

**PREVALENCE OF SIGNS AND SYMPTOMS OF
TEMPOROMANDIBULAR JOINT DYSFUNCTION IN SUBJECTS WITH
DIFFERENT OCCLUSIONS USING THE HELKIMO INDEX**

DUNSTAN KALANZI



A minithesis submitted in partial fulfillment of the requirements for the degree of Magister Scientiae Dentium in the Department of Restorative Dentistry, Faculty of Dentistry of the University of Western Cape.

Supervisor: Professor Y.I. Osman

Co-supervisor: Dr. A. Shaikh

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ABSTRACT

The controversy surrounding the role of malocclusion and orthodontic treatment in temporomandibular joint (TMJ) dysfunction led to this study. The purpose of this study was to establish the prevalence and compare the status of signs and symptoms of TMJ dysfunction in four groups of adolescents and young adults. The groups consisted of 14 persons with normal occlusions, 23 with untreated malocclusions, 20 with malocclusions currently undergoing treatment, and 18 with treated malocclusions. The Helkimo index was used to collect the TMJ dysfunction data. The results showed that the untreated malocclusion group had the most number of persons with signs and symptoms of dysfunction, but the differences between the groups in the distribution of persons according to the anamnestic and clinical dysfunction indices were not statistically significant. There were also no statistically significant differences in the distribution of signs and symptoms between boys and girls. According to anamnesis, the most frequently reported symptoms were joint sounds and headaches or neckaches occurring more than twice a week. Amongst the clinical signs and symptoms, the most commonly occurring were joint sounds on auscultation and muscle tenderness on palpation. In light of the small study sample and the absence of any substantial differences between the four groups, the role of malocclusion and orthodontic treatment in the aetiology of TMJ dysfunction remains obscure.

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KEYWORDS

TMJ dysfunction

Prevalence

Normal occlusion

Malocclusions

Helkimo Index



DECLARATION

I declare that *Prevalence of signs and symptoms of Temporomandibular joint dysfunction in subjects with different occlusions using the Helkimo Index* is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Dunstan Kalanzi

November 2005

Signed



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5. Last but not in anyway least, My Lord and King through whom all blessings flow.



DEDICATION

To my mother, for sacrificing so much, so that I could get a decent education.



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CHAPTER 1

Introduction

Temporomandibular joint (TMJ) dysfunction has been the subject of considerable study for over a century, yet despite voluminous literature, the multifactorial aetiology of temporomandibular dysfunction, is even today a cryptic issue.^{1, 2}

It has been well established, by means of epidemiological studies that signs and symptoms of temporomandibular dysfunction are common in adults of all ages. A high prevalence of such signs and symptoms have also been found in children. However, they have been judged to be milder in character and less frequent in children and young individuals.³

The cause of the signs and symptoms of TMJ dysfunction is not clearly understood and various opinions on their aetiology have been offered.⁴ At present, it is the opinion of most authors that the causation of TMJ dysfunction is multifactorial.^{1, 4-8}

Occlusion has been cited as one of the major aetiological factors within the acknowledged multifactorial origin of TMJ dysfunction. It has been for this reason that the diagnosis and treatment of this disorder has remained within the purview of dentistry. This is despite the fact that more recent debate suggests a more limited role for occlusal factors.⁶

To date, there is no published data on the role of malocclusion and orthodontics in TMJ dysfunction from South Africa in particular and Africa in general and this is what this study hopes to address.



CHAPTER 2

Literature Review

2.1 Definition

Over the years functional disturbances of the masticatory system have been identified by a variety of terms including: - Costen's syndrome, temporomandibular joint disturbances, temporomandibular joint dysfunction syndrome, functional temporomandibular joint disturbances, occlusomandibular disturbance, myoarthropathy of the temporomandibular joint, pain-dysfunction syndrome, temporomandibular pain-dysfunction syndrome, craniomandibular syndrome and temporomandibular syndrome.

The wide variety of terms used has contributed to the great amount of confusion that exists in this already complicated field of study.⁵

The term that is going to be used throughout this thesis is temporomandibular joint (TMJ) dysfunction.

Dysfunction is a term that can be used to describe a disturbance, impairment, or abnormality of the normal function of an anatomic unit.⁹

Therefore, TMJ dysfunction refers to a variety of symptoms, signs and combinations thereof associated with functional and structural disturbances of the temporomandibular joint (TMJ) and its related structures that include muscle, bone, and facial structures.^{1, 5, 10}

2.2 History of TMJ dysfunction

In 1934, Dr. James Costen,¹¹ an ear, nose and throat (ENT) surgeon was the first to describe a syndrome that centered around the ear and temporomandibular joint and named it Costen's syndrome.

It was thought that over-closure of the mandible following loss of teeth was responsible for various ear symptoms such as impaired hearing (continuous or intermittent), stuffy or stopping sensations in the ears occurring around mealtimes, tinnitus, vertigo, and a dull pain within and about the ears. Obstruction of the eustachian tube resulted in an associated headache that was localized to the vortex of the occiput. Impingement of the auriculotemporal nerve and chorda tympani were also considered to cause pain and burning sensations in the throat, tongue, side of the nose, and sinuses.¹¹

However, most of these symptoms had been described together prior to Costen's famous article.⁹

Not long after Costen's article, clinicians began to question the accuracy of his conclusions regarding aetiology and treatment. Although most, if not all, of Costen's original proposals had been disproved, the dental profession's interest was certainly stimulated by his work.⁵

Dental "occlusionists" then contended that occlusal disharmony rather than a closed bite was the primary aetiological factor in TMJ dysfunction. Various restorative techniques to balance and stabilize the occlusion were utilized during the period from the late 1930s' to the post-2nd world war era.⁵ The most common therapies provided at that time were bite-raising appliances that were first suggested and described by Costen in his original article.¹¹

The role of occlusion in temporomandibular joint dysfunction gained popularity from the late 1950s' with an emphasis on occlusal equilibration or adjustment. In the 1960s' the quality of clinical investigation and scientific research was becoming increasingly sophisticated and there was a gradual de-emphasis on the role of occlusion in the aetiology of TMJ dysfunction.¹²

Although long recognized by orthodontists as a clinical problem, little emphasis was placed on the diagnosis and management of temporomandibular joint dysfunction within the speciality until the mid-1980s'. The interest of the orthodontic community was awakened abruptly in the late 1980s' following litigation that alleged that orthodontic treatment was the proximal cause of TMJ dysfunction in orthodontic patients, with substantial monetary judgments being awarded to several plaintiffs.¹³ The outcome of these court cases resulted in a burst of research activity investigating the relationship if any between orthodontic treatment and TMJ dysfunction.^{6, 8}

Although a series of clinical studies reported that orthodontic treatment was not a primary factor in TMJ dysfunction, this controversy has still not been settled. Research cites faulty intercuspation of the teeth and dental intrusions into the freeway space as two of the many aetiological factors that may lead to TMJ dysfunction and its sequelae.⁶

2.3 Epidemiology of TMJ dysfunction

The prevalence of signs and symptoms associated with TMJ dysfunction can best be appreciated by examining epidemiological studies.⁵

Epidemiological studies of TMJ dysfunction in different populations may enable a better understanding of patterns of prevalence and the nature of

these disorders. Differences between populations may enable cause-effect relationships to be better understood.¹⁴

It has been well established by means of epidemiological studies that signs and symptoms of temporomandibular joint dysfunction can be found in persons from all age groups.^{3, 15, 16}

2.3.1 Age distribution

The prevalence is low in children but increases with age. ^{1, 3-8, 15-22} However, this population (children) rarely complain of any significant symptoms. In a similar finding, patients who are 60 years of age or older also rarely complain of TMJ dysfunction symptoms. ⁵

Epidemiological studies reveal that the age group with the most reported TMJ dysfunction symptoms is found to be in the 20 to 40 year-age cohort of the population.^{4, 5} However, in some studies the 40 to 50 year-age cohort was more predominant and in another series of studies, the age distribution was found to be more evenly distributed than that reported in earlier investigations as cited by Helkimo.⁴

2.3.2 Prevalence of signs and symptoms

Data from epidemiological studies varies from study to study. A series of epidemiological studies indicate that at any given time, between 40% and 75% of those surveyed had at least one sign of dysfunction such as joint noise, deviation on opening or episodic locking, while approximately 33% reported at least one symptom of temporomandibular joint dysfunction such as face pain or jaw pain.^{5, 6, 20}

A review of 18 epidemiologic studies found the prevalence rates ranging from 16% to 59% for reported symptoms and 33% to 86% for clinical signs as cited by Carlsson.²¹ A more recent meta-analysis of 51

prevalence studies registered even more extreme variations of prevalences ranging from 6% to 93% based on subjects' reports and from 0% to 93% according to clinical assessments of an adult population.²³

The most frequent sign of TMJ dysfunction is joint sounds that are often present in the absence of any other symptoms.^{4, 6} TMJ sounds are common and occur in 20% to 30% of the population, including patients before and after orthodontic treatment.⁷

Prevalence figures may overstate the clinical significance of this problem since many studies include individuals with mild transient symptoms that may not require treatment. Indeed, of the large percentage of the population who have signs and/or symptoms, it is estimated that only approximately 5% to 6% are in need of treatment.²⁴

2.3.3 Gender differences with reference to signs and symptoms

Symptoms have been reported to be more prevalent in females than in males.^{4, 15, 17, 20, 21}

In practically all clinical series on record the vast majority of patients are females. No convincing explanation has been offered for this female dominance though interesting suggestions have been offered that are thought to include differences between sexes in behavioral, psychosocial, hormonal, and other constitutional factors.^{4, 22}

Since no conclusive results have yet been presented, the issue of gender difference in TMJ dysfunction remains a puzzle and warrants further investigation.²¹

2.3.4 Signs and symptoms in children and adolescents

Prevalence figures of temporomandibular joint dysfunction signs and symptoms reported in epidemiologic studies of children are lower than in adults. Most of the signs have been characterized as mild and often fluctuating.^{3, 15, 16, 21, 25}

The prevalence of TMJ dysfunction in children and adolescents varies widely in the literature from 16% in children with only a primary dentition to 90% in children with a mixed dentition. However, some of these studies are considered inconclusive since they tend to focus on patients seeking treatment or because they were conducted for convenience on non-representative samples of the population.²⁶

Furthermore, the literature indicates that symptoms of TMJ dysfunction are inconsistent during the mixed dentition stage, and should not be given excessive attention unless the symptoms are marked and progressive.⁷

In one study among Saudi children, the prevalence of TMJ dysfunction signs was found to be 20.7% and the most common sign of temporomandibular joint dysfunction was joint sounds (11.8%).²⁶

In a large epidemiologic study of 7,337 children by Motegi and co-workers,²⁷ the prevalence of TMJ dysfunction symptoms was 12.2%. Joint sounds represented the most common symptom (89.3%) while pain from opening and closing the mouth, from chewing food and in the temporomandibular joint was present in 2.2% of cases.

It is interesting to note that the incidence of signs and symptoms generally increases with age. Magnusson and colleagues³ investigated 119 children in a longitudinal study with a 4-year interval and reported a significant increase in signs and symptoms of TMJ dysfunction with age. The results showed that 66% of 11 and 15 year-olds had clinical signs while 62% and 66%, respectively, complained of subjective symptoms. When comparisons were made with their findings of 4 years earlier, it was noted that the subjective symptoms had increased in frequency in the younger children, while the clinical signs had increased in both groups.

Egermark-Eriksson and colleagues²⁸ stated that the prevalence of TMJ dysfunction symptoms increased from 30% to 60% between the ages of seven and 15 years, and coincidentally that was also the same time most patients usually received orthodontic treatment.

2.4 Malocclusion and TMJ dysfunction

Numerous clinical studies have investigated the relationship of occlusal factors and the signs and symptoms associated with TMJ dysfunction in relatively large patient and nonpatient populations. Some studies reported statistically significant associations while others did not, and few common trends were apparent.⁶

In epidemiological and some postmortem studies, certain types of malocclusion have been more closely associated with the development of TMJ dysfunction than others. This seems to be especially true with regard to Angle class II malocclusion, extreme maxillary overjet, class III malocclusions, crossbite and open bite.^{15, 29-31} These associations may be partly explained by the less-stable occlusion found in connection with such malocclusions and the less-resistant muscles in these malocclusions, often characterized by a steep mandibular plane angle as

cited by Mohlin and colleagues.²⁹ Another proposed explanation concerns associations between class II malocclusion and head posture and clicking.³²

Brandt, as cited by McNamara and others⁶ in a study of 1,342 children noted a positive correlation of overbite, overjet, and anterior open bite with TMJ dysfunction.

Similarly, Riolo and others,³³ in a cross-sectional survey of 1,342 subjects aged 6 to 17 years, concluded that there was an increased frequency of joint noises and tenderness of the masticatory muscles in patients who had a cusp-to-cusp or a Class II molar relationship, an overjet greater than 6.0 mm or a negative overjet, as well as in patients with an anterior open bite.

In a study among Bogotanian children and adolescents by Thilander and others,³⁰ the prevalence of dysfunction varied from between 24.3% and 45.7% for the different types of malocclusion, though they were generally of a mild type. Moderate and severe forms of dysfunction, however, were found above all in children with a posterior crossbite in 10.3% of cases, an anterior open bite in 8.2% of cases, in Angle Class III type of malocclusion in 5.3% of cases, and in extreme maxillary overjet in 4.0% of cases. All the other types of malocclusions had moderate and severe dysfunction in less than 3% of cases.

In contrast, DeBoever and Adriaens³⁴ in 135 TMJ dysfunction patients, found no relation between the number of occluding molars and premolars and the severity of the symptoms or the evolution of the complaints.

In a critical review of the literature conducted by Seligman and Pullinger,³⁵ no relationship was found between TMJ dysfunction and

anterior open bite, overbite, overjet, asymmetry of contact in retruded contact position, crossbite and loss of posterior occlusal support. However, they found that, unilateral retruded contact position may encourage disc displacement, and lack of molar support may be associated with osteoarthritis.

As can be seen from the above mentioned studies, there is no universal agreement as to the relationship of occlusal factors to TMJ dysfunction.⁶ In general however, there is only a weak correlation between malocclusions and TMJ dysfunction.^{4, 7, 16, 27, 28, 36}

2.5 Orthodontics and TMJ dysfunction

In a comprehensive review of the literature between 1966 and 1988 on this subject published by Reynders,³⁷ it was found that of the 91 publications, the most numerous were viewpoint articles totalling 55. These publications were usually anecdotal, stating the opinion of the author regarding the orthodontic-TMJ dysfunction relationship. Little or no data were presented to support the authors' opinions.

The second most frequent type of article totalling 30 was based on case reports, a category of publication that described the influence of certain orthodontic treatment modalities used in one or more patients on the signs and symptoms of TMJ dysfunction. The least numerous type of publication totalling 6 were sample studies that reported data from large sample groups.

However, since 1988, a substantial number of clinical investigations have considered the association of orthodontics and TMJ dysfunction.^{6, 8}

Sadowsky and BeGole³⁸ reported on the findings from a University of Illinois study of 75 adult subjects who, at least 10 years previously, had

been treated with full orthodontic appliances as adolescents. The treated group was compared to a group of 75 adults with untreated malocclusions. The findings indicated that in patients who underwent orthodontic treatment, the prevalence of TMJ dysfunction signs and symptoms was similar to that of the control group of adults with untreated malocclusions. Furthermore, a trend did exist that suggested that subjects who had undergone extensive fixed appliance orthodontic treatment many years previously may possibly have a lower prevalence of TMJ problems than a similar group of adults with untreated malocclusions.

In a subsequent article by Sadowsky and Polson,³⁹ the sample from the Illinois study (increased to 96 treated and 103 controls) was compared to a treatment group of 111 subjects who had been treated at least 10 years previously at the Eastman Dental Centre and a control group of 111 individuals with untreated malocclusions. In the two studies, 15% to 21% of the subjects presented with one or more signs of TMJ dysfunction and between 29% and 42% had at least one or more symptom of TMJ dysfunction, usually joint sounds. There was no statistically significant difference between the treated and untreated groups. The results of these two studies provide evidence in support of the concept that orthodontic treatment performed during adolescence generally does not increase or decrease the risk of developing temporomandibular joint dysfunction later in life.

Another study that looked at the long-term effects of orthodontic treatment was conducted by Larsson and Rönnerman.⁴⁰ They evaluated 23 adolescents who had been treated orthodontically at least 10 years earlier. Using the Helkimo index as an evaluative tool, mild dysfunction was recorded in eight patients, while one patient had severe dysfunction. Comparing their results to published epidemiologic studies, Larsson and

Rönnerman stated that comprehensive orthodontic treatment can be undertaken without fear of causing TMJ dysfunction.

One of the few clinical studies to report positive findings is the investigation of Smith and Freer,⁴¹ who examined 87 patients treated with full orthodontic appliances during adolescence compared to an untreated control group of 28 persons. Four years following the end of retention, symptoms were found in 21% of the treated group while only 14% of the control subjects had symptoms. This difference however, was not statistically significant. The investigators, however, noted that not a single sign was significantly different statistically, the exception being the association between what they termed “soft clicks” and previous treatment. Interestingly, although the rate of soft clicks in the treatment group was almost twice that in the control group, the authors commented that this was not clinically significant and concluded the article by stating, “The null hypothesis that there is a significant association between orthodontic treatment and occlusal or joint dysfunction has been rejected by nearly all previously reported studies and continues to be rejected by the present study.”⁴¹

In conclusion, clinical studies and an extensive review of the literature suggest that orthodontic treatment may only have a minor role to play in worsening or precipitating TMJ dysfunction when treated patients are compared to untreated individuals, with or without different types of malocclusion, or when different types of orthodontic treatment are compared; indeed, longitudinal studies tend to show a reduction in temporomandibular joint dysfunction signs in orthodontically treated individuals.^{6-8, 17-19, 39, 42-44} Although this may be the case, there is still an ongoing debate regarding the role of orthodontic treatment in TMJ dysfunction.⁴⁴

2.6 Conclusion

Epidemiologic studies regarding signs and symptoms of TMJ dysfunction have reported great variation in prevalence rates, probably due more to methodological shortcomings than real differences between samples. Irrespective of this variation, it can be concluded that signs and symptoms of TMJ dysfunction are common.^{4, 21, 30} This implies that dentists must interest themselves more than before in the diagnosis and treatment of the functional disturbances of the masticatory system in general practice.²¹

2.7 Aetiology of TMJ dysfunction

Many diseases do not have a clear-cut aetiology and this is especially true of temporomandibular joint dysfunction. A number of contrasting theories have evolved, some of which appear to be tailored to fit the treatment administered rather than the evidence. This is primarily due to a failure to establish the aetiology of TMJ dysfunction accurately.⁴⁵

Different theories according to DeBoever⁴⁶ have been advanced to explain the aetiology of TMJ dysfunction, and these include: -

Mechanical displacement theory

- It was hypothesized that a lack of molar support or functional occlusal prematurities caused a direct eccentric position of the condyle in the fossa leading to pain, dysfunction and ear symptoms.
- This faulty condylar position then led directly to an inadequate and adverse muscle activity.

Neuromuscular theory

- It was postulated in this theory that occlusal interferences resulted in the presence of stress and tension that promoted parafunction such as grinding and clenching.
- The occlusal interferences were, according to this concept, able to provoke muscle spasm and muscle hyperactivity.

Muscle theory

- This theory suggested that the primary aetiological factor was in the masticatory muscles themselves.
- The tension in the muscles increased constantly under the influence of over stimulation leading to painful spasm.
- This theory placed the TMJ pain in the context of a wider general muscle disorder and denied any influence of the occlusion.

Psychophysiological theory

- The primary factor was the spasm of the masticatory muscles, caused by overextension, over-contraction or muscle fatigue due to parafunction.

Psychological theory

- This theory proposed that emotional disturbances, initiating centrally-induced muscular hyperactivity, led to parafunction and so indirectly to occlusal abnormalities.

Based on these aetiological concepts, totally divergent treatment protocols were established and used in daily practice.⁴⁷ Advocates of each theory mentioned a different aetiological factor as the primary cause for the classical triad of symptoms:

- pain in and around the joint and in the whole masticatory system,
- joint sounds such as clicking and crepitation,
- restrictions and deviations in jaw movements.

Although the signs and symptoms of TMJ dysfunction are primarily the above, other symptoms such as headache, parotid gland enlargement, masseter muscle tremor, tinnitus, vertigo, cervical joint neck pain and causalgia do occur occasionally in association with, coincidental with or secondary to TMJ dysfunction.^{5, 9}

Gradually, concepts based on a single causative factor lost their scientific and clinical credibility according to DeBoever and Carlsson.⁴⁷

It became more and more apparent that the aetiology was multifactorial and that not any of these theories could explain the aetiological mechanism in TMJ dysfunction patients. It became generally accepted, as a simplified model, that three main groups of factors were thought to be involved: - anatomical factors including occlusion and the joint itself, neuromuscular, and psychogenic factors.⁴⁷

Garn, as cited by Mew⁴⁵ stated that, 'When the unitary explanations were exhausted the multifactorial hypothesis was advanced, this yielded an equation with an unknown number of unknowns instead of one'.

A multifactorial aetiology implied that a large number of factors may have been involved; their relative importance, however, was different in each individual. It was then proposed that factors be classified into predisposing, initiating and perpetuating factors.⁴⁷

Occlusion was cited as one of the major aetiological factors within the acknowledged multifactorial origin of TMJ dysfunction.^{1, 6} The assumed strong association between TMJ dysfunction and occlusion has been a major reason that the diagnosis and management of these disorders has remained within the purview of dentistry. Numerous aetiological and therapeutic theories are based either partly or completely on this

presumed connection and have justified many of the common treatment approaches such as occlusal appliance therapy, anterior repositioning appliances, occlusal adjustment, restorative procedures, and orthodontic/orthognathic treatment.⁶

Despite agreement among TMJ dysfunction experts that occlusion actually only had a relatively small role in the aetiologically diverse and multifactorial origins of temporomandibular joint dysfunction, the influence of occlusion continued to be greatly overrated in comparison by practicing dentists and specialists outside the TMJ dysfunction circle.⁴⁸ This considerable discrepancy between the opinions of practicing dentists and TMJ dysfunction experts on the role of occlusion in the pathophysiology of TMJ dysfunction had a great impact on the contemporary quality of diagnosis and management for these chronic conditions.⁶

The five occlusal features according to clinical studies that had been associated with specific diagnostic groups of temporomandibular joint dysfunction conditions included skeletal anterior open bite, an overjet greater than 6 to 7 mm, a retruded cuspal position/intercuspal slide greater than 4mm, a unilateral lingual cross bite, and five or more missing posterior teeth.⁴⁹

The causation of TMJ dysfunction is generally viewed as being multifactorial. Since there are many aetiological variables, it follows that malocclusion alone cannot be used to predict whether or not a person will develop temporomandibular joint dysfunction in the future.⁷

Since malocclusion has been implicated as a factor in the multi-factorial aetiology of TMJ dysfunction,³³ orthodontics has been suggested as a

treatment modality for prevention or correction of some of the TMJ problems related to the different types of malocclusion.^{33, 50, 51}

Conversely, orthodontic treatment has also been implicated as contributing to mandibular dysfunction as a result of mechanotherapy.^{52, 53} This is more so with methods employing extractions and extensive tooth movements. It has been theorized that this kind of orthodontic treatment is the cause of posterior displacement of the condyles in the mandibular fossae, that subsequently results in anterior disc displacement causing TMJ dysfunction.⁵⁴ However, this contention is not supported in all the studies reported.

Kremenak and co-workers⁴⁴ assessed 109 patients prior to orthodontic treatment and followed them for a mean period of two years. Ninety per cent of these patients had unchanged or improved TMJ dysfunction scores, while only 10 per cent had worse scores- indicating that orthodontic treatment *per se* is not an aetiological factor in TMJ dysfunction.

Hirata and colleagues² examined 102 patients before and after orthodontic treatment for signs of TMJ dysfunction. The findings from this group were compared to findings from 41 untreated subjects matched for age. The incidence of temporomandibular signs for the treatment and control groups was not significantly different statistically. It was concluded that orthodontic treatment based on this study neither increased nor decreased the incidence of TMJ dysfunction.

In another study, Rendell and co-workers⁵⁵ examined 451 patients receiving treatment in an orthodontic graduate clinic (90% adolescents, 10% adults), using a modification of the Helkimo index. Eleven of the patients presented with signs and symptoms of TMJ dysfunction prior to

commencing treatment. During the 18-month study period, none of the patients who had been free from signs and symptoms at the beginning of treatment developed signs or symptoms of TMJ dysfunction. No clear or consistent changes in the levels of pain and dysfunction occurred during the treatment period in those patients with pre-existing signs and symptoms. Rendell and co-workers⁵⁵ concluded that a relationship could not be established in their patient population between orthodontic treatment and either the onset or the change in severity of signs and symptoms of TMJ dysfunction.

The orthodontic procedures that had received the majority of criticism with respect to TMJ dysfunction are premolar extractions and maxillary incisor retraction with the use of elastics and/or headgear. It was hypothesized that distal pressure on the mandibular complex could put distal pressure on the condyles and conceptually caused an anteriorly displaced disc. Some functional orthodontists believe that premolar extractions and retraction of the anterior maxillary incisors would trap the mandible in a retruded position.⁵⁴ However, there are no controlled studies that support this opinion.⁷

Dibbets and van der Weele^{18, 43} followed 172 patients in a longitudinal prospective study over 15 years. In this group, a non-extraction approach was used in 34% of the patients, four premolars were extracted in 29%, and other extraction patterns were used in the remaining 37%. The subjects were treated with either removable appliances that were mostly functional, or fixed appliances using Begg mechanics or chin-cups. In contrast to the finding from the first 10 years during which there was no difference between the three treatment groups with regard to clicking, after 15 years this symptom was more prevalent in the premolar extraction group. The authors noted, however, that clicking was higher in the premolar extraction group before treatment was started and

concluded that the original growth pattern, rather than the extraction protocol, was the most likely factor responsible for the TMJ dysfunction complaints seen many years post-treatment.

Kremenak and colleagues,⁵⁶ in another study related Helkimo scores with premolar extractions in 65 patients for whom orthodontic treatment had been completed. Twenty-six patients were treated without premolar extractions, 25 had four extractions, and 14 had two upper premolars extracted. Tests for significance of differences between mean Helkimo scores were conducted for the non-extraction group compared to the extraction groups, and between pre-treatment and post-treatment Helkimo scores for each group. Results showed no statistically significant intergroup differences between mean pretreatment and posttreatment scores, and small but statistically significant differences (in the direction of improvement) between mean pre-treatment and post-treatment scores for both the non-extraction and for the four premolar extraction groups.

The effects of extractions and Class II elastics on the signs and symptoms of TMJ dysfunction were studied by O'Reilly and co-workers.⁵⁷ In that study, the experimental group consisted of 60 subjects. The control group consisted of 60 subjects as well with no previous orthodontic treatment. Signs and symptoms of TMJ dysfunction were measured before, during, and after treatment in both groups, and no statistically significant differences were seen in the frequency of TMJ dysfunction between the groups. O'Reilly and co-workers concluded that orthodontic treatment involving extractions and Class II elastics had little or no effect on the presence of TMJ signs and symptoms.

Although the concern about orthodontics as a possible aetiological factor of TMJ dysfunction is lessening, there is still debate.⁴⁴ Thus, this study will investigate the prevalence of signs and symptoms of

temporomandibular joint dysfunction in subjects with a normal occlusion, those with an untreated and treated malocclusion and malocclusions under current treatment in a selected South African population.



CHAPTER 3

Aims and Objectives

3.1 Aim of the study

1. To determine the prevalence of signs and symptoms of temporomandibular disorders in subjects with normal occlusion and in patient groups before, during, and after orthodontic treatment.

Null Hypothesis: There is no significant difference in signs and symptoms of temporomandibular disorders in subjects with normal occlusion and in patient groups before, during, and after orthodontic treatment.



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3.2 Objective of the study

1. To compare the prevalence of signs and symptoms of temporomandibular disorders in patients before, during, and after orthodontic treatment with normal subjects.

CHAPTER 4

Materials and methods

4.1 Study design

This was a descriptive cross-sectional study.

4.2 Subjects

The entire sample comprised of four groups selected on the basis of the type of occlusion: normal, untreated and treated malocclusions, and malocclusions currently undergoing treatment.

The untreated malocclusion sample was drawn from amongst persons seeking treatment at the Orthodontic clinic, Faculty of Dentistry, University of Western Cape (UWC). The malocclusions undergoing treatment sample was similarly drawn from patients on a recall programme during active orthodontic treatment at the same institution. The treated malocclusion sample was drawn from patients following active orthodontic treatment at the same institution that were called and requested to participate in the study. The normal occlusion sample consisted of persons who are relatives of parodontal colleagues who volunteered to participate in the study.

Only residents of the Western Cape in the age range of 14 to 18 years of age were included in the study. Selection criteria were established to exclude other causes of TMJ dysfunction as much as possible. Initial selection of the subjects was based on the following criteria:

1. Good general health
2. Good periodontal health and absence of active carious lesions
3. Presence of a full complement of permanent teeth with or without third molars, except in the case of those who had teeth extracted for orthodontic purposes only.

When a person fulfilled these requirements, he or she was further evaluated according to a second set of criteria. At this stage of selection, there were four different sets of criteria for the four study groups, i.e. for normal occlusion, untreated malocclusions, malocclusions undergoing treatment, and treated malocclusions.

The criteria for inclusion of a person into Group I (normal occlusion) were as follows:

1. Absence of an anterior or posterior crossbite.
2. Absence of posterior rotations and with anterior rotations if present not exceeding 15° and in not more than two anterior teeth.
3. Not needing comprehensive fixed orthodontic treatment.

The criteria for inclusion of a person into Group II (untreated malocclusions) were as follows:

1. Presence of a Class I or Class II or Class III malocclusion requiring comprehensive fixed orthodontic treatment.
2. No previous history of orthodontic treatment

The criteria for inclusion of a person into Group III (malocclusions currently undergoing treatment) were as follows:

1. A full-banded comprehensive orthodontic treatment plan instituted at the Orthodontic clinic, Faculty of Dentistry, UWC.
2. Should be at least one year into the active treatment phase at the time of the study.

The criteria for inclusion of a person into Group IV (treated malocclusions) were as follows:

1. A full-banded comprehensive orthodontic treatment plan instituted at the Orthodontic clinic, Faculty of Dentistry, UWC.
2. Should be through with the active phase of treatment at the time of the study.

4.3 Clinical examination and registrations

Before the clinical registrations, the researcher (author) was trained by specialists in the fields of orthodontics and prosthodontics to be able to perform a comprehensive orthodontic-prosthodontic evaluation.

The prevalence of TMJ dysfunction was assessed according to the Helkimo Dysfunction Index.⁴

The Helkimo index has been applied in a number of investigations and it has been claimed that this index provides a good indication of the severity of TMJ dysfunction.

The merit of the Helkimo index, undoubtedly, is that it introduced a fixed set of symptoms with well-defined assignments of the parts of the index and a computation of the index-class. This has resulted in a number of studies that have demonstrated comparable results concerning the presence of dysfunction, or even better, the presence of a number of symptoms in the patients subject to examination. Thus well-defined estimates have been revealed and comparisons of the prevalence of symptoms in different populations can be made. However, the relevance of the index for measuring the latent variable, 'TMJ dysfunction' has not yet been demonstrated.⁵⁸

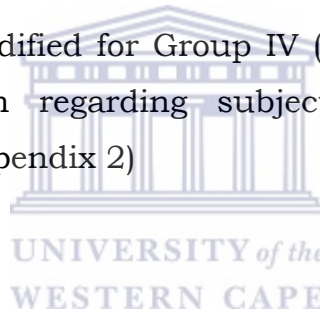
The required information was gathered by subjects filling in a questionnaire for any positive history of TMJ dysfunction followed by a clinical examination for the signs and symptoms of TMJ dysfunction as described by Helkimo.⁴

Symptoms of TMJ dysfunction

Registration of subjective symptoms was accomplished by the use of a questionnaire. The questionnaire gathered demographic information as well as answers to nine questions related to subjective symptoms of TMJ dysfunction. (Appendix 1)

The questionnaire was modified for Group IV (treated malocclusions) so as to collect information regarding subjective symptoms prior to orthodontic treatment. (Appendix 2)

Signs of TMJ dysfunction



These registrations were performed according to the following criteria.

1. Impaired range of movement. Maximal opening less than 40mm and 35mm for boys and girls respectively.
2. Impaired TMJ function. Deviation of the mandible was recorded if the mandibular midline deviated at least 2mm during opening or closing. Joint sounds were recorded for right and left sides using a stethoscope after listening to each joint at least two times. Locking and luxation were recorded during mandibular movements.
3. Muscle tenderness. Muscle tenderness was recorded by palpation of the temporalis, masseter, medial and lateral pterygoid muscles.

4. TMJ tenderness. The joints were palpated both from the lateral sides and via the auditory meatus. The tenderness was recorded as palpable.
5. Pain on movement of the mandible. This was recorded if pain was present on opening the mouth wide and during right and left lateral movements of the lower jaw.

Also recorded on the same form were the subject's group and certain occlusal characteristics which included: Angle's dental classification, molar and canine classification, overjet and overbite, occlusal contacts/interferences, slide from CR to ICP, cross bite and open bite. (Appendix 3)

The data were then used to calculate the anamnestic and clinical dysfunction indices for the subjects.

The anamnestic index has three grades: Ai0, no history of dysfunction; AiI, history of mild dysfunction; and AiII, history of severe dysfunction.

The clinical dysfunction index has four grades: Di0, clinically symptom free; DiI, mild dysfunction; DiII, moderate dysfunction; and DiIII, severe dysfunction. (Appendix 4)

4.4 Data Analysis

Data was entered into a computer using SPSS (a statistical package designed for analysis of social science data) program for statistical computation.

The prevalence of TMJ dysfunction signs and symptoms were analyzed for the entire sample and also for the different groups.

The Chi-square and Fisher's exact tests were applied to the data to test for statistically significant differences in the distribution of signs and symptoms of TMJ dysfunction in the four groups examined.

4.5 Pilot Study

A pilot study was carried out. It was found that the methodology of this study was sound and was worth pursuing with a greater number of patients. (Appendix 5)

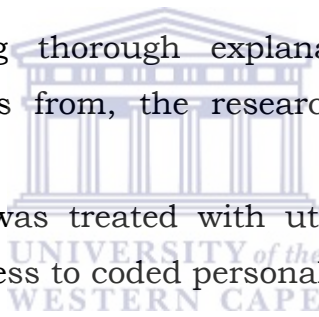
4.6 Ethical considerations

The protocol was submitted to the institutional ethics committee (Faculty of Dentistry, University of Western Cape) for approval.

Any request for consultation or treatment was referred to the appropriate authority.

Written consent following thorough explanation of the aims and objectives of, and benefits from, the research was sought from the participants. (Appendix 6)

All information obtained was treated with utmost confidentiality with only the author having access to coded personal information.



CHAPTER 5

Results

5.1 Participant Characteristics

Seventy-five adolescents and young adults participated in the study. There were 40 male and 35 female subjects (Table 1) between the ages of 14 and 18 years with a mean age of 15.8 years (Table 2), of which 14 had normal occlusion, 23 had untreated malocclusions, 20 were undergoing treatment, and 18 had treated malocclusions (Table 3). The male-female ratio was approximately 1:1.

Table 1: Subjects' gender

	Frequency	Percent
Female	35	46.7
Male	40	53.3
Total	75	100.0

Table 2: Subjects' ages

	Frequency	Percent
14	16	21.3
15	16	21.3
16	18	24.0
17	17	22.7
18	8	10.7
Total	75	100.0

Table 3: Subjects' group

	Frequency	Percent	Sex	
			Male	Female
Untreated	23	30.7	14	9
Under treatment	20	26.7	7	13
Treated	18	24.0	9	9
Normal	14	18.7	10	4
Total	75	100.0	40	35

5.2 Anamnestic Index

Results of the anamnestic investigation are captured in Table 4 and graphically illustrated in Fig. 1. The most commonly reported symptom was joint sounds and headaches or neckaches more than twice a week (Table 5). The other reported symptoms were pain in the region of the TM joints and feeling of tiredness in the jaws on awakening. Statistically, there was no significant difference between the four groups, ($p > 0.05$) Table 6.

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Table 4: Anamnestic Index * Subject's group Crosstabulation

		Subject's group				Total
		Untreated	Under treatment	Treated	Normal	
Anamnestic Index	Ai0	8	12	12	9	41
	AiI	5	3	2	1	11
	AiII	10	5	4	4	23
Total		23	20	18	14	75

Anamnestic Index

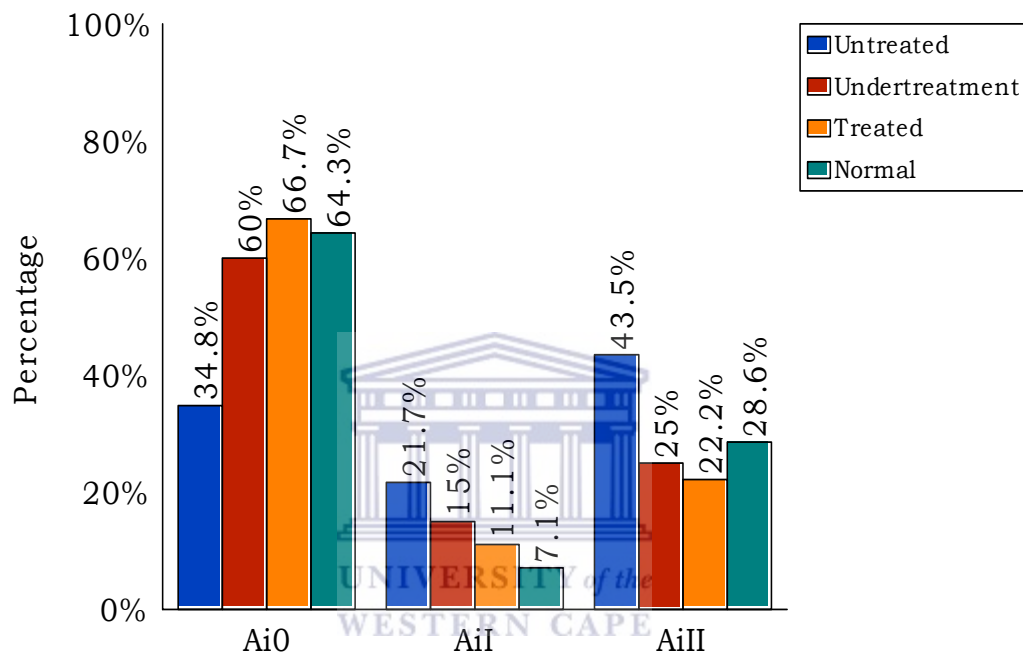


Fig. 1. Distribution of subjects of four study groups according to the anamnestic index (Ai)

Table 5: Frequency of subjective symptoms of the entire sample

Symptom	Frequency (n %)
Difficulty in wide mouth opening	9.3
Pain on opening the mouth wide	8.0
Clicking, popping, or grating noises on opening the mouth wide	21.3
Headaches or neckaches more than twice a week	21.3
Pain in ears, or in front of ears	17.3
Movement of the jaw sideways or hand guiding it in order to open the mouth wide or close together	2.7
Sports, bicycle, car or other accident involving the head	5.3
Muscle ache, tenderness or stiffness on awakening in the morning	12.0
Financial, legal, or personal stress	8.0

Table 6: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	5.839(a)	6	.441	.457
Likelihood Ratio	5.997	6	.424	.479
Fisher's Exact Test	5.642			.470
N of Valid Cases	75			

a 5 cells (41.7%) have expected count less than 5. The minimum expected count is 2.05

5.3 Clinical Dysfunction Index

Table 7 and Fig. 2 illustrate the distribution of the subjects in accordance with the clinical dysfunction index. There was no statistically significant difference in the distribution of scores in the four groups, ($p > 0.05$) Table 8.

Table 7: Clinical dysfunction index * Subject's group Crosstabulation

		Subject's group				Total
		Untreated	Under treatment	Treated	Normal	
Clinical dysfunction index	Di0	6	9	8	7	30
	DiI	16	10	10	7	43
	DiII	1	1	0	0	2
Total		23	20	18	14	75

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Table 8: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	4.111(a)	6	.662	.683
Likelihood Ratio	4.941	6	.551	.671
Fisher's Exact Test	4.364			.626
N of Valid Cases	75			

a 4 cells (33.3%) have expected count less than 5. The minimum expected count is .37.

Clinical Dysfunction Index

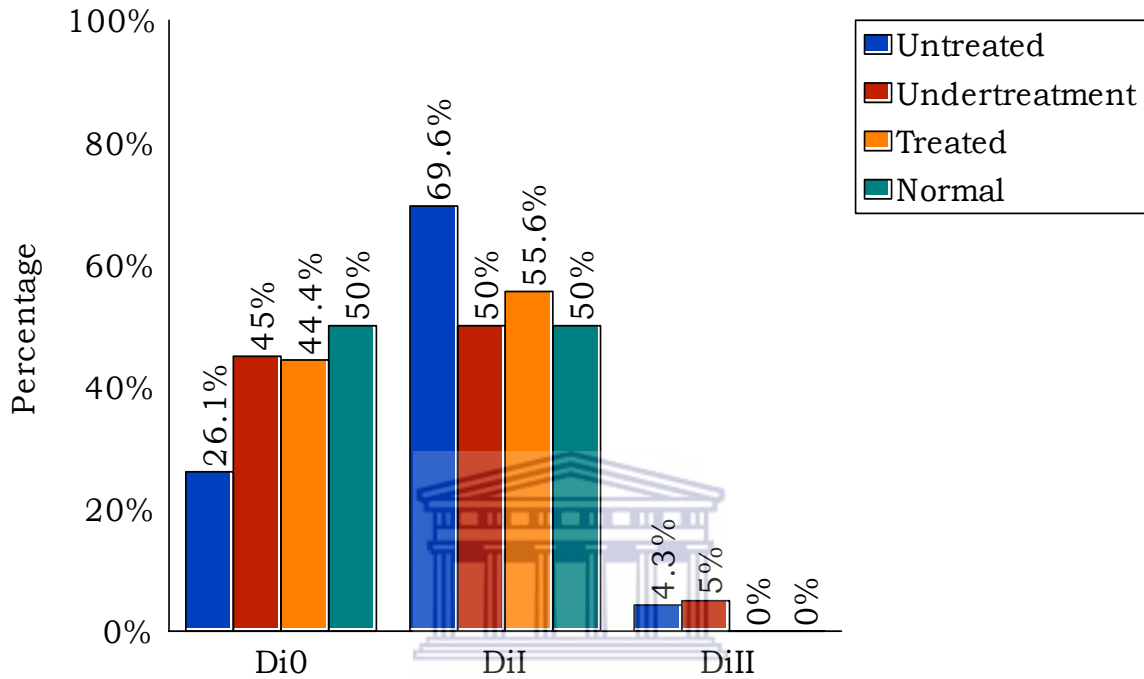


Fig. 2. Distribution of subjects of four study groups according to the clinical dysfunction index (Di)

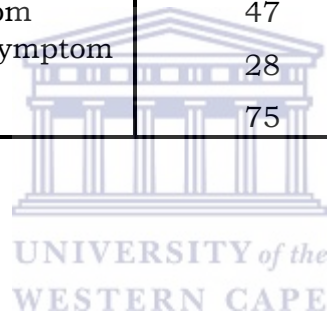
Amongst the signs and symptoms, the most frequently occurring sign was TMJ impairment as evident in Table 9. The data for impaired TMJ function of the entire sample is summarized in Table 10 and the frequency of occurrence in the four groups graphically illustrated in Fig. 3. There were no subjects who had severe symptoms. The most frequently occurring sign of TMJ impairment was sounds on auscultation.

Table 9: Frequency of clinical signs or symptoms of the entire sample

Sign or symptom	Frequency (n %)
Muscle tenderness	25.3
Pain on palpation of the TMJs	12.0
Pain during mouth opening and lateral movements	4.0
Impaired mobility	10.7
Impaired TMJ function	37.3

Table 10: Impaired TMJ function

	Frequency	Percent
Absence of symptom	47	62.7
Presence of mild symptom	28	37.3
Total	75	100.0



Impaired TMJ function

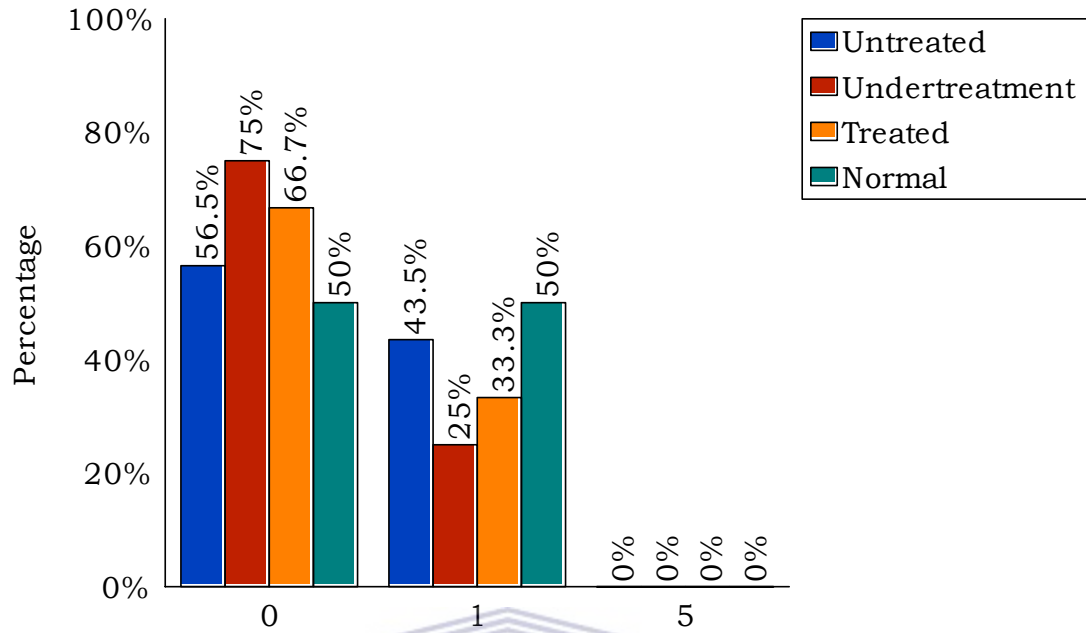


Fig. 3. Percentage distribution of subjects according to 3-point scale for impaired TMJ function. 0, Absence of symptom; 1, presence of mild symptom; and 5, presence of severe symptom

Fig. 4 graphically illustrates the frequency of occurrence of muscle tenderness in the various groups. Table 11 is summarized data for the entire four groups.

Table 11: Muscle tenderness on palpation

	Frequency	Percent
Absence of symptom	56	74.7
Presence of mild symptom	17	22.7
Presence of severe symptom	2	2.7
Total	75	100.0

Muscle tenderness

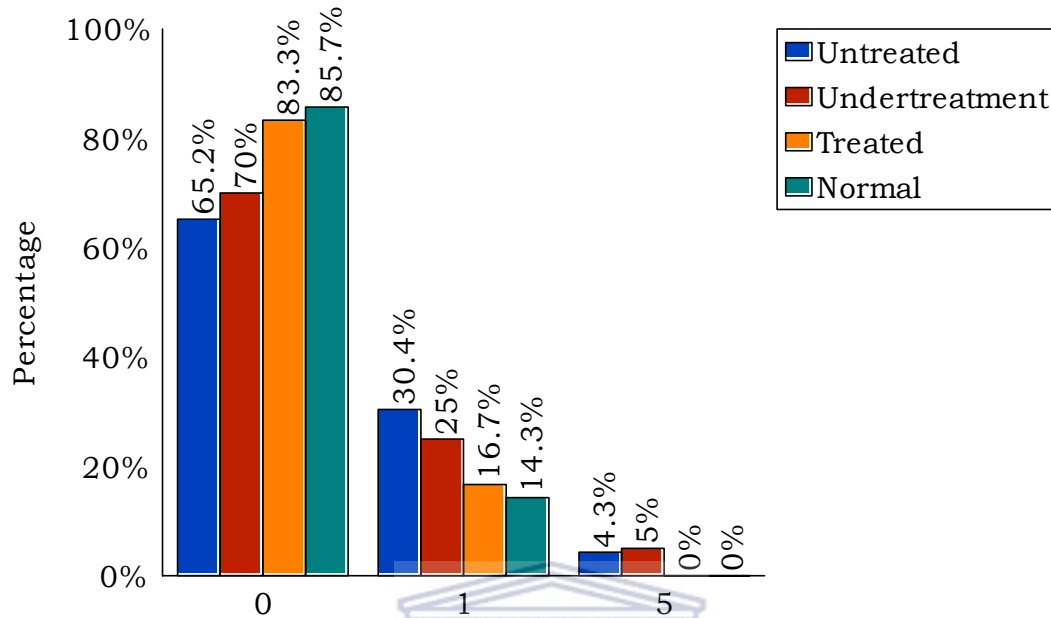


Fig. 4. Percentage distribution of subjects according to 3-point severity scale for muscle tenderness

Fig. 5 graphically illustrates the frequency of occurrence of joint tenderness in the various groups. The data summarized in Table 12 is for entire the four groups. For this clinical symptom, there are no subjects with severe symptoms of TMJ dysfunction.

Table 12: Pain on palpation of the temporomandibular joints

	Frequency	Percent
Absence of symptom	66	88.0
Presence of mild symptom	9	12.0
Total	75	100.0

Pain on palpation of the TMJs

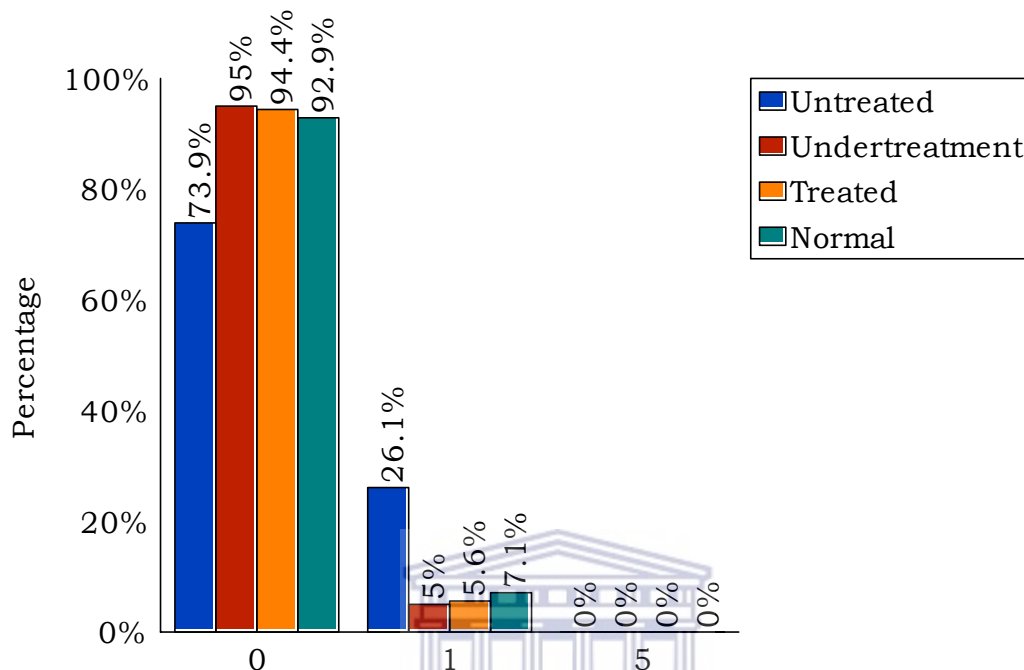


Fig. 5. Percentage distribution of subjects according to 3-point severity scale for pain on palpation of the TMJs

Pain on movement of the mandible was the least reported symptom as shown in Tables 9 and 13 and graphically illustrated in Fig. 6. With regard to this symptom, there were no subjects with severe dysfunction.

Table 13: Pain during mouth opening and lateral movements

	Frequency	Percent
Absence of symptom	72	96.0
Presence of mild symptom	3	4.0
Total	75	100.0

Pain on movement

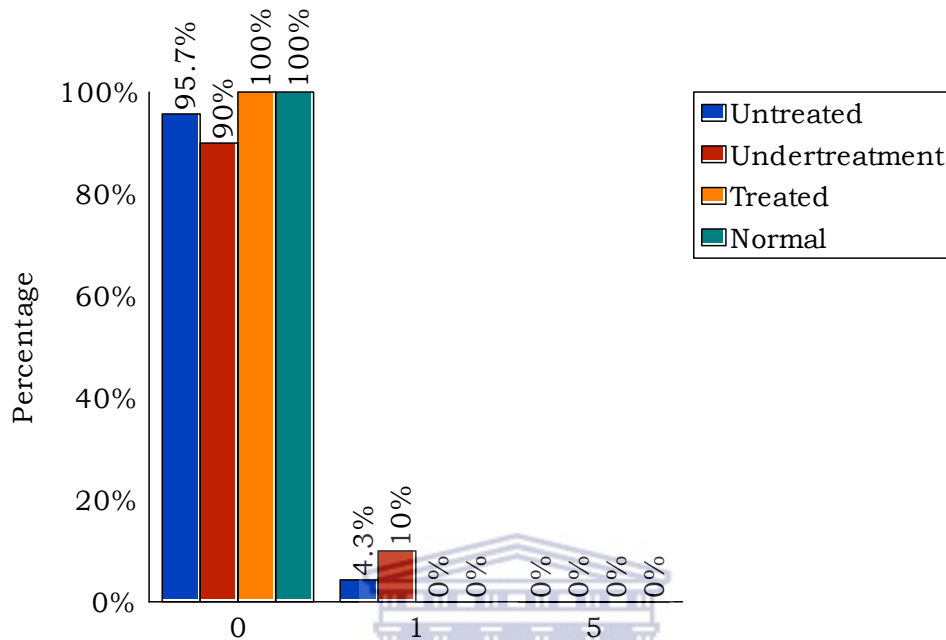


Fig. 6. Percentage distribution of subjects according to 3-point severity scale for pain on movement

Tables 9 and 14 and Fig. 7 show that impaired mobility was the most infrequently detected sign in the entire sample. There were no subjects with severe symptoms.

Table 14: Impaired mobility

	Frequency	Percent
Absence of symptom	67	89.3
Presence of mild symptom	8	10.7
Total	75	100.0

Impaired mobility

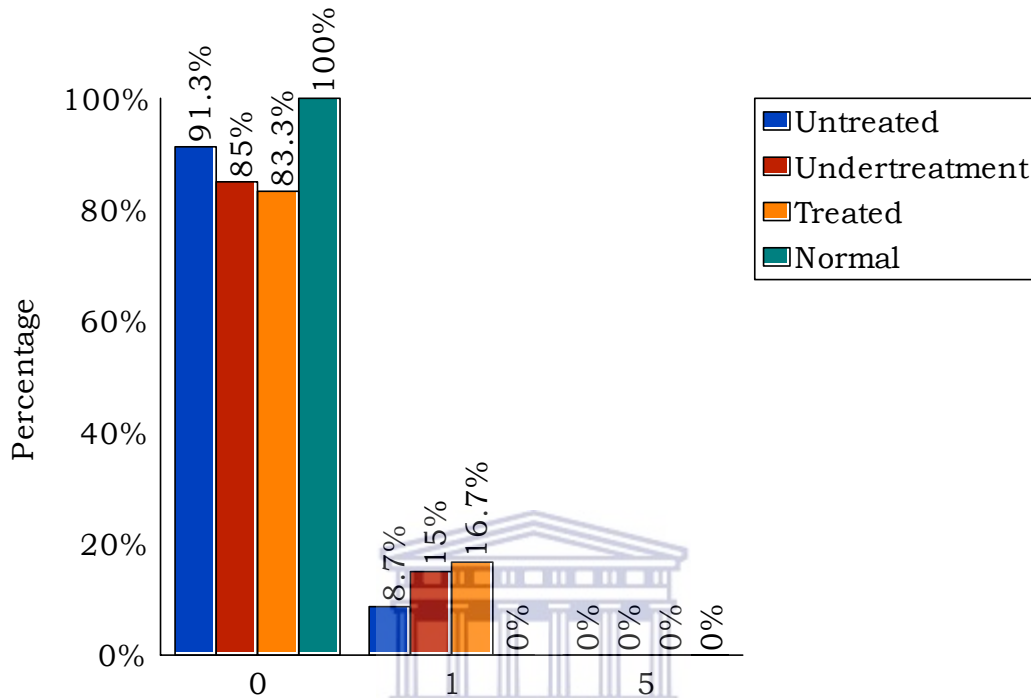


Fig. 7. Percentage distribution of subjects according to 3-point severity scale for impaired mobility

5.4 Anamnesis and gender

The results show no statistically significant differences between males and females for subjective symptoms of temporomandibular joint dysfunction, Tables 15 and 16, Fig. 8. ($p = 0.278$)

Table 15: Anamnestic Index * Subjects' gender Crosstabulation

		Subject's gender		Total
		Female	Male	
Anamnes tic Index	Ai0	19	22	41
	AiI	3	8	11
	AiII	13	10	23
Total		35	40	75

Table 16: Chi-Square Tests

	Value	df	Asymp. Sig. (2- sided)
Pearson Chi-Square	2.562(a)	2	.278
Likelihood Ratio	2.637	2	.268
N of Valid Cases	75		

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.13.

Anamnestic index and gender

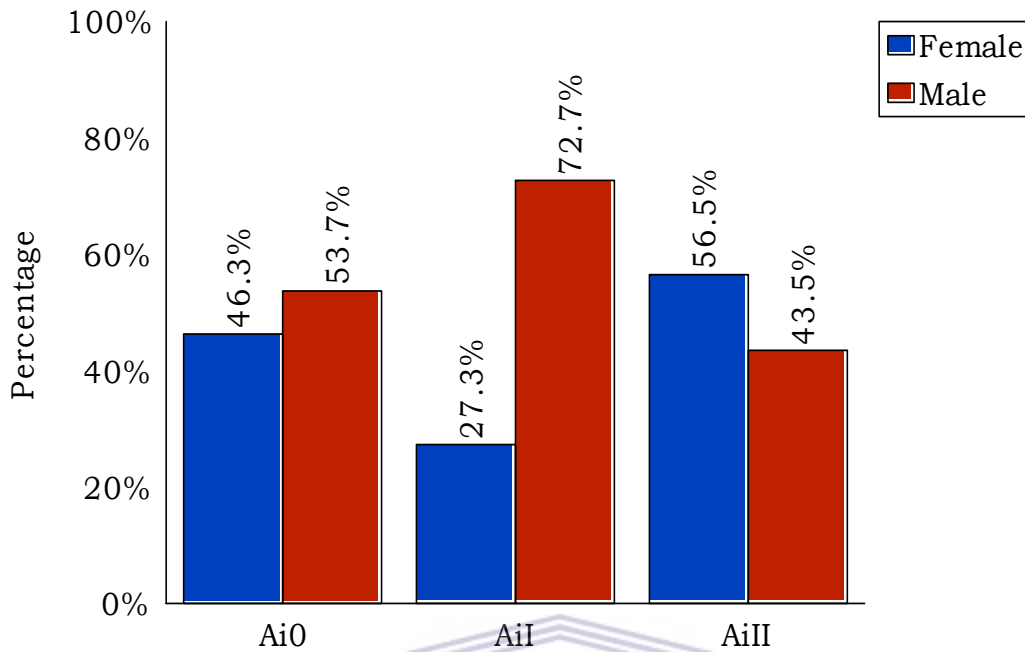


Fig. 8. Distribution of males and females according to the anamnestic index (Ai)

5.5 Clinical dysfunction and gender

The distribution as regards gender in accordance with the clinical dysfunction index is represented in Table 17. This distribution was not significantly different statistically as shown in Tables 18, and is graphically illustrated in Fig. 9. ($p = 0.613$)

Table 17: Clinical dysfunction index * Subject's gender Crosstabulation

		Subject's gender		Total
		Female	Male	
Clinical dysfunction index	Di0	14	16	30
	DiI	21	22	43
	DiII	0	2	2
Total		35	40	75

Table 18: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	1.831(a)	2	.400	.613
Likelihood Ratio	2.596	2	.273	.543
Fisher's Exact Test	1.481			.613
N of Valid Cases	75			

a 2 cells (33.3%) have expected count less than 5. The minimum expected count is .93.

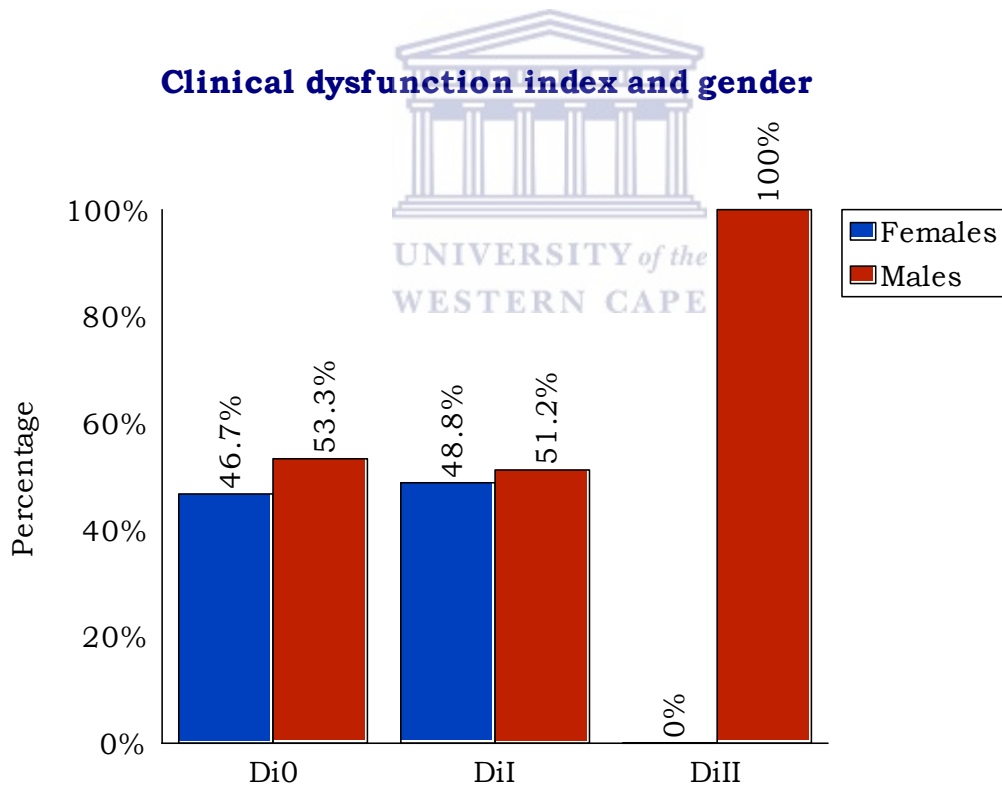


Fig. 9. Distribution of males and females according to the clinical dysfunction index (Di)

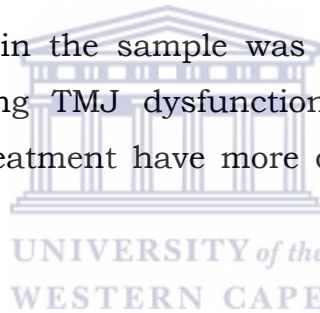
CHAPTER 6

Discussion

6.1 Patient Characteristics

Since epidemiological studies have indicated that the incidence of TMJ dysfunction increases with age³, an attempt was made to narrow down the sample to adolescents and young adults only. The participants in this study were therefore limited to those between the ages of 14 and 18 years of age with a mean age of 15.8 years. The age distribution for the males and females was similar

The female to male ratio in the sample was approximately 1:1. Some studies^{2, 40, 43} investigating TMJ dysfunction in patients seeking or undergoing orthodontic treatment have more or less reported a similar gender ratio.



6.2 Anamnestic index

The findings of the anamnestic investigation revealed that 45.3% (Table 5.4) of the entire sample reported one or more subjective symptoms of temporomandibular joint dysfunction. General population studies carried out among children showed varied prevalence rates of subjective symptoms of TMJ dysfunction. Motegi and colleagues²⁷ reported the prevalence of TMJ dysfunction symptoms to be 12.2% whereas Magnusson and co-workers³ reported it to be 62% to 66%. According to Egermark-Eriksson and colleagues²⁸ subjective symptoms of TMJ dysfunction (mostly occasional) were reported by 16% to 25% of the children studied. Farsi²⁶, in a study among Saudi children reported a prevalence of TMJ dysfunction symptoms of 24.2%. No wonder the

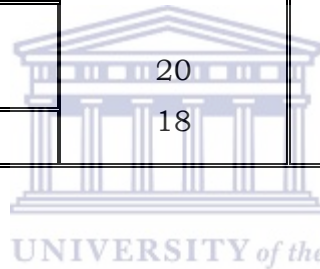
prevalence of TMJ dysfunction in children and adolescents has been reported to vary widely in the literature.²⁶

Joint sounds and headaches or neckaches more than twice a week represented the most common symptoms in all four groups in this study (21.3%). Motegi and colleagues²⁷ in their study also found joint sounds to be the most frequently occurring symptom, reported by 89.3% of the study population, followed by a combination of sound in the joint and pain that occurs from opening and closing the mouth, chewing food and in the TMJ (2.2%). In one study³⁰ among children and adolescents, the only reported symptom of TMJ dysfunction was headache and in another study²⁶, the most common symptoms were headache and pain on chewing.

Regarding the four groups of the study, the findings of the anamnestic investigation were different for each group. The untreated group had a prevalence of 65.2%, 40% for the group of malocclusions currently undergoing treatment, 33.3% for the treated malocclusions group, and 35.7% for the group with normal occlusion (Table 5.4 and Fig. 1). Other investigations have found prevalence rates of subjective symptoms of TMJ dysfunction to be similar in all the groups studied.^{1, 39}. As compared with other studies, the percentage of reported symptoms of the entire sample, is on the whole, higher. Table 6.1 gives a comparative picture of the anamnestic scores in different investigations of orthodontically treated patients.

Table 19: Anamnestic index (Ai) in different investigations

Authors	Sample	Number of subjects	Age range (years)	Ai (%)		
				0	I	II
Larsson & Ronnerman ¹⁴	Treated	23	24-28	73.0	27.0	-
Wadhwa et al ¹	Normal occlusion	30	14-25	80.0	20.0	-
	Untreated	41	13-25	85.4	14.6	-
	Treated	31	15-24	80.6	19.4	-
Present study	Normal occlusion	14	14-18	64.3	7.1	28.6
	Untreated	23	14-18	34.8	21.7	43.5
	Under treatment	20	14-18	60.0	15.0	25.0
	Treated	18	14-18	66.7	11.1	22.2



Although on the outlook the untreated group shows a higher prevalence of symptoms, the Fisher's exact test showed that there was no statistically significant difference among the four groups (Table 6). $p = 0.470$

This can probably be attributed to the small study sample ($n = 75$) and consequently the inability to use the Chi-square test (Table 6). In such cases the Fisher's exact test which is more sensitive can be employed to test for any statistically significant differences.

22.2% of the subjects in the treated group reported having had symptoms of TMJ dysfunction before commencing orthodontic treatment whereas 77.8% had no symptoms. Indeed the majority of persons in this

group (72.2%) reported no difference in symptoms of TMJ dysfunction before or after orthodontic treatment. This is in agreement with most longitudinal studies looking at orthodontically treated subjects that have concluded that orthodontic treatment neither increases nor decreases TMJ dysfunction.^{2, 39} However, Egermark and Thilander¹⁹ reported that subjects with a history of orthodontic treatment had a lower prevalence of subjective symptoms of TMJ dysfunction than those without any experience of orthodontics, whereas Smith and Freer⁴¹ noticed a trend towards slightly higher prevalence rates of various symptoms of TMJ dysfunction in the treated group when compared to the control group.

6.3 Clinical Dysfunction Index

Regarding the four groups of the study, the findings of the clinical dysfunction index were similar except for the untreated group. The untreated group had a prevalence of 74%, 55% for the group of malocclusions currently undergoing treatment, 55.6% for the treated malocclusions group, and 50% for the group with normal occlusion (Table 7). The results further show that 60% of the entire study sample had at least one clinical sign of temporomandibular dysfunction. This is in agreement with the prevalence of clinical signs that Magnusson and colleagues³ reported among 15 year-olds. Farsi²⁶ in a study, found the prevalence of signs of TMJ dysfunction to be 20.7% while Thilander and colleagues³⁰ recorded it as 25% in their subjects.

The results from this study support the evidence in the literature that, the prevalence rates of TMJ dysfunction in children and adolescents varies widely.²⁶

In this study the most frequently occurring clinical sign in the entire sample was joint sounds (33.3%). Egermark-Eriksson and colleagues²⁸ also found the most occurring clinical sign of TMJ dysfunction to be TMJ sounds. Wadhwa¹ reported the prevalence of joint sounds to be 35.5%, whereas Farsi²⁶ found it to be 11.8%.

Clinical dysfunction index scores of most investigations show the treated group to have similar or lower scores compared to the untreated groups^{39, 40}. In the present study, the untreated group had Di scores higher than the treated group. However, the treated group, the normal occlusion group, and the malocclusion group undergoing treatment had comparable Di scores. The percentage of subjects who were symptom-free in the treated group, normal occlusion group, and malocclusion group currently undergoing treatment was higher than that in the untreated group (26.1%). Moderate dysfunction was only recorded in the untreated malocclusion group and the malocclusion group currently undergoing treatment, (4.3 % and 5% respectively). No group reported a case of severe clinical dysfunction. Table 6.2 gives an overview of the clinical dysfunction index scores in the present study and comparative figures from other investigations of orthodontically treated subjects.

Table 20: Clinical dysfunction index (Di) in different investigations

Authors	Sample	Number of subjects	Age range (years)	Di (%)			
				0	I	II	III
Larsson & Ronnerman ¹⁴	Treated	23	24-28	65.0	31.0	4.0	-
Wadhwa et al ¹	Normal occlusion	30	14-25	46.7	40.0	10.0	3.3
	Untreated	41	13-25	19.6	51.2	29.2	-
	Treated	31	15-24	22.6	43.4	25.8	3.2
Present study	Normal occlusion	14	14-18	50.0	50.0	-	-
	Untreated	23	14-18	26.1	69.6	4.3	-
	Under treatment	20	14-18	45.0	50.0	5.0	-
	Treated	18	14-18	44.4	55.6	-	-

No statistically significant differences were observed in the four groups with regard to the clinical dysfunction index scores although at a glance the untreated group appears to have higher prevalence rates compared to the other groups. (p= 0.626)

The orthodontic procedures that have received the majority of criticism with respect to TMJ dysfunction are premolar extractions and maxillary incisor retraction. It is hypothesized that distal pressure on the mandibular complex can put distal pressure on the condyles and conceptually cause an anteriorly displaced disc. This study had only three persons who were treated with nonextraction compared to thirty-

five treated with extractions. Therefore it can be considered primarily as an extraction group. The prevalence of subjective symptoms and clinical signs of TMJ dysfunction was 40% and 57.1% respectively in this extraction group. This is lower than the prevalence of signs and symptoms found in the untreated group. Dibbets and van der Weele⁴³ found similar prevalences of TMJ dysfunction after 20 years in extraction and nonextraction groups. Beattie and colleagues⁵⁹ found no significant differences in the prevalence of TMJ dysfunction between the extraction and nonextraction samples. Luppapanornlarp and Johnston⁶⁰ also found that extraction and nonextraction groups did not differ with respect to the signs and symptoms of dysfunction. Kremenak and colleagues⁵⁶ in their study found small but significant differences in the direction of improvement between mean pretreatment and post-treatment scores for both extraction and nonextraction groups.



6.4 Gender differences

Although signs and symptoms of TMJ dysfunction have been reported to be more prevalent in females than in males in the literature^{4, 15, 17, 20, 21}, this is not the case in this study.

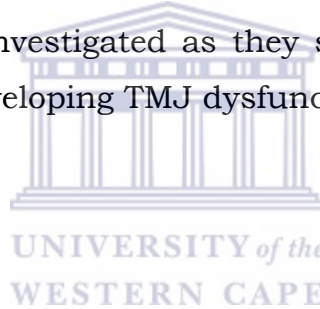
Our findings show the prevalence of signs and symptoms to be similar in both males and females. Magnusson and colleagues³ also noted no differences in the prevalence of signs and symptoms of TMJ dysfunction between boys and girls.

CHAPTER 7

Limitations of present study

The sample size in this study was small. This made comparisons between groups difficult since the Chi-square test could not be applied. Therefore, in many instances it was necessary to collapse some of the groups in order to assess associations.

However, there was an overall tendency for higher prevalence rates of signs and symptoms of TMJ dysfunction in the untreated group even though statistically significant differences in the four groups could not be established. The high prevalence rates in the untreated malocclusion group should be further investigated as they seem to suggest that this group may be at risk of developing TMJ dysfunction.



CHAPTER 8

Conclusion

The aim of this study was to determine the prevalence of signs and symptoms of temporomandibular dysfunction in subjects with normal occlusions, untreated malocclusions, malocclusions currently undergoing treatment and treated malocclusions. It was also the intention of this study to compare the prevalence of these signs and symptoms in the different groups.

Some important conclusions can be drawn from the present study and the related literature review. The role of orthodontic treatment as a possible aetiological factor in TMJ dysfunction is highly questionable. The susceptibility of patients undergoing extractions as part of orthodontic treatment toward development of TMJ dysfunction as compared with those being treated with nonextraction is again questionable and cannot be supported by the limited results of this study. Further, the difference in the prevalence of TMJ dysfunction in the treated and untreated groups indicates that the role of the orthodontic treatment in prevention or correction of mild to moderate TMJ dysfunction needs to be investigated further as the untreated malocclusion group may be a high risk group based on the limited data from this study.

The present study also revealed the need for further research in the area of TMJ dysfunction and occlusal features in South Africa and Africa in general as most of the literature cited is from outside the African continent and may be influenced by other factors including dietary and sociological factors.

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Appendices

Appendix 1: Screening Examination Questionnaire

Registration No

Kindly give us the details below and tick the correct answer

Name:

Contact Number:

Age:

Gender:

- | | Yes | No |
|---|--------------------------|--------------------------|
| 1. Is it difficult to open your mouth wide to eat an apple, to yawn, or to sing? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Do you feel pain on opening your mouth wide? | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Do you hear any clicking, popping, or grating noises from the joint, when you open your mouth wide? | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Do you have headaches or neckaches more than twice a week? | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Do you ever have pain in your ears, or in front of your ears? | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Do you have to move your jaw sideways or hand guide it to get by a “catch” in your joint in order to open your mouth wide or to close your teeth together? | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Have you ever had or recently had any kind of sports, bicycle, car, or other type of accident that caused you discomfort or injury to the head? | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Do your jaws (muscles) ache; feel tender or stiff after awakening in the morning? | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Are you under financial, legal, or personal stress that may affect your quality of life? | <input type="checkbox"/> | <input type="checkbox"/> |

Thank you very much

Appendix 2: Screening Examination Questionnaire (modified)

Registration No

Kindly give us the details below and tick the correct answer

Name:

Contact number:

Age:

Gender:

Yes No

1. Is it difficult to open your mouth wide to eat an apple, to yawn, or to sing?
2. Do you feel pain on opening your mouth wide?
3. Do you hear any clicking, popping, or grating noises from the joint, when you open your mouth wide?
4. Do you have headaches or neckaches more than twice a week?
5. Do you ever have pain in your ears, or in front of your ears?
6. Do you have to move your jaw sideways or hand guide it to get by a “catch” in your joint in order to open your mouth wide or to close your teeth together?
7. Have you ever had or recently had any kind of sports, bicycle, car, or other type of accident that caused you discomfort or injury to the head?
8. Do your jaws (muscles) ache; feel tender or stiff after awakening in the morning?
9. Are you under financial, legal, or personal stress that may affect your quality of life?
10. Did you have any of the above symptoms before orthodontic treatment?
11. To the best of your knowledge, have these symptoms decreased, increased or has there been no difference after treatment?.....

Thank you very much

Appendix 3: Clinical examination form

Occlusion: Normal/Class of malocclusion

In case of malocclusion:

Type of treatment:

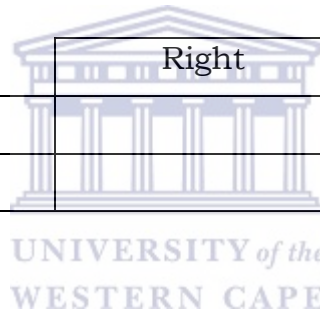
Untreated	
Under treatment	
Treated	

Extraction	
Non-extraction	

Duration into or after treatment:

months

	Right	Left
Molar classification		
Canine classification		



Overjet	mm
Overbite	mm

Occlusal contacts/interferences:

Right	18 17 16 15 14 13 12 11	21 22 23 24 25 26 27 28
Lateral	48 47 46 45 44 43 42 41	31 32 33 34 35 36 37 38
Left	18 17 16 15 14 13 12 11	21 22 23 24 25 26 27 28
Lateral	48 47 46 45 44 43 42 41	31 32 33 34 35 36 37 38
Protrusion	18 17 16 15 14 13 12 11	21 22 23 24 25 26 27 28
	48 47 46 45 44 43 42 41	31 32 33 34 35 36 37 38
CR/CO	18 17 16 15 14 13 12 11	21 22 23 24 25 26 27 28
	48 47 46 45 44 43 42 41	31 32 33 34 35 36 37 38

Slide from CR to ICP:

Yes	No

Cross bite:

Open bite:

Impaired range of movement/Mobility index		Impaired TMJ function	Muscle pain	TMJ pain	Pain on movt of the mandible
Maximum mouth opening		Deviation on opening/closing	Masseter	Right side	Opening
			R L		
Lateral movement R		Joint sounds	Temporalis	Left side	Lateral movement R
			R L		
Lateral movement L			Medial ptyregoid		Lateral movement L
			R L		
		Lateral ptyregoid			
				R L	

Appendix 4: Helkimo's Index

Anamnestic dysfunction index, Ai (Helkimo 1974)

Ai0 denotes complete absence of subjective symptoms of dysfunction of the masticatory system (i.e. symptoms mentioned under AiI and AiII).

AiI denotes mild symptoms such as temporomandibular joint sounds such as clicking and crepitation, feeling of stiffness or fatigue of jaws.

AiII denotes severe symptoms of dysfunction. One or more of the following were reported in anamnesis: difficulty in opening the mouth wide, locking, luxation, pain on movement, facial and jaw pain.

Clinical dysfunction index, Di, based on evaluation of five common clinical symptoms (Helkimo 1974)

A. Symptom: Impaired range of movement/mobility index

Criteria: Normal range of movement	0
Slightly impaired mobility	1
Severely impaired mobility	5

B. Symptom: Impaired TM-joint function

Criteria: Smooth movement without TM-joint sounds and deviation on opening or closing movements ≤ 2 mm	0
TM-joint sounds in one or both joints and/or deviation > 2 mm on opening or closing movements	1
Locking and/or luxation of the TM-joint	5

C. Symptom: Muscle pain

Criteria: No tenderness to palpation in the masticatory muscles	0
Tenderness to palpation in 1-3 palpation sites	1
Tenderness to palpation in 4 or more palpation sites	5

D. Symptom: Temporomandibular joint pain

Criteria: No tenderness to palpation	0
Tenderness to palpation laterally	1
Tenderness to palpation posteriorly	5

E. Symptom: Pain on movement of the mandible

Criteria: No pain on movement	0
Pain on 1 movement	1
Pain on 2 or more movements	5



F. Sum A + B + C + D + E - dysfunction score (0-25)

G. Dysfunction group 0-5, according to code

H. Clinical dysfunction index, Di, according to code

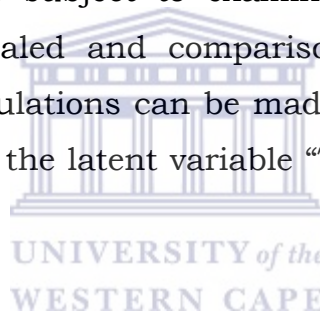
Code: 0 points	=	Dysfunction group 0	=	clinically symptom free	=	Di0
1-4 points	=	"	"	1 = mild dysfunction	=	DiI
5-9 points	=	"	"	2 = moderate dysfunction	=	DiII
10-13 "	=	"	"	3 = severe dysfunction	=	DiIII
15-17 "	=	"	"	4 = "	"	"
20-25 "	=	"	"	5 = "	"	"

Appendix 5: Pilot Study

Evaluation of Orthodontic patients using the Helkimo index.

The Helkimo index has been applied in a number of investigations and it has been claimed that this index provides a good indication of the severity of TMJ dysfunction. ⁴

The merit of the Helkimo index, undoubtedly, is that it introduced a fixed set of symptoms with well-defined assignments of the parts of the index and a computation of the index-class. This has resulted in a number of studies that have demonstrated comparable results concerning the presence of dysfunction, or even better, the presence of a number of symptoms in the patients subject to examination. Thus, well-defined estimates have been revealed and comparisons of the prevalence of symptoms in different populations can be made. However, the relevance of the index for measuring the latent variable “TMJ dysfunction” has not yet been demonstrated. ⁵⁸



The aim of this study was to determine the prevalence of signs and symptoms of subjects with different occlusions using the Helkimo index. Study subjects completed a questionnaire which analyzed physical symptoms such as headaches, joint sounds, muscle tenderness, difficulty in mouth opening, pain in and around ears. They also underwent a clinical examination for signs of temporomandibular dysfunction.

Ten patients (5 boys and 5 girls) attending the Orthodontic Clinic, Faculty of Dentistry, University of Western Cape were examined for signs and symptoms of temporomandibular dysfunction by Helkimo method. 60% reported at least one or more subjective symptoms of TMJ

dysfunction. At least one clinical sign or symptom of TMJ dysfunction was also found in 60% of the subjects.

It was concluded that the method of Helkimo was sound and could be pursued with larger numbers



Appendix 6: CONSENT FORM

Background Information

Title: Prevalence of signs and symptoms of temporomandibular dysfunction in subjects with different occlusions using the Helkimo Index

Introduction: Studies show that signs and symptoms of jaw joint problems (temporomandibular (TM) dysfunction) occur in all age groups. The occurrence of these signs and symptoms increases with age, from childhood, through adolescence to adulthood. The cause of jaw joint problems is thought to be due to many factors.

What is the study about? This study is aimed at establishing how common the signs and symptoms of jaw joint problems are in subjects with normal tooth arrangement, those with skewed teeth that have not yet been treated and those undergoing treatment, and in subjects who have had their maligned/skewed teeth corrected.

Who is to participate in the study?

The main part of the study involves collecting information from you related to jaw joint problems.

You were selected because you are between the ages of 14 and 18 years. We are requesting you to answer the questions that we have prepared for you. We are interested in the information about you.

In accepting to participate in the study you are giving us a few minutes of your time to answer the questions and undergo a clinical exam.

Is there risk involved? There is no risk associated with participating in this study. It involves no treatment or procedure that could cause harm, injury or discomfort to you. It involves collecting information by filling out a questionnaire and a clinical exam. The findings of the clinical examination will be recorded.

What do I benefit from the study? Participants will not benefit directly from their participation in the study. We hope the results will contribute to a better understanding of jaw joint problems especially in relation to malocclusion and orthodontic treatment.

What if I don't want to participate? Participation in this study is entirely voluntary.

Participants are free to withdraw from the study at any time – even in the middle of the interview. Failure to participate will not bias or affect the treatment you will receive at the clinic.

We assure all information gathered during the course of the study will be kept completely confidential. Only Dr. Kalanzi (the researcher), Prof Osman (the supervisor), Dr. Shaikh (the Co-Supervisor), and the research assistants collecting the data will have access to the data. All the data will be coded for identification. The results of the study will be published in scientific journals in an anonymous form. All data will be kept for a period of five years after which they will be destroyed.

For further information or any queries please do not hesitate to call Dr. Kalanzi Dunstan at 021-370-4400/4462 or 0734863498

I.....(name) having been well explained and informed of the intentions and benefits of the study, voluntarily consent to participate in the study. I have been made aware that there are no direct benefits, no treatment will be carried out, and there are no risks involved. I have also been made aware that I am free to withdraw from the study at any time and confidentiality has been assured.

.....

signature

.....

witness

Date (___/___/___)

Date (___/___/___)

Hiermee stem ek.....(naam) vrywilliglik in om aan die studie deel te neem. Ek bevestig ook hiermee dat ek ten volle ingelig was oor die voordele asook die doel van genoemde studie.

Ek bevestig ook dat ek deeglik ingelig was dat daar geen direkte voordele sal wees, geen behandeling uitgevoer word en dat daar ook geen risiko's betrokke is nie.

Vertroulikheid is verseker.

.....

handtekening

.....

getuie

Datum (___/___/___)

Datum (___/___/___)