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**BRUXISM AND PARAFUNCTIONAL CLENCHING:
CLINICAL CHARACTERISTICS AND ASSOCIATIONS
WITH SLEEP AND GUT DISTURBANCES**

A CROSS-SECTIONAL PILOT STUDY

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A treatise submitted in partial fulfillment of
the requirements for the degree of

**Master of Dental Science
(Prosthodontics)**



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STATEMENT OF AUTHORSHIP

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ABBREVIATIONS

SB	Sleep bruxism
RMMA	Rhythmic masticatory muscle activity
GIT	Gastrointestinal tract
IBS	Irritable bowel syndrome
FD	Frequent dyspepsia
RDC/TMD	Research Diagnostic Criteria for Temporomandibular Disorders
SCL-90-R	Symptom Checklist-90-Revised
STAI	Spielberger Trait-State Anxiety Inventory
BSQ	Bowel Symptom Questionnaire
BQ	Berlin Questionnaire
ESS	Epworth Sleepiness Scale
EMG	Electromyographic
FMA	Faecal microbial analysis

ABSTRACT

Bruxism and parafunctional clenching: clinical characteristics and associations with sleep and gut disturbances. A cross-sectional pilot study.

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Introduction: Sleep bruxism has major implications in dentistry. It can result in tooth fractures, masticatory muscle disorders and loss of tooth structure. There is no agreement on its pathophysiology, and it remains a poorly understood and a poorly managed entity. A medical aetiology (sleep and gut disturbance) for bruxism needs to be considered.

Objectives: This study was conducted to: (1) identify study and control groups based on specific inclusion criteria; (2) investigate levels of sleep disturbance, anxiety symptoms, jaw muscle activity, gastrointestinal symptoms and gastrointestinal microbial imbalances in test and control subjects.

Methods: Test group subjects with signs and symptoms of bruxism (n=17) and control group subjects without signs and symptoms of bruxism (n=15) were examined by one investigator involving two visits per subject. Visit 1 - (1) intraoral examination (wear score of anterior dentition), (2) medical and dental history, (3) consent forms, (4) saliva test, (5) diagnostic casts. Visit 2 - (1) Questionnaires: Bowel Symptom Questionnaire (BSQ) for level of gut disturbance, Epworth Sleep Questionnaire, Berlin Sleep Questionnaire, Research Diagnostic Criteria/Temporomandibular Disorders (RDC/TMD), Symptom Checklist-90-Revised (SCL-90-R) for psychosomatic symptoms assessment, Spielberger State-Trait Anxiety Inventory Questionnaire (STAI); (2) Electromyographic (EMG) recordings of masticatory muscles at maximum voluntary clenches in various jaw positions; (3) Faecal Microbial Analysis. Statistical analysis: independent t tests.

Results: The study comprised of 32 subjects (17 study and 15 control subjects). The age range was 27 to 60 years (mean age 40.16 ± 9.67 years). There was no statistically significant difference between the mean age of the 2 groups ($p=0.14$). There was an obvious gender difference within each group. Bruxers displayed greater levels of anterior tooth wear, elevated levels of anxiety, increased obsessive-compulsive symptoms, and greater somatisation of pain. TMD muscle pain symptoms were present in 71% of bruxers and 0% in non-bruxers. The masseter muscle activity during maximum voluntary clenches in intercuspal or retruded jaw position was significantly greater in sleep bruxers than non-bruxers ($p<0.05$). The temporalis muscle activity during excursive maximum voluntary clenches was significantly less in bruxers than non-bruxers ($p<0.05$). There was no significant difference in the levels of sleep or gut disturbance between the two groups. There was a marked difference in the percentage of subjects with normal faecal streptococcus, lactobacillus and bifidobacterium counts between the two groups. The clinical significance of this difference is uncertain and requires further investigation.

Conclusions: Sleep bruxers displayed: (1) significantly greater levels of anterior tooth wear, anxiety, obsessive-compulsive symptoms, somatisation of pain and masseter muscle activity; (2) significantly less temporalis muscle activity in excursive jaw positions. No significant difference in the level of sleep or gut disturbance was found between the bruxers and non-bruxers.

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INTRODUCTION

Bruxism has major implications in dentistry. Patients with bruxism often present with tooth wear, fractured dental restorations, tooth hypersensitivity, masticatory discomfort and or jaw muscle pain (Kato et al., 2001b). Bruxism is a clinically relevant problem.

The emphasis on teeth and occlusion as a trigger has resulted in a focus on dental diagnosis and dental management of sleep bruxism. However the evidence for this has since been suggested to be weak, if not irrelevant (Lobbezoo and Naeije, 2001). As a result, management strategies based solely on teeth and occlusion are inappropriate. Despite the importance of this clinical problem there is poor knowledge and no agreement on the pathophysiology of bruxism.

Bruxism however has been associated with certain sleep-related physiological functions, including autonomic activation (Lavigne et al., 2001). It is yet unknown why some sleep bruxers suffer from temporomandibular disorders while others do not (Attanasio, 1991).

Bruxism remains a poorly understood and a poorly managed entity. A medical aetiology for bruxism needs to be considered. In addition, specific and validated clinical features of bruxism need to be established.

1. Definition of Sleep Bruxism

Bruxism can be described as a “diurnal or nocturnal parafunctional activity that includes clenching, bracing, gnashing, and grinding of teeth” (Ahlberg et al., 2005). Hence, bruxism is an oral parafunctional activity that can occur when an individual is asleep or awake. In 2000, Lavigne and Manzini further classified bruxism (Table 1).

Table 1. Classification of Bruxism (Modified from Lavigne and Manzini, 2000)

	During Sleep	During Sleep and Wakefulness	During Wakefulness
Primary Form	Sleep Bruxism		
Secondary/Iatrogenic Form	Alcohol	Selective serotonin uptake inhibitors	Cocaine
	Cigarettes		Amphetamines
	Caffeine		Neuroleptics
	Hemifacial spasms	Antidepressants	Tardive dyskinesia
		Calcium antagonists	
	Gilles de la Tourett Syndrome	Levodopa	Cerebellar haemorrhage
		Antidopaminergic drugs	
		Oromandibular dystonia	
	Restless leg syndrome	Huntington's disease	Dementia
	Periodic leg movement	Parkinson's disease	Rett's Syndrome
	Sleep apnoea	Whipple's disease	
		Mental retardation	
	REM sleep behaviour disorder	Coma	
	Night terrors		
	Confusional awakenings		
	Sleep epilepsy		
	Sleep myoclonus		
	Shy-Drager Syndrome		
	Olivo-pont-cerebellar atrophy		

Bruxism occurring during wakefulness should be differentiated from sleep bruxism (SB). The two conditions occur under different environments and have been considered as separate entities (Rugh and Harlan, 1988).

2. Usual Orofacial Motor Activity During Sleep

Numerous healthy orofacial motor activities occur during sleep such as grimacing, talking, sighing, swallowing and coughing (Kato et al., 2001b). Activities such as chewing automatism is similar to chewing activities during wakefulness, but occur at a reduced frequency of jaw movement.

Rhythmic masticatory muscle activity (RMMA) without tooth grinding has been found in 60% of a normal study population at a frequency of 1.8 times per hour of sleep (Kato et al., 2001b). It has been hypothesized that RMMA and SB are related to salivary secretion during sleep. Because salivary flow is known to be reduced during sleep, RMMA may increase salivary flow to lubricate oral and oesophageal structures (Thie et al., 2002).

3. Unusual Orofacial Movements During Sleep

Unusual orofacial movements during sleep include the following (Kato et al., 2001b):

- Sleep myoclonus in masticatory muscles
- Violent parasomnias
- Oromandibular dystonia
- Parkinson's disease

Sleep myoclonus in the masticatory muscles involve rapid, brief, shock-like muscle jerks which may occur in certain medical conditions such as those observed in epilepsy and insomnia. Higher prevalence of SB (25.3%) is reported in patients suffering from violent parasomnias during sleep than in people without them (9.1%) (Kato et al., 2001b).

Oromandibular dystonia (OMD) is characterized by slow, sustained twitching and repetitive orofacial activities involving the lower jaw, tongue, and upper face. Patients with OMD are reported to have secondary bruxism during wakefulness and sleep (Kato et al., 2001b).

Parkinson's disease can be described as a hypokinetic movement disorder caused by degeneration of dopaminergic system. Bruxism during wakefulness and sleep has been reported in some patients with Parkinson's disease treated with levodopa therapy (Kato et al., 2001b).

4. Prevalence and Risk Factors

The prevalence of SB decreases linearly with age: 19% in children 3 to 10 years of age, 13% in teenagers, and 3% in people over 60 years of age (Lavigne and Montplaisir, 1994). No gender difference has been reported in some studies (Rugh and Harlan, 1988) while other studies have reported a female predilection (Glaros, 1981). It is most likely that the occurrence of SB is underestimated as it is generally based on either a bed partner's or family member's report of grinding sounds. Sleep bruxism is even more difficult to diagnose in people who sleep alone, in denture wearers who sleep without their prostheses, and in SB patients who predominantly clench their teeth during sleep (Kato et al., 2001b).

Several risk factors have been reported. Risk factors include smoking, obstructive sleep apnoea syndrome, caffeine or alcohol intake, stressful life events, and high anxiety levels (Kato et al., 2001b). Orofacial pain and various temporomandibular disorders are frequently reported in SB patients (Lobbezoo and Lavigne, 1997).

5. Pathophysiology

The exact pathophysiological mechanisms of SB remain to be identified. The possible schools of thought regarding the aetiology of bruxism include peripheral (morphological) and central (pathophysiological, psychological/psychosocial and evolutionary) (Every, 1960, Ahlberg et al., 2005, Carlsson et al., 2003, Every, 1965). At present, peripheral morphological factors such as occlusal discrepancies, are believed to play a minor role, if any, in the aetiology of bruxism (Ahlberg et al., 2005). Central factors, such as abnormal functions of the dopaminergic system and stress, are suggested to be more significant in the aetiology of bruxism (Ahlberg et al., 2005).

Recent reports suggest that SB is influenced by central and autonomic cardiac nervous system processes related to oromotor functions and sleep-waking regulation as well as psychosocial and genetic factors (Kato et al., 2001b). Other evidence supports the view that SB is related to anxiety and is secondary to sleep arousal (Lavigne et al., 2003, Rugh and Harlan, 1988).

5.1. Rhythmic Masticatory Muscle Activity

In 80% to 95% of SB episodes of sleep bruxers, rhythmic masticatory muscle activity (RMMA) may be present with or without tooth grinding sounds (Lavigne et al., 2001). Rhythmic masticatory muscle activity also occurs in normal controls. Kato et al (2001a) have found that 60% of normal controls exhibit RMMA during sleep regardless of the presence of tooth-grinding sounds. In SB patients, however, RMMA occurs three times more often where the EMG amplitude of those episodes is 30% greater than in age- and gender-matched normal controls (Lavigne et al., 2001).

5.2. Sleep

Sleep bruxism in older populations is reported to be associated with diminished sleep quality (Kato et al., 2001b). Dao et al (1994) reported that bruxing subjects with muscle pain disorders and chronic-pain sufferers in general experience greater sleep disturbance. In young persons, a normal sleep macrostructure is evident with minimal complaint of sleep disturbance (Lavigne et al., 1996). As rhythmic masticatory muscle activity can be observed in 60% of normal subjects (Lavigne et al., 2001), this activity may be strongly related to normal sleep-related physiological functions including autonomic activation (Lavigne et al., 2001). Hence, a more frequent and elevated rhythmic masticatory muscle activity in SB patients is believed to be associated with sleep microarousal in these patients (Lavigne et al., 2001, Kato et al., 2001a).

5.3. Neurochemistry

Medications that act on the neurotransmitter system may induce the development of secondary iatrogenic bruxism. Bruxism during sleep or wakefulness is becoming increasingly evident following the use of selective serotonin reuptake inhibitors (SSRI). In contrast, certain groups of SSRI drugs have been reported to reduce bruxism induced by other SSRI medications (Kato et al., 2001b). Studies investigating bruxism must exclude subjects taking SSRI medications.

5.4. Oesophageal pH and Salivary Flow

There is increasing literature investigating the relationship between oropharyngeal physiology and SB. Miyawaki et al (2003 and 2004) proposed that RMMA is secondary to gastric oesophageal reflux. Thie et al (2002) proposed that SB may be a mechanism of increasing the oromotor activity, thereby increasing the salivary flow and lubrication to the oroesophageal tissues during sleep. These studies have been based on a small number of subjects and require future investigations. However, studies such as these highlight the fact that bruxism is poorly understood and a more physiological and biological aetiology needs to be investigated.

5.5. Psychophysiologic Aspects

The literature concerning the influence of psychophysiological aspects on SB remains controversial. A number of subjective reports and questionnaire-based cross sectional studies have suggested that tooth-grinding SB patients exhibit elevated levels of anxiety, stress and aggressiveness (Kato et al., 2001b, Manfredini et al., 2004, Glaros, 1981). Rugh and Harlan (1988) described elevated masseter EMG activity during sleep in SB patients following emotionally or physically stressful events. In contrast, other studies show only a low correlation between self-reported daytime stress and masseter muscle EMG activity during sleep (Pierce et al., 1995). Controlled studies are required to clarify the role of psychosocial factors in SB patients.

5.6. Autonomic Nervous System

Studies have indicated abnormal results to autonomic function tests during wakefulness in 64% of SB patients (Sjohom et al., 1995). Other reports have indicated that SB patients do not display abnormal autonomic nervous system (ANS) function during sleep in comparison with age- and gender-matched controls (Bader and Lavigne, 2000).

An increase in the levels of urinary catecholamines has been reported in SB patients. This finding is suggestive of a higher sympathetic nervous activity in response to physiologic stress (Vanderas et al., 1999). In general, there is no conclusive evidence relating the abnormal function of the autonomic nervous system with SB in the current literature.

5.7. Genetic Factors

A genetic component to SB pathophysiology has been suggested. However the literature investigating genetic factors are extremely limited and dated (Abe and Shimakawa, 1966, Hublin et al., 1998). To clarify an inheritance pattern, studies must be conducted over several generations along with chromosomal identification.

5.8. Peripheral Sensory Factors

There is considerable controversy regarding the role of occlusal factors in SB pathogenesis with studies throughout the years showing ambiguous results (Kato et al., 2001b). Many of these studies suffer from poorly controlled study methodologies.

5.9. Temporomandibular Disorders (TMD)

The correlations between reported TMD symptoms, tooth-clenching and tooth-grinding has been interesting. Magnusson and colleagues' 20 year prospective study concluded that "reports of bruxism as baseline were a predictor for the presence of clinical signs 20 years later". Their report indicated that "parafunction cannot be ruled out as possible aetiological factors in the development of TMD". Johansson et al (2004) in their epidemiological study based on self-report

questionnaires reported that bruxism was a significant risk factor for pain from the TMJ. It is still unknown whether parafunction is the cause or the result of pain and dysfunction. There is still no strong scientific evidence of a definitive relationship between bruxism and TMD. Bruxism and TMD may be coexisting entities in a considerable number of subjects (Lobbezoo and Lavigne, 1997).

5.10. Functional Gastrointestinal Disturbances and Microbiology

Functional gastrointestinal (GI) disorders, including irritable bowel syndrome (IBS) and frequent dyspepsia (FD) are highly prevalent in the general population (Vege et al., 2004, Talley et al., 1995). Functional gastrointestinal disturbances cause substantial morbidity. Interestingly, an association has been made between sleep disturbance and functional GI disturbance (Vege et al., 2004). The question arises then, as to whether functional gastrointestinal disturbances appear as a feature or a coexisting entity in patients with disturbed sleep associated with sleep bruxism. There appears to be no studies investigating this possible coexistence.

In patients with TMD and chronic fatigue syndrome, it has been suggested that gastrointestinal microbiology has an influence in the pathophysiology of sleep (Aaron et al., 2000, McGregor et al., 2003). Bacterial muramyl peptides, most probably from the gastrointestinal tract, have been implicated in causing disordered slow-wave sleep, and suppressing active sleep in these patients (Krueger et al, 1984; Brown et al, 1990). TMD may be a comorbid feature of sleep bruxism and may share a common aetiology with sleep bruxism (Lobbezoo and Lavigne, 1997). Does gastrointestinal microbiology influence sleep in sleep bruxing subjects? There is no present scientific knowledge on the gastrointestinal microbial profiles of sleep bruxers.

5.11. Smoking

Smoking has been implicated to increase bruxism by 1.9 factors (Kato et al., 2001b). When examining the effects of smoking on bruxism, nicotine dose response, duration of habit and degree of dependence need to be more carefully controlled (Ahlberg et al., 2005).

5.12. Thegosis

Thegosis is defined as “sharpening a tooth, beak or bill by deliberately and forcefully grinding it across surfaces of an opposing tooth, beak or bill” (Every, 1960). Thegosis is a term proposed by Dr Ron Every (1960) to describe a “necessary naturally-occurring biological phenomenon that sharpens and maintains teeth for increased masticatory efficiency and defence”.

Thegosis in the zoological literature is described to be an evolutionary development in the animal kingdom (Archer, 1981, Every et al., 1998, Every, 1960). It is observed to be an instinctive process whereby thegotic facets are produced from tooth grinding action without a food bolus while the teeth are firmly in contact, in order to maintain their sharpness (Every, 1960). This is observed in both herbivores and carnivores (Archer, 1981) .

The theory of thegosis by Every (1960) proposes that tooth clenching and grinding is therefore an inherited characteristic which is dominant in the animal kingdom and has been retained in modern man (Every, 1965, Klineberg, 1994). Thegotic action in man is believed to be, as observed in the animal kingdom, provoked mainly by stress (Klineberg, 1994, Every, 1965). Thegosis provides an interesting concept whereby teeth clenching and grinding is viewed as an evolutionary mechanism of increasing the masticatory function and survival rather than a component of dysfunction or disorder.

Murray and Sanson (1998) drew interesting counter arguments to the theory of thegosis in their critical review. A number of concluding statements were made including the following:

“The evidence for the existence of thegosis was largely drawn from the behaviour of stressed animals, including man, producing thegotic facets” and “thegotic facets were also observed in animals of unknown behavioural status and in animals from other phyla”.

“Every, with his observations of baboon canine honing, developed an attractive theory for the sharpening of anterior teeth as social or defensive weapons....these views conflict with the chronologically intermediate opinion that thegosis is not found in mammalian taxa, in all members of a population, or in all teeth of a dentition.”

Thegotic theory as it applies to dentistry, requires further investigation (Murray and Sanson, 1998).

5.13. Summary

The available research in the field of bruxism is limited. Many studies suffer from poor methodology and poor standardization. The possible relationship between bruxism and factors or theories such as smoking, thegosis and functional gastrointestinal disturbances requires future investigations. In addition, associations between bruxism and psychophysiological aspects require confirmation or clarification.

6. Clinical Findings and Diagnosis

Definitive diagnosis of SB can be made with electrophysiologic tools such as polysomnographic or ambulatory recording systems. For dental clinicians, recognition of SB is based mainly on the clinical observations (Kato et al., 2001b).

6.1. Subjective Reports

A history of tooth-grinding sounds is a predominant feature of SB. It is often reported by a patient's bed partner. A report of ongoing history of this sound suggests ongoing SB. The occurrence of tooth-grinding sounds is however highly variable and needs to be objectively distinguished from other oral sounds during sleep through sleep laboratory studies with audiovisual recordings (Kato et al., 2001b).

6.2. Clinical Observations

The following clinical observations can be made in sleep bruxism patients according to Kato et al (2001a) and Dao et al (1994):

- Reports of tooth grinding or tapping sounds.
- Presence of tooth wear seen within normal range of jaw movements or at eccentric position.
- Presence of masseter muscle hypertrophy on voluntary contraction.
- Complaint of masticatory muscle discomfort, fatigue, or stiffness in the morning. Muscular pain or morning discomfort suggests an episode of sleep bruxism the night before.
- Tooth or teeth hypersensitive to cold air or liquid.
- Clicking or locking of temporomandibular joint.
- Tongue or cheek indentations.

6.2.1. Tooth Wear

It is established that bruxism can lead to increased tooth wear (Carlsson *et al.*, 1985). Authors such as Rugh and Harlan (1988) proposed that “wear pattern of teeth were the best guides in diagnosing bruxism”. Tooth wear is a feature of SB and can be identified by clinical examination. However, definitive diagnosis of SB cannot be made by the presence of tooth wear alone, as tooth wear may only indicate a history of SB and not ongoing active SB (Kato et al., 2001b). Localized or generalised tooth wear may be evident on the incisal edges of the anterior teeth or on the occlusal surfaces of molar teeth. Severity will range from shiny spots on enamel to dentine exposure leading to complaints of tooth pain or sensitivity to cold liquids or air (Rugh and Harlan, 1988). Tooth wear related to oral habits, dental work, or specific diets needs to be differentiated from SB (Kato et al., 2001b).

Other authors clearly contradict statements made by Rugh and Harlan (1988). Seligman et al (1988) have reported poor correlation between wear patterns and self reported bruxism. The controversy exists because tooth wear is an all-embracing term that describes the combined processes of attrition, abrasion and

erosion (Hooper et al., 2004, Kato et al., 2001b). Studies need to clearly specify what form of tooth wear is being measured.

The complex aetiology and diverse presentation of tooth wear coupled with the varied time scale of tooth wear has made the development of useful indices challenging (Hooper et al., 2004). Numerous indices have been described in the dental literature. Most indices rely on the ability to recognize the extent of dentine exposure intraorally (Hooper et al., 2004).

Johansson et al (1996) utilized photographs to verify whether the wear had reached the secondary dentine. However the distinction between primary and secondary dentine is very difficult to make in the clinical setting even with photographs. Seligman et al (1988) proposed a scale in which any dentine exposure is graded as 4 on a scale from 0 to 4. The scale enables a detailed evaluation of enamel wear. However, in clinical practice, wear into dentine is commonly found. This makes their scale less applicable in the clinical setting.

Other scoring systems require identification of secondary dentine in order to estimate the size of the exposed dentine surface (Smith and Knight, 1984). Hugoson et al (1988) required the use of terms such as *negligible* and *obvious*. Similar limitations exist with other earlier studies (Milosevic et al., 1994).

Recent studies on tooth wear of younger subjects indicated that the wear of permanent molars were small (Kononen et al., 2006a). Magnusson et al (2005) reported on the statistically significant correlation of occlusal wear index to reports of tooth-grinding and/or tooth-clenching ($p < 0.01$). The scoring of wear was limited to canines and incisors as the wear of these teeth appeared to be more significant over time. Magnusson et al (2005) scored only the anterior dentition: 1 = no or slight wear, 2 = wear of enamel only, 3 = wear into the dentine in single spots, 4 = exposure of dentine in an area of more than 2 mm², 5 = wear of more than one-third of the clinical crown.

In view of the current literature, the 5-point scale proposed by Magnusson et al (2005) is the most appropriate as it provides good reliability, simplicity of use, sensitivity, and a tooth by tooth score. The author of this treatise believes that other categorical scales (e.g. rating the amount of wear on a scale of 1 to 4) does not provide adequate sensitivity to examine wear (Kononen et al., 2006a). In addition, many other proposals of tooth wear indices utilize obscure qualitative measures as discussed.

6.2.2. Orofacial Examinations

Masseter muscle hypertrophy seen upon voluntary jaw clenching is a secondary sign used for SB diagnosis. However, it needs to be differentiated from inflammatory swellings and tumours. Tooth indentations on the buccal oral mucosa or lateral margins of the tongue are sometimes observed in SB patients but are not specific to SB. They may represent the presence of other oral habits such as daytime clenching and tongue pushing (Kato et al., 2003).

The criteria suggested to screen patients with moderate to severe SB are:

- A recent history of tooth-grinding sounds occurring at least 3 to 5 nights per week over 6 months
- Presence of tooth wear
- Morning masticatory muscle pain or fatigue
- Masseter muscle hypertrophy

6.3. Electrophysiologic Monitoring

Electrophysiologic monitoring systems allow a more definitive diagnosis of SB (Kato et al., 2001b). Detailed research diagnostic criteria for this method have been proposed by Kato et al (2001) and also by Lavigne et al (1996). To satisfy the diagnostic criteria proposed by Kato and colleagues, a sleep laboratory must be utilized with the following facilities:

- EEG – electroencephalogram
- EMG – electromyogram
- ECG – electrocardiogram

- Thermally sensitive resistor to monitor air flow
- Simultaneous audiovisual recordings.

The sleep laboratory offers a highly controlled recording environment allowing the exclusion of other sleep disorders and the differentiation of SB from other motor activities of the face. The recording must also be conducted over several nights. The disadvantages of sleep laboratories are increased number of manpower, cost, and the removal of the patient from his or her comfortable sleep environment.

This pilot study did not aim to distinguish sleep bruxism from daytime bruxism, daytime clenching, or nocturnal clenching. The term “bruxing” or “bruxism” will therefore encompass all of these. Due to financial limitations, bruxing subjects were identified through specific selection criteria (discussed later) and not through sleep laboratory assessments.

7. Aims & Hypotheses

The aim of this pilot study was to compare the following areas of interest between bruxing and healthy non-bruxing subjects as a cross-sectional retrospective analysis:

- Gastrointestinal microbial profile through faecal microbial analysis
- Gastrointestinal symptoms
- Sleep disturbances
- Anxiety levels
- Jaw muscle activity through EMG recordings
- Tooth wear levels

We hypothesised the following observations in bruxers, when compared to non-bruxers (1) elevated level of tooth wear; (2) elevated sleep disturbance; (3) an imbalance in the gastrointestinal microbial flora; (4) increased gastrointestinal symptoms; (5) an elevated level of anxiety; (6) elevated jaw muscle activity.

MATERIALS AND METHODS

1. Study Participants

Thirty-two subjects (age 27 to 60 years, 8 males and 24 females) comprised the study population. Fifteen control and 17 study (bruxing) subjects were selected according to the inclusion and exclusion criteria described in this report. Thirty-one subjects were recruited from the Orofacial Pain Clinic and Oral Restorative Specialist Clinic at the Westmead Centre for Oral Health, Westmead Hospital, Sydney, and one subject was recruited from a private specialist clinic in Sydney.

1.1. Inclusion Criteria: Bruxing and/or Clenching Study Group

The inclusion criteria for the sleep bruxing study group were as follows:

- a) Absence of complex multiple medical conditions and medications influencing the dopaminergic system.
- b) Absence of history of oesophageal reflux.
- c) Presence of one or more of the following:
 - a. Mapping of bruxofacet details on occlusal splint where possible.
 - b. A recent history of tooth grinding or tooth tapping sounds by a bed partner, occurring at least 3 to 5 nights per week over 6 months.
 - c. Provocation testing of matched bruxofacets with clench leading to jaw muscle or jaw joint pain or discomfort.
 - d. Complaints of jaw muscle discomfort, fatigue, or stiffness on waking in the morning.
- d) Presence of at least 20 teeth.
- e) Age between 17 and 65 years.

1.2. Inclusion Criteria: Non-bruxing and/or Non-clenching Control Group

The inclusion criteria for the control group were as follows:

- a) No known or reported history of bruxism as identified by the criteria described in 1.1.
- b) No known history of jaw muscle pain disorders or orofacial pain disorders.
- c) Absence of complex medical history, oesophageal reflux and medications.
- d) No known or reported neurological or psychiatric disorders.
- e) Age between 17 and 65 years.
- f) Presence of at least 20 teeth.

Experimental details were discussed with all subjects and written consents were received. The study protocol and consent forms were reviewed and approved by The University of Sydney and the Sydney West Area Health Services Ethics Committees.

2. Data Collection

All investigations were carried out at the Jaw Function Research Unit, Westmead Centre for Oral Health, Westmead Hospital, Sydney. Initial assessment involved routine medical history and an intraoral examination for the completion of the "Intraoral Examination Checklist for Suspected Bruxism" (Table 2). Features observed were noted as a 'yes' or a 'no' on the "Intraoral Examination Checklist for Suspected Bruxism".

Table 2. Intraoral examination checklist for suspected bruxism

1.	Mapping of bruxofacet details on occlusal splint where possible.
2.	A recent history of tooth grinding or tooth tapping sounds by a bed partner.
3.	Provocation testing of matched bruxofacets with clench leading to jaw muscle or jaw joint pain or discomfort.
4.	Complaints of jaw muscle discomfort, fatigue, or stiffness on waking in the morning.
5.	Presence of tooth wear associated with initial tooth contact position (intercuspal position) clenching or with antero-lateral or antero-protrusive jaw positions (as this may be associated with tooth grinding).
6.	Presence of masseter muscle hypertrophy as a result of clenching.
7.	Tongue or cheek indentations.
8.	Other: tooth mobility, fractures of tooth structure, split tooth or dental restorations, occlusal trauma or complaints of metallic taste, tooth or teeth hypersensitivity and clicking or locking of the temporomandibular joint

A score of “yes” to one or more of the checklist points 1 to 4 above and the fulfillment of all the inclusion criteria described previously were necessary to be allocated into the sleep-bruxing study group. Sleep-bruxing study group subjects and non-bruxing or clenching control group subjects were invited to return after one week following their initial examination.

2.1. Medical History

The medical history was reviewed during the second visit to record any changes in reported medical conditions. This information was used to include or exclude the participant in the study according to the inclusion criteria.

The second visit also involved: (1) Questionnaires: Bowel Symptom Questionnaire (BSQ) for assessment of level of gastrointestinal disturbance, Epworth Sleep Questionnaire, Berlin Sleep Questionnaire, Research Diagnostic Criteria/Temporomandibular Disorders (RDC/TMD), Symptom Checklist-90-Revised (SCL-90-R) for psychosomatic symptoms assessment, Spielberger State-Trait Anxiety Inventory Questionnaire (STAI); (2) Electromyographic (EMG) recordings of jaw muscles at maximum voluntary clenches in various jaw positions; and (3) Faecal Microbial Analysis for gastrointestinal microbial assessments.

2.2. Saliva Testing

Saliva testing was completed using the GC MI Saliva-Check Buffer test (GC Corporation, Japan) to determine salivary health. The results were used to eliminate the confounding effects of accelerated tooth wear due to poor saliva. The test involved everting the lower lip, wiping the inside of the lower lip with gauze and timing the period taken for small salivary drops to appear in the minor salivary glands. This tested resting saliva hydration. Saliva under the tongue was drawn with a dental mirror to check the resting saliva viscosity. Resting salivary pH was tested by asking the patient to avoid swallowing for 30 seconds and then to expectorate this saliva into a styrofoam cup. A single sheet of pH test paper was dipped into the saliva and the colour change compared to the Dental Saliva pH Indicator colour map to determine the corresponding pH.

Stimulated saliva quantity was tested by asking the participant to chew the supplied piece of wax. After 30 seconds, the patient expectorated the saliva into the spittoon to discard their first generated saliva. The participant continued chewing the wax for a further 5 minutes and expectorated this saliva into a measuring cup provided. The volume of saliva in the cup, excluding froth, was recorded. A pipette was used to draw up a small amount of this saliva. One drop of saliva was dispensed onto 3 test pads of a buffer test strip. After 5 minutes, the colour of each of the test pads was compared with the score table and the score recorded.

2.3. Study Models

Study models were fabricated for the purposes of scoring tooth wear. Alginate impressions of maxillary and mandibular dental arches were taken with plastic stock trays. Detail was achieved by smearing alginate onto the occlusal surfaces of the teeth, ensuring that minimal or no bubbles of alginate were trapped on the occlusal surfaces. Impressions were disinfected with hospital detergent and Milton's hydrochloride solution and poured in hard yellow stone. Once the stone was set, the models were trimmed and inspected.

2.4. Questionnaires

The following questionnaires were completed by the participant: (1) RDC/TMD Questionnaire #1 and #2, (2) SCL-90-R, (3) STAI, (4) BSQ, (5) Epworth Sleep Questionnaire, (6) Berlin Questionnaire.

2.4.1. Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)

The details to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) are comprehensively described by Dworkin and LeResche (1992). The RDC/TMD composes of RDC/TMD #1, #2 and #3. Questionnaire #1 and #2 were completed by each subject. RDC/TMD #3 comprised of a clinical examination performed by the investigator. In brief, the RDC/TMD uses a dual axis system for diagnosing and classifying TMD subjects. Axis I assigns physical diagnoses of the most common masticatory muscle and/or temporomandibular joint disorders. Three main physical diagnostic groups are included: Group I Muscle Disorders; Group II TMJ Disc Displacements; and Group III Arthralgia, Arthritis, and Arthroses of the TMJ (Dworkin and LeResche, 1992). Axis II assesses behavioural, psychological and psychosocial factors relevant to the management of TMD subjects (Dworkin et al., 2002). For the purposes of this study, only the Axis I diagnoses were noted for each subject.

2.4.2. Symptom Checklist-90-Revised (SCL-90-R)

The SCL-90-R is a widely used self-report clinical rating scale and measure of distress and psychopathology (Derogatis et al., 1973, Derogatis et al., 1976, Derogatis, 1977). Because of its simplicity of administration and design, the SCL-90-R has been extensively used in studies of anxiety and obsessive compulsive disorders. The administration, scoring and procedures are described in Derogatis (1977).

2.4.3. Spielberger State-Trait Anxiety Inventory (STAI)

The STAI is a well-known 40-item self-report instrument measuring transient and persistent levels of anxiety (Spielberger et al., 1983). The STAI consists of two separate self-report questionnaires, the state and the trait.

The STAI *state* has been shown to be a satisfactory screening instrument to predict or measure anxiety levels and disorders (Kvaal et al., 2001). The state scale assesses how the respondent feels at the moment of administration of the state scale. It is scored on four levels of anxiety intensity from 1 = “not at all” to 4 = “very much” and with a total score of 20~80. The 20 items are divided into two groups. Ten items are calculated to score the anxiety symptoms and the remaining ten items are scored to reflect the absence of anxiety symptoms (Spielberger et al., 1983). A cut-off of 39-40 is normally used for clinically significant symptoms of a state of anxiety (Knight et al., 1983).

The STAI *trait* scale measures persistent levels of anxiety. It is scored on four levels of anxiety intensity persistent over time from 1 = “not at all” to 4 = “very much”. The STAI trait scale also provides a total score of 20~80 and is analysed in the same manner as STAI *state*.

2.4.4. Bowel Symptom Questionnaire (BSQ)

The Bowel Symptom Questionnaire (BSQ) is a self-report questionnaire providing reliable and valid data on gastrointestinal symptoms. The BSQ contains 83 items including age, gender, marital status, level of educational training. Thirty-six items of the 83 items concern GI symptoms, while 4 relate to health care seeking (Talley et al., 1995).

2.4.5. Epworth Sleepiness Scale (ESS)

The ESS is a simple, self-administered questionnaire designed to indicate a subject's general level of daytime sleepiness. The subject rates the chances of dozing during eight commonly encountered situations during the day. The subject rates the chances of falling asleep in each of the eight situations described in the questionnaire. The score of 0, 1, 2, 3 corresponds to never, slight chance, moderate chance and high chance for each of the situation. This gives a score of 24. A cut-off of 10 is prescribed for sleepiness. The total ESS score can significantly distinguish normal subjects from subjects with various sleep disorders such as obstructive sleep apnoea syndrome and narcolepsy (Johns, 1991, Johns, 1992, Johns, 2000).

2.4.6. Berlin Questionnaire (BQ)

The Berlin Questionnaire is also a self-report questionnaire developed during 1996 Berlin Conference on Sleep and Primary Care. By consensus, the questionnaire focuses on a limited set of known risk factors for sleep apnoea. The questionnaire involves one question involving weight changes; four questions concerning snoring; four questions addressing daytime sleepiness; and one question regarding blood pressure history (Netzer et al., 1999).

The determination of high and low risk for sleep apnoea was determined from responses in three symptom categories. In category one, high risk was defined as persistent symptoms (> 3 to 4 times/week) in two or more questions about snoring. In category 2, high risk was defined as persistent (> 3 to 4 times/week) waketime sleepiness, drowsy driving, or both. In category 3, high risk was defined as a history of high blood pressure. An overall high risk for sleep apnoea was assigned to a subject when the subject qualified for at least two categories at high risk. Those who qualified for only one symptom category were considered to be at low risk for sleep apnoea (Netzer et al., 1999).

2.5. Electromyographic (EMG) Recording

Preparations for EMG recordings followed. The skin covering the bilateral anterior temporalis, posterior temporalis and masseter muscles were wiped with alcohol. Topical anaesthetic was applied (Emla®, Astra Zeneca, Australia). The boundaries of the masseter and temporalis muscles were determined by palpation during voluntary contraction. The mid point and the inferior border of the masseter were noted during the voluntary contraction. Disposable surface silver-silver chloride disc electrodes (Figure 1) were placed between the mid-point and the inferior border of both left and right masseter muscles following the axis of the main direction of the muscle fibers. Intradermal indwelling hook electrodes (Figure 2) were placed in the anterior and posterior temporalis muscles. A saline-soaked grounded electrode was placed on the participant's right wrist. Electrodes were connected to a digital amplifier (World Precision Instruments, Florida) which signaled to a digitizer (CED2501, Cambridge Electronic Design, Cambridge, UK). The digitized EMG data was collected, stored and later analysed using the Spike 3 program. A quiet and calm atmosphere was established while the patient faced a plain wall.

The recording procedure commenced with a test trial of voluntary maximum clench in maximum intercuspation. This established suitable gains for the EMG recordings. Once the gains were established, the first trial was recorded in the participant's postural jaw position. The investigator directed the participant into the postural jaw position by verbal encouragement such as "stay relaxed with teeth apart, jaw relaxed". Each trial involved approximately 6 seconds of recording time. This comprised of the initial 2 second recording with no muscle activity; followed by approximately 3 second recording of the postural jaw position or maximum muscle activity of the prescribed specific clench position; followed by 2 seconds of no muscle activity. One minute rest was given between each trial.

The initial single trial recording of postural jaw position was followed by various sequences of trials in various jaw positions. The sequences of the trials recorded and the verbal directions given to the participants were as follows:

- 1) Four trials of maximum voluntary clench on cotton rolls in maximum intercuspation. Directions given during trial recording: "I want you to bite down as hard as you can on the cotton rolls between your top and bottom back teeth".
- 2) Four trials of maximum voluntary clench on maximum intercuspation position. Directions given during trial recording: "I want you to bite down as hard as you can using your normal bite".
- 3) Four trials of maximum voluntary clench on maxillary incisal edges. Directions given during trial recording: "I want you to bite down as hard as you can on your front teeth".
- 4) Four trials of maximum voluntary clench on the left canine tooth or on the tooth or teeth providing left antero-protrusive guidance. Directions given during trial recording: "I want you to bite down as hard as you can on your left 'eye' tooth." This position was visually confirmed by the investigator.
- 5) Four trials of maximum voluntary clench on the right canine tooth or on the tooth or teeth providing right antero-protrusive guidance. Directions given during trial recording: "I want you to bite down as hard as you can on your right 'eye' tooth." This position was visually confirmed by the investigator.
- 6) Four trials of maximum voluntary clench on retruded contact position whereby the jaw is retruded. Directions given during trial recording: "I want you to bite down as hard as you can and with your jaw pulled as far back and as you can. Pull your jaw towards your throat".
- 7) One trial recording of the postural jaw position.

Multiunit EMG signals were amplified and processed at a bandwidth of 30 to 100 Hertz (Hz) and a sampling rate of 5000 samples per second. The data was rectified, filtered and analysed using the root mean square (RMS) to represent muscle activity.

Figure 1. Subject with intradermal hook electrodes in the temporalis muscles and silver-silver chloride surface electrode over the left and right masseter muscles.

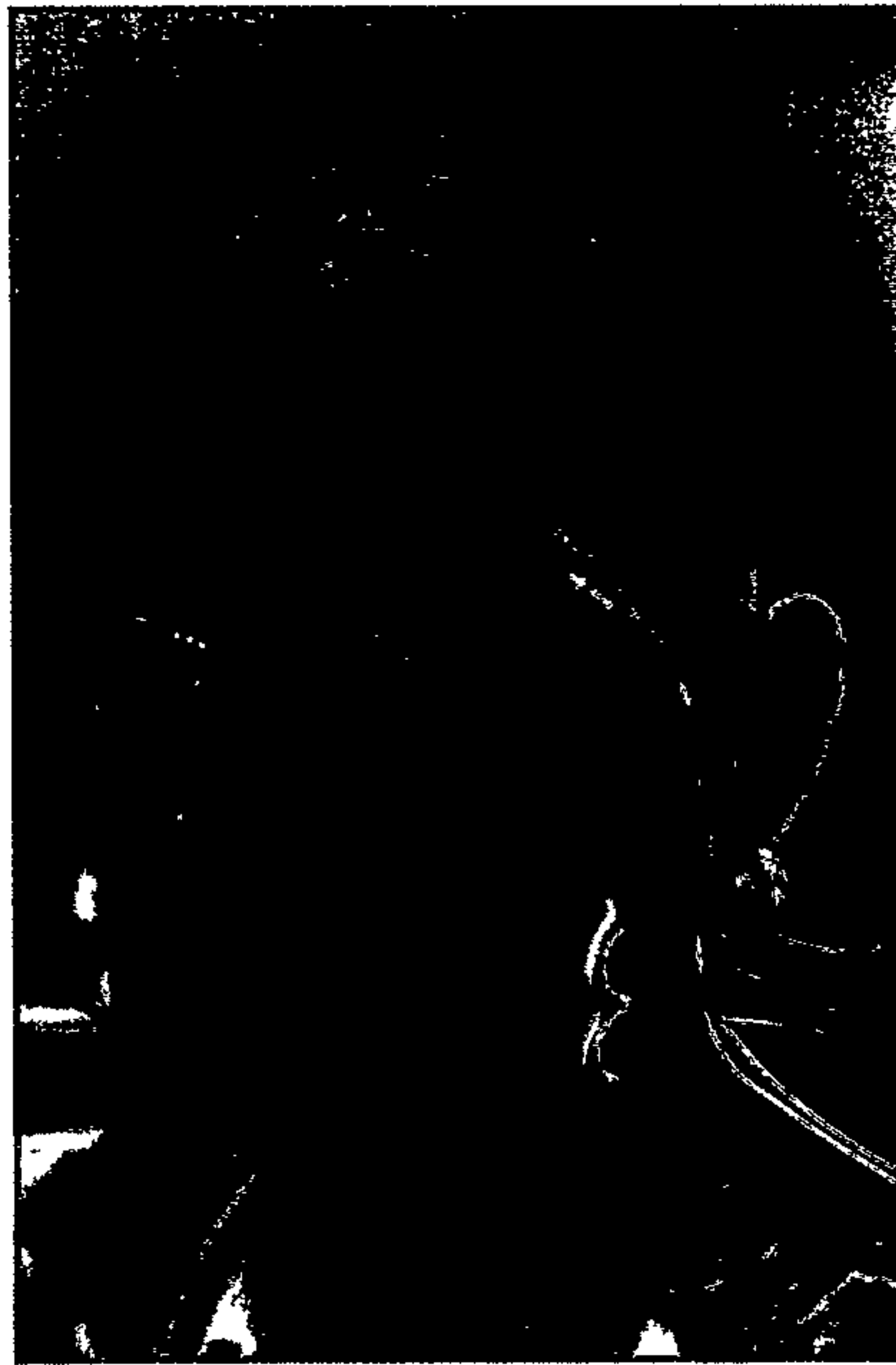


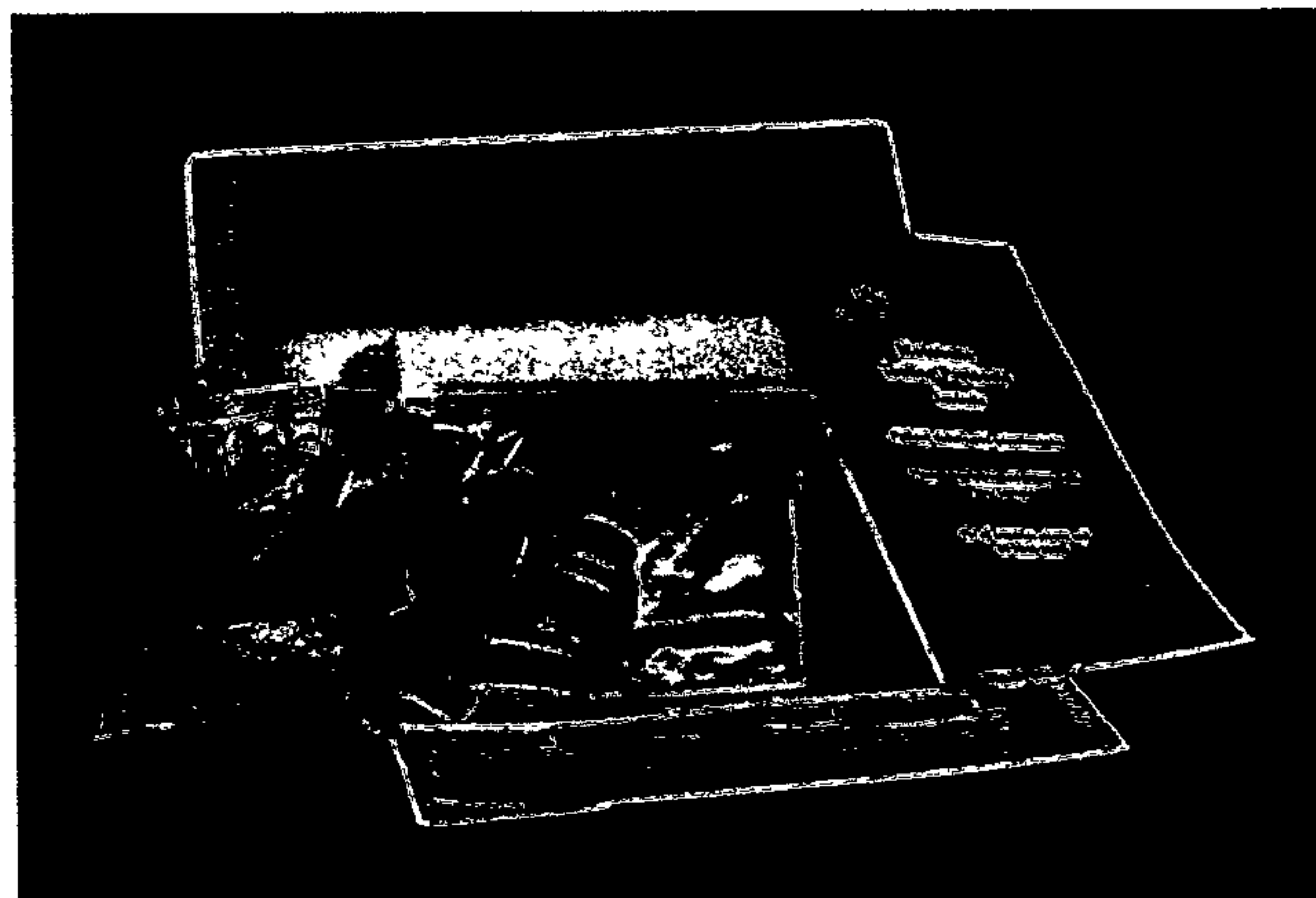
Figure 2. Intradermal indwelling hook electrodes into the anterior and posterior temporalis muscles.



2.6. Faecal Microbial Analysis (FMA)

A Faecal Microbial Analysis contains the faecal collection kit (Bioscreen, Parkville, VIC) and the Bioscreen Symptom Questionnaire (Figure 3). This kit was dispensed to all sleep bruxer (n=17) and some control (n=9) participants for collection of faecal samples and their subsequent analysis through Bioscreen Biotechnology, Parkville, Victoria. Faecal specimens were collected and transported as directed by Bioscreen laboratory (Appendix I: Bioscreen Patient Information).

Figure 3. Bioscreen Faecal Microbial Analysis Kit



The Faecal Microbial Analysis (FMA) consists of the culture and quantification of commensal microflora of the large bowel. The FMA identifies changes in the distribution of 12 major microbial species which include 4 aerobic bacteria (*E.coli*, *Klebsiella/Enterobacter*, *Enterococcus*, and *Streptococcus* species), 7 anaerobic bacteria (*Bacteroides*, *Eubacterium*, *Bifidobacterium*, *Lactobacillus*, *Clostridium*, *Prevotella* and *Porphyromonas* species), and 1 fungus, *Candida albicans*. The FMA focuses on gastrointestinal imbalance of commensal microflora in order to ascertain gut integrity (Bioscreen Specialist Testing Medical Laboratory, 2005).

The Faecal Microbial Analysis also provides quantitative and qualitative data of microbial flora to indicate the balance or imbalance of the intestinal ecosystem of an individual. In certain cases, the test has proven useful for the management of conditions such as irritable bowel syndrome (IBS).

The four most numerous microbial species identified in the intestine of humans are (Holdeman et al., 1976):

- 1) *Bacteroides*
- 2) *Eubacterium*
- 3) *Peptostreptococcus*
- 4) *Fusobacterium*

Several studies have indicated that the microbial flora of an individual remains consistent over time. Changes in the diet results in only minimal changes in the flora (Deitch et al., 1987). Therefore, a single sample of the faecal microbial flora will be highly representative of the flora of that individual (Goldberg et al., 1977). The consistency of the faecal flora suggests that the environment of the host is the major factor in influencing the composition of the flora. Under normal conditions, the commensal faecal microbial ecosystem is self-regulating. Factors of the host environment which may disrupt this commensal ecosystem include the following (Berg, 1981, Deitch et al., 1987):

- 1) stress
- 2) worry or anger
- 3) altitude changes
- 4) starvation
- 5) parasitic organisms
- 6) diarrhoea
- 7) use of antibiotics

The components of the Bioscreen Symptom Questionnaire to be analysed in this pilot study were questions relating to:

- 1) Stress symptoms
- 2) Sleep symptoms
- 3) Gastrointestinal symptoms
- 4) Irritable bowel symptoms
- 5) Cognitive symptoms

Subjects were asked to rank the severity (over the preceding 7 days) and the frequency (over the preceding 12 months) of various symptoms displaying the 5 groups of symptoms above. The range of the 7-day severity symptom indices is as follows: 0=nil; 1=mildly; 2=moderately; 3=quite a bit; 4=extremely. The 12-month frequency symptom indices were: 0=nil; 1=rarely; 2=occasionally; 3=frequently; 4=constantly. Bioscreen laboratory assessment provides average 7-day severity and 12-month frequency scores for each of the 5 symptom groups.

3. Statistical Analysis

Statistical analyses were achieved in the following manner:

- The Statistical Package for Social Sciences (SPSS, Release 10.0) was utilised on a DELL personal computer.
- Qualitative analyses were used to evaluate the RDC/TMD variables and allocations into study and control groups.
- Data relating to sleep disturbance and bowel symptoms were analysed with Fisher's exact test.
- All remaining data were analysed using the independent t-test.
- All p values < 0.05 were considered to be statistically significant.

RESULTS

1. Study Population

Thirty-two subjects (17 study and 15 control subjects) were examined and invited to participate in the study. The age range was 27 to 60 years (mean age 40.16 ± 9.67 years). There was no statistically significant difference between the mean age of the 2 groups ($p=0.14$). However, there was an obvious gender difference within each group. All control subjects were recruited from the Westmead Centre for Oral Health (WCOH). Of the study subjects 7 were recruited from the Orofacial Pain Clinic and 1 from private specialist practice. Nine of the study subjects were staff members of the WCOH. The results of the study population sample characteristics are outlined (Table 3).

Table 3. General characteristics of participating subjects

	Study Group (n=17)	Control Group (n=15)	Total (n=32)
Female	13	11	24
Male	4	4	8
Age range (yrs)	27~60	28~54	27~60
Mean Age $\pm$ SD (yrs)	42.5 ± 10.8	37.5 ± 7.6	$40.2 \pm 9.7^*$

* $p=0.14$ independent t-test

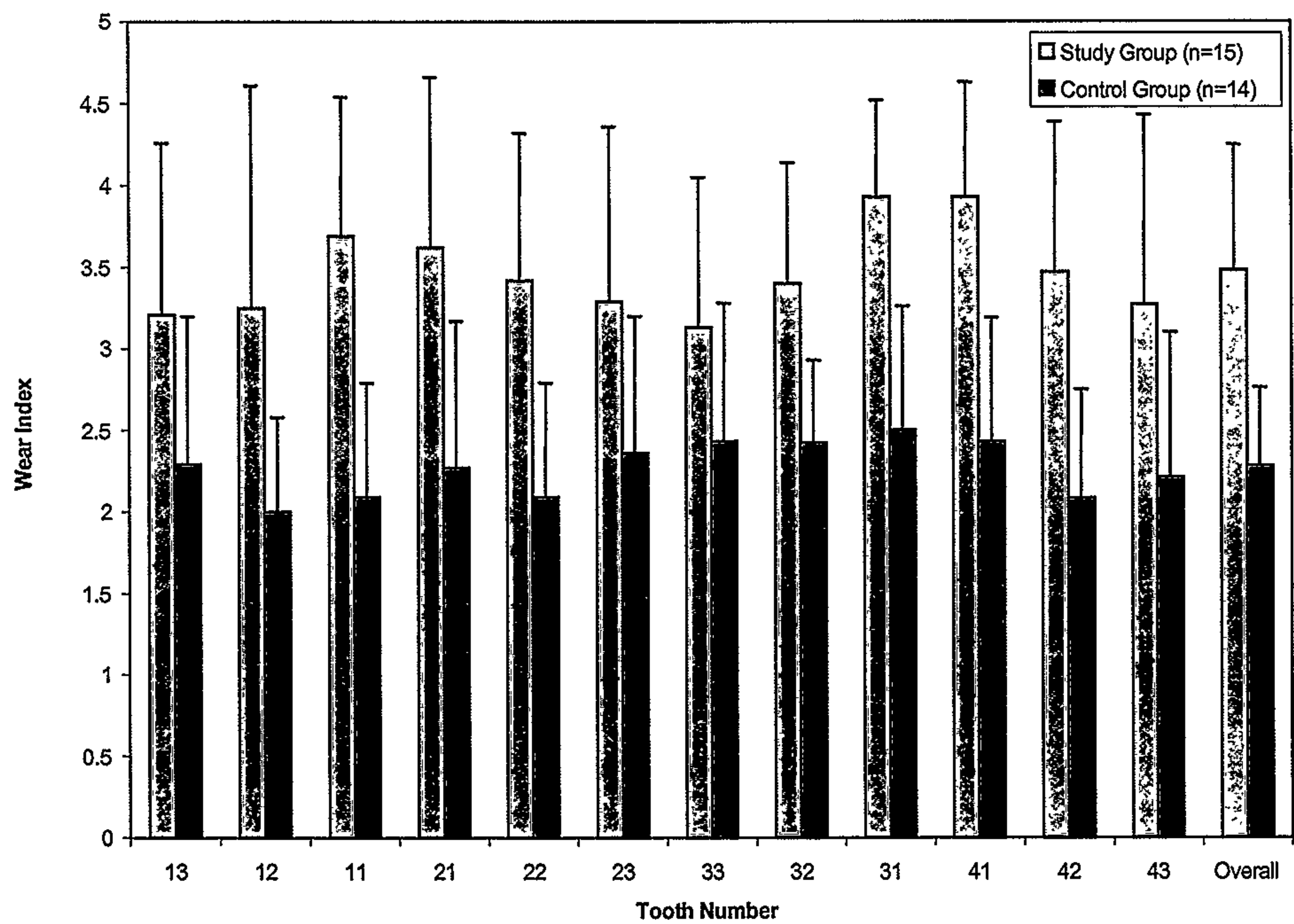
2. Wear Index

The wear indices of 15 study and 14 control subjects were analysed. Two study subjects and one control subject were excluded from the dental wear analysis. One study subject and one control subject displayed an open bite with no anterior tooth contact. One study subject had crown replacement of all the maxillary and mandibular anterior dentition. This subject was excluded from the dental wear analysis as the wear of porcelain and metal could not be easily determined. Study subjects displayed significantly higher wear scores than the control subjects ($p<0.01$). Statistically significant difference between the study and control groups was present in each of the tooth groups with all p values < 0.05 (Table 4 and Figure 4).

Table 4. Mean wear index (independent t-test)

Tooth Number	Study Group (n=15)	Control Group (n=14)	p value for difference
	Mean Wear Index (SD)		
13	3.21 (1.05)	2.29 (0.91)	0.02
12	3.25 (1.36)	2.00 (0.58)	0.01
11	3.69 (0.85)	2.09 (0.70)	<0.01
21	3.62 (1.04)	2.27 (0.90)	<0.01
22	3.42 (0.90)	2.09 (0.70)	<0.01
23	3.29 (1.07)	2.36 (0.84)	0.02
33	3.13 (0.92)	2.43 (0.85)	0.04
32	3.40 (0.74)	2.42 (0.51)	<0.01
31	3.93 (0.59)	2.50 (0.76)	<0.01
41	3.93 (0.70)	2.43 (0.76)	<0.01
42	3.47 (0.92)	2.08 (0.67)	<0.01
43	3.27 (1.16)	2.21 (0.89)	0.01
Overall	3.48 (0.77)	2.28 (0.48)	p < 0.01

Figure 4. Wear Score Differences of Anterior Dentition Between Study and Control Groups (Independent t-test; all p<0.05)



3. Salivary Parameters

The salivary health of 17 study and 15 control subjects was analysed (Table 5). There was a greater proportion of study subjects (29% vs 0%) with pH between 6.0 and 6.6 and poor to good buffering capacity (24% vs 7%). There was no obvious major differences in other salivary parameters between study and control subjects.

Table 5. Salivary parameters of study and control groups

Salivary Parameters		Study Group (n=17)		Control Group (n=15)	
Hydration	>60 seconds	0	(0%)	0	(0%)
	30~60 seconds	0	(0%)	0	(0%)
	<30 seconds	17	(100%)	15	(100%)
Viscosity	Sticky/frothy	1	(12%)	0	(0%)
	Frothy/bubbly	1	(12%)	0	(0%)
	Watery/clear	15	(88%)	15	(100%)
pH	5.0~5.8	1	(6%)	1	(7%)
	6.0~6.6	5	(29%)	0	(0%)
	6.8~7.8	11	(65%)	14	(93%)
Quantity	<3.5 ml	1	(6%)	0	(0%)
	3.5~5.0 ml	2	(12%)	1	(7%)
	>5.0 ml	14	(82%)	14	(93%)
Buffering	Poor (Score 0~5)	2	(12%)	0	(0%)
	Good (Score 6~9)	2	(12%)	1	(7%)
	Very Good (Score 10~12)	13	(76%)	14	(93%)

4. RDC/TMD Axis I

The RDC/TMD axis I diagnosis in the study group displayed: (1) diagnosis of muscle pain disorder with/or without joint disorder symptoms in the majority of subjects (70%); (2) joint disorders only in 6% and; (3) no axis I symptoms in 24% of subjects. In the control group, the majority of subjects displayed no symptoms (87%) and 13% displayed joint disorder symptoms. See Table 5, Figure 5 and Figure 6 for summary.

Table 6. RDC/TMD Axis I diagnosis

RDC/TMD	Study Group (n=17)		Control Group (n=15)	
Axis I Diagnosis				
Muscle Pain Disorder	5	(29%)	0	(0%)
Muscle and Joint Disorders	7	(41%)	0	(0%)
Joint Disorders only	1	(6%)	2	(13%)
Nil	4	(24%)	13	(87%)

Figure 5. Distribution of Study Group RDC/TMD Axis I Diagnosis: 29% Muscle Disorders, 41% Muscle and Joint Disorders, 6% Joint Disorders and 24% Nil Symptoms.

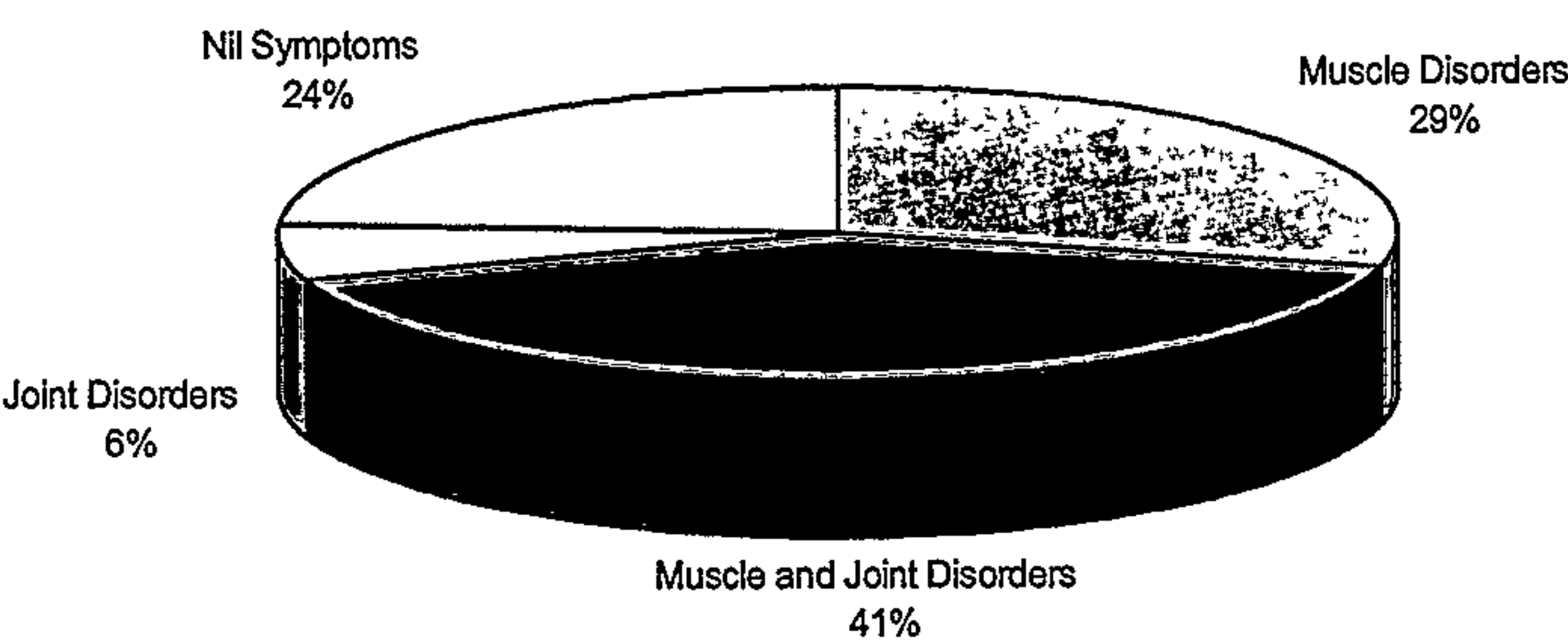
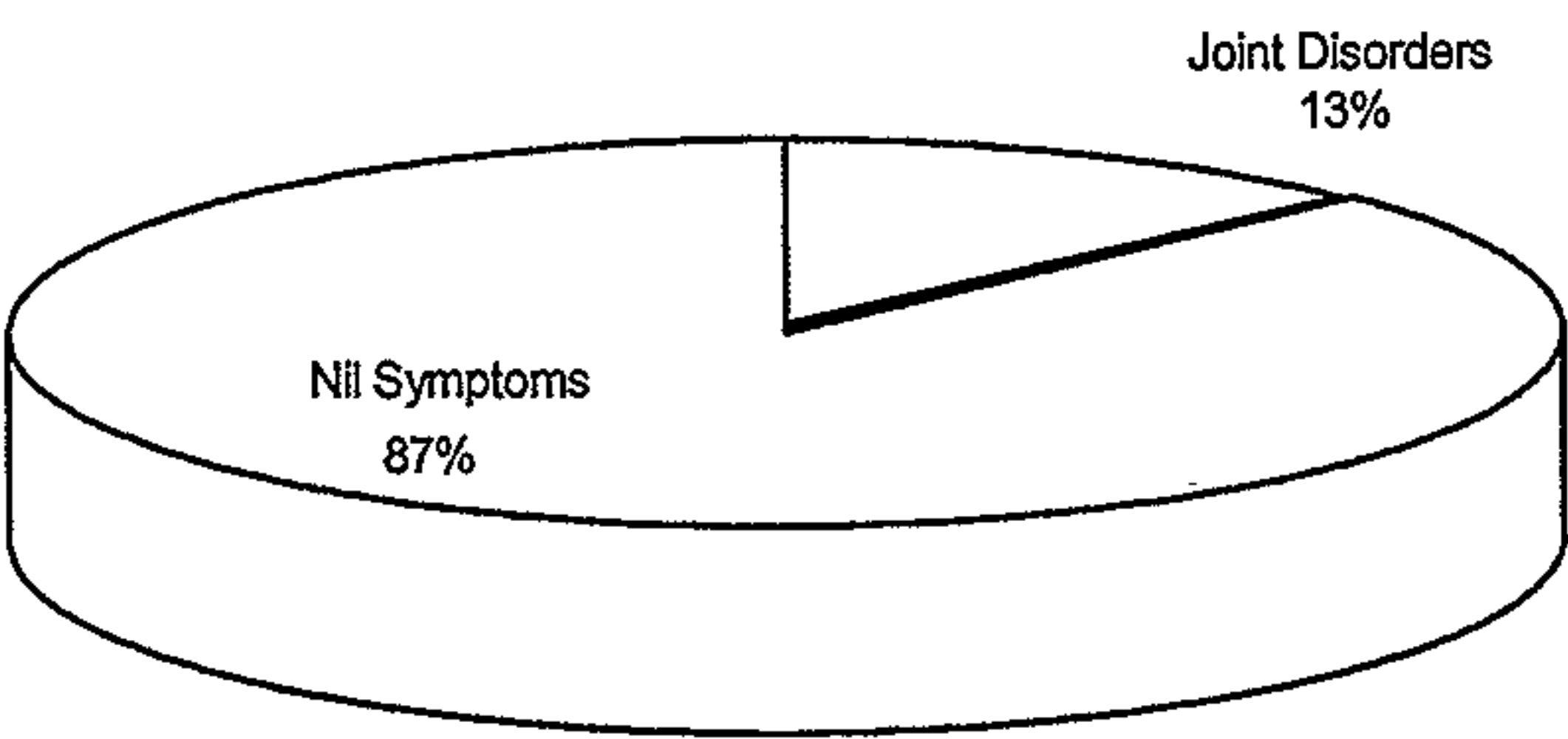


Figure 6. Distribution of Control Group RDC/TMD Axis I Diagnosis: 13% Joint Disorders and 87% Nil Symptoms.



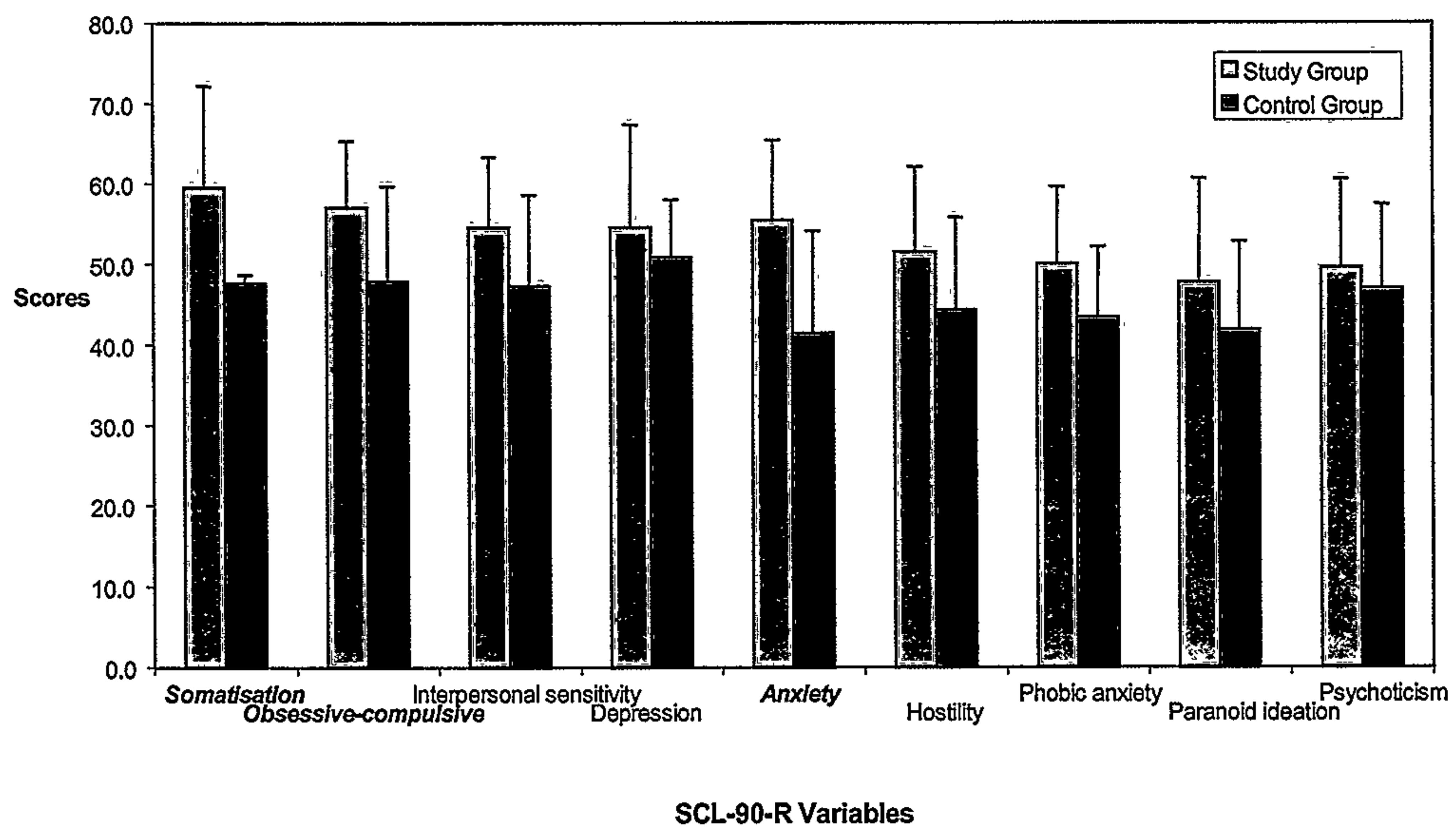
5. SCL-90-R

Sixteen study and 13 control subjects correctly completed the SCL-90-R questionnaire. The results of one study subject and two control subjects were disregarded in the analysis due to incorrect completion. Psychometric parameters of somatisation, obsessive-compulsive behaviour and anxiety were significantly higher in study group subjects than control group subjects ($p=0.01$, $p=0.02$ and $p<0.01$ respectively) as indicated in Table 7. All other measures were lower in the control group (Figure 7).

Table 7. SCL-90-R scores of study and control groups (independent t-test)

	Study Group (n=16) Mean Scores (SD)	Control Group (n=13) Mean Scores (SD)	p value
Somatisation	59.6 (12.6)	47.7 (1.0)	0.01
Obsessive-compulsive	57.1 (8.3)	47.9 (11.8)	0.02
Interpersonal sensitivity	54.6 (8.8)	47.3 (11.3)	0.06
Depression	54.6 (12.7)	50.9 (7.2)	0.35
Anxiety	55.5 (9.9)	41.4 (12.7)	<0.01
Hostility	51.5 (10.6)	44.3 (11.5)	0.09
Phobic anxiety	50.0 (9.6)	43.5 (8.7)	0.07
Paranoid ideation	47.8 (12.9)	41.9 (11.0)	0.20
Psychoticism	49.6 (11.0)	47.0 (10.4)	0.53

Figure 7. Comparison of SCL-90-R Scores Between Study and Control Groups (Italicized variables are statistically significant using independent t-test)



6. STAI

All subjects were analysed for trait and state anxiety levels. The state anxiety level of the study group was significantly higher than the control group (p=0.03). See Table 8 below.

Table 8. Mean trait and state values (independent t-test)

	Study Group (n=17)	Control Group (n=15)	
STAI	Mean value (SD)		p value
Trait	37.29 (7.54)	34.47 (7.50)	0.30
State	34.35 (8.06)	29.07 (4.28)	0.03

7. Sleep Disturbance Levels (Epworth Sleepiness Scale and Berlin Questionnaire)

All questionnaires were analysed for daytime sleepiness and level of risk for sleep apnoea. The same 5 of the 17 study subjects (20% study subjects) and 2 of the 15 control subjects (13% control subjects) rated high scores (>10 score) of daytime sleepiness as well as a high level of risk of sleep apnoea (Table 9). The difference between control and study groups were insignificant (p=0.40).

Table 9. Daytime sleepiness and risk of sleep apnoea

Variable	Category	Study Group (n=17)	Control Group (n=15)	Fisher's exact p value
ESS (daytime sleepiness)	Score >10	5 (29%)	2 (13%)	0.40
	Score <10	12 (71%)	13 (87%)	
Berlin (risk of sleep apnoea)	High Risk	5 (29%)	2 (13%)	0.40
	Low Risk	12 (71%)	13 (87%)	

8. EMG Recordings

The EMG analysis involved 16 study and 15 control subjects. One study subject with an openbite was excluded from the EMG analysis. This subject was unable to achieve incisal, left lateral and right lateral maximum voluntary clenches due to the tooth arrangements. The recording involved 2 trials of muscle activity during postural jaw position and 4 trials of each of the remaining jaw positions per subject. As a result, the EMG recording consisted of a total of 26 trials per subject.

Abbreviations used:

- Postural 1 – Postural jaw position 1
- MIP – Maximum intercuspal position
- MIP-R – Maximum intercuspal position with cotton rolls
- Incisal – Incisal edge-to-edge position
- LLC – Left laterotrusive clench
- RLC – Right laterotrusive clench
- Retruded – Retruded jaw position
- Postural 2 – Postural jaw position 2
- RMS – root means square
- SD – standard deviation

8.1. The Left Masseter

The left masseter muscle displayed significantly higher levels of EMG activity in the study subjects during voluntary maximum clenches in the maximum intercuspation position ($p=0.01$), incisal position ($p=0.02$), left laterotrusive position ($p=0.05$) and retruded position ($p<0.01$). These data were significantly different as indicated bold in Table 10. Data also indicated that there was a higher EMG level in right laterotrusive jaw position but their difference was not significant.

Table 10. Left masseter EMG results (independent t-test)

Jaw Positions	Study Group (n=16)	Control Group (n=15)	p value
	Mean EMG RMS Values (SD)		
Postural 1	0.05 (0.02)	0.04 (0.02)	0.33
MIP-R	2.70 (1.79)	2.11 (2.13)	0.10
MIP	2.20 (1.73)	1.46 (1.13)	0.01
Incisal	1.09 (0.82)	0.77 (0.61)	0.02
LLC	0.50 (0.54)	0.34 (0.32)	0.05
RLC	0.96 (1.24)	0.72 (0.59)	0.17
Retruded	1.32 (1.88)	0.32 (0.41)	<0.01
Postural 2	0.05 (0.02)	0.04 (0.03)	0.65

8.2. The Right Masseter

The right masseter muscle EMG activity in the study subjects was significantly greater than control subjects in maximum voluntary clenches in the maximum intercuspation (p=0.02), and retruded positions (p<0.01). However, the level of EMG activity was significantly lower than controls during maximum voluntary clenches in the left laterotrusive position (p=0.03). See Table 11 below.

Table 11. Right masseter EMG results (independent t-test)

Jaw Positions	Study Group (n=16)	Control Group (n=15)	p value
	Mean EMG RMS Values (SD)		
Postural 1	0.03 (0.01)	0.03 (0.01)	0.68
MIP-R	2.32 (1.72)	2.24 (1.90)	0.81
MIP	2.14 (1.91)	1.49 (0.90)	0.02
Incisal	0.91 (0.61)	0.84 (0.40)	0.45
LLC	0.57 (0.39)	0.74 (0.48)	0.03
RLC	0.67 (0.93)	0.50 (0.36)	0.19
Retruded	1.18 (1.78)	0.38 (0.47)	<0.01
Postural 2	0.03 (0.02)	0.03 (0.02)	0.64

8.3. The Left Anterior Temporalis

The left anterior temporalis muscle activity was significantly lower in study subjects than control subjects during maximum voluntary clenches in the incisal (p<0.01) and left laterotrusive position (p=0.03). See Table 12 below.

Table 12. Left anterior temporalis EMG results (independent t-test)

Jaw Positions	Study Group (n=16)	Control Group (n=15)	p value
	Mean EMG RMS Values (SD)		
Postural 1	0.07 (0.04)	0.05 (0.03)	0.10
MIP-R	1.65 (1.20)	1.74 (1.33)	0.70
MIP	1.88 (1.46)	1.66 (0.96)	0.318
Incisal	0.38 (0.48)	0.14 (0.16)	<0.01
LLC	0.68 (0.61)	0.95 (0.70)	0.03
RLC	0.34 (0.68)	0.24 (0.30)	0.29
Retruded	1.61 (1.64)	1.16 (0.84)	0.06
Postural 2	0.08 (0.08)	0.05 (0.02)	0.31

8.4. The Right Anterior Temporalis

The right anterior temporalis activity in study subjects was significantly lower during maximum voluntary clenches in the right laterotrusive position ($p<0.01$) and significantly higher in the retruded position ($p=0.03$) when compared with control group subjects. See Table 13 below.

Table 13. Right anterior temporalis EMG results (independent t-test)			
Jaw	Study Group (n=16)	Control Group (n=15)	p value
Positions	Mean EMG RMS Values (SD)		
Postural 1	0.09 (0.14)	0.04 (0.02)	0.19
MIP-R	2.06 (1.20)	2.15 (1.24)	0.70
MIP	2.53 (2.26)	2.15 (1.31)	0.25
Incisal	0.33 (0.35)	0.33 (0.69)	0.98
LLC	0.25 (0.29)	0.29 (0.33)	0.53
RLC	0.78 (0.75)	1.30 (0.91)	<0.01
Retruded	2.07 (1.47)	1.52 (1.30)	0.03
Postural 2	0.21 (0.48)	0.05 (0.04)	0.23

8.5. The Left Posterior Temporalis

The left posterior temporalis muscle activity in study subjects was significantly lower during maximum voluntary clenches in the left laterotrusive position ($p<0.01$) compared with control group subjects. See Table 14 below.

Table 14. Left posterior temporalis EMG results (independent t-test)			
Jaw	Study Group (n=16)	Control Group (n=15)	p value
Positions	Mean EMG RMS Values (SD)		
Postural 1	0.06 (0.01)	0.07 (0.01)	0.62
MIP-R	0.61 (0.05)	0.74 (0.07)	0.11
MIP	0.87 (0.09)	1.03 (0.12)	0.27
Incisal	0.12 (0.01)	0.12 (0.02)	0.95
LLC	0.37 (0.04)	0.59 (0.05)	<0.01
RLC	0.16 (0.03)	0.20 (0.04)	0.37
Retruded	0.82 (0.07)	0.95 (0.11)	0.32
Postural 2	0.11 (0.04)	0.07 (0.02)	0.44

8.6. The Right Posterior Temporalis

The right posterior temporalis muscle activity of the study subjects during maximum voluntary clenches was significantly higher in the maximum intercuspation position (p=0.05) and significantly lower in the right laterotrusive position (p<0.01) when compared with control subjects. See Table 15 below.

Table 15. Right posterior temporalis EMG results (independent t-test)

Jaw Positions	Study Group (n=16)	Control Group (n=15)	p value
	Mean EMG RMS Values (SD)		
Postural 1	0.07 (0.07)	0.06 (0.03)	0.35
MIP-R	0.81 (0.87)	0.75 (0.55)	0.60
MIP	1.14 (0.90)	0.87 (0.58)	0.05
Incisal	0.16 (0.24)	0.13 (0.13)	0.32
LLC	0.16 (0.22)	0.15 (0.16)	0.66
RLC	0.37 (0.35)	0.59 (0.40)	<0.01
Retruded	1.06 (0.80)	0.86 (0.63)	0.14
Postural 2	0.08 (0.10)	0.06 (0.04)	0.51

8.7. Summary

In summary, both the left and right masseter muscle activity was significantly greater in the study group subjects during maximum voluntary clenches in the maximum intercuspal ($p<0.01$ left masseter, $p=0.02$ right masseter) and retruded jaw positions ($p<0.01$) compared with control subjects. However, both the anterior and posterior temporalis muscle activity of study subjects was significantly less during maximum voluntary clenches in the ipsilateral jaw position compared with control subjects. See Table 16 for details and levels of significance.

Table 16. Summary of statistically significant muscle activity differences between study and control group (independent t-test)

Muscle	Jaw Position	Study Group (n=16)		Control Group (n=15)		p value
		Mean	(SD)	Mean	(SD)	
Left Masseter	MIP	2.20	(1.73)	1.46	(1.13)	0.01
	Incisal	1.08	(0.82)	0.76	(0.61)	0.02
	LLC	0.50	(0.54)	0.34	(0.32)	0.05
	Retruded	1.32	(1.88)	0.32	(0.41)	<0.01
Right Masseter	MIP	2.14	(1.91)	1.49	(0.90)	0.02
	LLC	0.57	(0.39)	0.74	(0.48)	0.03
	Retruded	1.18	(1.78)	0.38	(0.47)	<0.01
Left Anterior Temporalis	Incisal	0.38	(0.48)	0.14	(0.16)	<0.01
	LLC	0.68	(0.61)	0.95	(0.70)	0.04
Right Anterior Temporalis	RLC	0.78	(0.75)	1.30	(0.91)	<0.01
	Retruded	2.07	(1.47)	1.52	(1.30)	0.03
Left Posterior Temporalis	LLC	0.37	(0.04)	0.59	(0.05)	<0.01
Right Posterior Temporalis	MIP	1.14	(0.90)	0.87	(0.58)	0.05
	RLC	0.37	(0.35)	0.59	(0.40)	<0.01

Figure 8. Comparison of Masseter Muscle Activity of Study and Control Groups During Maximum Voluntary Clench in Various Jaw Positions (Independent t-test; all $p=0.05$ or $p<0.05$)

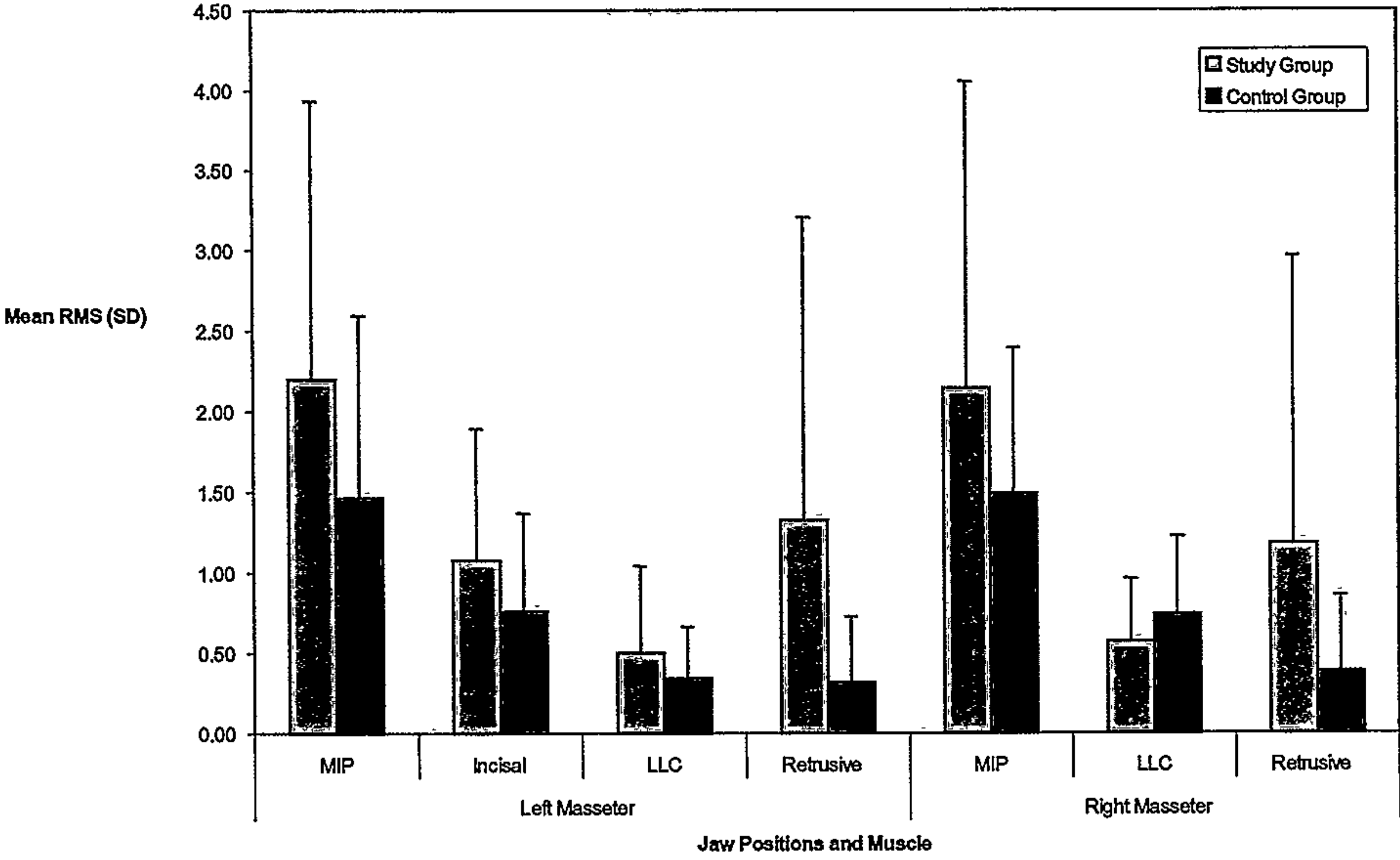


Figure 9. Comparison of the Anterior Temporalis Muscle Activity of Study and Control Groups During Maximum Voluntary Clench in Various Jaw Positions (Independent t-test; all $p<0.05$)

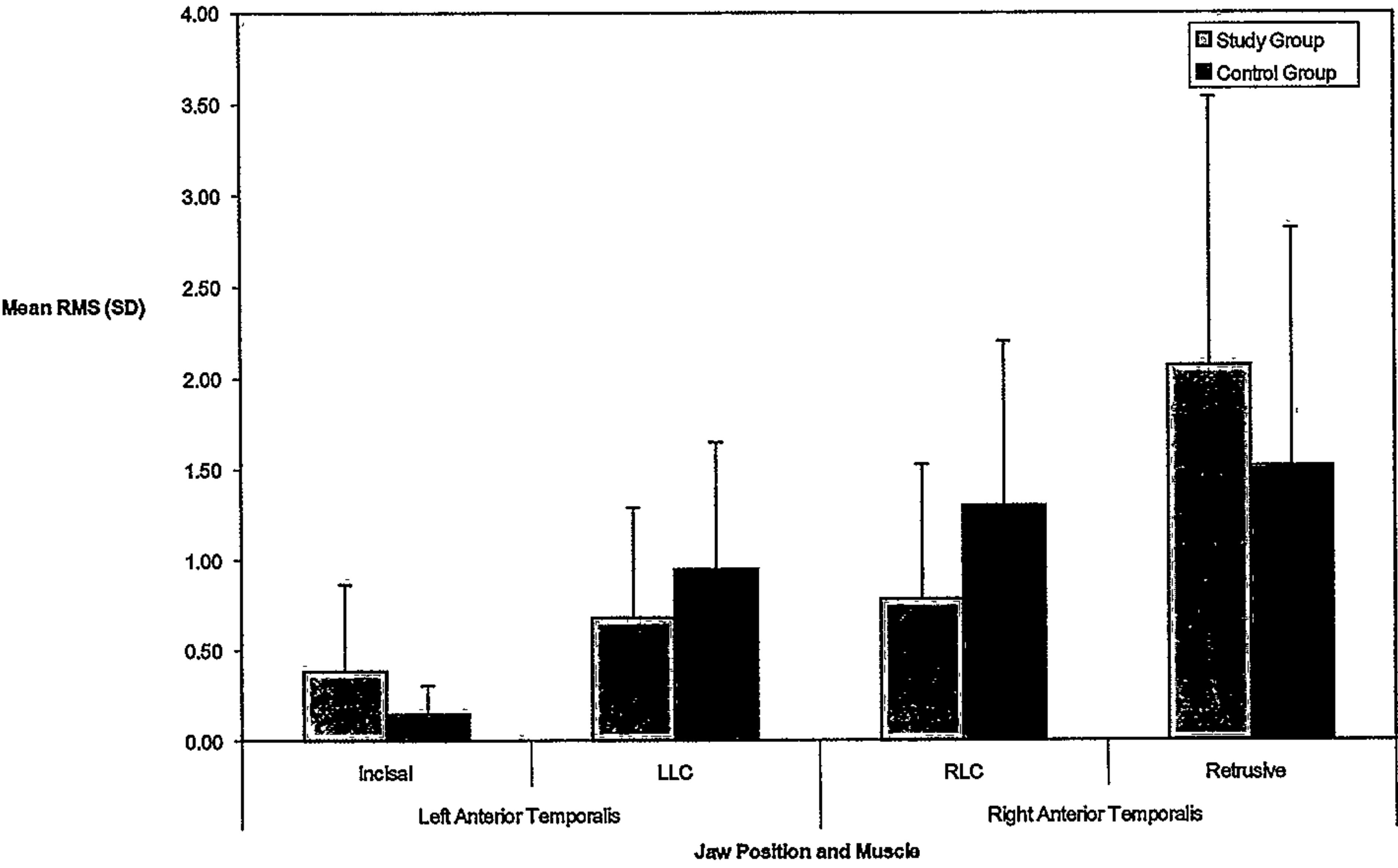
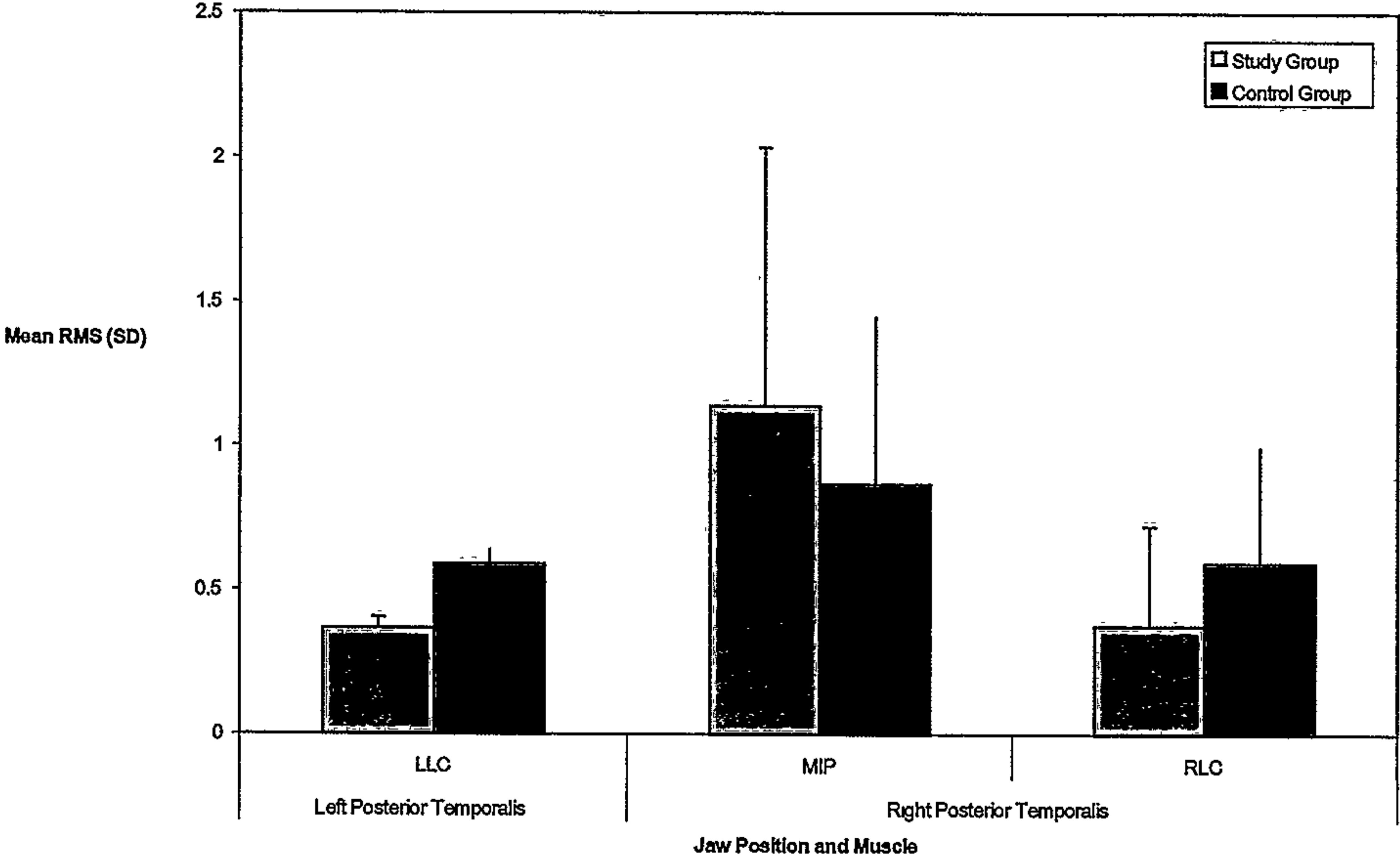


Figure 10. Comparison of the Posterior Temporalis Muscle Activity of Study and Control Groups During Maximum Voluntary Clench in Various Jaw Positions (Independent t-test; all $p=0.05$ or $p<0.05$)



9. Gut Disturbance Symptoms

The BSQ is a reliable and validated questionnaire identifying 5 symptom groups: (1) chronic abdominal pain, (2) constipation, (3) diarrhoea, (4) irritable bowel syndrome, and (5) dyspepsia (Talley et al., 1995). The BSQ determines symptom prevalence in large scale epidemiological studies. Due to the lack of power in this pilot study, only 3 questions were analysed to provide general information on gastrointestinal discomfort of study and control group subjects.

The questions analysed were:

Q3: IN THE PAST 12 MONTHS, has there been a time when you KEPT GETTING pains or discomfort in your stomach or abdomen?

Q4: IN THE PAST 12 MONTHS did this pain or discomfort keep happening over a period of THREE MONTHS OR LONGER?

Q5: IN THE PAST 12 MONTHS, how bad has the pain or discomfort been, usually?

Very mild: can usually be ignored
Mild: can be ignored if you don't think about it
Moderate: cannot be ignored, but does not affect lifestyle
Severe: affects lifestyle Very severe: markedly affects lifestyle
Very severe: markedly affects your lifestyle

Table 17. BSQ responses in study and control group subjects

BSQ Question	Subject Response	Study Group (n=17)		Control Group (n=15)		Fisher's exact p value
		No. of Subjects		No. of Subjects		
Q - 3	Yes	9	53%	4	27%	0.17
	No	8	47%	11	73%	-
Q - 4	Yes	5	30%	3	20%	-
	No	4	23%	1	7%	-
Q - 5	Very mild	0	0%	0	0%	-
	Mild	5	30%	0	0%	-
	Moderate	4	23%	3	20%	-
	Severe	0	0%	1	7%	-
	Very severe	0	0%	0	0%	-

Nine of the 17 study subjects (53%) and 4 of the 15 control subjects (27%) experienced pain or discomfort in the abdomen or stomach during a 12-month period preceding the time of questionnaire completion (Table 17). This difference was however not statistically significant (p=0.17). Of these, 5 study subjects and 4 control subjects experienced pain or discomfort for 3 months or longer. Mild pain or discomfort was experienced by 5 study subjects; moderate pain or discomfort by 4 study and 3 control subjects; and severe pain or discomfort by one control subject. Refer to Table 17 for details.

10. Bioscreen Symptom Questionnaire

Fifteen of the 17 study group subjects and 7 of the 9 invited control group subjects correctly completed the Bioscreen Symptom Questionnaire. The results were interpreted with caution as there was reduced statistical power in the analysis due to the low number of control subjects. Refer to Table 18 below.

There was a significant difference in the mean sleep disturbance symptom (7-day severity) score between the two groups (p=0.04).

Table 18. Bioscreen symptoms between study and control groups (independent t-test)

Bioscreen Symptoms		Study Group (n=15)		Control Group (n=7)		p value
		Mean Score (SD)				
7 Day Severity	GIT	1.89	(1.50)	0.83	(1.58)	0.16
	IBS	1.72	(1.41)	0.71	(1.29)	0.12
	Cognitive	1.93	(1.64)	0.90	(0.87)	0.07
	Sleep	2.84	(1.93)	1.34	(1.19)	0.04
	Stress	1.81	(1.82)	0.83	(0.81)	0.10
12 Month Frequency	GIT	2.11	(1.81)	1.69	(1.08)	0.50
	IBS	1.94	(1.67)	1.47	(0.92)	0.41
	Cognitive	2.13	(1.75)	1.70	(1.45)	0.55
	Sleep	3.25	(2.09)	1.83	(1.43)	0.08
	Stress	2.43	(2.11)	1.30	(1.78)	0.22

11. Faecal Microbiology

Fifteen of the 17 study group subjects and all 9 control group subjects successfully completed the Bioscreen faecal microbial analysis. The number of subjects with faecal microbial counts within the normal range as indicated by the Bioscreen analysis was compared between the two groups (Table 19). There was a greater proportion of study subjects with normal faecal total streptococcus (47%), bifidobacterium (13%) and lactobacillus (20%) counts, when compared with control group subjects (11%, 0% and 0% respectively). However, this difference was not statistically significant ($p=0.18$, $p=1.00$ and $p=0.27$ respectively). The proportions of subjects with normal faecal microbial counts of all remaining microbial species were similar between the two groups.

Table 19. Percentage of subjects with normal microbial counts (qualitative analysis)

Faecal Microbe	Normal Range		Study Group (n=15)		Control Group (n=9)	
	Minimum (cfu/g)*	Maximum (cfu/g)*	No. of Subjects	(%)	No. of Subjects	(%)
Total Aerobes	1.50E+07	1.00E+08	6	40	3	33
E Coli	7.00E+06	9.00E+07	8	53	6	67
Enterococcus		5.00E+05	8	53	6	67
Staphylococcus		2.00E+05	13	87	9	100
Total Strep		3.00E+05	7	47	1	11
Candida		1.00E+04	12	80	8	89
Total Anaerobes	1.00E+08	1.00E+12	15	100	9	100
Bacteroides	9.00E+07	9.50E+11	15	100	9	100
Prevotella		5.00E+08	7	47	4	44
Porphyromonas		5.00E+08	13	87	9	100
Eubacterium		1.00E+09	14	93	9	100
Bifidobacterium	5.00E+06	5.00E+08	2	13	0	0
Lactobacillus	5.00E+05	1.00E+07	3	20	0	0
Clostridium		5.00E+08	13	87	7	78
Peptostrep		1.00E+05	10	67	5	56

*colony forming units per gram of faecal sample

Figure 11. Percentage of Study and Control Group Subjects with Normal Faecal Microbial Counts (Aerobes and Yeast). Qualitative Analysis.

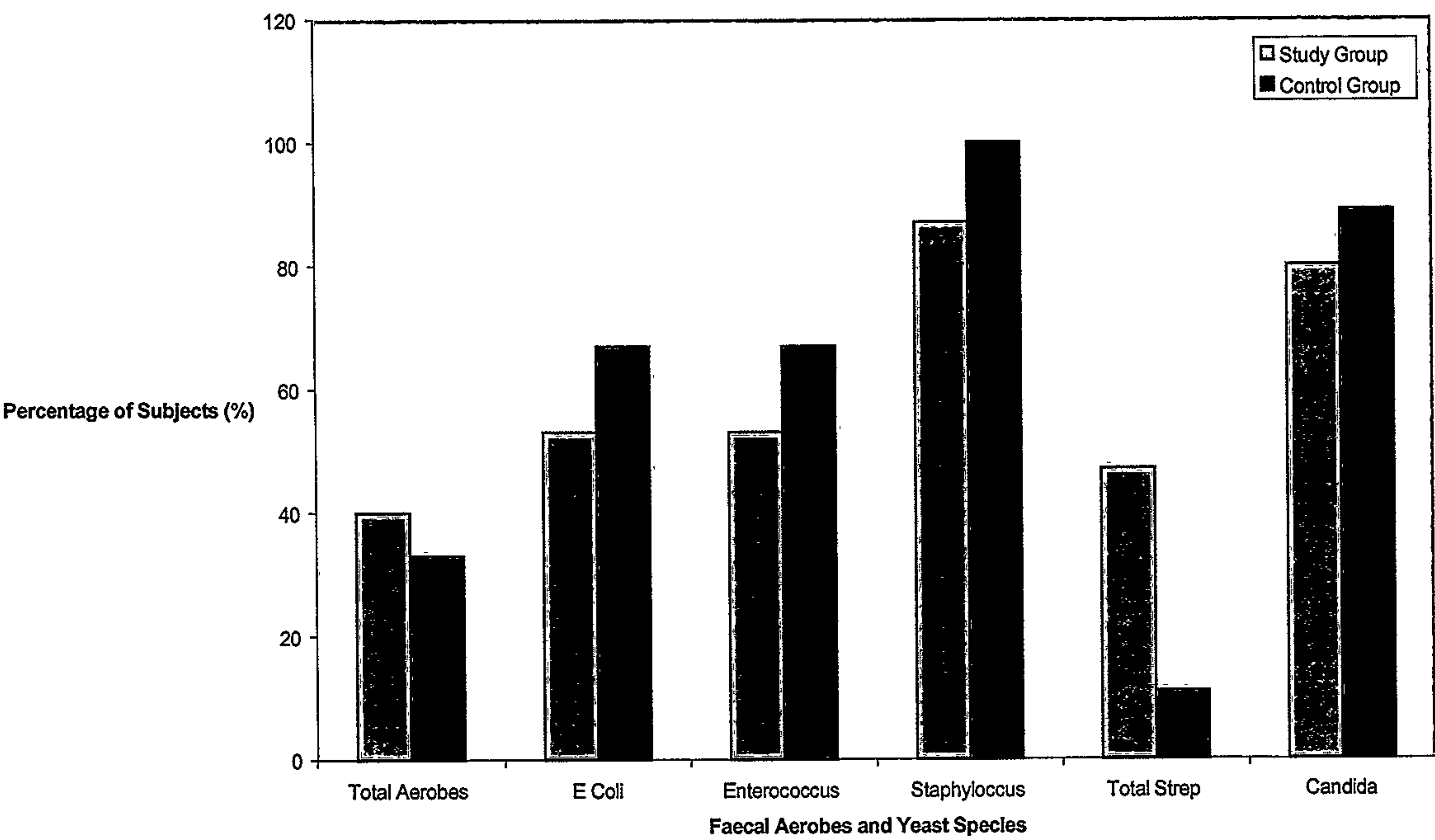
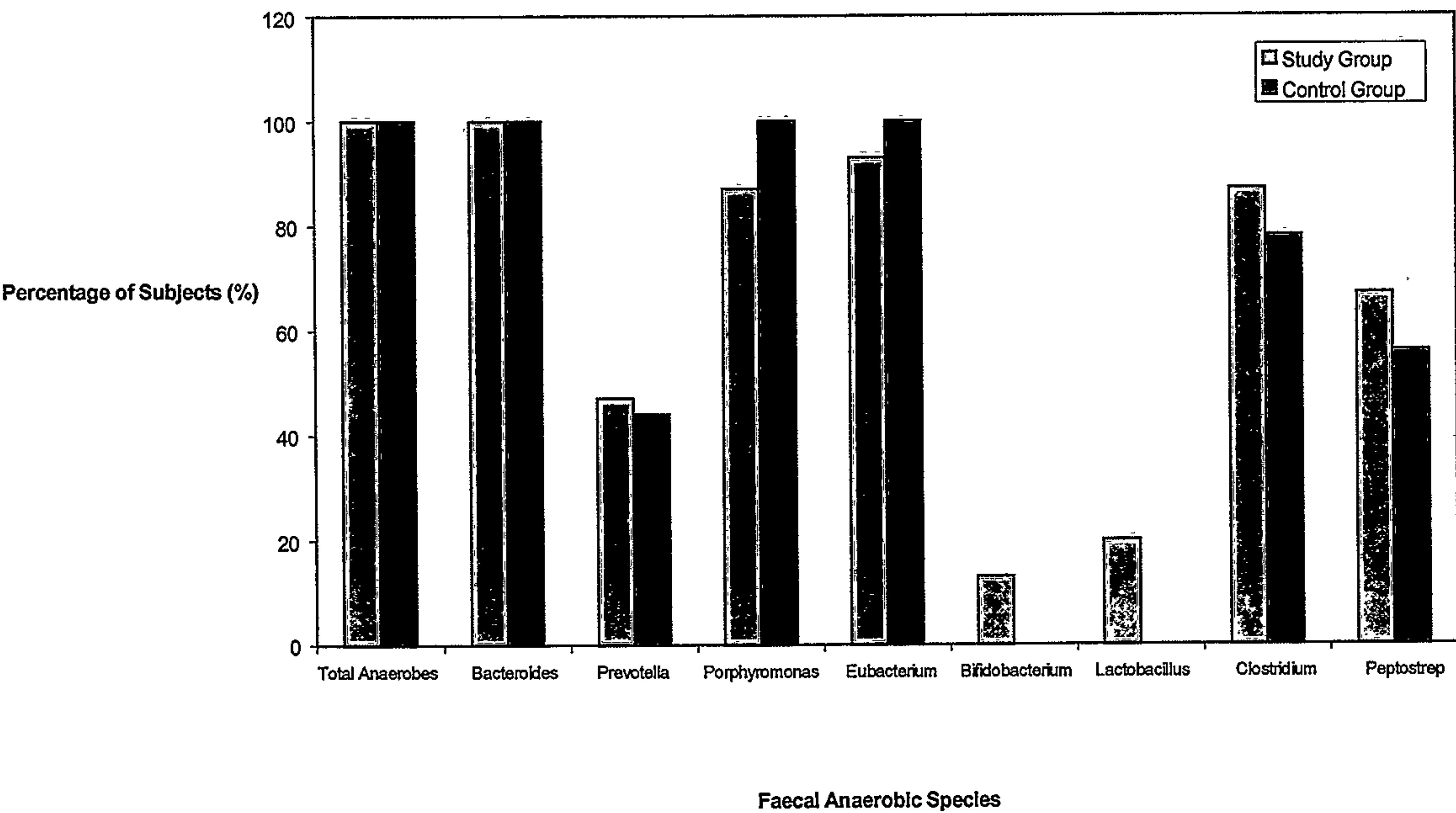


Figure 12. Percentage of Study and Control Group Subjects with Normal Faecal Microbial Counts (Anaerobes). Qualitative Analysis.



DISCUSSION

This pilot study did not aim to differentiate bruxism from daytime bruxism, daytime clenching, or nocturnal clenching. In addition, rhythmic masticatory muscle activity during sleep (sleep bruxism) occurs in 60% of normal controls (Kato et al, 2001a). In sleep bruxing subjects, RMMA occurs three times more often where the EMG amplitude of those episodes is 30% greater than that of controls (Lavigne et al., 2001). Thus, a true indication of existing sleep bruxism requires a sleep laboratory study which remains the gold standard (Kato et al., 2001b). This cross-sectional pilot study did not include sleep laboratory studies due to financial and accessibility reasons. This study cannot draw any conclusions on causality.

In a clinical setting, a sleep laboratory study cannot be easily conducted. This is due to the cost and the waiting periods demanded by many of the sleep laboratory facilities of the public hospitals. Thus a dental clinician must rely on other clinical criteria specific to bruxism. To date many of the clinical characteristics of bruxism remain to be validated (Kato et al., 2001b). There is also a need for the development of reliable standards for clinical assessment of bruxism (Marbach et al., 2003).

This pilot study did not aim to validate clinical characteristics of bruxism, but to outline the differences observed between the study and control groups which may be an indicator of bruxism or parafunctional clenching in the study group selected for this study. These differences may then be further investigated in future studies to assess their reliability as diagnostic indicators of existing or past bruxism and/or parafunctional clenching.

Cross-sectional retrospective pilot analysis of sleep disturbance levels, anxiety levels, jaw muscle activity, GIT symptoms, GIT microbial flora and TMD symptoms was conducted across bruxing and non-bruxing subjects. Some findings of this pilot study agree with published data on bruxism. Other aspects of this pilot study warrant further investigations. Within the limitations of this pilot

study, bruxers displayed: (1) significantly greater levels of anterior tooth wear, anxiety, obsessive-compulsive symptoms, somatisation of pain and masseter muscle activity; (2) significantly less temporalis muscle activity in excursive jaw positions; and (3) little difference in the level of sleep or gut disturbance when compared to control subjects.

1. Study Population

Thirty-two subjects (17 study and 15 control subjects) comprised the study population. Thirty-one subjects were recruited from the Westmead Centre for Oral Health (WCOH) and one subject from private specialist practice. The population sample of this study was biased towards study and control subjects found within the Westmead Centre for Oral Health. Age differences between the study and control groups were not statistically significant ($p=0.14$). Hence age was not a confounder to the study. However, there was a selection bias of 24 females versus 8 males.

2. Bruxism and TMD

It is interesting to note the high proportion of study subjects (70%) experiencing jaw muscle pain; however, this is not surprising as 7 (41%) of the 17 study subjects originally sought treatment for muscle pain at the Orofacial Pain Clinic, WCOH. The high proportion of muscle pain sufferers in the study group may also be explained by the greater proportion of females in the study population. Temporomandibular pain is 1.5 to 2 times more commonly reported in women than in men (LeResche, 1997, Johansson et al., 2003).

The presence of temporomandibular pain in the study group supports the conclusion made by Magnusson and colleagues' 20 year prospective study on bruxism. Magnusson et al (2005) concluded that reports of bruxism at baseline were a predictor for the presence of clinical signs of TMD 20 years later. Other studies such as those of Goulet et al (1995) have also reported TMD symptoms in 30% bruxing subjects. In contrast to these authors, van der Meulen et al (2006) found no association between the signs and symptoms of bruxism and TMD. It is important to note that the majority of published data on the association with bruxism and TMD rely on self-reports of bruxism and/or parafunctional clenching.

This introduces confounders as self-reports of the condition are unreliable (Kato et al, 2001b).

Of the 17 study subjects, 5 subjects (30%) presented no orofacial jaw muscle pain. The existence of distinct subgroups of bruxers, those with muscle pain disorder and those without, have been reported previously (Dao et al, 1994). However the cause of the pain levels in the two subgroups is unclear. The muscle pain disorder of the study participants may be due to post-exercise muscle soreness provoked by excessive muscular loading that may damage the muscle fibres and/or connective tissue. This would be followed by pain and inflammation that proceeds over several hours and gradually diminishes over several days (Dao et al, 1994). As post-exercise muscle soreness often follows exercise of untrained muscles, it is expected to be uncommon in patients with bruxism. Study subjects who do not experience muscle pain disorders may have possibly bruxed over many years, training their jaw muscles to become more fatigue resistant (Dao et al, 1994). There is still no strong scientific evidence of a definitive causal relationship between bruxism and TMD; and bruxism and TMD may be coexisting entities (Lobbezoo and Lavigne, 1997).

3. Bruxism, Wear and Saliva

Extensive tooth wear may be caused by parafunction, certain morphological occlusions, dietary factors, digestive factors or a combination of these (Kononen et al., 2006a). In this pilot study, no subjects reported oesophageal gastric reflux. However, a slightly greater proportion of study subjects displayed poor salivary measures, compared with control subjects. This difference however was not statistically significant. The greater proportion of study subjects displaying poor salivary measures may be due to dietary and physiological factors contributing to the salivary function on the day of the saliva test. Greater proportion of study subjects perceive more anxiety during a given event, as indicated by the state STAI results, and physiological changes to the saliva may result. The exact influence of salivary health on dental wear levels observed in this pilot study is difficult to determine as the salivary buffering test was completed at a single point

in time. The results should therefore be interpreted with caution and do not indicate past salivary status.

The overall anterior tooth wear of bruxing subjects was significantly greater than non-bruxing control subjects ($p < 0.01$). Similar results were found in each tooth group (all $p < 0.05$). The wear results of this pilot study disagree with the findings of Pergamalian (2003) in which no differences were observed in the levels of tooth wear between bruxing (and/or clenching) and control subjects. Pergamalian et al (2003) utilized bruxism questionnaires and clinical investigations to diagnose bruxism rather than the inclusion criteria described in this pilot study. The differing methodology contributes to the differing findings. The wear found in all anterior dentitions of both study and control group subjects in this pilot study can be explained by the overall age of the two groups (40.2 ± 9.7 years) as tooth wear in the form of attrition is moderately dependent on age (Kononen et al., 2006b). However, the greater level of dental wear detected in this study group is not associated with age as the mean age difference between the two groups was not statistically significant ($p = 0.14$). This greater level of wear may be associated with existing or past habits of bruxism and/or parafunctional clenching. Wear status on its own is a poor predictor of ongoing levels of bruxism and/or parafunctional clenching (Baba et al., 2004). Wear may also be associated with dietary factors such as dietary acids and food texture which were not analysed in this pilot study. For future studies on dental wear, a computer-assisted quantitative computer analyzing system is recommended. This system utilizes a digital image analyzer to quantitatively calculate dental wear (Haketa et al., 2004).

4. Bruxism, SCL-90-R and STAI

Anxiety, somatisation and obsessive-compulsive symptoms as indicated by the SCL-90-R were greater in the study group subjects than control group subjects ($p < 0.01$, $p = 0.01$ and $p = 0.02$ respectively). Elevated anxiety and pain somatisation levels are commonly observed in chronic TMD sufferers (Bonjardim et al., 2005, Velly et al., 2003, Ohrbach and Dworkin, 1998, Wilson et al., 1994). Therefore, the elevated anxiety and somatisation levels observed in this study group may be largely due to the high proportion (70%) of muscle pain sufferers. TMD of

muscular nature may have been a large confounder to this study. However, anxiety, somatisation and obsessive-compulsive symptoms may also coexist with muscle pain disorders in bruxers and/or parafunctional clenchers suffering from TMD of muscular nature (Lobbezoo and Lavigne, 1997). Elevated obsessive-compulsive symptoms however have not been reported in the TMD or bruxism literature. This symptom may be more importantly associated with bruxism and/or parafunctional clenching and warrants further investigation.

STAI *trait* measures the anxiety levels persistent over time. STAI *state* measures anxiety levels present at a single moment in time, the time during which the subject completed the questionnaire. The STAI assessment revealed an elevated *state* anxiety score in bruxing subjects and this was statistically significant ($p=0.03$) when compared with control subjects. This indicates that bruxing subjects experience and perceive greater anxiety levels during a given event when compared with control subjects. This finding agrees with published data for TMD and bruxism (Monaco et al., 2002, Bonjardim et al., 2005, Velly et al., 2003, Ohrbach and Dworkin, 1998, Wilson et al., 1994, Manfredini et al., 2005, Pierce et al., 1995).

5. Sleep Disturbances and Bruxism

Sleep apnoea is more prevalent in bruxers (3.4% to 4.8%) than in non-bruxers (1.4%) (Ohayon et al., 2001). However, bruxism or parafunctional clenching is rarely directly associated with apnoeic events (Sjoholm et al., 2000). In this pilot study a greater proportion of study subjects (29% study group vs 13% control group) suffered from daytime sleepiness and displayed a high risk of sleep apnoea. However, this difference was not statistically significant ($p=0.40$). Self-report of sleep disturbance is a frequent comorbidity in TMD sufferers (Yatani et al., 2002). Despite the high proportion of TMD sufferers in this study group, a statistical difference in sleep disturbance was not observed in the study subjects when compared with control subjects. This may be explained by the use of the Berlin Questionnaire and the ESS in this pilot study.

The ESS and the Berlin Questionnaire are more commonly used in sleep apnoea studies (Ng et al., 2005, Mehta et al., 2001, Cistulli et al., 1998). Future studies

should also consider the Sleep Assessment Questionnaire (SAQ) for the assessment of sleep disturbance (Cesta et al., 1997). The ESS predicts high or low degree of daytime sleepiness and the Berlin Questionnaire indicates high or low risk of sleep apnoea. In comparison, the SAQ identifies six sleep factors: (1) insomnia, (2) non-restorative sleep, (3) restlessness, (4) daytime sleepiness, (5) sleep apnoea, (6) sleep schedule disorder (Cesta et al., 1997). The SAQ also displays sensibility, reliability, and validity (Mansfield et al., 2000). Further studies with a larger population sample are required to investigate sleep disturbance levels in bruxing or clenching subjects.

6. Jaw Muscle Activity and Bruxism

Seventy percent of the study subjects displayed positive Axis I RDC/TMD diagnosis for signs and symptoms of TMD (muscle pain disorder). The differences in the EMG activity detected between study and control subjects in this pilot study cannot be used to distinguish bruxers/clenchers from non-bruxing/clenching controls. TMD may have been a confounder to this study. However, all EMG results indicated that EMG activities during postural jaw position were close to zero. This is an important reference point standardizing baseline EMG levels of all study and control subjects in this pilot study. This finding also contradicts other authors reporting residual muscle activity in sufferers of TMD at postural jaw position (Liu et al., 1999, Pinho et al., 2000). The findings of this cross-sectional study support the conclusions of Glaros et al (1997) - there is little support for the use of resting EMG data in accurately distinguishing TMD patients from control subjects (Glaros et al., 1997).

Much of the EMG studies on bruxism were conducted in the 1970s and the 1980s applying EMG biofeedback mechanisms in bruxing subjects (Cassisi et al., 1987, Rugh and Johnson, 1981, Kardachi and Clarke, 1977). Very little research appears to be present in the literature reporting baseline figures of muscle activity in bruxers and non-bruxers. Sherman (1985) was the first to describe an elevated EMG muscle activity level in bruxers compared with non-bruxing control subjects. Similar findings were reported in a recent study (Jardini et al., 2006). However, these reports exhibit either poor identification of bruxism or absence of age and

gender-matched controls. Literature reporting the use of the EMG in the differential diagnosis and treatment of dental conditions are based on studies that failed to include sufficient age and gender-matched controls. This accounts for the high degree of variability observed in the literature (Lund and Widmer, 1989).

In this study, control subjects were age and gender-matched. Both the left and the right masseter muscle activity was significantly greater in the study group subjects during maximum voluntary clench (MVC) in the MIP and retruded jaw positions ($p < 0.03$) when compared with control group subjects. The greater muscle activity of the left masseter muscle in the study subjects, when compared with control subjects, during MVC in the incisal, and the LLC jaw positions, was not replicated by the right masseter muscle. The right masseter muscle in the study subjects displayed decreased activity during LLC. Both the left and right (anterior and posterior) temporalis muscle activity of the study group subjects was significantly less, when compared with control group subjects, during MVC in the corresponding ipsilateral excursive jaw positions ($p < 0.05$). This finding has not previously been reported in the literature.

In addition, in the study group: (1) the left anterior temporalis muscle activity during MVC in the incisal jaw position was significantly greater than the control group ($p < 0.01$); (2) the right anterior temporalis activity during MVC in the retruded jaw position was also significantly greater than control group ($p = 0.03$); and (3) the right posterior temporalis muscle activity during MVC in the MIP was significantly greater than the control group ($p = 0.05$). However, this was not observed in the left posterior temporalis of study subjects during MVC in the MIP.

The variations observed between the left and right anterior and posterior temporalis muscles, as with the masseter muscle, may be due to the varying tooth arrangements and occlusal contact patterns influence the bite force potential on the right and left sides. The variations may also be explained by the chewing side preference of each subject. A prescribed jaw position to a preferred chewing side may generate greater bite force as a result of this side being frequently used in function. This would more readily generate MVC.

For future EMG studies on bruxism, the following may be advantageous:

- 1) a bite force gauge and occlusal jig for laboratory-based EMG studies,
- 2) a portable EMG-based recording system for utilization of the EMG at the subject's home.

In this study, EMG recordings in all subjects were assumed to be recorded at 100% maximum voluntary clench (MVC). This was not quantitatively verified. A bite force gauge and an occlusal jig may be valuable in the measure, verification and standardization of voluntary clench and jaw positions. Haketa et al (2003) has suggested portable EMG-based bruxism recording systems which allow high resolution digital recordings of the masseter EMG in the comfort of the subject's home. The system also enables systematic discrimination of artifact signals using semiautomated software and provides a more financially viable option over the sleep laboratory study.

7. Gut Disturbance Symptoms (BSQ) and Bruxism

The BSQ is a reliable and validated questionnaire identifying gastrointestinal symptom groups: chronic abdominal pain, constipation, diarrhoea, irritable bowel syndrome, and dyspepsia. The BSQ provides significant information when applied in large scale epidemiological studies (Talley et al., 1995). However, this study was a retrospective cross-sectional pilot analyses based on 32 subjects, and hence only 3 general questions of the BSQ were analysed. During a 12-month period, a larger proportion of study subjects (53%) reported experience of pain or discomfort in the abdomen or stomach when compared with control group subjects (27%). This difference, however, was not statistically significant ($p=0.17$).

Large population-based studies have reported independent associations of gastrointestinal symptoms in those with self-reported sleep disturbance (Vege et al., 2004). Specific conclusions cannot be drawn from this pilot study regarding gut disturbance symptoms and bruxism.

8. Bioscreen Symptom Questionnaire

Sleep disturbance 7-day severity score was greater in the study group subjects when compared with control group subjects ($p=0.04$). This indicates that during the 7 days preceding the completion of the Bioscreen Symptom Questionnaire, greater levels of sleep disturbance was experienced by the study group subjects. No statistically significant difference was observed between the two groups in the frequency of sleep disturbance in a 12-month period preceding the Bioscreen Symptom Questionnaire (12-month frequency). The results to the Bioscreen Symptom Questionnaire should be interpreted in the context of the following: (1) the questionnaire has been used in a major research project and in regular clinical data collection but is yet to be validated; (2) the statistical power of the results of the control group was low due to small control group numbers (9 subjects). As a result, no substantial conclusions can be drawn from the results to this questionnaire.

9. Bioscreen Faecal Microbial Analysis

There were limitations to the Bioscreen faecal microbial analysis: (1) the normal range reported by Bioscreen was based on previous unpublished Bioscreen data derived from 177 subjects; (2) the 177 subjects were university students and were selected to represent Bioscreen controls; (3) the 177 subjects were selected as an asymptomatic control group for comparison with data from clinically specific patients study group with a range of irritable bowel symptoms.

Statistical analysis of faecal microbial analyses was limited by the large standard deviations within the study and control groups. The results were therefore reported descriptively. There was a greater proportion of study subjects with normal faecal microbial streptococcus, bifidobacterium and lactobacillus counts (47%, 13% and 20% respectively) when compared with control group subjects (11%, 0% and 0% respectively). The significance of the above three GIT bacterial species requires further investigation.

The microbial environment within the gastrointestinal system involves a vast array of GIT communities that play an important role in health and disease. Major functions of the gut microflora include metabolic activities that salvage energy, absorb nutrients and protect the host against alien microbial invasion (Guarner, 2006). However, the gastrointestinal literature reports the need to yet describe a substantial part of the GIT bacterial population (Guarner, 2006). Significant progress has been made in recent years in describing the intestinal microbial composition based on the application of 16S ribosomal RNA (rRNA)-based approaches which were instrumental in describing more than 1000 different intestinal species. These approaches not only also illustrate the temporal and spatial diversity of the microbial GIT composition, but highlight the current limitations in the understanding of the molecular and cellular bases of host-microbe interactions in the GIT (Zoetendal et al., 2006).

10. Limitations of the Study and Future Directions

The limitations of this retrospective cross-sectional pilot study are as follows:

- 1) No causal conclusions can be drawn
- 2) The study population was limited (n=32)
- 3) TMD is a possible confounder
- 4) No blinding procedures were used

The following recommendations are made for future retrospective studies on bruxism:

- 1) Blinding of investigator/s.
- 2) Computer-assisted quantitative computer analyzing system using digital image analyzer for quantification of dental wear (Haketa et al., 2004).
- 3) Bite force gauge and occlusal jig for laboratory-based EMG studies.
- 4) Portable EMG-based recording system for utilization of the EMG at the subject's home (Haketa et al., 2003).
- 5) Diet analyses.
- 6) Sleep laboratory study (gold standard) would be advantageous.

CONCLUSION

Within the limitations of this retrospective cross-sectional pilot analyses, no conclusion can be drawn on the difference in the level of sleep or gut disturbance ($p=0.40$ and $p=0.17$ respectively) between bruxing (and/or clenching) and non-bruxing subjects. The significance of the marked difference in the percentage of subjects with normal streptococcus, lactobacillus and bifidobacterium faecal microbial counts between the two groups requires further investigation.

Other findings of this study support similar published reports on bruxism: (1) greater levels of anterior tooth wear ($p<0.01$); (2) elevated levels of anxiety ($p<0.05$) and; (3) greater masseter muscle activity during prescribed jaw positions ($p<0.05$). The greater somatisation of pain ($p<0.05$) and higher level of anxiety ($p<0.05$) observed in bruxers may be explained by the TMD muscle pain symptoms in many of these subjects (70%).

This study also described data not commonly reported in bruxers and/or clenchers: (1) increased obsessive-compulsive symptoms ($p<0.05$) and; (2) reduced temporalis muscle activity in ipsilateral excursive clenches ($p<0.05$).

Further controlled studies with larger study samples are needed to confirm and utilize the above findings in the clinical characterization bruxism.

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APPENDIX I

Bioscreen Patient Information (Obtained from Bioscreen Metabolic Protocols Patient Information with permission)

The Faecal Microbial Analysis (FMA) kit consisted of the following:

1. 1 specimen container (brown lid)
2. 1 plastic pouch
3. 1 AnaeroGen COMPACT foil sachet
4. 1 sealing rod and bar
5. 1 disposable glove
6. 1 styrofoam cup (not included in kit but later added)

Faecal specimen collection procedure:

1. Print your name clearly on the specimen jar.
2. Collect faeces sample into the styrofoam cup using disposable gloves. Fill at least 1/3 of specimen jar. Sample must not contact water.
3. Secure lid tightly, and place specimen jar into plastic pouch.
4. Take the small, white square sachet labeled "BR0055B" and snip off the top carefully with scissors. Take out the moist white square inside and immediately put this into the pouch with your sample container. It will turn pink in the air.
5. Tear open AnaeroGen Compact foil near the top only and remove the paper sachet. Do not tear open the paper sachet as your sample will be rejected. Leave the paper sachet intact and place immediately into the plastic pouch.
6. Immediately seal the plastic pouch completely with the frozen ice packs and place in styrofoam container provided with your Bioscreen Symptom Questionnaire.
7. Place the styrofoam container into the box provided and seal. Complete and attach the courier details provided.

APPENDIX II: BOWEL SYMPTOM QUESTIONNAIRE

SECTION A

Thank you for participating in this important research. All you need to do is tick the answers. Some of the questions are of a sensitive nature. You do not have to answer any question that you don't want to, but please remember all answers are kept totally confidential. If you are NOT SURE or CAN'T REMEMBER the answer to a question, just tick your best guess.

Q - 1 How old are you? _____ YEARS

Q - 2 Are you (tick answer):

- | | | |
|---|--------------------------|--------|
| 1 | ☐ | FEMALE |
| 2 | ☐ | MALE |

FIRST, WE WOULD LIKE TO GET SOME DETAILS ABOUT **ONLY THE PAST 12 MONTHS**.

Stomach, abdominal or tummy pain or discomfort can be difficult to describe and sometimes more than one type of pain can occur. We would like to ask you some questions *only* about the usual or primary pain or discomfort in your stomach or abdomen in the past year

Q - 3 IN THE PAST 12 MONTHS, has there been a time when you KEPT GETTING pains or discomfort in your stomach or abdomen ? (Please do NOT count cramps or pain with menstrual periods, and do NOT count pain in your chest) (tick answer).

- | | | |
|---|--------------------------|-----|
| 1 | ☐ | YES |
| 0 | ☐ | NO |

IF YES, PLEASE ANSWER THE FOLLOWING QUESTIONS

IF NO , PLEASE GO TO QUESTION 12.

Q - 4 IN THE PAST 12 MONTHS did this pain or discomfort keep happening over a period of THREE MONTHS OR LONGER? (tick answer)

- | | | |
|---|--------------------------|-----|
| 1 | ☐ | YES |
| 0 | ☐ | NO |

Q - 5 IN THE PAST 12 MONTHS, how bad has the pain or discomfort been, usually? (tick one answer)

- | | | |
|---|--------------------------|---|
| 1 | ☐ | VERY MILD: can usually be ignored |
| 2 | ☐ | MILD: can be ignored if you don't think about it |
| 3 | ☐ | MODERATE: cannot be ignored, but does not affect your lifestyle |
| 4 | ☐ | SEVERE: affects your lifestyle |
| 5 | ☐ | VERY SEVERE: markedly affects your lifestyle |

Q - 6 IN THE PAST 12 MONTHS, ON AVERAGE, how often have you had this pain or discomfort ? (tick one answer)

- | | | |
|---|--------------------------|----------------------------------|
| 1 | ☐ | LESS THAN ONCE A MONTH |
| 2 | ☐ | ABOUT ONCE A MONTH |
| 3 | ☐ | ABOUT TWO OR THREE TIMES A MONTH |
| 4 | ☐ | ABOUT ONCE A WEEK |
| 5 | ☐ | SEVERAL TIMES A WEEK |
| 6 | ☐ | DAILY |

Q - 7 Please look at Diagram 1 (below). IN THE PAST 12 MONTHS, has this pain or discomfort in your stomach or abdomen usually been: (tick one answer)

- 1

☐

IN THE AREA MARKED A
- 2

☐

IN THE AREA MARKED B
- 3

☐

IN BOTH AREAS (A AND B)

DIAGRAM 1

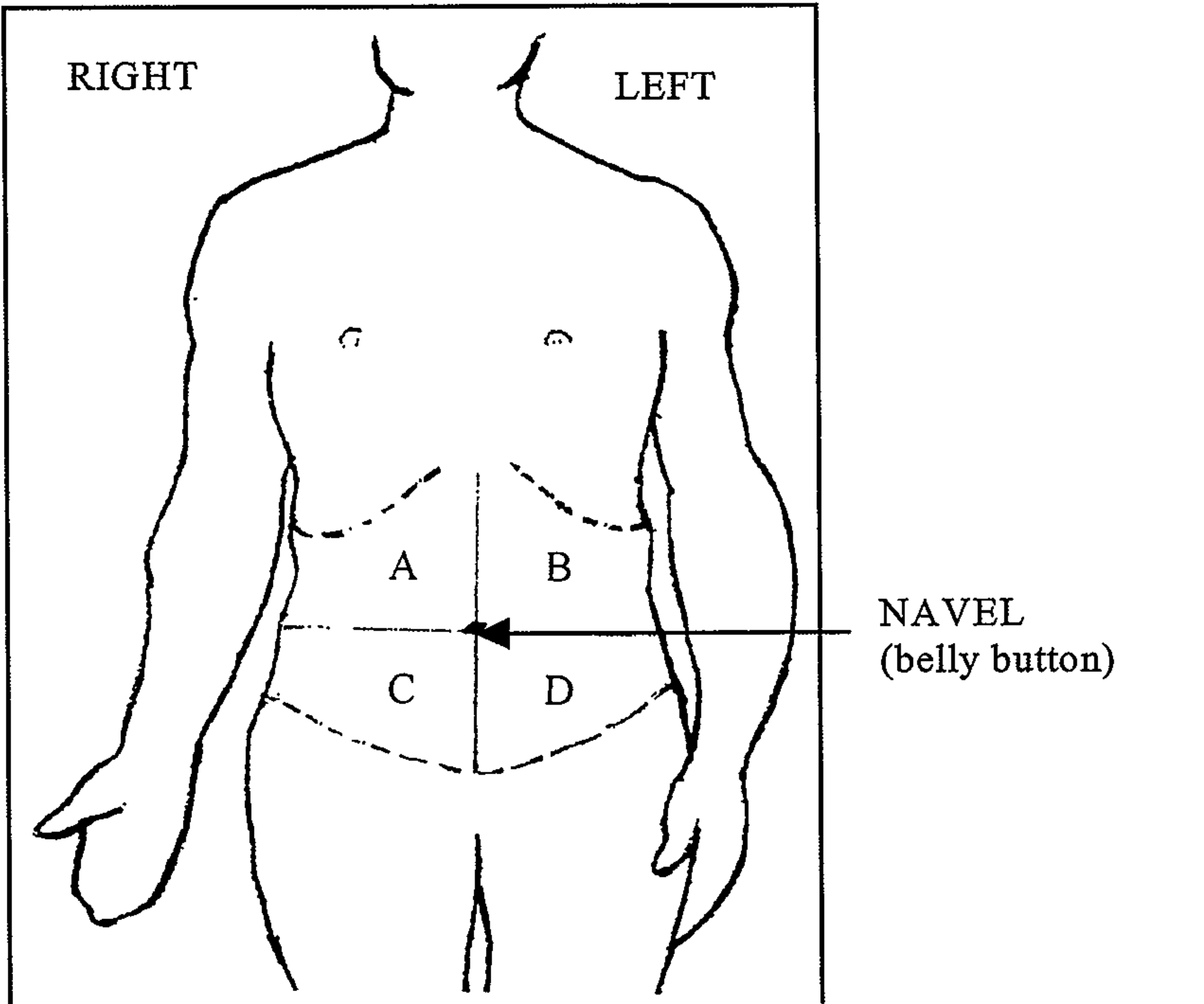
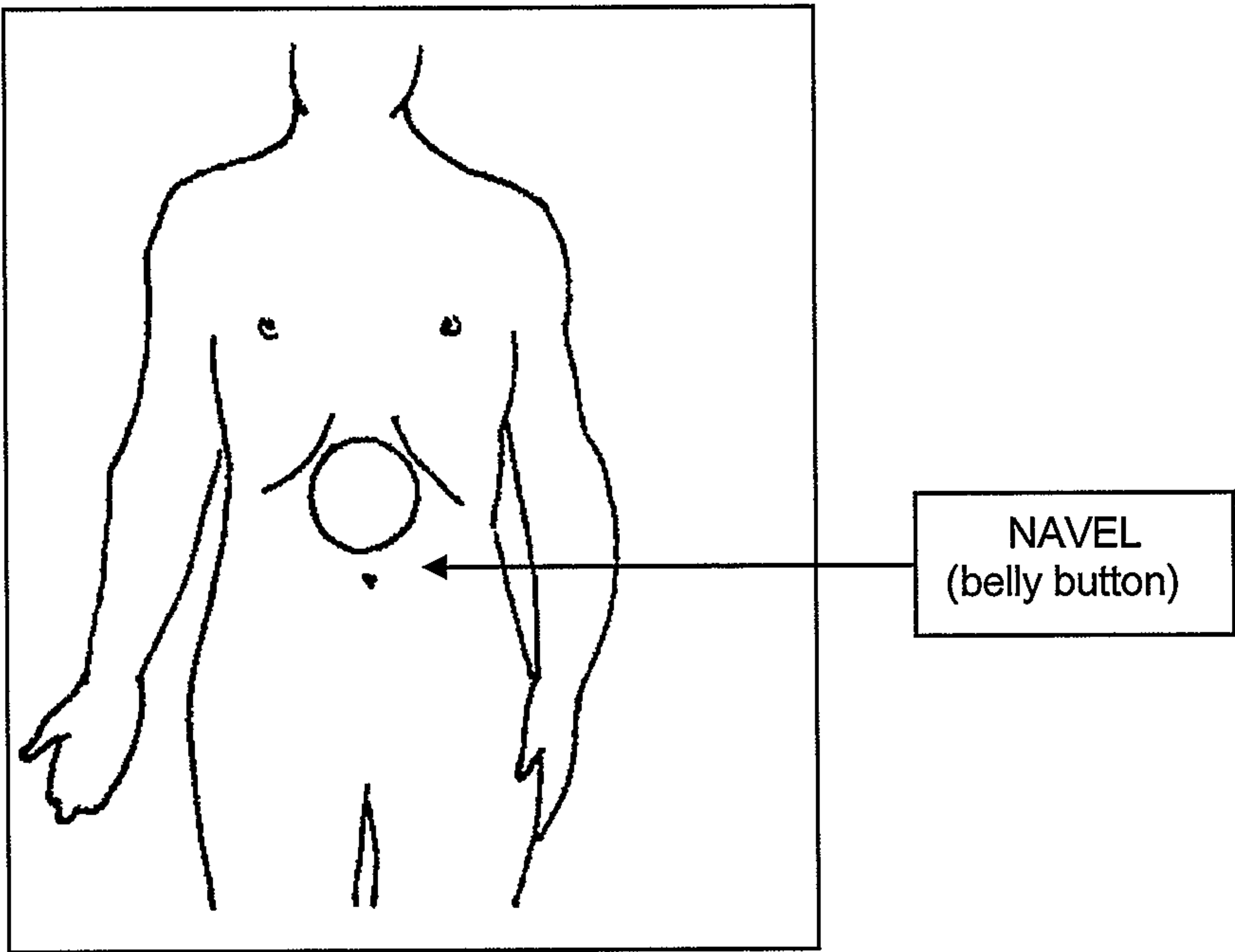


DIAGRAM 2



Q - 8 Please look at Diagram 2. Has the pain or discomfort in your stomach or abdomen usually been in a single small area, WITHIN THE AREA MARKED O, that you could point to with one or two fingers? (tick answer)

1	☐	YES
0	☐	NO

Q - 9 IN THE PAST 12 MONTHS, has your pain or discomfort EVER WOKEN YOU from sleep at night? (tick answer)

1	☐	YES
0	☐	NO

Q - 10 Does this pain or discomfort COME AND GO PERIODICALLY? Periodically here means periods of at least a month with **no** pain or discomfort, with periods in between of weeks to months when there **is** pain or discomfort. (tick answer)

1	☐	YES
0	☐	NO

PLEASE NOTE: WHEN WE SAY **OFTEN** WE MEAN MORE THAN **25%** (ONE QUARTER) OF THE TIME.

Q - 11 IN THE PAST 12 MONTHS, WOULD YOU SAY THAT : (Tick YES or NO for **each** item)

	YES	NO
This pain or discomfort was OFTEN made BETTER by having a bowel movement (passing stool)?	☐	☐
You OFTEN had MORE bowel movements than usual when this pain or discomfort began?	☐	☐
You OFTEN had LESS bowel movements than usual when this pain or discomfort began?	☐	☐
You OFTEN had LOOSER bowel movements (stools) than usual when this pain or discomfort began?	☐	☐
You OFTEN had HARDER bowel movements (stools) than usual when this pain or discomfort began?	☐	☐
This pain or discomfort was OFTEN made BETTER by either food or milk?	☐	☐
This pain or discomfort was OFTEN made BETTER by belching (burping)?	☐	☐
This pain or discomfort was OFTEN made BETTER by taking indigestion medicine (like Mucaine, Gastrogel, Amphogel, Mylanta, Gaviscon, Dijene, Dexsal, Quick-Eze, Roluids, etc)?	☐	☐
This pain or discomfort was OFTEN made WORSE by food?	☐	☐
This pain or discomfort OFTEN occurred BEFORE meals or when hungry?	☐	☐
This pain or discomfort OFTEN occurred AFTER meals?	☐	☐

REMEMBER: WHEN WE SAY **OFTEN** WE MEAN MORE THAN **25%** (ONE QUARTER) OF THE TIME.

Q - 12 IN THE PAST 12 MONTHS, WOULD YOU SAY THAT: (Tick YES or NO for each item)		YES	NO
		☐	☐
	You OFTEN had MORE than 3 bowel movements each DAY ?	☐	☐
	You OFTEN had LESS than 3 bowel movements each WEEK ?	☐	☐
	Your stools were OFTEN VERY LUMPY or HARD ?	☐	☐
	After finishing a bowel movement, you OFTEN felt there was still stool that needed to be passed?	☐	☐
	You OFTEN experienced an URGENT need to have a bowel movement that made you rush or hurry to a toilet?	☐	☐
	You OFTEN felt FULL soon after starting to eat so that you could not finish a normal meal?	☐	☐
	You OFTEN had an unpleasant feeling of food STAYING in your stomach after normal meals?	☐	☐
	You OFTEN needed to STRAIN a lot to have a bowel movement?	☐	☐

PLEASE CHECK YOU HAVE ANSWERED **ALL** THE ITEMS IN Q - 11 AND Q - 12

REMEMBER: WHEN WE SAY **OFTEN** WE MEAN MORE THAN **25%** (ONE QUARTER) OF THE TIME.

Q - 13 IN THE PAST 12 MONTHS, have you OFTEN been troubled by feeling as if your stomach or abdomen was swollen (BLOATED)?(tick answer)		
1	☐	YES
0	☐	NO

IF **YES**, PLEASE ANSWER
QUESTION 14

IF **NO**, PLEASE GO TO
QUESTION 15

Q - 14 Please look at Diagram 1 (page 3). IN THE PAST 12 MONTHS, has your bloated feeling usually been (tick one answer)		
1	☐	IN THE AREA MARKED A
2	☐	IN THE AREA MARKED B
3	☐	IN BOTH AREAS (A AND B)
Q - 15 IN THE PAST 12 MONTHS, have you OFTEN seen your stomach or abdomen swell up, or had to loosen your belt or clothes because of swelling? (tick answer)		
1	☐	YES
0	☐	NO
Q - 16 IN THE PAST 12 MONTHS, have your stools been VERY LOOSE or WATERY ? (tick one answer)		
0	☐	SOMETIMES (LESS THAN ONE QUARTER OF THE TIME) OR NEVER
1	☐	OFTEN (MORE THAN ONE QUARTER OF THE TIME)
2	☐	USUALLY (MORE THAN THREE QUARTERS OF THE TIME)

Q - 17 IN THE PAST 12 MONTHS, how many times have you had a feeling of NAUSEA (wanting to vomit)? (tick one answer)

- 0 ☐ NONE
- 1 ☐ 1-3 TIMES
- 2 ☐ 4-10 TIMES
- 3 ☐ MORE THAN 10 TIMES

Q - 18 IN THE PAST 12 MONTHS, how many times have you actually vomited ? (tick one answer)

- 0 ☐ NONE
- 1 ☐ 1-3 TIMES
- 2 ☐ 4-10 TIMES
- 3 ☐ MORE THAN 10 TIMES

Q - 19 IN THE PAST 12 MONTHS, how many times have you had RETCHING (heaving as if to vomit, but not vomiting)? (tick one answer)

- 0 ☐ NONE
- 1 ☐ 1-3 TIMES
- 2 ☐ 4-10 TIMES
- 3 ☐ MORE THAN 10 TIMES

Q - 20 IN THE PAST 12 MONTHS, have you had HEARTBURN (a burning pain or discomfort behind the breastbone in the chest)? (Do not count pain from angina or heart trouble) (tick one answer)

- 0 ☐ NO
- 1 ☐ LESS THAN ONCE A MONTH
- 2 ☐ ABOUT ONCE A MONTH
- 3 ☐ ABOUT ONCE A WEEK
- 4 ☐ SEVERAL TIMES A WEEK
- 5 ☐ DAILY

Q - 21 IN THE PAST 12 MONTHS have you had a bitter or sour tasting fluid that comes into your throat or mouth ? (tick one answer)

- 0 ☐ NO
- 1 ☐ LESS THAN ONCE A MONTH
- 2 ☐ ABOUT ONCE A MONTH
- 3 ☐ ABOUT ONCE A WEEK
- 4 ☐ SEVERAL TIMES A WEEK
- 5 ☐ DAILY

Q - 22 IN THE PAST 12 MONTHS, have you EVER seen MUCUS (white or green slimy material) in your stools? (tick answer)

- 1 ☐ YES
- 0 ☐ NO

WE WOULD NOW LIKE TO ASK YOU ABOUT PAIN OR DISCOMFORT IN YOUR STOMACH OR ABDOMEN DURING YOUR WHOLE LIFETIME, **EXCEPT** FOR THE PAST YEAR.

Q - 23 IN YOUR LIFETIME **BEFORE** THE PAST 12 MONTHS, was there ever a time when you **KEPT GETTING** pains or discomfort in your stomach or abdomen ? (Please do NOT count cramps or pain with menstrual periods, and do NOT count pain in your chest) (tick answer).

- 1 ☐ YES
- 0 ☐ NO

IF **YES**, PLEASE ANSWER THE FOLLOWING QUESTIONS

IF **NO**, PLEASE GO TO QUESTION 28

Q - 24 When in your life did this pain or discomfort FIRST begin, as close as you can recall? (tick one answer)

- | | | |
|---|--------------------------|------------------------------------|
| 1 | ☐ | UP TO 2 YEARS AGO |
| 2 | ☐ | MORE THAN 2 YEARS TO 5 YEARS AGO |
| 3 | ☐ | MORE THAN 5 YEARS TO 10 YEARS AGO |
| 4 | ☐ | MORE THAN 10 YEARS TO 20 YEARS AGO |
| 5 | ☐ | MORE THAN 20 YEARS AGO |

Q - 25 IN YOUR LIFETIME **BEFORE** THE PAST 12 MONTHS, were you ever TROUBLED by pain or discomfort in your stomach or abdomen over a period of THREE MONTHS OR LONGER? (tick answer)

- | | | |
|---|--------------------------|-----|
| 1 | ☐ | YES |
| 0 | ☐ | NO |

Q - 26 Please look at Diagram 1 (page 3). IN YOUR LIFETIME **BEFORE** THE PAST 12 MONTHS, was that pain or discomfort in your stomach or abdomen USUALLY: (tick one answer)

- | | | |
|---|--------------------------|-------------------------|
| 1 | ☐ | IN THE AREA MARKED A |
| 2 | ☐ | IN THE AREA MARKED B |
| 3 | ☐ | IN BOTH AREAS (A AND B) |

Q - 27 IN YOUR LIFETIME **BEFORE** THE PAST 12 MONTHS, when you were TROUBLED BY that pain or discomfort, were you also TROUBLED BY BOWEL DISTURBANCES (such as CONSTIPATION and/or DIARRHEA) ? (tick answer)

- | | | |
|---|--------------------------|-----|
| 1 | ☐ | YES |
| 0 | ☐ | NO |

NOW WE NEED TO KNOW ABOUT YOUR GENERAL HEALTH AND LIFESTYLE

Q - 28 IN THE PAST 12 MONTHS, how frequently have you visited a doctor for any reason (for yourself)? (tick one answer)

- | | | |
|---|--------------------------|----------------------------|
| 0 | ☐ | NEVER |
| 1 | ☐ | OCCASIONALLY (1-3 TIMES) |
| 2 | ☐ | SOMETIMES (4-10 TIMES) |
| 3 | ☐ | OFTEN (MORE THAN 10 TIMES) |

Q - 29 IN THE PAST 12 MONTHS, how frequently have you sought alternative therapy of any kind (acupuncture, naturopathy, homeopathy, etc) for any reason (for yourself)? (tick one answer)

- | | | |
|---|--------------------------|----------------------------|
| 0 | ☐ | NEVER |
| 1 | ☐ | OCCASIONALLY (1-3 TIMES) |
| 2 | ☐ | SOMETIMES (4-10 TIMES) |
| 3 | ☐ | OFTEN (MORE THAN 10 TIMES) |

Q - 30 IN THE PAST 12 MONTHS, how frequently were your visits to a doctor or alternative therapist for pain or discomfort in your stomach or abdomen? (tick one answer)

- | | | |
|---|--------------------------|----------------------------|
| 0 | ☐ | NEVER |
| 1 | ☐ | OCCASIONALLY (1-3 TIMES) |
| 2 | ☐ | SOMETIMES (4-10 TIMES) |
| 3 | ☐ | OFTEN (MORE THAN 10 TIMES) |

Q - 31 IN YOUR LIFETIME **BEFORE** THE PAST 12 MONTHS, about how frequently have you visited any doctor or alternative therapist for pain or discomfort in your stomach or abdomen? (tick one answer)

- | | | |
|---|--------------------------|----------------------------|
| 0 | ☐ | NEVER |
| 1 | ☐ | OCCASIONALLY (1-3 TIMES) |
| 2 | ☐ | SOMETIMES (4-10 TIMES) |
| 3 | ☐ | OFTEN (MORE THAN 10 TIMES) |

Q - 32 What is your CURRENT marital status: (tick one answer)

- | | | |
|---|--------------------------|----------------------|
| 1 | ☐ | MARRIED |
| 2 | ☐ | DE FACTO/LIVING WITH |
| 3 | ☐ | NEVER MARRIED |
| 4 | ☐ | WIDOWED |
| 5 | ☐ | DIVORCED |
| 6 | ☐ | SEPARATED |

Q - 33 Please indicate your HIGHEST level of EDUCATIONAL training, or equivalent: (tick one answer)

- | | | |
|---|--------------------------|--|
| 1 | ☐ | POSTGRADUATE QUALIFICATIONS |
| 2 | ☐ | UNIVERSITY GRADUATE (3 YEARS OR MORE) |
| 3 | ☐ | COMPLETED TAFE CERTIFICATE/ASSOCIATE DIPLOMA,
TRADES APPRENTICESHIP, OR 2 YEARS UNIVERSITY. |
| 4 | ☐ | H.S.C. (HIGHER SCHOOL CERTIFICATE) |
| 5 | ☐ | COMPLETED YEAR 10 (FOURTH FORM/SCHOOL
CERTIFICATE) |
| 6 | ☐ | SOME YEARS AT HIGH SCHOOL |
| 7 | ☐ | PRIMARY SCHOOL ONLY |

APPENDIX III: EPWORTH SLEEPINESS SCALE

Name:	Today's Date:
Your gender:	Your age:

These questions are related to:

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you. Please complete the questions below and choose the **most appropriate number** for each situation:

- 0= would **never** doze
- 1= **slight** chance of dozing
- 2= **moderate** change of dozing
- 3= **high** chance of dozing

Please answer these questions:

Situation	Chance of dozing
1. Sitting and reading	
2. Watching TV	
3. Sitting, inactive in a public place (e.g. a theater or a meeting)	
4. As a passenger in a car for an hour without a break	
5. Lying down to rest in the afternoon when circumstances permit	
6. Sitting and talking to someone	
7. Sitting directly after lunch without alcohol	
8. In a car, while stopped for a few minutes in the traffic	

The above has been modified from Johns MW. (1991) A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep*, 14, 540-545.

APPENDIX IV: BERLIN QUESTIONNAIRE

Question	Response
Has your weight changed over the last 1 year?	Increased Decreased No change
Do you snore?	Yes No
Snoring loudness	Loud as breathing Loud as talking Louder than talking Very loud Never or almost never
Snoring frequency	Almost every day 3~4 times per week 1~2 times per week 1~2 times per month Never or almost never
Does your snoring bother other people?	Yes No
How often have your breathing pauses been noticed?	Almost every day 3~4 times per week 1~2 times per week 1~2 times per month Never or almost never
Are your tired after sleeping?	Almost every day 3~4 times per week 1~2 times per week 1~2 times per month Never or almost never
Are you tired during waketime?	Almost every day 3~4 times per week 1~2 times per week 1~2 times per month Never or almost never
Have you ever fallen asleep with driving?	Yes No
Do you have high blood pressure?	Yes No Do not know

The above has been adapted from Netzer NC, Stoohs RA, Netzer CM, et al. (1999) Using the Berlin Questionnaire to identify patients at risk for sleep apnoea syndrome. *Annals of Internal Medicine*, 131, 485-491.

We notice that you mentioned pain as one of your symptoms. Because pain is a very individual experience, not the same for everyone, could you please help us to understand what your pain is like by answering the following questions as fully as you can.

1. SEVERITY : The line below is a scale for pain ranging from NO PAIN at all to VERY SEVERE PAIN. Place a cross on this line to show us how severe your pain problem is **most of the time**.

NO PAIN

VERY SEVERE PAIN

IF your pain varies and is worse at some times than others, put a **cross on the line** to show us how bad it gets and **another cross** at the point on the line to show us the least pain you experience.

IF you have **more than one pain** (e.g. headache and jaw pain) and would find it easier to rate these separately, please do so on the scales below.

(1) Which pain are you rating? _____

NO PAIN

VERY SEVERE PAIN

(2) Which pain are you rating? _____

NO PAIN

VERY SEVERE PAIN

(3) Which pain are you rating? _____

NO PAIN

VERY SEVERE PAIN

2. PAIN CORRELATES : Have you noticed a **relationship** of any kind between your pain and any of the items listed below. **Put a tick in the box if your pain is worse:**

- | | | | |
|------------------------|--------------------------|--------------------------|--------------------------|
| after eating | ☐ | during meals | ☐ |
| in the morning | ☐ | in the evening | ☐ |
| during the night | ☐ | while talking | ☐ |
| while laughing | ☐ | while yawning | ☐ |
| when lying down | ☐ | when under mental stress | ☐ |
| when muscles are tense | ☐ | when cold | ☐ |

Describe any other relationship you have noticed. _____

3. PAIN DURATION : When you have pain, which of the words below best describes your pain?

- | | | |
|------------|--------------|-----------|
| 1 | 2 | 3 |
| Continuous | Rhythmic | Brief |
| Steady | Periodic | Momentary |
| Constant | Intermittent | Transient |

How often does the pain occur? **Place a tick in the box that best describes your pain.**

- | | |
|--|---|
| ☐ Only occasionally with no fixed pattern | ☐ Occasionally, lasting for a day or more |
| ☐ Frequently, with no fixed pattern | ☐ Frequently, lasting for a day or more |
| ☐ Every day with no fixed pattern | ☐ Every day and seems related to certain times and things I do |
| ☐ Every day and is always present | |

CLINICAL (RDC/TMD) QUESTIONNAIRE No. 2

Date: _____

ID. _____

Please read each question and respond accordingly.
For each of the questions below circle only one response.

1. Would you say your health in general is:

Excellent Very good Good Fair Poor

2. Would you say your oral health in general is:

Excellent Very good Good Fair Poor

3. Have you had pain in the face, jaw, temple, in front of the ear or in the ear in the past month?

No
Yes

[If no pain in the past month SKIP to question 14]

If Yes,

4.a. How many years ago did your facial pain begin for the first time? _____ years ago

[If one year ago or more SKIP to question 5]

4.b. How many months ago did your facial pain begin for the first time? _____ months ago

5. Is your facial pain persistent, recurrent or was it only a one-time problem? Persistent

Recurrent
One-Time

6. Have you ever gone to a physician, dentist, chiropractor or other health professional for facial ache or pain?

No

Yes, in the last six months

Yes, more than six months ago

7. How would you rate your facial pain on a 0 to 10 scale at the present time, that is right now, where 0 is "no pain" and 10 is "pain as bad as could be"?

NO PAIN

0 1 2 3 4 5 6 7 8 9 10

PAIN AS BAD
AS COULD BE
10

8. In the past six months, how intense was your worst pain rated on a 0 to 10 scale where 0 is "no pain" and 10 is "pain as bad as could be"?

NO PAIN

0 1 2 3 4 5 6 7 8 9 10

PAIN AS BAD
AS COULD BE
10

9. In the past six months, on the average, how intense was your pain rated on a 0 to 10 scale where 0 is "no pain" and 10 is "pain as bad as could be"? [That is, your usual pain at times you were experiencing pain].

NO PAIN										PAIN AS BAD AS COULD BE	
0	1	2	3	4	5	6	7	8	9	10	

10. About how many days in the last six months have you been kept from your usual activities (work, school or housework) because of facial pain? _____DAYS

11. In the past six months, how much has facial pain interfered with your daily activities rated on a 0 to 10 scale where 0 is "no interference" and 10 is "unable to carry on any activities"?

NO INTERFERENCE									UNABLE TO CARRY ON ANY ACTIVITIES	
0	1	2	3	4	5	6	7	8	9	10

12. In the past six months, how much has facial pain changed your ability to take part in recreational, social and family activities where 0 is "no change" and 10 is "extreme change"?

NO CHANGE									EXTREME CHANGE	
0	1	2	3	4	5	6	7	8	9	10

13. In the past six months, how much has facial pain changed your ability to work including housework) where 0 is "no change" and 10 is "extreme change"?

NO CHANGE									EXTREME CHANGE	
0	1	2	3	4	5	6	7	8	9	10

14.a. Have you ever had your jaw lock or catch so that it won't open all the way?

No
Yes

[If no problem opening all the way SKIP to question 15]

If Yes,

14.b. Was this limitation in jaw opening severe enough to interfere with your ability to eat?

No
Yes

15. a. Does your jaw click or pop when you open or close your mouth or when chewing?

No
Yes

b. Does your jaw make a grating or grinding noise when it opens and closes or when chewing?

No
Yes

c. Have you been told, or do you notice that you grind your teeth or clench your jaw while sleeping at night?

No
Yes

d. During the day, do you grind your teeth or clench your jaw?

No
Yes

e. Does your jaw ache or feel stiff when you wake up in the morning?

No
Yes

f. Do you have noises or ringing in your ears?

No
Yes

g. Does your bite feel uncomfortable or unusual?

No
Yes

16.a. Do you have rheumatoid arthritis, lupus, or other systemic arthritic disease?

No
Yes

16.b. Do you know of anyone in your family who has had any of these diseases?

No
Yes

16.c. Have you had or do you have any swollen or painful joints) other than the joints close to your ears (TMJ)?

No
Yes

[If no swollen or painful joints, SKIP to question 17.a]

If Yes,

16.d. Is this a persistent pain which you have had for at least one year?

No
Yes

17.a. Have you had a recent injury to your face or jaw?

No
Yes

[If no recent injuries SKIP to question 18]

If Yes,

17.b. Did you have jaw pain before the injury?

No
Yes

18. During the last six months have you had a problem with headaches or migraines?

No
Yes

19. What activities does your present jaw problem prevent or limit you from doing?

a. Chewing	No Yes	g. Sexual activity	No Yes
b. Drinking	No Yes	h. Cleaning teeth or face	No Yes
c. Exercising	No Yes	i. Yawning	No Yes
d. Eating hard foods	No Yes	j. Swallowing	No Yes
e. Eating soft foods	No Yes	k. Talking	No Yes
f. Smiling/laughing	No Yes	l. Having your usual facial appearance	No Yes

20. In the last month, how much have you been distressed by.

	Not At All	A Little Bit	Moder ately	Quite A Bit	Ex- tremelv
a. Headaches	0	1	2	3	4
b. Loss of sexual interest or pleasure	0	1	2	3	4
c. Faintness or dizziness	0	1	2	3	4
d. Pains in the heart or chest	0	1	2	3	4
e. Feeling low in energy or slowed down	0	1	2	3	4
f. Thoughts of death or dying	0	1	2	3	4
g. Poor appetite	0	1	2	3	4
h. Crying easily	0	1	2	3	4
i. Blaming yourself for things	0	1	2	3	4
j. Pains in the lower back	0	1	2	3	4
k. Feeling lonely	0	1	2	3	4
l. Feeling blue	0	1	2	3	4
m. Worrying too much about things	0	1	2	3	4
n. Feeling no interest in things	0	1	2	3	4
o. Nausea or upset stomach	0	1	2	3	4
p. Soreness of your muscles	0	1	2	3	4
q. Trouble falling asleep	0	1	2	3	4
r. Trouble getting your breath	0	1	2	3	4
s. Hot or cold spells	0	1	2	3	4
t. Numbness or tingling in parts of your body	0	1	2	3	4
u. A lump in your throat	0	1	2	3	4
v. Feeling hopeless about the future	0	1	2	3	4
w. Feeling weak in parts of your body	0	1	2	3	4
x. Heavy feelings in your arms or legs	0	1	2	3	4
y. Thoughts of ending your life	0	1	2	3	4
z. Overeating	0	1	2	3	4
aa. Awakening in the early morning	0	1	2	3	4
bb. Sleep that is restless or disturbed	0	1	2	3	4
cc. Feeling everything is an effort	0	1	2	3	4
dd. Feelings of worthlessness	0	1	2	3	4
ee. Feeling of being caught or trapped	0	1	2	3	4
ff. Feelings of guilt	0	1	2	3	4

21. How good a job do you feel you are doing in taking care of your health overall?

- Excellent
- Very good
- Good
- Fair
- Poor

22. How good a job do you feel you are doing in taking care of your oral health?

- Excellent
- Very good
- Good
- Fair
- Poor.

23. When were you born? Month_____Day_____Year_____

24. Are you male or female? Male Female

25. In what country were you born? _____

26a. Does this country best represent your race, national origin or ancestry?

- Yes
- No

If No,

26b. What is your country of national origin or ancestry?

27. What is the highest grade or year of regular school that you have completed?

- Never attended or Kindergarten
- Primary School
- High School
- University

28.a. During the past 2 weeks, did you work at a job or business not counting work around the house (include unpaid work in the family farm/business)?

- Yes
- No
- N/A

[If Yes SKIP to question 29]

If No,

28b. Even though you did not work during the past 2 weeks, did you have a job or business?

- Yes
- No
- N/A

[If Yes SKIP to question 29]

If No,

28c. Were you looking for work or on layoff from a job during those 2 weeks?

- Yes, looking for work
- Yes, layoff
- Yes, both on layoff and looking for work
- No
- N/A

29. Are you married, widowed, divorced, separated or never been married?

- Married / spouse or defacto in household
- Married / spouse or defacto- not in household
- Widowed
- Divorced
- Separated
- Never Married

30. Which of the following best represents your total **combined household income** during the past 12 months?

- | | | |
|-------------------|-------------------|------------------|
| \$0-\$14,999 | \$25,000-\$34,999 | \$50,000 or more |
| \$15,000-\$24,999 | \$35,000-\$49,999 | |

5. Joint Sounds (palpation)		RIGHT	LEFT
(a) Opening	None	0	0
	Click	1	1
	Coarse Crepitus	2	2
	Fine Crepitus	3	3
Measurement of Opening Click		_____ mm	_____ mm
(b) Closing	None	0	0
	Click	1	1
	Coarse Crepitus	2	2
	Fine Crepitus	3	3
Measurement of Closing Click		_____ mm	_____ mm
(c) Reciprocal click eliminated on protrusive opening		No	No
		Yes	Yes
		NA	NA

6. Excursions		MUSCLE PAIN				JOINT PAIN			
		<u>None</u>	<u>Right</u>	<u>Left</u>	<u>Both</u>	<u>None</u>	<u>Right</u>	<u>Left</u>	<u>Both</u>
(a) Right Lateral Excursion	_____ mm	0	1	2	3	0	1	2	3
(b) Left Lateral Excursion	_____ mm	0	1	2	3	0	1	2	3
(c) Protrusion	_____ mm	0	1	2	3	0	1	2	3
(d) Midline Deviation	_____ mm	RIGHT		LEFT		NA			

7. Joint Sounds on Excursions

Right Sounds:		None	Click	Coarse Crepitus	Fine Crepitus
	Excursion Right	0	1	2	3
	Excursion Left	0	1	2	3
	Protrusion	0	1	2	3
Left Sounds:					
	Excursion Right	0	1	2	3
	Excursion Left	0	1	2	3
	Protrusion	0	1	2	3

DIRECTIONS FOR ITEMS 8-10

The examiner will be palpating (touching) different areas of your face, head and neck. We would like you to indicate if you do not feel pain or just feel pressure (0), or pain (1-3). Please rate how much pain you feel for each of the palpations according to the scale below. Circle the number that corresponds to the amount of pain you feel. We would like you to make a separate rating for both the right and left palpations.

- 0 = No Pain/ Pressure Only
- 1 = Mild Pain
- 2 = Moderate Pain
- 3 = Severe Pain

PLEASE GIVE PATIENT RATING CARD

8. Extraoral muscle pain with palpation:

	RIGHT	LEFT
a. Temporalis (posterior) "Back of temple"	0 1 2 3	0 1 2 3
b. Temporalis (middle) "Middle of temple"	0 1 2 3	0 1 2 3
c. Temporalis (anterior) "Front of temple"	0 1 2 3	0 1 2 3
d. Masseter (superior) "Cheek/under cheekbone"	0 1 2 3	0 1 2 3
e. Masseter (middle) "Cheek/side of face"	0 1 2 3	0 1 2 3
f. Masseter (inferior) "Cheek/jawline"	0 1 2 3	0 1 2 3
g. Posterior mandibular region (Stylohyoid/posterior digastric region) "Jaw/throat region"	0 1 2 3	0 1 2 3
h. Submandibular region (Medial pterygoid/Suprahyoid/anterior digastric region) "Under chin"	0 1 2 3	0 1 2 3
i. Sternocleidomastoid (origin) "Under ear"	0 1 2 3	0 1 2 3
j. Sternocleidomastoid (body) "Side of neck"	0 1 2 3	0 1 2 3
k. Trapezius (origin) "Back of head"	0 1 2 3	0 1 2 3
l. Trapezius (body and insertion) "Neck and shoulders"	0 1 2 3	0 1 2 3

9. Joint pain with palpation:

a. Lateral pole "Outside"	0 1 2 3	0 1 2 3
b. Posterior attachment "Inside ear"	0 1 2 3	0 1 2 3

10. Intraoral muscle pain with palpation:

a. Lateral pterygoid area "Behind upper molars"	0 1 2 3	0 1 2 3
b. Tendon of temporalis "Tendon"	0 1 2 3	0 1 2 3
c. Tongue "Tongue"	0 1 2 3	0 1 2 3

SELF-EVALUATION QUESTIONNAIRE

Name _____

DIRECTIONS : A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

		NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1	I feel calm	1	2	3	4
2	I feel secure	1	2	3	4
3	I am tense	1	2	3	4
4	I feel strained	1	2	3	4
5	I feel at ease	1	2	3	4
6	I feel upset	1	2	3	4
7	I am presently worrying over possible misfortunes	1	2	3	4
8	I feel satisfied	1	2	3	4
9	I feel frightened	1	2	3	4
10	I feel comfortable	1	2	3	4
11	I feel self-confident	1	2	3	4
12	I feel nervous	1	2	3	4
13	I am jittery	1	2	3	4
14	I feel indecisive	1	2	3	4
15	I am relaxed	1	2	3	4
16	I feel content	1	2	3	4
17	I am worried	1	2	3	4
18	I feel confused	1	2	3	4
19	I feel steady	1	2	3	4
20	I feel pleasant	1	2	3	4

SELF-EVALUATION QUESTIONNAIRE

Name _____

DIRECTIONS : A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
I feel pleasant	1	2	3	4
I feel nervous and restless	1	2	3	4
I feel satisfied with myself	1	2	3	4
I wish I could be as happy as others seem to be	1	2	3	4
I feel like a failure	1	2	3	4
I feel rested	1	2	3	4
I am calm, cool and collected	1	2	3	4
I feel that difficulties are piling up so that I cannot seem to overcome them	1	2	3	4
I worry too much over something that really doesn't matter	1	2	3	4
I am happy	1	2	3	4
I have disturbing thoughts	1	2	3	4
I lack self-confidence	1	2	3	4
I feel secure	1	2	3	4
I make decisions easily	1	2	3	4
I feel inadequate	1	2	3	4
I am content	1	2	3	4
Some unimportant thought runs through my mind and bothers me	1	2	3	4
I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
I am a steady person	1	2	3	4
I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

INSTRUCTIONS:

Below is a list of problems people sometimes have. Please read each one carefully, and circle the number to the right that best describes **HOW MUCH THAT PROBLEM HAS DISTRESSED OR BOTHERED YOU DURING THE PAST 7 DAYS INCLUDING TODAY**. Circle only one number for each problem and do not skip any items. If you change your mind, erase your first mark carefully. Read the example below before beginning, and if you have any questions please ask about them.

SEX

MALE

☐

FEMALE

☐

NAME: _____

LOCATION: _____

EDUCATION: _____

MARITAL STATUS: MAR.____SEP.____DIV.____WID.____SING.____

DATE

MO	DAY	YEAR

**ID.
NUMBER**

--	--	--	--

AGE

--	--

VISIT NUMBER: _____

EXAMPLEHOW MUCH WERE
YOU DISTRESSED BY:

1. Bodyaches

NOT AT ALL

A LITTLE BIT

MODERATELY

QUITE A BIT

EXTREMELY

0

1

2

3

4

HOW MUCH WERE YOU DISTRESSED BY:

NOT AT ALL

A LITTLE BIT

MODERATELY

QUITE A BIT

EXTREMELY

1. Headaches
2. Nervousness or shakiness inside
3. Repeated unpleasant thoughts that won't leave your mind
4. Faintness or dizziness
5. Loss of sexual interest or pleasure
6. Feeling critical of others
7. The idea that someone else can control your thoughts
8. Feeling others are to blame for most of your troubles
9. Trouble remembering things
10. Worried about sloppiness or carelessness
11. Feeling easily annoyed or irritated
12. Pains in heart or chest
13. Feeling afraid in open spaces or on the streets
14. Feeling low in energy or slowed down
15. Thoughts of ending your life
16. Hearing voices that other people do not hear
17. Trembling
18. Feeling that most people cannot be trusted
19. Poor appetite
20. Crying easily
21. Feeling shy or uneasy with the opposite sex
22. Feelings of being trapped or caught
23. Suddenly scared for no reason
24. Temper outbursts that you could not control
25. Feeling afraid to go out of your house alone
26. Blaming yourself for things
27. Pains in lower back
28. Feeling blocked in getting things done
29. Feeling lonely
30. Feeling blue
31. Worrying too much about things
32. Feeling no interest in things
33. Feeling fearful
34. Your feelings being easily hurt
35. Other people being aware of your private thoughts

1

0

1

2

3

4

2

0

1

2

3

4

3

0

1

2

3

4

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35

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1

2

3

4

HOW MUCH WERE YOU DISTRESSED BY:

HOW MUCH WERE YOU DISTRESSED BY:		NOT AT ALL	A LITTLE BIT	MODERATELY	QUITE A BIT	EXTREMELY	
36.	Feeling others do not understand you or are unsympathetic	36	0	1	2	3	4
37.	Feeling that people are unfriendly or dislike you	37	0	1	2	3	4
38.	Having to do things very slowly to insure correctness	38	0	1	2	3	4
39.	Heart pounding or racing	39	0	1	2	3	4
40.	Nausea or upset stomach	40	0	1	2	3	4
41.	Feeling inferior to others	41	0	1	2	3	4
42.	Soreness of your muscles	42	0	1	2	3	4
43.	Feeling that you are watched or talked about by others	43	0	1	2	3	4
44.	Trouble falling asleep	44	0	1	2	3	4
45.	Having to check and double-check what you do	45	0	1	2	3	4
46.	Difficulty making decisions	46	0	1	2	3	4
47.	Feeling afraid to travel on buses, subways, or trains	47	0	1	2	3	4
48.	Trouble getting your breath	48	0	1	2	3	4
49.	Hot or cold spells	49	0	1	2	3	4
50.	Having to avoid certain things, places, or activities because they frighten you	50	0	1	2	3	4
51.	Your mind going blank	51	0	1	2	3	4
52.	Numbness or tingling in parts of your body	52	0	1	2	3	4
53.	A lump in your throat	53	0	1	2	3	4
54.	Feeling hopeless about the future	54	0	1	2	3	4
55.	Trouble concentrating	55	0	1	2	3	4
56.	Feeling weak in parts of your body	56	0	1	2	3	4
57.	Feeling tense or keyed up	57	0	1	2	3	4
58.	Heavy feelings in your arms or legs	58	0	1	2	3	4
59.	Thoughts of death or dying	59	0	1	2	3	4
60.	Overeating	60	0	1	2	3	4
61.	Feeling uneasy when people are watching or talking about you	61	0	1	2	3	4
62.	Having thoughts that are not your own	62	0	1	2	3	4
63.	Having urges to beat, injure, or harm someone	63	0	1	2	3	4
64.	Awakening in the early morning	64	0	1	2	3	4
65.	Having to repeat the same actions such as touching, counting, or washing	65	0	1	2	3	4
66.	Sleep that is restless or disturbed	66	0	1	2	3	4
67.	Having urges to break or smash things	67	0	1	2	3	4
68.	Having ideas or beliefs that others do not share	68	0	1	2	3	4
69.	Feeling very self-conscious with others	69	0	1	2	3	4
70.	Feeling uneasy in crowds, such as shopping or at a movie	70	0	1	2	3	4
71.	Feeling everything is an effort	71	0	1	2	3	4
72.	Spells of terror or panic	72	0	1	2	3	4
73.	Feeling uncomfortable about eating or drinking in public	73	0	1	2	3	4
74.	Getting into frequent arguments	74	0	1	2	3	4
75.	Feeling nervous when you are left alone	75	0	1	2	3	4
76.	Others not giving you proper credit for your achievements	76	0	1	2	3	4
77.	Feeling lonely even when you are with people	77	0	1	2	3	4
78.	Feeling so restless you couldn't sit still	78	0	1	2	3	4
79.	Feelings of worthlessness	79	0	1	2	3	4
80.	The feeling that something bad is going to happen to you	80	0	1	2	3	4
81.	Shouting or throwing things	81	0	1	2	3	4
82.	Feeling afraid you will faint in public	82	0	1	2	3	4
83.	Feeling that people will take advantage of you if you let them	83	0	1	2	3	4
84.	Having thoughts about sex that bother you a lot	84	0	1	2	3	4
85.	The idea that you should be punished for your sins	85	0	1	2	3	4
86.	Thoughts and images of a frightening nature	86	0	1	2	3	4
87.	The idea that something serious is wrong with your body	87	0	1	2	3	4
88.	Never feeling close to another person	88	0	1	2	3	4
89.	Feelings of guilt	89	0	1	2	3	4
90.	The idea that something is wrong with your mind	90	0	1	2	3	4