite with > 2 mm discrepancy between RCP and ICP

4.l Posterior lingual crossbite with no functional occlusal contact in one or both buccal segments

4.d Major contact point displacements > 4 mm

4.e Extreme lateral or anterior open bite > 4 mm

4.f Increased and complete overbite with gingival or palatal trauma

4.t Partially erupted teeth, tipped and impacted against adjacent teeth

4.x Existence of supernumerary teeth

Grade 5: Treatment need

5.i Impeded tooth eruption (3rd molars) attributable to crowding, displacements, supernumerary teeth, retained deciduous teeth and all pathological reasons

5.h Extensive hypodontia with restorative impact (more than 1 congenitally missing tooth in any quadrant) requiring prerestorative orthodontics

5.a Increased overjet > 9 mm

5.m Reverse overjet > 3.5 mm with masticatory problems and speech disorders

5.p Cleft lip and palate and other craniofacial anomalies

5.s Retained deciduous teeth

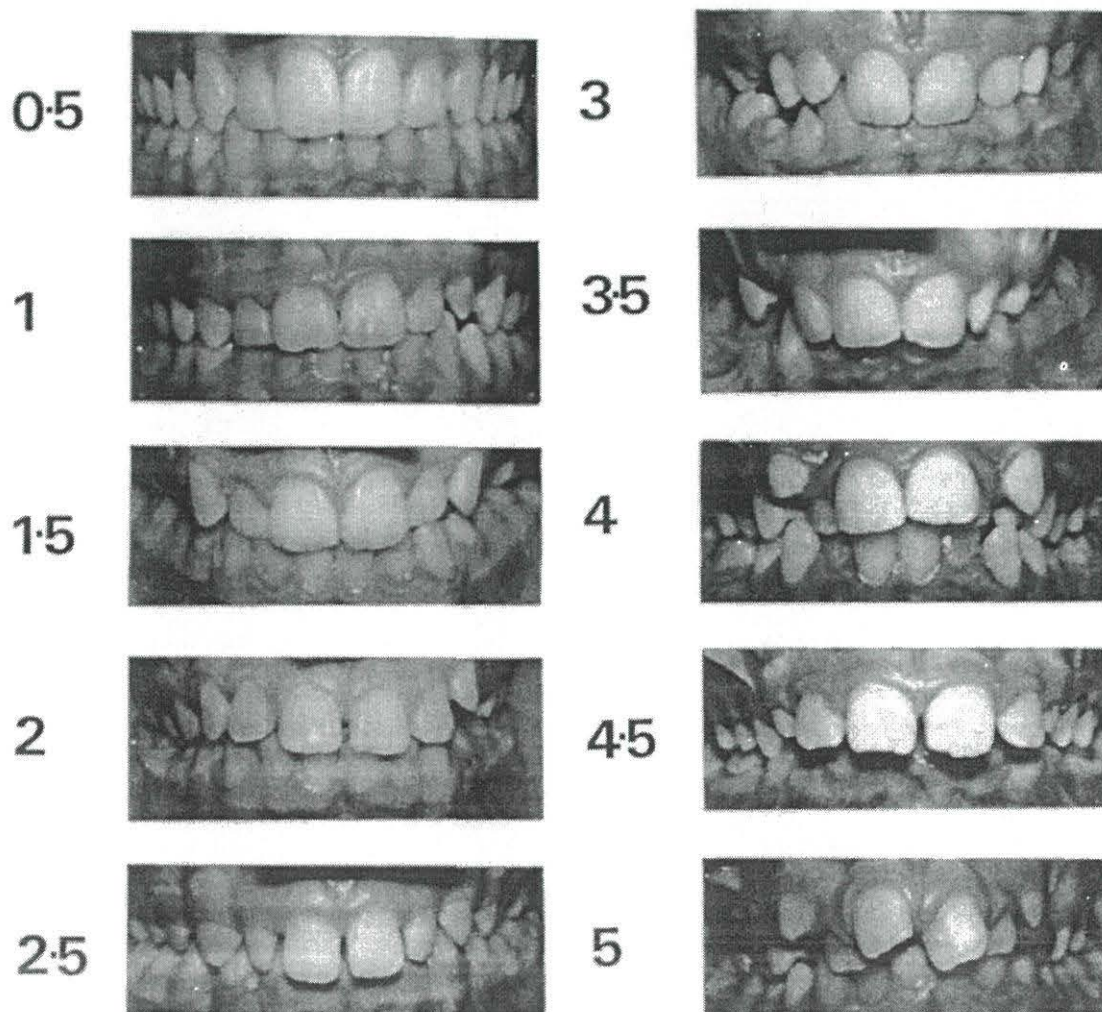


Figure 2.2 Aesthetic components of IOTN (Brook & Shaw, 1989)

2.2 Malocclusion and Dental Conditions

Protruded incisors increase the chance of anterior teeth trauma as reported by Grimm *et al*, (2004), which pointed out a positive association between maxillary overjet $\geq 3\text{mm}$ in children aged 12 with dental trauma. They investigated the possible reasons for dental trauma and in their study they found a high prevalence of 52% of maxillary overjet in school children aged 12 years old. It was also suggested that poor lip coverage in children is related with

increased risk for traumatic injuries in anterior region and children with inadequate lip coverage are five times more likely to dental injuries than the other groups. The maximum number of injuries have been found in children with Class II division 1 incisor relationship and the least injury was recorded for Class II division 2 malocclusion in comparison to Class III malocclusion (Patel & Sujana, 2012).

A study on prevalence of malocclusion and its association with dental caries by Gabris *et al*, (2006) revealed that orthodontic anomalies such as crowding may be associated with susceptibility to plaque retention and development of caries. By using the decayed, missing, and filled teeth (DMFT) index in this study they found a statistically significant association between presence of the malocclusion, caries experience and level of oral hygiene ($p < 0.05$).

Despite of demographic, and socioeconomic factors, clinical of aspect malocclusion is also an important factor for occurrence of dental caries. As dental caries is a multifactorial disease and the contribution of socioeconomic, behavioral and biological aspect are important Feldens *et al*, (2015) reported a significant involvement of malocclusion in the occurrence of dental caries. This study also suggested that the malocclusion made the teeth 30% more susceptible to develop dental caries, and increase in severity of dental caries (demonstrated by DMFT) found to be related with severity of the malocclusion and the need for orthodontic treatment.

Geiger, (2001) suggested no statistical relationship between different type of the malocclusion as described by Angle classification and periodontal health of the subjects. The study revealed that there is no association between Class II malocclusion and periodontal pathologies however in severe type of overjet there was an association with periodontitis. By contrast Poulton and Aaronson (1961) suggested that severe type of malocclusion can be

considered as causative factor for periodontal diseases, malocclusion lead to direct trauma to soft tissue by food particles. This is because of the abnormal structure of gingiva that environs the misaligned teeth which makes them prone to abrasive forces and irritants. Furthermore, food impaction and compromised natural cleaning of the oral cavity may lead to further problem.

Functional disturbances of the masticatory apparatuses are common in children and adolescent. A study by Thilander *et al*, (2002) revealed that 25% of children and adolescents have a mild degree of functional disturbances which they found it more common in female. They also found a significant association between temporomandibular joint dysfunction (TMD) and posterior cross bite, anterior open bite, Angle Class III malocclusion, and severe overjet. In another study that compared subjects with signs and symptoms of TMD with those without TMD problem, it was reported that only crowding of the teeth was significantly correlated with TMD (Mohlin *et al.*, 2004).

Sonnesen *et al*, (1998) study, revealed a high prevalence of different traits of malocclusion and their associations with TMD. Angle Class II malocclusion was recorded the most prevalent trait (72%) followed by crowding (57%), severe overjet (37%), and deep bite (31%). They also pointed out a significant association between signs and symptoms of TMD and various malocclusion traits such as distal molar occlusion, open bite, extreme overjet, unilateral cross bite, midline displacement, and disturbances in tooth formation. Their study also suggested that children with severe types of malocclusion were at higher risk to develop TMD. Most importantly, tooth formation disturbances such as peg-shaped lateral and developmentally missing of the teeth in dental arch were significantly associated with signs and symptoms of TMD.

In a longitudinal study of orthodontic treatment and its influence on symptoms and signs of TMD (Egermark *et al.*, 2003), it showed that unilateral cross bite is related to the signs and symptoms of TMD ($p < 0.01$). They also found that subjects with malocclusion are at high risk of developing signs and symptoms of TMD in long-term compared to subjects without malocclusion. By contrast some other studies (Mohlin *et al.*, 2007), (Sousa *et al.*, 2015) reported no association between malocclusion and TMD.

2.3 The impact of malocclusion on children's self-esteem

In social and personality research, self-esteem is one of the most frequently measured construct. Self-esteem as a global, unidimensional construct is composed of different domains; such as home, work, and social or can be specified in one area of functioning, for example, academic self-esteem. Although the measurement of self-esteem reflects these diverse conceptualisations, the self-report is the most frequently used approach. The RSE scale is a self-reported instrument used to assess the level of self-esteem (Rosenberg, 1965). Many studies (Sinclair *et al.*, 2010) (Bagley *et al.*, 2007) revealed a high reliability and validity of RSE scale. Bagley and Mallick (2001) conducted a study on secondary school children aged 12-19 years, they showed that RSE scale can be used as a valid and reliable instrument for assessing the self-esteem of school children in England.

Physical attractiveness begins to function as a significant personal characteristic very early in individual's life (Dion & Berscheid, 1974) which can be affected by malocclusion. In a psychological assessment of a large adolescent population Jung (2010) found that anterior crowding led to low self-esteem in adolescent girls. In this study the adolescent with anterior crowding had a lower self-esteem than that of protruded group.

The United State Public Health Service reported a 49% prevalence of crowding in

adolescents aged between 12 to 17 years old and a higher demand for orthodontic treatment was recorded for girls (11.8%) compared to boys (9.6%) (Kelly & Harvey, 1977). According to Seehra *et al*, (2011), malocclusion affected the individual's body image formation, self-esteem, and social integration rather than functional limitation. This study also suggested that other factors such as status seeking, parental wishes and peer acceptance could play a role and affect self-esteem and could be a core factor for treatment.

A study of the level of self-esteem and depression pre and post-operative in patients with Angle Class III malocclusion with reverse overjet of $4 \geq$ mm showed a statistically significant change in self-esteem and depressive symptoms of patients after treatment and this improvement was more noticeable in female (Nicodemo *et al.*, 2008).

A study on 1784 adolescents aged 10 to 17 years old was conducted to assess the different types of dental disorders such as decay, anterior teeth trauma, missing teeth and malocclusion and their impact on adolescent's self-esteem, Kaur *et al*, (2017). They reported low self-esteem in children with dental disorders including malocclusion that was measured with IOTN DHC and AC.

In a comparison of self-esteem score in 12 to 16 years old children with Angle Class I, II and III malocclusion, it was found that the mean score of Rosenberg self-esteem scale was not significantly different between sex. Analysis of COVARIANCE indicated that adolescents that exhibited Class II malocclusion had significantly higher RSES score compared to other groups. In further analysis, they reported that only participants with Class II division 2 malocclusion seemed to have higher self-esteem compared to other groups. Their study also suggested that self-esteem was not associated with different classes of Angle malocclusion (Florián-Vargas *et al.*, 2016).

A longitudinal study was conducted in 1981, evaluating the effect of malocclusion and orthodontic treatment need on self-esteem of 1018 participants aged 11 to 12 years old.

In this study, they extensively assessed the dental health and psychosocial wellbeing of the participants. Facial and dental photographs along with the plaster casts of participant's dentition were assessed to evaluate the attractiveness and need for orthodontic treatment. This study revealed that subjects who received orthodontic treatment exhibited satisfaction with their dentition however, self-esteem was not associated with the malocclusion and there was little evidence suggesting that orthodontic treatment would improve long-term psychological health in participants (Kenealy *et al.*, 2007).

An interesting four years longitudinal cohort study was done in Norway to evaluate the association of malocclusion to self-esteem. In 1993 a sample of grade four students (11 years old) from eight regions of Norway were invited to participate. This study was conducted on 359 school children aged 11 years old, a questionnaire was sent to the participants which included the Global Negative Self Evaluation Scale (GNSES) and occlusion satisfaction of the children. In 1996 to 1997, same group of students were invited again to participate in the follow up study. In both studies the clinical examination was conducted and the dental casts were obtained to evaluate the occlusion status using IOTN DHC. Positive self-esteem was observed for children aged 15 years compared to younger children, also an improvement in self-esteem was evident in children after in later stages of treatment. However, the reason for improvement was claimed to be age related rather than orthodontic treatment per se (Birkeland *et al.*, 2000).

Varela and Garcia-Camba conducted a cohort study on 40 patients in 1995. 37 women and three men aged 18 to 40 years were included in this study. For psychological evaluation of the subjects, the questionnaires were distributed within different time interval, one to four weeks before initiation of treatment, 6 months after start of treatment, and 2 to 4 weeks after termination of treatment and removal of all orthodontic appliances except retainers. Participants of this study exhibited normal score in different self-concept dimensions

specifically self-esteem. No relationship between severity and type of malocclusions and subjects body image score was found and self-esteem was not changed over time (Varela & García-Camba, 1995).

Psychosocial effect of orthodontic treatment in patients with impaired aesthetic as a result of malocclusion was assessed in a longitudinal study. 93 patients aged 11 to 14 years old were randomly assigned for orthodontic treatment. Participants had mild to moderate malocclusion, the psychosocial status of the participants were assessed using different psychosocial and social measures including Coopersmith Self-Esteem Inventory, RSE scale proved after orthodontic treatment and the difference was statistically significant ($P<0.01$) but this was not related to orthodontic treatment (Albino *et al.*, 1994).

A study was also conducted to evaluate the effect of malocclusion and self-perceived aesthetic on self-esteem of adolescents. Their findings indicated that students with higher need for orthodontic treatment as assessed by DHC and AC of IOTN were dissatisfied with their dental appearance. The self-perceived aesthetic assessment of students showed that students with low self-esteem as measured by Global Self-Esteem scale (GSE), exhibited dissatisfaction with their dental appearance and perceived an impact of malocclusion on their social acceptance. In contrast, high self-esteem was observed in students who received orthodontic treatment however the correlation was weak (Badran, 2010).

2.4 The impact of malocclusion on children's OHRQoL

Epidemiological study of different types of malocclusion in Malaysia on children aged 12 to 13 years old with Dental Aesthetic Index (DAI) showed that 62.6% had minor to no anomaly, 19.6% had definite malocclusion, (10.6) had severe and (7.2%) were recognised with handicapping type of malocclusion (Esa *et al.*, 2001).

The concept of quality of life nowadays is used in many disciplines and it reflects individual's experiences that influence one's satisfaction with life (Bowling, 2005). Despite of different age group, the negative impact of malocclusion cannot be underestimated as many studies have shown that malocclusion has negative impact on OHRQoL (Sardenberg *et al.*, 2012).

The orthodontic treatment brings positive changes in quality of life of adolescents, even though during the orthodontic treatment, the negative impact of the malocclusion on the OHRQoL is observed higher. The IOTN DHC has its limitation in which it can only help to assess the normative need and it does not reflect the patient's perception regarding their overall oral status (De Oliveira & Sheiham, 2004).

The controversy about the treatment of malocclusion still remains debatable as the malocclusion can be defined as a type of deviation rather than disease, and treatment is based on correction of variation from the defined norm (O'Brien *et al.*, 2007). This can raise question on how much difference from the norm should be considered as sufficient for orthodontic treatment as it is known that despite of improvement in dental health care in developing and developed countries, dental diseases remain as an economical burden for governments (Petersen *et al.*, 2005). However, some studies interestingly revealed that the individual's OHRQoL cannot be influenced by the malocclusion all the time hence, consideration of the multidimensional characteristic of the OHRQoL is important in treatment planning (De Oliveira & Sheiham, 2003).

Severity of the malocclusion had been found to have significant relationship with the OHRQoL. A study on 472 (156 males and 315 female) Korean patients reported that with increase in age, severe type of malocclusion leads to masticatory function deterioration and also decrease in the OHRQoL which was measured by OHIP-14 and Food Intake Ability questionnaires. This study also reported that malocclusion was more severe in male group than that of female, but desire for orthodontic treatment was more in female group (Choi *et al.*, 2016).

Longitudinal study of patients with dentofacial deformity revealed high satisfaction with the outcome of orthognatic surgery in which the, this satisfaction was more prominent in aesthetic domain (Kiyak *et al.*, 1984). The impact of occlusal changes on the OHRQoL of school children aged 8 to 10 years old was assessed in a cross sectional study with 1204 participants. In this study the OHRQoL was measured by Child Perceptions Questionnaire (CPQ) and clinical assessment of the malocclusion was performed using Dental Aesthetic Index (DAI). There was a significant association between anterior segment spacing and anterior mandibular overjet ($P<0.05$) and school children with malocclusion experienced more negative impact on the OHRQoL 1.30 fold (95% CI; 1.15-1.46; $P<0.05$) in comparison to those without malocclusion (Sardenberg *et al.*, 2012).

Chen *et al.*, (2014) conducted a study in young adult aged 18 to 25 years old and assessed the impact of malocclusion on the OHRQoL. In this study the OHRQoL was measured by the OHIP-14 questionnaire. Their findings indicated that malocclusion has a significant negative impact on the OHRQoL. The greatest impact was observed in psychological disability and discomfort domains of the OHIP-14. The assessment of the study sample after orthodontic treatment highlighted a significant improvement in overall OHIP-14 score.

CHAPTER THREE

METHODOLOGY

3.1 Study design

This prospective cross-sectional study.

3.2 Population and sample

3.2.1 Reference population

The reference population was school children of Maktab Rendah Sains MARA (MRSM) Kepala Batas, Penang Malaysia. It is a boarding school situated in Bertam, Kepala Batas, Penang. They are aged between 13 to 16 years old, both male and female.

3.2.2 Source of population

Subjects were enrolled to the study from the student list retrieved from administration office of MRSM Kepala Batas.

3.3 Sampling frame

The sampling frame was based on inclusion and exclusion criteria.

3.3.1 Inclusion criteria

The inclusion criteria were as the follows:

1. Students aged between 13-16 years old.

2. Students without craniofacial deformities such as cleft lip and palate.
3. Students without learning difficulties.
4. Students with parental consent.

3.3.2 Exclusion criteria

The exclusion criteria were as follows:

1. Students with previous orthodontic treatment.
2. Students who were undergone orthodontic treatment.
3. Students with severe caries and periodontal diseases.
4. Subjects with chronic medical conditions.

3.4 Sampling method

Subjects were enrolled using simple random sampling method. Student list was obtained from school, which consisted of 819 students aged between 13 to 16 years old. A consecutive number was assigned to each students, and by the use of “Random Integer Generator” (Haahr, 2018), 255 students were selected randomly. In this software the number of the sample size and minimum and maximum number in students list was entered and it created a list containing 255 random numbers, which was based on consecutive number in which subjects were assigned.

3.5 Sample size calculation

Objective 1

To determine the severity of malocclusion, self-esteem and OHRQoL based on literature (Esa et al., 2001) sample size was calculated as follows:

$$n = \left(\frac{Z_{\alpha/2} \sigma}{d} \right)^2$$

$$n = \left(\frac{1.96 (6.6)}{0.85} \right)^2$$

$$n = \left(\frac{3.84 (43.56)}{0.7225} \right)$$

$$n = 231$$

$$231 \times 10 \div 100 = 255$$

$$n = 255$$

Objective 2

To compare RSES and OHIP-14 score between sexes and age groups based on literature (Florián-Vargas et al., 2016) sample size was calculated as follows:

$$n = \left(\frac{Z_{\alpha/2} \sigma}{d} \right)^2$$

$$n = \left(\frac{1.96 (4.81)}{0.85} \right)^2$$

$$n = \left(\frac{3.84 (23.14)}{0.7225} \right)$$

$$n = 123$$

Objective 3

To compare RSES and OHIP-14 score according to severity of malocclusion based on literature (Choi et al., 2016) sample size was calculated as follows:

$$n = \left(\frac{Z_{\alpha/2} \sigma}{d} \right)^2$$

$$n = \left(\frac{1.96 (0.4)}{0.1} \right)^2$$

$$n = \left(\frac{3.84 (0.16)}{0.01} \right)$$

$$n = 61$$

Objective 4

No sample size calculation can be done, because no such study was done before.

Objective 5

For evaluation of the impact of malocclusion severity on self-esteem based on literature review (Jung, 2010) and using of following equation sample size was calculated as follows:

$$n = \left[\frac{p_1(1 - p_1) + p_2(1 - p_2)}{(p_1 - p_2)^2} \right] x (z_{\alpha} + z_{\beta})^2$$

$$n = \left[\frac{0.41 (1 - 0.41) + 0.53 (1 - 0.53)}{(0.41 - 0.53)^2} \right] x (1.96 + 0.084)^2$$

$$n = 142$$

To evaluate the effect of malocclusion severity on the OHRQoL, we found that mean SD was equal to 22.6 ± 12.5 (Masood *et al.*, 2013)

$$n = \left[\frac{2\sigma^2}{\Delta^2} \right] (z_\alpha + z_\beta)^2$$

$$n = \left[\frac{2 (12.5)^2}{14.3^2} \right] (1.96 + 0.84)^2$$

$$n = 24$$

Considering all sample size calculation for different objectives, we decided to take the largest sample size which was 231 allowing for 10% drop out the final sample size was obtained 255.

3.6 Research tools

3.6.1 RSE scale

For the present study the Malay version of RSE scale was used (Jamil, 2006). This questionnaire consists of positively worded questions (question number 1, 2, 4, 7, 9 and 10) and negatively worded items (question number 3, 5, 6 and 9) and question number 8 (I wish I could have more respect for myself) which shows inverse correlation in positively worded construct. This sentence had been translated in a different way in Malaysian context (Appendix III). The translated Malay version of RSE scale showed good validity and reliability among Malaysian population for assessing the level of self-esteem with Cronbach's