THE ASSOCIATION BETWEEN MYOFASCIAL TRIGGER POINTS OF THE QUADRICEPS FEMORIS MUSCLE AND THE CLINICAL PRESENTATION OF PATELLOFEMORAL PAIN SYNDROME USING A PILOTED PATELLOFEMORAL PAIN SEVERITY SCALE.

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I, Donna Dippenaar, do declare that this dissertation is representative of my own work in both conception and execution.

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DEDICATION

To my parents Peter and Robynn Dippenaar, for their unconditional love and support in all that I do. I'm proud to be your daughter.

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ABSTRACT

The purpose of this study was to investigate the role of Myofascial Trigger Points of the quadriceps femoris muscle in the clinical presentation of Patellofemoral Pain syndrome.

Patellofemoral Pain Syndrome according to current literature suggests an extensor mechanism dysfunction as the most probable etiology, however this syndrome has posed many unsolved mysteries and challenges to the medical community and remains a difficult condition to treat.

Myofascial pain syndrome in contrast to this is a regional muscular disorder that results from myofascial trigger points within the muscle. The presence of these trigger points could result in anterior knee pain, imbalance of the extensor mechanism and instability of the patellofemoral joint, which could present as a Patellofemoral Pain Syndrome.

Therefore this study was structured as a pilot non-intervention clinical assessment study, which included eighty participants from the greater Durban area. Each participant underwent a case history, relevant physical and knee regional examination. Data was collected at the first consultation after which two free treatments were offered. The subjective measurement used was the Numerical Pain Rating Scale. The objective measurements used included the Myofascial Diagnostic Scale and algometer readings. The Patellofemoral Pain Severity Scale provided both subjective and objective readings. The duration of condition and the location of the myofascial trigger points were also noted.

Descriptive statistics were performed using frequency distribution tables, various graphs and charts such as the bar and pie charts and appropriate measures of central location and dispersion such as the arithmetic mean and standard

deviation. Finally correlation statistics were run using Spearman's rank correlation coefficient with a significance level of <=0.05. Categorical and dichotomous variables where cross-tabulated using the eta functions.

The results show that ninety five percent (95%) of subjects presented with active and / or latent myofascial trigger points of the quadriceps femoris muscle. Active myofascial trigger points accounted for symptoms in 46.2% of the patients that presented, whereas 95% of the patients presenting had evidence of latent myofascial trigger points. Although myofascial trigger points were found in all four-component muscles of the quadriceps, the most common location of active myofascial trigger points was the mid belly of the vastus lateralis muscle with the second most common location being the distal muscular portion of the vastus lateralis. The distal muscular portion of the vastus medialis also contained a significant amount of myofascial trigger points.

According to Travel and Simons (1983), myofascial trigger points in these muscles produce the following referred pain pattern:

- The anterior knee with some referral to the anteromedial aspect of the knee
- The lateral aspect of the patella
- Deep within the knee joint

This therefore indicates that there is a high degree of overlap between the presence of myofascial trigger points and Patellofemoral Pain Syndrome, when the patients present with diagnosed Patellofemoral Pain Syndrome. Thus it can be concluded that myofascial pain syndrome is a positive predictive factor in the development of Patellofemoral Pain Syndrome.

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CHAPTER ONE:

INTRODUCTION

1.1 The Problem and its Setting:

The term Patellofemoral pain syndrome (PFPS) was chosen for this study as it is descriptive, identifies the condition as a syndrome and is non assumptive (Meyer et al., 1990).

In this respect PFPS refers to a syndrome comprising of the following signs and symptoms:

- Anterior knee pain,
- Imbalance of the extensor mechanism,
- Instability of the patellofemoral joint,
- Inflammation of the surrounding tissues,
- Or any combination of the above

[Wood, 1998].

The complexity of this syndrome is illustrated by the many names given to PFPS; these include patellalgia, patella tracking problem, peripatellar syndrome and anterior knee pain syndrome (Reid, 1992:349).

Rowlands and Brantingham (1999), state that the prevalence of PFPS in the general population may be as high as 40% and may account for up to 25% of all running injuries for which medical attention is sought.

The cause of PFPS appears to be an enigma with a variety of possible etiologies being cited in the literature: anatomical abnormalities, misalignments or anatomical predisposition (Walsh, 1994) or repetitive trauma (Davidson, 1993). The current trend in literature suggests an extensor mechanism dysfunction as the most probable etiology (Galantly et al., 1994; Juhn, 1999; and William, 1998).

This extensor dysfunction presents with the following signs and symptoms indicative of PFPS including peripatella or retropatella pain that is worsened with physical activity, negotiating stairs and prolonged sitting (Juhn, 1999; Post, 1998). Powers et al. (1996) and Delee & Drez (1994), add kneeling, deep squats and isometric quadriceps femoris contractions to the previous points as factors that aggravate the pain associated with PFPS.

Myofascial pain syndrome (MPS) in contrast to this is a regional muscular disorder that results from myofascial trigger points (MTrp's) (Lee et al., 1997). A trigger point is a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band (Chaitow and DeLany, 2002). "MTrp's are characterized by snapping or palpation of the band may produce a local twitch response. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness and motor dysfunction" (Travell, Simons and Simons, 1999).

According to prevailing literature, the presence of myofascial trigger points (MTrp's) in quadriceps femoris (QF) muscle could result in a combination of the following signs and symptoms:

- Retro- or peripatella pain,
- Weakness of the quadriceps muscle (Chaitow and DeLany, 2002; Travell and Simons 1983:248-250)
- Loss of full lengthening (Travell and Simons, 1983:248-250)

Any of the above would result in inhibition of QF muscle activity and a resultant extensor mechanism dysfunction (Travell and Simons, 1983:248-250).

The signs and symptoms diagnostic of MTrp's of the QF muscle include referred pain under or around the patella, pain on prolonged sitting, stair climbing or kneeling. Active extension of the knee will also cause pain (Travell and Simons, 1983:248-263).

Therefore there appears to be a clinical overlap between the two syndromes, in terms of an extensor mechanism dysfunction and of signs and symptoms:

Table 1.1

PFPS	**MPS**
Retro-peripatella pain	Anterior knee pain or pain deep in the knee joint
QF muscle weakness	Weakness of knee extension
Pain on ascending or descending stairs	Pain on ascending or descending stairs
Movie goer's sign	Pain on prolonged sitting
Pain on kneeling (Powers et al., 1996)	Pain on kneeling (Travell and Simons, 1983:248-263).

The treatment of PFPS is often difficult and frustrating with permanent relief of symptoms often not being achieved (Reid, 1992:349). Walsh (1994:1193), suggests that every effort should be made to avoid surgery in a condition where the etiology of the pain is so poorly understood. Herrington and Payton (1997), found PFPS to be unresponsive to conservative treatment over a long period of time. It is therefore important to investigate etiologies and establish clinical causative factors that may provide further understanding of this condition.

Thus the purpose of this study was to determine the role myofascial trigger points (MTrp's) of the QF muscle in the clinical presentation of PFPS.

1.2 Aim and Objectives of the study:

The aim of the investigation was to evaluate the role of MTrp's of the QF muscle on the clinical presentation of PFPS.

Sub problem One:

To observe and quantify the following:

1. The specific location of the MTrp's within the QF muscle.
2. The severity of the MTrp's.
3. The severity of the PFPS.
4. The acuteness or chronicity of PFPS.

Sub problem Two:

To assess correlations between the objective and subjective clinical findings.

1.3 Benefits of the study:

This research aims to provide information regarding the role of myofascial trigger points of the quadriceps femoris muscle group as a possible etiology or perpetuating factor in the clinical presentation of patellofemoral pain syndrome.

A better understanding of the etiology of PFPS will allow for further research considering and comparing alternate treatment protocol(s) for PFPS.

With knowledge of specific conservative therapies, myofascial trigger points (MTrp’s) could then be employed for the treatment of PFPS and their benefits may alter some of the current treatment methods as well as alleviate the trauma, costs and complications of surgical intervention.

CHAPTER TWO:

REVIEW OF RELATED LITERATURE:

2.0 Introduction:

This chapter provides a review of the available literature on Patellofemoral Pain Syndrome and Myofascial Pain Syndrome and attempts to highlight the areas of overlap between the two syndromes. The information reviewed will provide a clearer understanding of the current concepts in the etiology, diagnosis and treatment of both conditions highlighting on the similarities and differences between the two.

2.1 Anatomy of the Patellofemoral joint:

The patella is a triangular sesamoid bone with its apex pointing inferiorly and is embedded in the quadriceps femoris tendon with the patella ligament (ligamentum patella) attaching it to the tibial tuberosity (Moore and Dalley, 1999: 619). The patella acts as a guide for the quadriceps mechanism, sliding in the sulcus between the femoral condyles, which hold it in place (Davidson, 1993).

The patellofemoral articulation consists of the facets of the patella in contact with the sulcus of the anterior femur (Moore and Dalley, 1999: 617). The patella surface can include up to seven facets, with three on the medial and lateral surfaces and an extra (odd) facet on the medial side (Tria et al., 1992). The lateral retinaculam, iliotibial tract, and the vastus lateralis muscle stabilize the patella laterally. Medially the stability is provided by the medial retinaculam and the vastus medialis obliquus (Bose et al., 1980; Moore and Dalley, 1999: 619).

The surface anatomy of each side of the patellofemoral articulation, the overall rotational anatomy of the entire lower limb and the relationship of the surrounding muscles affect the contact between the two surfaces (Tria et al., 1992).

Davidson (1993), states that correct tracking of the patella during flexion and extension is influenced by the height of femoral condyles and hence depth of femoral groove keeping the patella “seated”.

According to Moore and Dalley (1999: 534), the quadriceps muscle is divided into four components, which are responsible for extension of the knee:

- The vastus lateralis (VL),
- The vastus medialis (VM),
- The vastus intermedialis (VIM) and
- The rectus femoris (RF),

The femoral nerve, made up of the posterior divisions of L2, 3 and 4, innervates this muscle (Moore and Dalley, 1999: 530).

The anatomical origins are described as follows: (Moore and Dalley, 1999: 534)

- Rectus Femoris: anterior inferior iliac spine and groove superior to the acetabulum
- Vastus lateralis: Greater trochanter and the lateral lip of the linea aspera of the femur
- Vastus medialis: Intertrochanteric line and medial lip of the linea aspera of the femur
- Vastus intermedialis: anterior and lateral surfaces of the body of the femur.

These muscles insert into the patella proximally in a layered fashion. According to Lieb and Perry (1968), the common direction of pull of the muscle fibers is as follows:

- RF: 7-10 degrees medially in the frontal plane
- VL: 12-15 degrees laterally in the frontal plane
- VM longus (VML): 15-18 degrees medially in the frontal plane and
- VM obliquus (VMO): 50-55 degrees medially in the frontal plane.

Due to the valgus alignment [1] of the knee and the Q-angle[2] of the quadriceps there is a natural pull on the patella laterally (Bose et al., 1980). The patella is stabilized against this lateral pull by the bony contour of the lower end of the femur and the VMO. The raised articular surface on the lateral femoral condyle offers stability to the patella especially when the knee is flexed (Bose et al., 1980).

However during the last 30 degrees of extension, the patella sits above the patella articular surface of the femur and little stability is then offered by these bony contours. The VMO becomes the most important structure providing stability for the patella in the last 30 degrees of extension (Bose et al., 1980).

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1 Valgus alignment: normal angulation of the knee towards the midline. It is interesting to note that the original definition of valgus was bent or twisted away from the midline. Current accepted usage transposes this meaning with varus (bent or twisted toward the midline). The use of the modern terminology has been chosen for this study (Chaitow and Delany, 2002:83).

2 Q-Angle: the discrepancy between the resultant line of pull of the quadriceps muscle and the anatomical position of the ligamentum patellae (Reid, 1992:358).

2.2 Biomechanics of the Patellofemoral joint:

The main biomechanical function of the patella is to increase the effective lever arm of the quadriceps femoris muscle in affecting knee extension or resisting knee flexion (Callaghan and Oldham, 1996).

Two forces act on the patella during knee movement (Outerbridge and Dunlop, 1975):

1. The first is a patellofemoral compressive force.
   The patellofemoral compressive force is also known as the patellofemoral joint reaction force (PFJRF) and is a measure of the compression of the patella against the femoral condyles and depends on the angle of flexion of the knee and the muscle tension (Hungerford and Lennnox, 1983).

2. The second is a quadriceps muscle tension force (Outerbridge and Dunlop, 1975).

Correct tracking of the patella during flexion and extension of the knee is influenced by the following forces (Davidson, 1993):

- The height of the femoral condyles and hence depth of the femoral groove, keeping the patella “seated” and tracking correctly.
- The shape of the facets on the under surface of the patella determines the “fit” between the patella and the femoral groove.
- The medial and lateral retinaculam, which keep the patella “centered” in the femoral sulcus.
- The relative strength of the individual muscles comprising the QF muscle.

- The Q-angle[2].

[Davidson, 1993]

Any abnormality of anatomical structure influencing the movement of the patella can cause excessive pressure between the patella and the femoral condyles (Davidson, 1993) therefore increasing the PFJRF.

Variations in patella shape or size, for example: Wilberg type1-3, patella magna[3], patella parva or baugmaurti[4]; are believed to result in abnormal contact between the patella and the trochlea which result in patellofemoral pain (Tria et al., 1992). Patella alta[5] predisposes one to malalignment, as the patella is late in engaging the femoral trochlea during flexion (Singerman, Davy and Goldman, 1994).

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[3] Patella magna; an excessively large patella usually associated with prolonged hyperemia due to trauma or infection (Reid, 1992:374).

[4] Patella parva / Patella baugmaurti: dysplasia of the patella resulting in a small patella. (Reid, 1992:358-374).

[5] Patella alta: a high riding patella that may be associated with dislocation (Reid, 1992:357).

2.3 Introduction to Patellofemoral Pain Syndrome:

The patellofemoral joint has posed many unsolved mysteries and challenges in the medical community and has been documented in literature for almost 200 years. Volumes of literature have been published on theories and potential solutions to improve symptoms related to this troublesome joint (Kolowich et al., 1990). It is been referred to as a myth, mystical and frustrating and an enigma that remains a difficult condition to treat (Reid, 1993).

2.3.1 Definition of PFPS:

PFPS refers to a syndrome comprising of the following signs and symptoms (Wood, 1998):

- Anterior knee pain,
- Imbalance of the extensor mechanism,
- Instability of the patellofemoral joint,
- Inflammation of the surrounding tissues or any combination thereof.

The term PFPS was chosen for this study as it is “descriptive, identifies the condition as a syndrome and is non assumptive” (Meyer et al., 1990).

2.3.2 Incidence of PFPS:

The patellofemoral joint is a major source of pain and dysfunction for both men and women and in the sedentary and athletic population alike (Walsh, 1992). Once the problem has begun it frequently becomes chronic and may force subjects to limit physical activity (Kannus et al., 1999). In clinics dealing with musculoskeletal complaints Kannus et al. (1999), also reported that PFPS may account for 10 % of visits and 20 – 40 % of all knee complaints. McConnel (1986) states that PFPS affects 25 % of the general population.

LaBrier and O'Neil (1993), state that PFPS is amongst the most common complaints of athletes, while Paluska and McKeag (1999), state that disorders occur in both recreational and competitive athletes. However Salem and Powers (2001), found that athletes who participate in sports that involve jumping or running activities are at greater risk of developing patellofemoral joint related injuries.

Dehaven and Linter (1986), report the incidence of PFPS to be 19.6 % in female collegiate athletes and 7.4 % amongst their male counterparts. Salem and Powers (2001), also found these types of injuries significantly common in female athletes. Davidson (1993), attributes the higher incidence amongst women to the wider gynaecoid pelvic structure which in turn increases the Q-angle. However according to Fitzgerald and McClure (1995), the Q-angle is not a reliable indicator when assessing PFPS.

2.3.3 Natural History of PFPS:

In a 5½ year follow up study of PFPS by Blond and Hansen (1998), 150 subjects were asked to complete questionnaires. It was found that PFPS is not a self-limiting condition.

A study by Sandow and Goodfellow (1985), found that PFPS is a benign condition, which affects individuals for many years after the initial onset causing residual pain in most cases. The pain tended to be less intense in nature and tended to occur less frequently in the majority when compared to the initial visit. Only a small percentage experienced an increase in pain, which may have severely restricted sporting activities in some cases.

Kannus et al. (1999), state that only a 10-20 year follow up study will provide a clear picture of the natural history of this condition.

2.3.4 Etiology of PFPS:

According to Devereaux and Lachman (1984), in a five-year study on 137 athletes with PFPS, actual patella trauma only occurred in 29% of subjects. It would therefore appear unlikely that patella trauma plays a significant role in the etiology of PFPS. However Blond and Hansen (1998) and Singerman, Davy and Goldberg (1994), agree that a history of trauma may predispose one to PFPS.

Davidson (1993), states that PFPS appears to develop under one of two circumstances: anatomical abnormalities or repetitive trauma.

1. Anatomical abnormalities:

Variations in patella shape or size, for example Wilberg type1-3, patella magna, patella parva; are believed to result in abnormal contact between the patella and the trochlea which resulted in patellofemoral pain (Tria et al., 1992).

Patella alta predisposes one to malalignment, as the patella is late in engaging the femoral trochlea during flexion (Singerman, Davy and Goldman, 1994).

According to Sakai et al. (2000), dysplasia in the femoral condyle groove or malposition of the tibial tuberosity may contribute to patella maltracking.

Walsh (1994), believes that almost all patellofemoral disorders can be related to an anatomical predisposition.

In contrast to this Thomee et al. (1995), in a study of 60 women found no significant difference in subjects and controls, or between patients' most and least symptomatic knee regarding clinical lower extremity alignment such as Q-angle, leg heel measures, pelvic width, knee hyperextension and distance between knees. The patients in the experimental group were however found to be more physically active than the control group.

2. Repetitive trauma:

According to Salem and Powers (2001), athletes who participate in sports that involve jumping or running activities are at greater risk of developing patellofemoral joint related injuries. Fairbank et al. (1984) and Galantly et al. (1994), agree that overload of the patellofemoral joint is the most likely cause of PFPS.

Current literature suggests an extensor mechanism dysfunction as the most probable etiology. With respect to the role of the QF muscle in PFPS no consensus has been reached.

The popularly held beliefs include:

1. **Decrease in QF muscle strength** (Gilleard, McConnell and Parson, 1998; William, 1998; Juhn, 1999; Gotlin, 2000). Powers, Landel and Perry (1996), found subjects with PFPS demonstrated less activity of all the vastus muscles when compared to healthy subjects.

2. **Delayed activation of the VMO** (Voight and Wieder, 1991; Gilleard, McConnell and Parson, 1998). According to Gotlin (2000), the VMO plays a crucial role in cushioning the forces directed to the anterior knee. The stronger the VMO the less stress is transferred to the patellofemoral joint.

3. **Flexibility deficits of the QF muscle** (Delee and Drez, 1994; William,1998; Juhn, 1999).

4. **Significant muscle inhibition in the QF muscle**. In a study of subjects with PFPS Suter et al. (1998), demonstrated that QF muscle inhibition was closely associated with anterior knee pain.

Despite the various research results and opinions as to the role of the QF muscle in the etiology of PFPS, there can be little doubt of the importance of normal quadriceps activity to the functional integrity of the knee joint (Powers et al., 1996).

2.3.5 Presentation of PFPS:

1. Clinical history and Symptoms:

Tria et al. (1992) believes that the history is of paramount importance to the diagnosis of PFPS:

- Non-specific anterior knee discomfort, which may be bilateral, is the most common complaint.
- The condition may begin gradually and is not commonly related to trauma.

However Delee and Dreez (1994), state that the pain may occur spontaneously with some direct trauma to the anterior knee.

Most often the patient with PFPS presents with peripatella or retropatella pain (Juhn, 1999). The pain is usually dull and aching becoming sharp with patella compressive activities including climbing or descending stairs, squatting or deep knee bends or sitting for prolonged periods of time with the knee flexed (movie goer’s sign) (Davidson, 1993).

Powers et al. (1996) and Delee & Drez (1994), add kneeling, physical exercise and isometric quadriceps femoris contractions to the previous points as factors that aggravate the pain associated with PFPS.

Complaints of crepitus, effusions, intermittent catching during knee extension, a sense of insecurity or giving way (Blond and Hansen, 1998), knee stiffness and patella pseudolocking may also occur (Kannus et al., 1999).

Scaringe (1994), found that rest relieves the pain, especially when seated with the leg in an extended position as this enables the patella to disengage the femoral trochlea.

In this respect Tria et al. (1992) distinguishes five main groups of patients in which PFPS may occur:

1. Non-specific anterior knee discomfort in teenage girls
2. Patella instability with patella subluxation or dislocation.
3. Direct trauma to the anterior knee.
4. Athletic over activity.
5. Arthritis of the patellofemoral joint.

2 Physical findings:

On physical examination Davidson (1993), found three findings fairly specific for PFPS when the pain is originating from the patellofemoral joint:

1. Tenderness of the medial and lateral facets on palpation.
2. Compression of the patella on the femoral condyles may cause discomfort.
3. When both sides of the patella are grasped while the patient contracts the QF muscle the pressure of the patella against the femoral condyles may cause discomfort.

When the pain is extra-articular a consistently painful area involving the retinaculam may be palpated (Davidson, 1993). Walsh (1994), stated that patella mobility might be increased or decreased. Although most literature suggests a tightened lateral retinaculam will restrict the medial glide of the patella (Mc Connel, 1986).

Blond and Hansen (1998), found a tight lateral retinaculam more likely to be associated with movie goer’s sign. Mc Connel (1986), believes the majority of patients have some degree of restricted glide of the patella that needs correction.

She recommends assessing the glide, tilt, rotation and anterior-posterior position of the patella.

This may be assessed according to Kolowich et al. (1990), who suggest that the patella is divided into longitudinal quadrants. The examiner attempts to displace the patella medially or laterally using the thumb and index finger:

- A lateral glide of three quadrants is indicative of inadequate medial restraint, while
- A lateral glide of four quadrants is indicative of a deficient medial restraint or hypermobility.
- A medial glide of one quarter signifies a lateral restriction while
- A glide of three quadrants suggests a hypermobile patella.

Post (1998), suggested that the iliotibial band, which is frequently tight in subjects with PFPS, may result in a patella restriction due to the iliotibial bands strong attachment to the patella through the lateral retinaculam.

Walsh (1994), found that subjects with PFPS often lacked muscular control during step up and step down tasks. The concept was further supported by that of Blond and Hansen (1998), who suggested that quadriceps insufficiency has long been thought to contribute to PFPS.

Clifton (2003), in a study using an Isokinetic Dynamometer, confirmed the presence of both concentric and eccentric quadriceps femoris weakness and the presence of concentric hamstring weakness in participants with PFPS. Clifton (2003), also found a high likelihood of eccentric hamstring weakness in terms of peak torque values.

Thus it has been reported that there may be decreased muscular flexibility of the following muscles:

- Quadriceps Femoris
- Hamstring
- Gastrocnemius and soleus
- Tensor fasciae latae

[Walsh, 1994; William, 1998; Wood, 1998; Clifton, 2003].

Further findings in a seven-year follow up study by Kannus et al. (1999), suggest that the presence of patella abnormalities such as decrease in patella cartilage thickness, increase in the signal density of the patella cartilage or roughness of the patella surface were not common findings in the presentation of PFPS. In the study (Kannus et al., 1999), mild abnormalities were noted in 4 % of the subjects, moderate abnormalities were noted in 2 % of the subjects and severe abnormalities were noted in 3 % of the subjects. Therefore these factors cannot be considered significant physical findings, unless the more common findings cannot be elicited.

2.3.6 Diagnosis of PFPS:

Blond and Hansen (1998), state the diagnosis relies predominantly on history and characteristic symptoms / signs. The clinical diagnosis of PFPS was based on the criteria as used by Powers et al. (1996) and by Rowlands and Brantingham (1999), for the purposes of this study:

- Participants must present with retro- or peripatella pain (Rowlands and Brantingham, 1999)

- Participants must present with at least two of the following:
    - Pain on prolonged sitting. (Movie goer's sign)
    - Pain on climbing and descending stairs
    - Pain on deep knee bends or squats
    - Pain on kneeling
    - Pain on isometric quadriceps contraction

  [Powers et al., 1996].

2.3.7 Differential Diagnosis

It is important to note that knee pain may be referred to the knee from other origins e.g.: from the hip. Conditions such as Legg-Calve-Perthes Disease or Slipped Capital Femoral Epiphysis may occur in children or adolescence (Post, 1998). Lumbar radiculopathy and peripheral nerve entrapment must also be excluded (Post, 1998).

A differential diagnosis must also include patella subluxation and chondromalacia patella due to their similar presentation (Davidson, 1993).

It is important to differentiate between Chondromalacia patella and PFPS. In Chondromalacia patella there is morphological change or damage to the cartilage on the posterior aspect of the patella. This may often present in a similar manner to PFPS (Davidson, 1993). However many subjects with this degeneration are asymptomatic while many symptomatic patients have normal patella articular surfaces. There is no correlation between the morphological changes and symptomatology. Thus the use of the term Chondromalacia patella should be discontinued in young people with patellofemoral complaints (Insal, 1979).

2.3.8 Management of PFPS:

Treatment for PFPS is varied and includes various forms of therapeutic exercise, medication, rest, strapping, orthotics, physical modalities, modification of contributing factors or surgery (Stakes, 2000).

Callaghan and Oldham (1996), in their literature review found 60 – 80 % of patients with PFPS show a favorable response to conservative treatment.

1. Conservative treatment:

This discussion on conservative treatments will cover exercise, rest and activity modification, strapping, cryotherapy, mobilization and orthotics.

Meyer et al. (1990) recommend that in the management of PFPS a trial of conservative treatments be applied before surgery is considered. Davidson (1993), shares this opinion stating that only after 3 –6 months of unsuccessful conservative management should surgery be considered.

1a. Exercise:

Exercise is the most commonly used conservative approach and focuses on rehabilitation of the quadriceps muscle (Callaghan and Oldham, 1996).

Davidson (1993), states that a rehabilitation program of Quadriceps setting exercises, straight leg raises and terminal arc extensions seem to improve tracking of the patella and help prevent excessive pressure on the lateral facet.

In contrast to this Gotlin (2000), utilizing an uncontrolled trial, is of the opinion that it is essential to train multiple muscle groups to ensure maximum muscle efficiency. Functional or skill training focuses on increasing both muscle strength and co-ordination. It has been reported that nearly 80 % of patients with anterior knee pain responded successfully to skill training.

It was found that closed kinetic chain training (squats and step ups) is more effective in restoring patients perceived function than open chain or non weight bearing joint isolation quadriceps exercises, according to Post (1998). William (1998), agrees with Post (1998), that closed chain activities seem to be better tolerated than open chain exercises in patients with PFPS.

Stretching plays an important role in the rehabilitative exercises in the treatment of PFPS and aims to restore normal flexibility to the following muscles:

- Quadriceps femoris
- Hamstrings
- Gastrocnemius-soleus complex
- Iliotibial band

It is believed that these muscles frequently contain contractures (Walsh, 1994; William 1998). Scaringe (1994), adds adductors to the previous list of muscles that require stretching.

1b. Rest and activity modification:

Repetitive microtrauma or overuse is often the cause of PFPS according to Davidson (1993). Shelton (1992), recommends rest either partial (through activity modification) or complete rest. A change in activity from one that aggravates the problem to one that causes a decrease in the amount of pressure being applied to the femoral condyles should bring about a decrease in the symptoms and allow the patient to continue exercising.

1c. Strapping:

Strapping or taping techniques are another attempt to force the patella to track medially and to decrease pain (Tria et al., 1992). Gotlin (2000), states that taping or bracing the patellofemoral joint may help subject's progress more easily during rehabilitation due to a decrease in pain levels.

Three main reasons are suggested as possible reasons for the reduction in pain brought about by taping (Herrington and Payton, 1997):

- repositioning of the patella in the trochlear groove
- affect on afferent nervous system
- placebo effect of the tape.

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However a controlled trial by Kowall et al. (1996) found that adding tapping to a standard conservative treatment program for PFPS had no beneficial effect.

1d. Cryotherapy:

Davidson (1993), recommends the use of cryotherapy for its effects on both pain and inflammation in the treatment of PFPS. Ice packs placed over the effected area for 15 - 20 minutes up to 6 times daily initially, and later only after exercise is advised.

1e. Mobilization:

Rowlands and Brantingham (1999), in a randomized placebo controlled study found that patella mobilization has a beneficial effect and should be included in treatment protocol for PFPS. Many forms of patella and knee mobilization techniques have been described in the treatment of PFPS and according to Souza (1990), these techniques all strive to restore accessory motion to the patellofemoral joint and disrupt scar tissue formation.

1f. Orthotics:

It is believed that excessive pronation and supination in the foot, if corrected with an orthotic, may decrease the compensatory internal and external rotation misalignment of the tibia and thus decrease the excessive stress on the distal section of the extensor mechanism decreasing pain in the patellofemoral joint (Walsh, 1994). Post (1998), recommends the use of orthotics be reserved for patients who have not responded to flexibility and strengthening routines.

2 Non-conservative treatment

2a Medication:

Tria et al. (1992), Davidson (1993) and Delee and Drez (1994:1194) advocate the use of non-steroidal anti-inflammatory drugs (NSAID) in the acute phase of treatment. Suter et al. (1998), in a randomized clinical controlled trial found that a one-week administration of NSAID resulted in a decrease in pain but did not effect the muscle inhibition.

Davidson (1993), advises that the use of NSAID be limited to the acute phase only and prolonged use be avoided due to the potentially hazardous side effects. All NSAID can cause gastric irritation and possible peptic ulcers (Tria et al., 1992). Other complications include clotting disorders, decreased renal blood flow, hypersensitivity and adverse cutaneous reactions (Tria et al., 1992).

Injection of steroids has generally been discouraged due to the resultant articular cartilage degradation and the physical damage to tendons resulting in a high degree of subsequent tendon ruptures (Shelton, 1992).

2b Surgery

Surgery of the patellofemoral joint is considered as a last resort (Juhn, 1999). Scaringe (1994), Davidson (1993) and Shelton (1992), all warn of the dangers of complications with patellofemoral joint surgery.

The lateral release technique is most often used in the surgical treatment of PFPS (Delee and Drez, 1994). Biedert et al. (1992) purposed that the reason for the high failure rate of surgery of the patellofemoral joint may be due to the disruption of proprioceptive and other neurological links between the patella and its gliding and controlling structures.

Walsh (1994), suggests that every effort should be made to avoid surgery in a condition where the etiology of the pain is so poorly understood.

2.4 Introduction to Myofascial Pain Syndrome:

Myofascial Pain Syndrome is an extremely common type of muscular condition that frequently presents to primary health care practitioners and is (similar to PFPS) of a multi-factorial origin (Gatterman, 1990:287; Hubbard, 1998:16; Chaitow and Delany, 2002:18-20).

Muscular pain is the most common work-related injury and the second most common cause of visits by patients to physicians (in general) (Hubbard, 1998:16). In a review article written by Han and Harrison (1997:90) the incidence of Myofascial Pain Syndrome is reported as high as 85% at certain American pain clinics, yet it remains to be one of the least understood conditions, often being misdiagnosed, mistreated or simply unrecognized (Auleciems, 1995:18).

According to Fricton (1990), the confusion surrounding this syndrome seems to stem from the:

- Lack of obvious organic findings,
- The lack of unified theory to explain it and
- Inconsistencies in the literature defining the syndrome

2.4.1 Definitions:

A myofascial trigger point (MTrp's)

Is defied as "a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. Snapping or palpation of the band may produce a local twitch response. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction and autonomic phenomena" (Travell, Simons and Simons, 1999:5; Chaitow and Delany, 2002:18).

An active myofascial trigger point :

A MTrp that causes a clinical pain complaint. "It is a focus of hyperirritability in a muscle or it's fascia that is symptomatic with respect to pain; it refers to a pattern of pain at rest and/or in motion that is specific for the muscle. An active trigger point is always tender, prevents full lengthening of a muscle, weakens the muscle, usually refers pain on direct compression, mediates a local twitch response of the muscle fibers when adequately stimulated and often produces specific autonomic phenomena, generally in its referral zone" (Travell, Simons and Simons, 1999:1).

A latent myofascial trigger point:

"It is defined as a focus of hyperirritability in a muscle or its fascia that is clinically quiescent with respect to spontaneous pain: it is only painful when palpated. A latent myofascial trigger point may have all the other clinical characteristics of an active trigger point, from which it is to be distinguished" (Travell, Simons and Simons, 1999:4).

Chaitow and Delany (2002:124) and Travell, Simons and Simons (1999 1:12), agree that the main difference between active and latent MTrp's is that only active MTrp's spontaneously refer pain.

Table 2.4.1

Latent myofascial trigger points	**Active myofascial trigger points**
Commonalities	
Decreased stretch range of motion.	Decreased stretch range of motion.
Muscular stiffness.	Muscular stiffness.
Local twitch response.	Local twitch response
Painful and weak muscle on contraction.	Painful and weak muscle on contraction.
Differences	
Localized pain on manual compression.	Localized and referred pain on manual compression.
No spontaneous pain referral.	Spontaneous pain referral.
Recognition of an unfamiliar or previous pain.	Recognition of current pain.

As compiled by Wilks (2003:21).

Myofascial Pain Syndrome:

Myofascial Pain Syndrome (MPS) is a regional muscular disorder that results from MTrp's (Lee et al., 1997; Chaitow and Delany, 2002:124). Both active and latent MTrp's can result in MPS (Hou et al., 2002:1411-1412).

2.4.2 Incidence of MPS:

The literature available on MPS concentrates on the postural muscles of the lower back and neck with little information available on the quadriceps muscle.

Han and Harrison (1997), in a review article found that myofascial pain appeared to be the most common phenomenon in the clinical setting. Schneider (1995), found MPS one of the most predominant soft tissue syndromes seen in clinical practice. American studies based at pain clinics indicate that the incidence of MPS may be as high as 85 % (Han and Harrison, 1997:90).

Reports of the prevalence of MTrp's in patient populations can be found as early as the 1950's where physicians noted MPS as one of the most common frequent problems seen by physicians (Sola, Rodenberger and Getty, 1955:585).

Goldberg (1987), states that latent MTrp's are more common than active MTrp's. This opinion is shared by Travell, Simons and Simons (1999 1:12) and Gatterman (1990:287).

MPS occurs in both sexes but appears to be more prevalent in females (2:1) (Han and Harrison, 1997:89). Travell, Simons and Simons (1999 1:13) and Han and Harrison (1997:90), suggested that individuals in their later years (30-49) are more likely to suffer from MPS.

In the literature reviewed no statistics were found regarding the prevalence of MPS in the QF muscle. Travell and Simons (1983:248-250), describe the presence of MTrp's in the QF muscle as extremely common and frequently overlooked, but their findings are based on clinical experience and not clinical trials.

Bruce (1995), explains that, currently, the majority of research conducted in the field of epidemiology of MPS has been completed in a clinical setting. As a result the prevalence with regard to MPS in the general population can only be estimated indirectly.

2.4.3 Natural History of MPS:

According to Travell, Simons and Simons (1999 1:20), with adequate rest and in the absence of perpetuating factors an active trigger point may revert spontaneously to a latent state. Pain symptoms disappear but reactivation of the MTrp by exceeding the muscles stress tolerance can account for the history of recurrent episodes of the same pain over a period of years.

2.4.4 Etiology of MPS:

There is still uncertainty over the etiology of MPS as no studies conducted indicate positive predictive values for any one combination of factors.

However Travell, Simons and Simons (1999 1:19) and Chaitow and Delany (2002:20), agree that several primary factors may result in the development or activation of MTrp's:

Primary Factors:

- Mechanical abuse: acute sustained or repetitive muscle overload i.e.: prolonged muscle contraction.
- Trauma: this includes the precipitation of MTrp's by means of a local inflammatory response.
- Leaving the muscle in shortened position: for a prolonged period of time especially if the muscle is contracted in the shortened position.
- Nerve compression: this can cause identifiable neuropathic electromyography changes and results in disturbed microtubule communication between the neuron and the endplate.
- Adverse environmental conditions: this includes but is not limited to excessive heat, cold or dampness.
- Systemic biochemical imbalances: this could include hormonal disturbances.

<u>Secondary factors:</u> (Baldry, 1993)

- <u>Compensating synergistic or antagonistic muscles</u> to those housing MTrp's may as a result develop MTrp's.

- <u>Satellite MTrp's</u> can evolve in referral zone of primary trigger points.

- <u>Low oxygenation of tissues.</u>

- The development of active and latent MTrp's occur as a result of the same factors mentioned above (primary and secondary) but to varying degrees (Travell, Simons and Simons, 1999 1:19).

Fricton <u>et al.</u> (1985:621), suggested a multi-factorial etiologic basis for MPS and suggested that the development of MTrp's can be divided into two basic groups:

1) Factors that <u>directly traumatize</u> by direct injury, repetitive microtrauma from habits that produce muscle tension.
2) Factors that <u>weaken a muscle</u> and predispose it to the development of MTrp's through such factors as nutritional deficiencies, structural disharmony, lack of exercise, sleep disturbances or the presence of other disorders such as joint problems.

Rosen (1993) feels that the primary cause of skeletal imbalance is a muscle imbalance between the agonist and the antagonist muscles, which become overloaded. He (Rosen, 1993) feels this overload may be due to improper use or abnormal loads causing dysfunction to occur when exceeding the critical load capacity resulting in fatigue.

According to Auleciems (1995), the event that activates a trigger point is usually quite different from the factors that perpetuate them. Therefore the long-term prognosis improves with treatment of perpetuating factors, not just pain relief. Esenyel (2000), found that once perpetuating factors are corrected pain is more likely to be resolved.

Perpetuating factors may include any of the following, as outlined by Travell, Simons and Simons (1999 1:110-112):

- Mechanical stresses: such as skeletal asymmetry (short leg or small hemi pelvis), poor posture, prolonged immobility or muscular abuse.
- Nutritional inadequacies: commonly occur with mechanical stresses. Low levels of vitamin B1, B6, B12 folic acid and iron aggravate MTrp's. Inadequate levels of calcium, potassium, and several trace minerals can cause abnormal muscle functioning.
- Metabolic and endocrine inadequacies: hypoglycemia, hyperuricemia and hypothyroidism all perpetuate MTrp's.
- Chronic infection: viral, bacterial or parasitic.
- Psychological factors: such as anxiety or depression can delay recovery of MTrp's.
- Miscellaneous factors: such as fatigue, cold or damp weather, allergy, chronic visceral disease or radiculopathy.

2.4.5 Presentation of MPS of the QF Muscle Group:

Patients with MPS will typically present complaining of regional persistent pain. It may range from a mild ache to excruciating pain either sharp or dull. Words such as “throbbing”, “heavy” or “pressure” are frequently used to describe the pain. The patient may complain of decreased range of motion and muscle strength (Han and Harrison, 1997:92).

Motor disturbances as described by Travell, Simons and Simons (1999 1:21) include:

- Muscle weakness,
- Spasm of synergistic and/or antagonistic muscles and
- Decreases muscle power or work tolerance.

Travell, Simons and Simons (1999 1:21), also discuss the presence of autonomic dysfunction this does not commonly occur in the QF muscle.

1 Presentation of MTrp's in the **Quadriceps Femoris (QF) Muscle:**

1a. Presentation of MTrp's in the **Rectus Femoris (RF) muscle:**

According to Travell and Simons (1983:248-288) and Chaitow and Delany (2002:483-486), the location of:

The first MTrp is at hip level just below the anterior inferior iliac spine.

The referred pain pattern for the first MTrp of the RF muscle is felt at the knee in and around the patella and occasionally deep within the knee joint.

The second less common MTrp is found at the lower end of the muscle just above the patella.

The second MTrp refers pain deep into the knee joint. Since the target referral zone lies a significant distance from the associated MTrp's it can easily be overlooked as a source of knee pain.

This MTrp is not represented in figure 2.4.5.1a

Patients may present with knee pain and a sense of weakness when descending stairs (Chaitow and Delany, 2002:483-486). The pain is often worse at night (Chaitow and Delany, 2002:483-486) especially if the patients sleep with the hip flexed and the knee extended in a side lying position. This places the muscle in a fully shortened position. This muscle seldom undergoes a full stretch in daily activity and frequently has restrictions in its range of motion. Patients rarely discover for themselves that the combined position of hip extension and knee flexion is required to stretch the RF muscle fully in order to obtain relief (Travell and Simons, 1983:248-288; Chaitow and Delany, 2002:483-486).

Figure 2.4.5.1a

1b. Presentation of MTrp's in the **Vastus Medialis (VM) muscle:**

The VM muscle contains two MTrp's, the first and most common is found in the distal muscle superomedial to the patella.

The first MTrp refers pain to the anterior knee with some referral to the anteromedial aspect of the knee and some to deep within the knee joint.

The second is found proximal to the first at mid thigh level.

The second refers pain in a linear fashion over the anteromedial knee and lower thigh. These MTrp's are frequently over looked as they often produce dysfunction and not pain. Often after a period of a few weeks the pain phase changes to inhibition phase resulting in unexpected episodes of quadriceps weakness. This may result in buckling of the knee (Travell and Simons, 1983:248-288; Baker, 1989:129-131; Chaitow and Delany, 2002:483-486).

This muscle is likely to develop MTrp's as a result of strenuous athletic activity such as running, basketball, football or skiing (Travell and Simons, 1983:266). Deep knee bends may perpetuate MTrp's in the QF muscle, especially those in the VM (Travell and Simons, 1983:265). Prolonged kneeling on a hardened floor may aggravate VM MTrp's (Travell and Simons, 1983:265). MTrp's in the vastus medialis muscle may restrict normal lateral mobility of the patella (Travell and Simons, 1983:267).

Figure 2.4.5.1b

1c. Presentation of MTrp’s in the **Vastus intermedialis (VIM) muscle:**

The MTrp’s found here cannot be directly and easily palpated as they are hidden beneath the RF muscle (Travell and Simons, 1983:250). MTrp’s in this muscle are usually multiple and rarely solitary.

> They refer pain over the anterior thigh just superior to the knee (Travell and Simons, 1983:250; Chaitow and Delany, 2002:484).

Patients with active MTrp’s have difficulty climbing stairs or standing up after prolonged sitting. The pain occurs during active movement and rarely during rest (Travell and Simons, 1983:248-288; Chaitow and Delany, 2002:483-486).

Figure 2.4.5.1c

1d. Presentation of MTrp's in the **Vastus lateralis (VL) muscle:**

This large muscle characteristically develops multiple MTrp's along the lateral aspect of the thigh (Travell and Simons, 1983:251). The five areas in which the MTrp's can occur are spread out along the length of the muscle. They refer pain through out the full length of the muscle and to the lateral aspect of the patella (Chaitow and Delany, 2002:483).

The distinctive feature of MTrp's in the distal muscle is a "stuck patella" in combination with pain around the lateral boarder of the patella (Travell and Simons, 1983:251-252) therefore activation of this MTrp's can result in immobilization of the patella and loss of normal patella movement (Chaitow and Delany, 2002:484).

> The "hornets nest" of MTrp's found at mid thigh level slightly anteriorly. These trigger points are common and can refer pain over the entire length of the thigh and distally it swings anteriorly around the anterior boarder of the patella and occasionally the pain may refer posteriorly to the popliteus space. (Travell and Simons, 1983:248-288; Chaitow and Delany, 2002:483-486).

Figure 2.4.5.1d

2 Physical findings:

Travell, Simons and Simons (1999 1:21-22), state that MTrp's can be identified clinically by the following common characteristics:

1) **A palpable taut band.** By gently rubbing across the direction of the muscle fibers of a superficial muscle, the examiner can feel a ropelike induration. The taut band can be snapped or rolled under the fingers in accessible muscles. Gerwin and Shannon (2000:1257), state that the presence of a taut band is the most important factor in the physical examination as it distinguishes MTrp's from other muscle pains such as Fibromyalgia.

2) **Tender nodule**: Palpation along the taut band reveals a nodule exhibiting a highly localized exquisitely tender spot that is characteristic of an MTrp.

3) **Weakness of the muscle**. This may reflect reflex inhibition of the muscle by the MTrp's (Borg-Stein and Stein, 1996:309).

4) **Restricted stretch range of motion**: (Simons, 2000:706).

5) **Increased pain** on active and /or passive stretch: Passive stretching results in greater restrictions. This may be due to reciprocal inhibition.

6) **Referred pain on manual compression**: digital pressure on either a active or latent MTrp can elicit a referred pain pattern characteristic for that muscle.

7) **Local twitch response**: Snapping palpation of the MTrp frequently evokes a transient twitch response of the taut band fibers (Kuan et al., 2002:513).

8) **Painful contraction**: When a muscle with an active MTrp is strongly contracted against resistance the patient feels pain. This effect is most marked when an attempt is made to contract the muscle in a shortened position.

[Travell, Simons and Simons, 1999 1:21-22].

2.4.6 Diagnosis of MPS:

It is the opinion of Travell, Simons and Simons (1999:34-35), that no one diagnostic examination alone is a satisfactory criterion for the identification of a trigger point. According to Travell and Simons (1983:12-16), the signs of a trigger point are as follows:

- Referred pain in the zone of reference
- Local twitch response
- Palpable taut band and
- Focal tenderness

Lee et al. (1997), Gerwin et al. (1997) and Banks et al. (1997) all reported to using these criteria to identify trigger points.

The recommended criteria for identifying a latent or active trigger point according to Travell, Simons and Simons (1999:35), are as follows:

Essential criteria:

1. Taut palpable band
2. Exquisite spot tenderness of a nodule in a taut band
3. Painful limit to full stretch range of motion.
4. Subjects recognition of current pain complaint by pressure on the tender nodule.

Confirmatory Observations:

1. Visual or tactile identification of local twitch response
2. Pain or altered sensation on compression of the tender nodule.

For the diagnosis of MTrp's all 4 essential criteria must be present (Travell, Simons and Simons, 1999:35; Murphy, 1989). The presence of the confirmatory signs serves to reinforce the diagnosis.

The minimum criteria for identifying a MTrp according to Chaitow and DeLany (2002:18-19), are as follows:

Minimal criteria:

- -Taut palpable band
- -Exquisite spot tenderness of a nodule in a taut band.
- -Subject's recognition of pain.

Compression of the MTrp may result in:

- The person's recognition of a current pain complaint, which indicates an active MTrp.
- The person's recognition of an unfamiliar or previous pain, which indicates a latent MTrp.

2.4.7 Differential Diagnosis:

Pain in the region of the knee may arise from articular degeneration or dysfunction, meniscal tears, ligamentous injury, tendonitis or bursitis.

2.4.8 Management of MPS:

A large part of patient management is recognizing the underlying problems that influence the patient's pain by increasing the tension and irritability of the involved muscle (Fomby and Mellion, 1997:3). The treatment protocol must therefore take into consideration the contributing and perpetuating factors, so that long-term relief can be obtained (Esenyl et al., 2000:51).

Rosen (1993), is of the opinion that the most important goal of successful rehabilitation is not that of pain relief but rather restoration of normal range of motion to the tissues and achievement of strength and endurance. Bruce (1995:473), suggests a multidisciplinary approach to treatment is important and that treatment should first be directed towards correct diagnosis and elimination of perpetuating factors.

However Esenyl et al. (2000:49), feels the main goal of treatment is to relieve the muscle pain and spasm of the involved muscle.

Previous treatment for MPS includes: myofascial trigger point injection, dry needling, exercise, massage, transcutaneous electrical nerve stimulation (TENS), medication and stretch and spray (Han and Harrison, 1997:95; Hubbard, 1998:23). Of these numerous techniques available it seems that the choice of treatment is based more on personal preference than on clinical evidence

(Anderson, 1997). Rosen (1993), states that the most commonly used treatment techniques include spray and stretch and MTrp injecting.
Some of the many treatment techniques are discussed below.

1 Trigger Point Pressure Release

This concept has replaced ischemic compression. Travell, Simons and Simons (1999:140), found that the pressure release seems to be clinically more effective than ischemic compression. To perform the technique the involved muscle must be stretched or lengthened to a point of increased resistance within the patient's comfort zone. Gradually pressure is then applied until the finger encounters an increase in tissue resistance. The patient should experience discomfort but not pain. The pressure is maintained until a decrease in tension under the finger is felt. Pressure is then increased until a new point of tension is felt and then maintained until the tension releases again.

This approach appears to be more patient friendly and therefore more likely to be used by the patient at home (Travell, Simons and Simons, 1999:140).

2 Modalities

The use of modalities in the treatment of MTrp's is limited.

Transcutaneuos electrical nerve stimulation (TENS) has been successfully used in the treatment of MPS; however it does not have any long-term effect on the condition (Han and Harrison, 1997:97)

Gam et al. (1998:73) in a randomized control trial found that ultrasound gave no pain reduction and was ineffective in the treatment of MPS.

3 Spray and stretch

Spray and stretch using a vapocoolant spray (e.g. Fluori-Methane or ethyl chloride) along with passive stretching of the involved muscle has been described as an effective treatment for MPS by Hubbard (1998:25). The aim of this method is to decrease pain, increase range of motion and restore the muscle to its normal length. The sudden drop in skin temperature results in a temporary anaesthesia by blocking the spinal stretch reflex and the sensation of pain in the higher centres of the brain (Han and Harrison, 1997:97).

4 MTrp injection and Dry Needling:

Trigger point injections have been widely used to inactivate MTrp's (Esenyl, 2000:49) and are commonly used in the management of MPS with wide spread clinical acceptance (Alvarez, 2002:657).

According to Han and Harrison (1997:96), MTrp injection is preferred to dry needling because of the analgesic effect that the local anesthetic agent offers to the surrounding muscle tissue.

However Garvey et al. (1989), conducted a randomized double-blind study comparing four different treatment methods in 63 patients with active MTrp's. The results of the study show that dry needling and acupressure are more effective than transcutaneous injection of either local anesthetic or local anesthetic and steroids. This led the researchers to believe that the relief is likely due to the mechanical stimulation of the MTrp by the needle as appose to the substance injected.

Tschopp and Gysin (1996:306) and Hong (1994:256), share this opinion in stating that the long term therapeutic effect of MTrp injection and dry needling appears to be attributed to the needle rather than any substance injected into the MTrp.

Han and Harrison (1997:96), propose the following mechanism by which both needling and MTrp injection relieve the MTrp pain:

1. Mechanical disruption of muscle fibers, causing a release of potassium, which results in depolarization of nerve fibers
2. Mechanical disruption of nerve fibers
3. Interruption of central feedback mechanism that perpetuates pain.
4. Local dilution of nociceptive substances by the local anesthetic or saline that is infiltrated.
5. Vasodilatory effect of local anaesthetics, which increase the removal of metabolites.

2.5 In summary:

Table 2.5

	PFPS	MPS
Aetiology	Repetitive trauma	Repetitive trauma
	Decrease in QF muscle strength	QF muscle weakness
	Flexibility deficits of the QF muscle	Restricted stretch range of motion of the QF muscle
	Significant muscle inhibition in the QF muscle	Reflex inhibition of the muscle by the MTrp's
	Athletes who participate in sports that involve jumping or running activities are at greater risk of developing patellofemoral joint related injuries	A muscle is likely to develop MTrp's as a result of strenuous athletic activity such as running, basketball, football or skiing.
	A history of trauma may predispose one to PFPS.	A history of a fall or direct trauma to the area

	PFPS	**MPS**
Signs and Symptoms	Peripatella or Retropatella pain	Pain at the knee, in and around the patella and occasionally deep within the knee joint (RF), pain around the lateral boarder of the patella (VL), pain to the anterior knee with some referral to the anteromedial aspect of the knee and some to deep within the knee joint (VM)
	Pain on prolonged sitting (Movie goer's sign)	Placing the muscle in a fixed position for a long period of time tends to aggravate MTrp's (all muscle groups of the QF muscle)
	Pain worsened with ascending or descending stairs	Pain on climbing stairs (VIM), pain on descending stairs (RF).
	Pain worsened with physical activity	The pain occurs during active movement (VIM), MTrp's are likely to be aggravated by strenuous athletic activity such as running, basketball, football or skiing.
	Pain on deep squats	Deep knee bends may perpetuate MTrp's in all muscle groups but especially those in the VIM
	Pain on kneeling	Prolonged kneeling on a hardened floor may aggravate VM MTrp's.
	Pain on isometric quadriceps femoris contractions	When a muscle with an active MTrp is strongly contracted against resistance the patient feels pain. This effect is most marked when an attempt is made to contract the muscle in a shortened position.

	PFPS	**MPS**
Signs and Symptoms	Patella mobility restriction	MTrp's in the distal end of the VL can immobilize the patella. Partial loss of normal patella movement can result in difficulty in straightening or bending the knee after getting up from a chair.

The above PFPS table is compiled with references from: Davidson, 1993; Delee and Drez, 1994; Walsh, 1994; Powers, Landel and Perry, 1996; Suter et al., 1998; Juhn,1999; Salem and Powers, 2001.

The above MPS table is compiled with references from: Travell and Simons, 1983:248-288; Travell, Simons and Simons; 1999 1:19; Chaitow and Delany, 2002:20.

CHAPTER THREE:

MATERIALS AND METHODS

3.1. Introduction:

The aim of this research is to provide a greater insight into the role of myofascial trigger points of the quadriceps femoris muscle group in the clinical presentation of patellofemoral pain syndrome.

Therefore this chapter gives a description of:

- The primary and secondary data,
- The subjects,
- The design and
- The interventions used.

Each measurement parameter is discussed and an overview of each scale is given. Statistical analysis is also discussed.

3.2. The Data:

The data consisted of primary and secondary data.

3.2.1. The primary data:

The primary data consisted of:

- Case history (Appendix 5)
- Relevant regional examination (Appendix 6)
- Knee regional examination (Appendix 7)
- Patella Femoral Pain Severity Scale (Appendix 1
- Myofascial Diagnostic Scale (Appendix 2)
- Duration of Condition in Months (Appendix 3)
- Patients perception of their pain using a Numerical Pain Rating Scale (Appendix 2)
- Location of the Quadriceps Femoris MTrp's (Appendix 3)
- Algometer readings for Pressure-pain Threshold (Appendix 4)

3.2.2. The secondary data:

The secondary data was obtained from various sources including journal articles, textbooks and medical search engines on the Internet (Mantis, Pubmed and Medscape).

3.3. Study Design:

The design was that of a pilot non-intervention clinical assessment study of eighty participants.

3.4. The Subjects:

The subjects consisted of volunteers suffering from patellofemoral pain syndrome residing in the Kwazulu-Natal province.

3.4.1. Advertisements for subject recruitment:

The public was informed of the study by advertisements placed at local gyms, schools, in local newspapers and on the DIT Campus advertising for free participation in a research program being conducted on knee pain.

The advert called on patients between the ages of 18 and 55 years of age suffering from knee pain that was around or behind the kneecap (Appendix 11).

Upon reply all participants were required to undergo a cursory telephonic discussion with the examiner to exclude subjects that obviously did not fit the criteria for the study (Appendix 10).

3.4.2. Sampling and group allocation of Subjects:

As this study was not a clinical study, no patient groupings where necessary. The first eighty participants were consecutively selected from those successfully complying with the telephonic interview, where asked to attend the Chiropractic Day Clinic for assessment in terms of the inclusion and exclusion criteria.

3.4.3. Clinic assessment procedure:

An initial consultation was scheduled during which a case history (Appendix 5), relevant physical examination (Appendix 6) and knee regional examination (Appendix 7) were conducted.

Acceptance of the candidate was dependant on whether or not they met the specific inclusion criteria indicated below:

3.4.3.1. Inclusion Criteria:

- Participants were required to present with retro- or peripatella pain (Rowlands and Brantingham, 1999).

- Pain was required to be reproducible with at least two of the following (Powers et al., 1996):
    - squatting
    - kneeling
    - stair climbing
    - prolonged sitting
    - isometric QF muscle contraction.

- Patients were required to be between the ages of 18 and 55 years.

3.4.3.2. Exclusion Criteria:

Patients were excluded from the study for the following reasons:

- Participants with neurological deficit of the lower limbs (Rowlands and Brantingham, 1999).
- Participants who had undergone knee surgery within the past two years or have any history of traumatic patella dislocation (Rowlands and Brantingham, 1999).
- Participants who presented with any of the following: bursitis, patella tendonitis or any systemic arthritide that affects the knee (Powers et al., 1996).
- Participants who presented with evidence of a meniscal tear, ligamentous instability, abnormalities indicative of osteoarthritis, osteochondritis dessicans or loose bodies (Kannus et al., 1999).
- Participants who were pregnant or breastfeeding (Kannus et al., 1999). The hormones relaxin and estrogen secreted during pregnancy act to relax the ligaments of the body (Guyton and Hall, 1997). This may result in increased ligament laxity and instability of the knee.

All patients received a letter of information (Appendix 8) and were required to sign an informed consent form (Appendix 9) before treatment commenced.

3.4.4. Clinical treatment plan:

All the relevant data was gathered at the initial consultation. Two free treatments were given there after.

3.5. Study Assessments:

3.5.1. Diagnosis and assessment readings related to the myofascial trigger points:

Once the participant was included in the study they were screened for myofascial trigger points.

It is the opinion of Travell, Simons and Simons (1999:34-35), that no one diagnostic examination alone is a satisfactory criterion for the identification of a trigger point. According to Chaitow and Delany (2002:20) and Travell, Simons and Simons (1999:21-36), the signs of a trigger point are as follows:

- Palpable taut band
- Focal tenderness
- Referred pain in the zone of reference
- Painful limit to full stretch range of motion

Lee et al. (1997), Gerwin et al. (1997) and Banks et al. (1997) all reported to using these criteria to identify trigger points.

The minimal criteria for identifying a MTrp according to Chaitow and DeLany (2002:18-19) are as follows:

Minimal criteria:

-Taut palpable band

-Exquisite spot tenderness of a nodule in a taut band.

-Subject's recognition of pain.

Confirmatory Observations

-Visual or tactile identification of local twitch response.

-Pain or altered sensation on compression of the tender nodule.

-Painful limit to full range of motion.

-Pain on contraction of the muscle.

-Weakness of the muscle.

For the diagnosis of MTrp's all minimum criteria must be present (Chaitow and DeLany**,** 2002:18-19; Travell, Simons and Simons, 1999:35; Murphy, 1989). The presence of the confirmatory signs served to reinforce the diagnosis.

The myofascial trigger points were recorded as follows:

3.5.1.1. Objective Measurements:

3.5.1.1.a. Location of the trigger points: (Appendix 3)

The specific location of the trigger point within the four muscles, which constitute the QF, was noted as indicated by Chaitow and DeLany (2002:483-485) and Travell and Simons (1983:249-272).

- Trigger points in the vastus medialis muscle are usually found close to the medial boarder of the muscle in the mid belly and at the distal attachment of the muscle.

- Trigger points in the vastus lateralis muscle lie deep in the muscle and are extensively distributed throughout the length of the muscle.

- The vastus intermedialis muscle can develop multiple trigger points along its length, deep to the rectus femoris muscle and therefore can not be directly palpated. A clinician confirmed the diagnosis of vastus intermedialis MTrp's.

- The rectus femoris muscle trigger points are commonly located proximally in the muscle close to the anterior inferior iliac spine.

3.5.1.1.b. The Myofascial Diagnostic Scale (MDS):

(Chettiar 2001), (Appendix 2)

The purpose of this scale is to determine the extent to which a patient suffers from MTrp's.

The scale is rated out of 17 points. A score of 9 or above is considered indicative of an active trigger point. A score of less than 9 is considered indicative of a latent trigger point.

Even though the Myofascial Diagnostic scale is not yet fully validated, it is the most appropriate tool that can be applied to achieve a consistent result.

Due to the nature of the scale, it was only applied to one MTrp per subject. The MTrp that was deemed "worst" or most painful by both the researcher and the subject was chosen.

3.5.1.1.c. Algometer: (Appendix 4)

Since the development of the pocket-sized pressure Algometer in 1986, this tool has been widely used to document the tenderness of myofascial trigger points (Fischer, 1986). Nussbaum and Downes (1998) reported reliability of clinical pressure pain algometeric measurements. Reeves et al. (1986) and Fischer (1987: 207) demonstrated the reliability and validity of the pressure algometer in measuring myofascial trigger point sensitivity.

The algometer chosen for this study is the force dial manufactured by Wagner Instruments: P.O. Box1217 Greenwich CT 06836 as its pressure range measures kilograms as opposed to Newton meters which is preferable for this study. The pressure range of the algometer was 11kg.

The MTrp was located through palpation of the quadriceps femoris muscle. The footplate was placed over the MTrp with the shaft exerting pressure in the direction of the pain produced on palpation. The gauge was then turned away from the patient and pressure was applied at a rate of approximately 1kg / cm squared / second. The patient was informed to indicate when pain was first perceived by saying “yes”. At the patients response the instrument was removed and the reading recorded in kg per square centimetre. Three readings were taken on each MTrp from which an average was calculated.

The total number of MTrp’s was noted and the mean weight in kg was calculated by dividing the average algometer reading by the number of MTrp’s present.

3.5.1.2. Subjective measurements:

3.5.1.2.a. The Numerical Rating Scale (NRS): (Appendix 2).

The NRS assesses the patient's perception of their pain intensity.

The questionnaire consists of a numerical scale of eleven points with 10 representing pain at it's worst and 0 representing no pain. Liggins (1989), states that the NRS is the most appropriate method of rating pain intensity without comparison. Jenson et al. (1986), found it to be an accurate tool for the measurement of pain intensity in clinical trials.

3.5.2. Diagnosis and assessment readings related to the PFPS:

3.5.2.1 Objective Measurements:

3.5.2.1.a. Duration of the condition: (Appendix 3)

A sliding scale was applied. The scale comprises of 12 points representing the number of months the participant has been experiencing the pain. The purpose of this is to allow accurate recording of the duration of the condition. One week was recorded as 0.25 months, 2 weeks were recorded as 0.5 months, 3 weeks were recorded as 0.75 months etc.

3.5.2.2. Combined subjective and objective measurements:

3.5.2.2.a. The Patellofemoral Pain Severity Scale (PPSS):

(Appendix 1)

Background information:

This scale was piloted to assess the extent to which a patient suffers from PFPS in both a practical and economical method. The scale was developed by the researcher as no satisfactory questionnaires, laboratory tests or imaging techniques were available that could be clinically utilized as objective tools in the assessment of PFPS severity.

The scale contains both a subjective and an object component. This is based on Yeoman's (2000), statements that subjective tools quantify a patients disability or functional capacity while objective tools or tests quantify a patients functional losses or impairment.

Objective measures are static reliable measures that can be used to communicate information between practitioners. Portney and Watkins (1993), state that objectifying measures allows for communication of information in "real" terms in contrast to subjective measures that can be abstract or ambiguous, such as "the patient feels better".

However Triano et al. (1992), state: "The principal value of instrumentation lies in its ability to focus on the patients functional capacity and not the symptoms". Therefore the subjective component becomes important. Deyo and Diehl (1983) and Vernon (1990), agree that self-reports or subjective tools can be equally if not better suited to measure a patient's current status than objective tools. Therefore the need for both objective and subjective measures is apparent.

Each question in the PPSS consists of a subjective component to be answered by the patient and an objective component to be answered by the researcher. It is suggested that the patient is allowed to answer the questionnaires first in this way the patient will not be influenced by the researchers answer. The subjective component consists of a Likert scale, which is used for statistical analysis.
The objective component consists of a simple" yes/no" answer, which was given by the researcher.

The Patellofemoral Pain Severity Scale was further broken down into a history, signs and symptoms:

> The section on history comprises of questions that pertain to activities that may result in retropatella or peripatella pain. The nature of these activities renders them impractical to testing in a consulting room environment.
>
> The section on signs is comprised of simple tests the practitioner can perform in his/her consulting rooms that may aggravate the pain. In this section a positive test is one that produces pain.
>
> In the section on symptoms the patient's perception of their pain is rated. The patient could choose one of three options regarding the intensity. The researcher did likewise in the objective component.

Piloting procedure for the Patellofemoral Pain Severity Scale:

This scale was piloted to assess the extent to which a patient suffers from PFPS in both a practical and economical method.

Face validity

Five chiropractic consultants involved with the management of PFPS evaluated the scale. Their recommendations were followed in order to develop the scale to its current form (See Appendix 1).

To further assess face validity the scale was administered to four patients currently under care for PFPS and the results were recorded.

Finally piloting also included a measure of concurrent validity testing as the scale was compared to the Numerical Rating Scale –101 for the same four patients. The outcomes were correlated.

Correlation between the Patellofemoral Pain Severity Scale and the NRS-101.

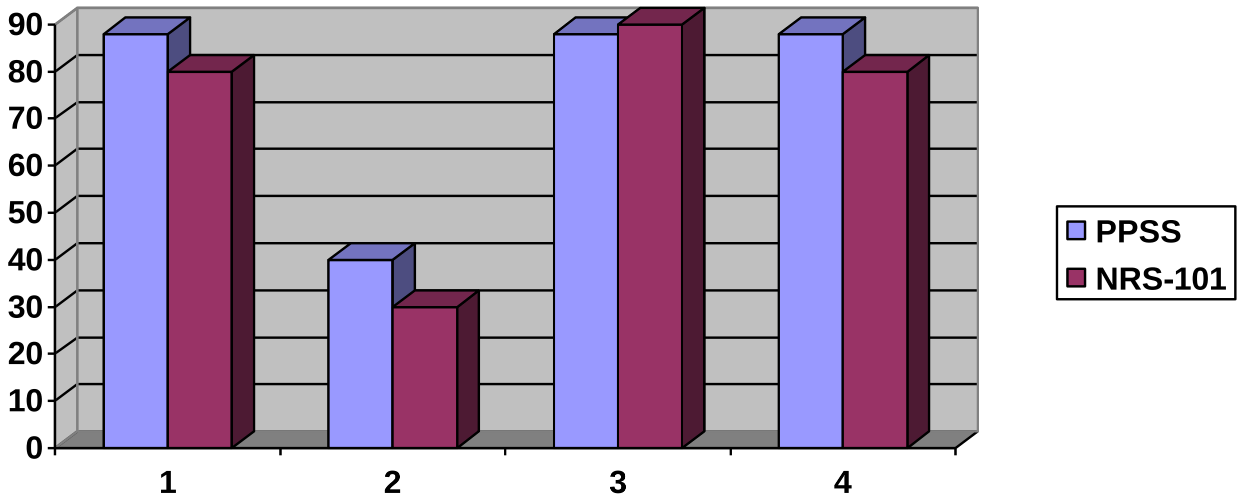

Figure 3.5.2.2

3.6. Statistical Analysis:

The SPSS statistical package (as supplied by SPSS Inc., Marketing Department, 444 North Michigan Avenue, Chicago, Illinois, 606611) was used for data entry and analysis.

Descriptive statistics were performed using frequency distribution tables, various graphs and charts such as the bar and pie charts and appropriate measures of central location and dispersion such as the arithmetic mean and standard deviation. Finally correlation statistics were run using Spearman's rank correlation coefficient with a significance level of <=0.05. Categorical and dichotomous variables where cross-tabulated using the eta functions.

3.7. Ethics:

The ethical procedures were adhered to in accordance with the Durban Institute of Technology guidelines.

Each patient was required to complete and sign an informed consent form (Appendix 9). The research involved no more than minimal risk and all information was treated as confidential.

CHAPTER FOUR:

RESULTS

4.0 Introduction:

This chapter tabulates the results obtained from the statistical analysis of the primary data collected over the duration of the study.

The measurements criteria included:

- Patellofemoral Pain Severity Scale (both subjective and objective)
- Numerical Pain Rating Scale (subjective)
- Myofascial Diagnostic Scale (objective)
- Duration of conditions in months (objective)
- Location of trigger points (objective)
- Algometer readings (objective)

The age, gender, sports occupation and duration of condition distributions are tabulated.

4.1 Criteria Governing the Admissibility of Data:

Data was collected only from those patients who met the research criteria. Only subjective pain perception data and the Patellofemoral Pain Severity Scale that was completed by patients under the supervision of the researcher were utilized. Only objective algometer readings, Myofascial Diagnostic Scale readings, duration of condition and location of MTrp's readings taken by the researcher were utilized.

4.2 Demographic Data:

4.2.1 Age distribution:

Table 4.2.1

Age Group Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
18 - 25	16	20.0	20.0	20.0
26 - 35	29	36.3	36.3	56.3
36 - 45	17	21.3	21.3	77.5
46 - 55	18	22.5	22.5	100.0
Total	80	100.0	100.0	

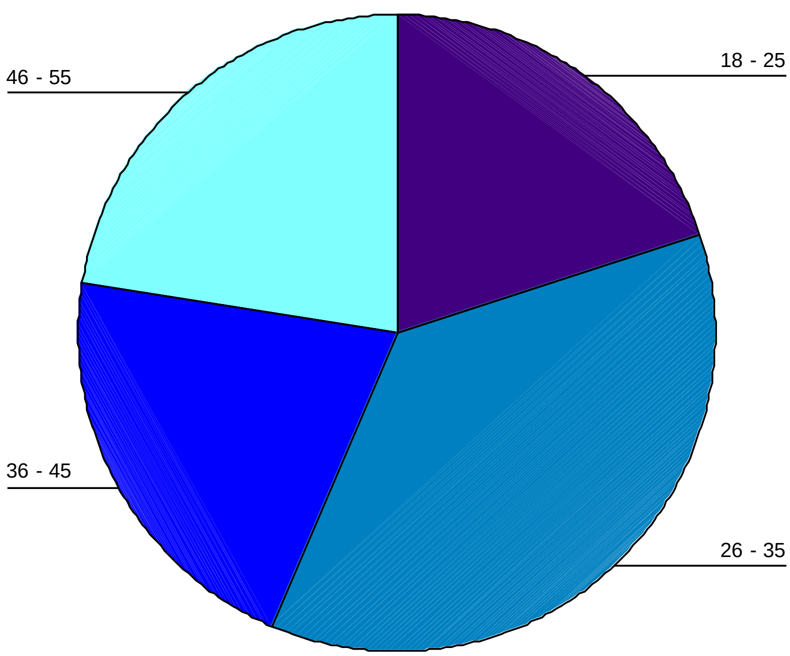

Figure 4.2.1

4.2.2 Gender distribution:

Table 4.2.2

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	49	61.3	61.3	61.3
Female	31	38.8	38.8	100.0
Total	80	100.0	100.0	

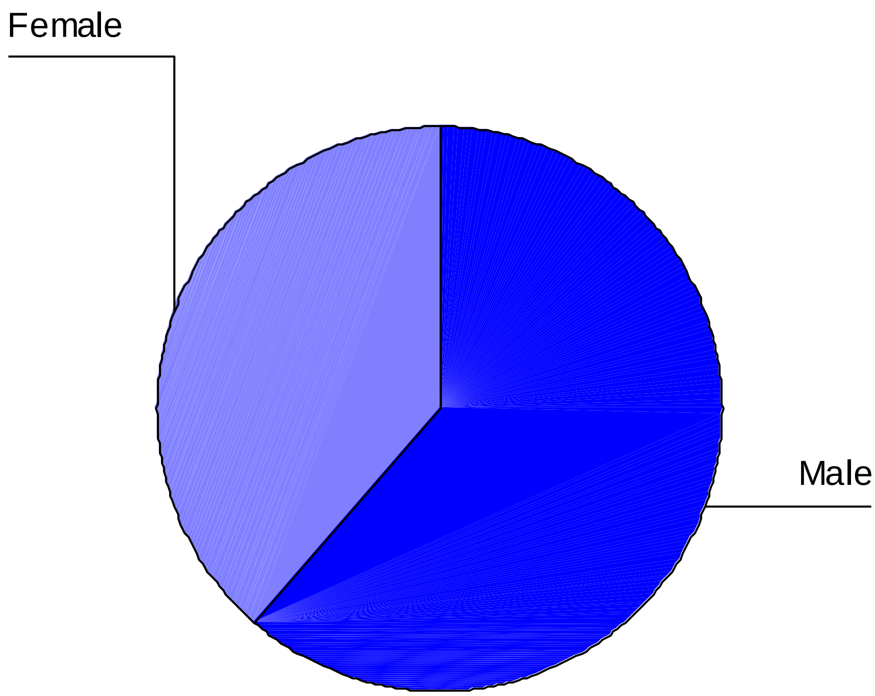

Figure 4.2.2

4.2.3 Sports Distribution:

Table 4.2.3

	Frequency	Percent	Valid Percent	Cumulative Percent
Running	15	18.8	18.8	18.8
Walking	10	12.5	12.5	31.3
Cycling	11	13.8	13.8	45.0
Field Sports (hockey, rugby, soccer)	5	6.3	6.3	51.3
Squash	7	8.8	8.8	60.0
Swimming	6	7.5	7.5	67.5
Gym (weights)	5	6.3	6.3	73.8
Other (aerobics, dancing, yoga, karate, fencing)	11	13.8	13.8	87.5
No Exercise	10	12.5	12.5	100.0
Total	80	100.0	100.0	

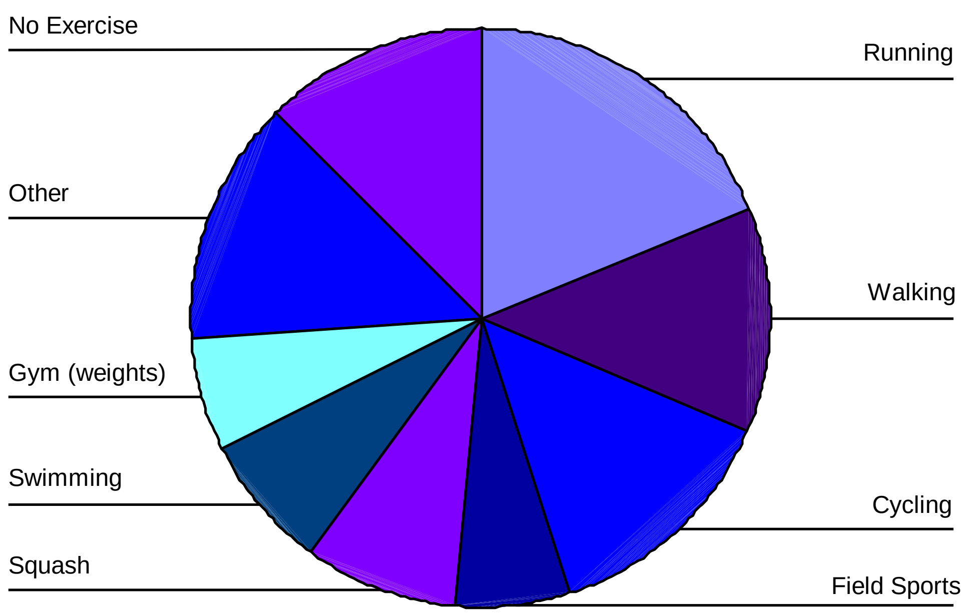

Figure 4.2.3

4.2.4 Duration of Condition:

Table 4.2.4a

Valid	80
Mean	39.8438
Std. Deviation	72.8007
Minimum	.25
Maximum	360.00

Table 4.2.4b

Duration in Months	Frequency	Percent	Valid Percent	Cumulative Percent
.25	4	5.0	5.0	5.0
.50	2	2.5	2.5	7.5
.75	2	2.5	2.5	10.0
1.00	8	10.0	10.0	20.0
1.25	2	2.5	2.5	22.5
1.50	1	1.3	1.3	23.8
2.00	5	6.3	6.3	30.0
3.00	5	6.3	6.3	36.3
4.00	2	2.5	2.5	38.8
5.00	3	3.8	3.8	42.5
6.00	3	3.8	3.8	46.3
7.00	1	1.3	1.3	47.5
8.00	1	1.3	1.3	48.8
10.00	2	2.5	2.5	51.3
11.00	1	1.3	1.3	52.5
12.00	6	7.5	7.5	60.0
18.00	2	2.5	2.5	62.5
24.00	9	11.3	11.3	73.8
36.00	4	5.0	5.0	78.8
48.00	1	1.3	1.3	80.0
60.00	4	5.0	5.0	85.0
84.00	1	1.3	1.3	86.3
96.00	1	1.3	1.3	87.5
120.00	2	2.5	2.5	90.0
156.00	1	1.3	1.3	91.3
168.00	1	1.3	1.3	92.5
216.00	1	1.3	1.3	93.8
240.00	3	3.8	3.8	97.5
264.00	1	1.3	1.3	98.8
360.00	1	1.3	1.3	100.0
Total	80	100.0	100.0	

Duration in Months

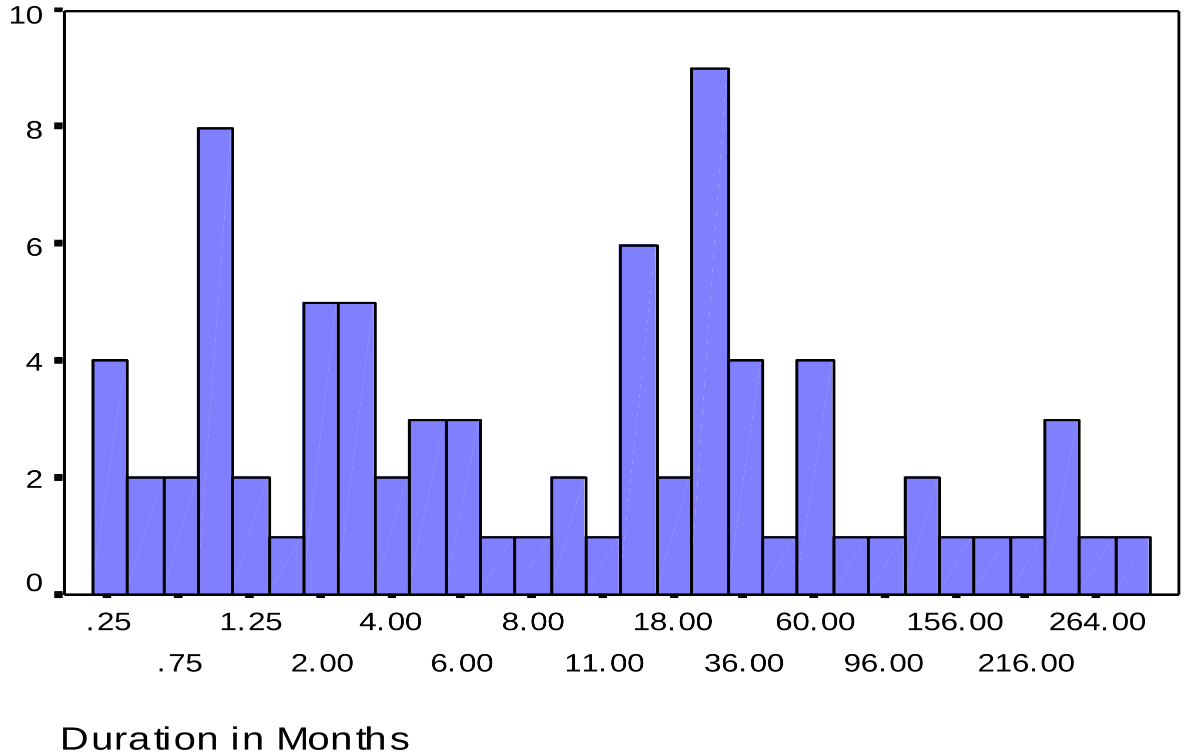

Figure 4.2.4

4.3 Demographics of the MTrp's:

4.3.1 Total Number of MTrp's:

Table 4.3.1a

Valid	80
Mean	4.11
Std. Deviation	2.21
Minimum	0
Maximum	12

Table 4.3.1b

Total Number of MTrp's	Frequency	Percent	Valid Percent	Cumulative Percent
0	4	5.0	5.0	5.0
1	2	2.5	2.5	7.5
2	11	13.8	13.8	21.3
3	17	21.3	21.3	42.5
4	18	22.5	22.5	65.0
5	7	8.8	8.8	73.8
6	11	13.8	13.8	87.5
7	6	7.5	7.5	95.0
9	3	3.8	3.8	98.8
12	1	1.3	1.3	100.0
Total	80	100.0	100.0	

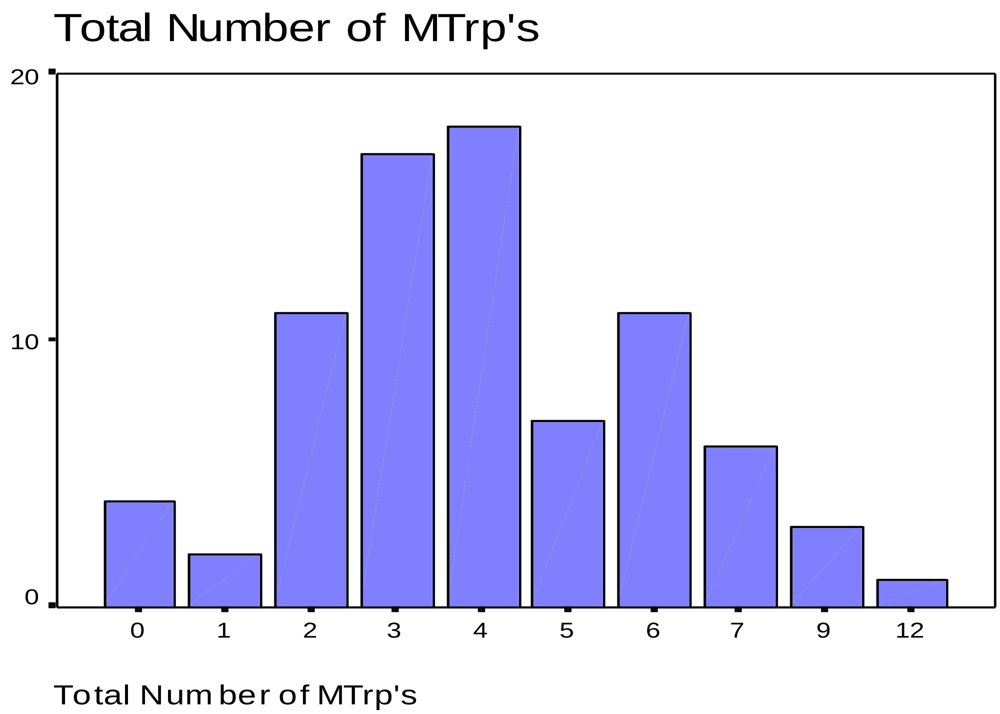
Total Number of MTrp's
20
10
0
0
1
2
3
4
5
6
7
9
12
Total Number of MTrp's

Figure 4.3.1

4.3.2 Number of Active MTrp's:

Table 4.3.2a

Valid	80
Mean	1.26
Std. Deviation	1.64
Minimum	0
Maximum	7

Table 4.3.2b

Number of Active MTrp's	Frequency	Percent	Valid Percent	Cumulative Percent
0	43	53.8	53.8	53.8
1	5	6.3	6.3	60.0
2	14	17.5	17.5	77.5
3	9	11.3	11.3	88.8
4	7	8.8	8.8	97.5
6	1	1.3	1.3	98.8
7	1	1.3	1.3	100.0
Total	80	100.0	100.0	

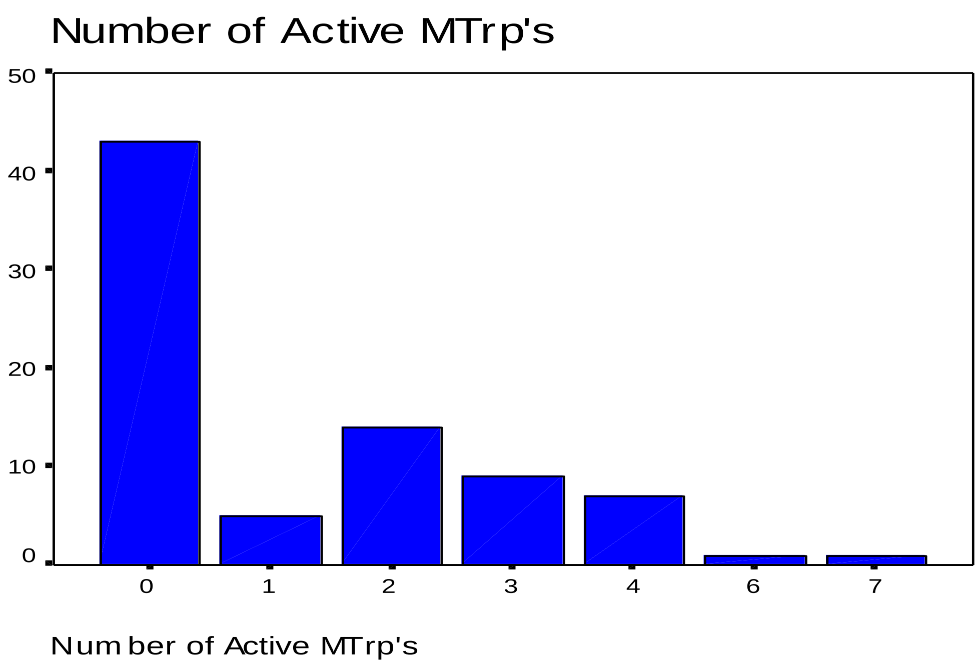

Figure 4.3.2

4.3.3 Number of Latent MTrp's:

Table 4.3.3a

Valid	80
Mean	2.86
Std. Deviation	1.42
Minimum	0
Maximum	7

Table 4.3.3b

Number of Latent MTrp's	Frequency	Percent	Valid Percent	Cumulative Percent
0	4	5.0	5.0	5.0
1	8	10.0	10.0	15.0
2	21	26.3	26.3	41.3
3	22	27.5	27.5	68.8
4	15	18.8	18.8	87.5
5	8	10.0	10.0	97.5
6	1	1.3	1.3	98.8
7	1	1.3	1.3	100.0
Total	80	100.0	100.0	

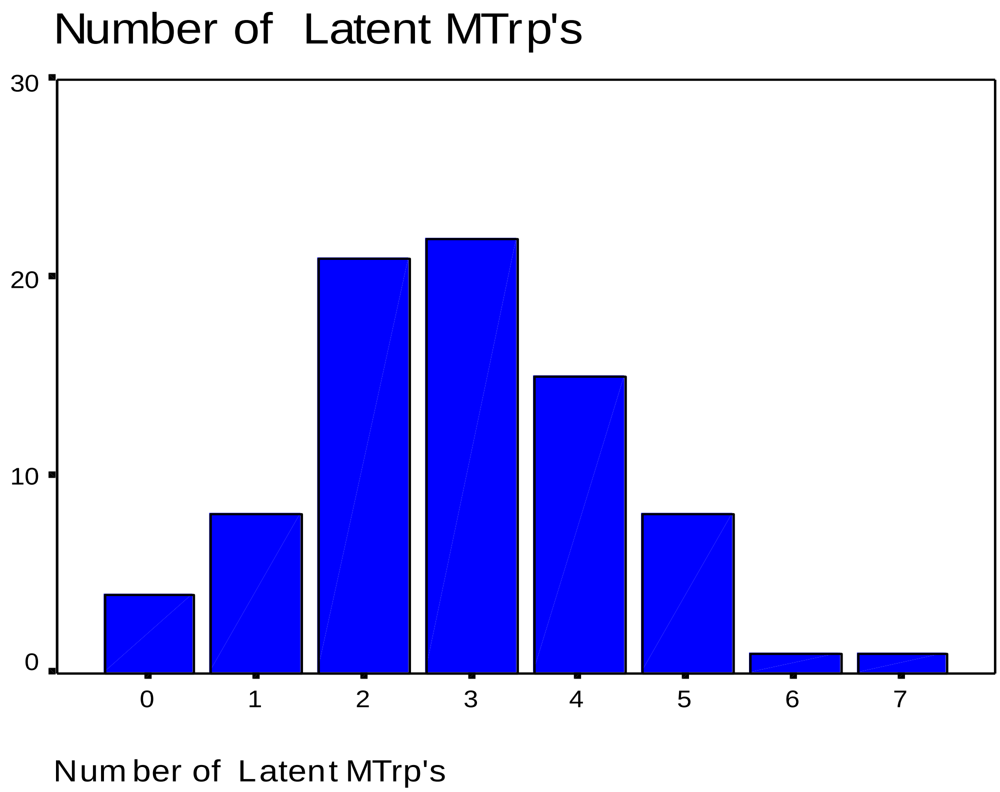
Number of Latent MTrp's
30
20
10
0
0
1
2
3
4
5
6
7
Num ber of Latent MTrp's

Figure 4.3.3

4.3.4 Location of Latent MTrp's:

Latent MTrp's were found in the following muscle components:

- Vastus Medialis Tendinous Portion (Latent)
- Vastus Medialis Distal Muscular Portion (Latent)
- Vastus Medialis Mid Belly of Muscle (Latent)
- Vastus Lateralis Tendinous Portion (Latent)
- Vastus Lateralis Distal Muscular Portion (Latent)
- Vastus Lateralis Mid Belly of Muscle (Latent)
- Vastus Lateralis Proximal Muscular Portion (Latent)
- Vastus Intermedialis Mid Belly of Muscle (Latent)
- Rectus Femoris Distal Muscular Portion (Latent)
- Rectus Femoris Mid Belly of Muscle (Latent)
- Rectus Femoris Proximal Muscular Portion (Latent)

No Latent MTrp's were found in the following muscle components: (Appendix 12)

- Vastus Medialis Proximal Muscular Portion (Latent)
- Vastus Intermedialis Tendinous Portion (Latent)
- Vastus Intermedialis Distal Muscular Portion (Latent)
- Vastus Intermedialis Proximal Muscular Portion (Latent)
- Rectus Femoris Tendinous Portion (Latent)

1. **<u>The Vastus Medialis Muscle:</u>**

Vastus Medialis Tendinous Portion (Latent)

Table 4.3.4.1.a

Vastus Medialis Tendinous Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	68	85.0	85.0	85.0
1	12	15	15	100.0
Total	80	100.0	100.0	

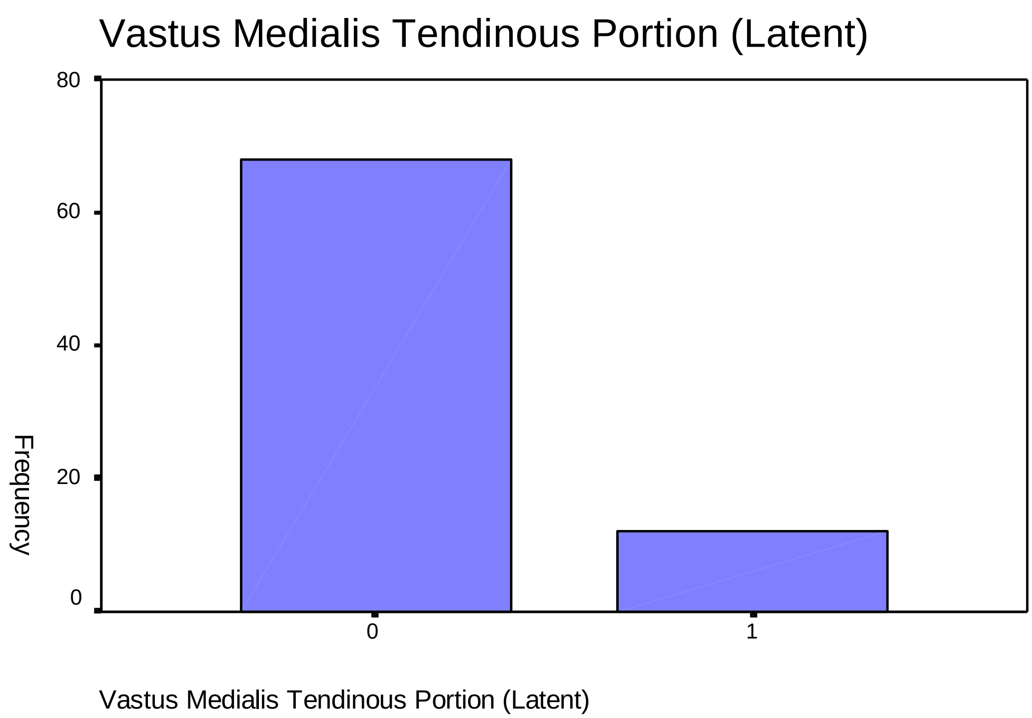

Figure 4.3.4.1.a

Vastus Medialis Distal Muscular Portion (Latent)

Table 4.3.4.1.b

Vastus Medialis Distal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	55	68.8	68.8	68.8
1	23	28.8	28.8	97.5
2	2	2.5	2.5	100.0
Total	80	100.0	100.0	

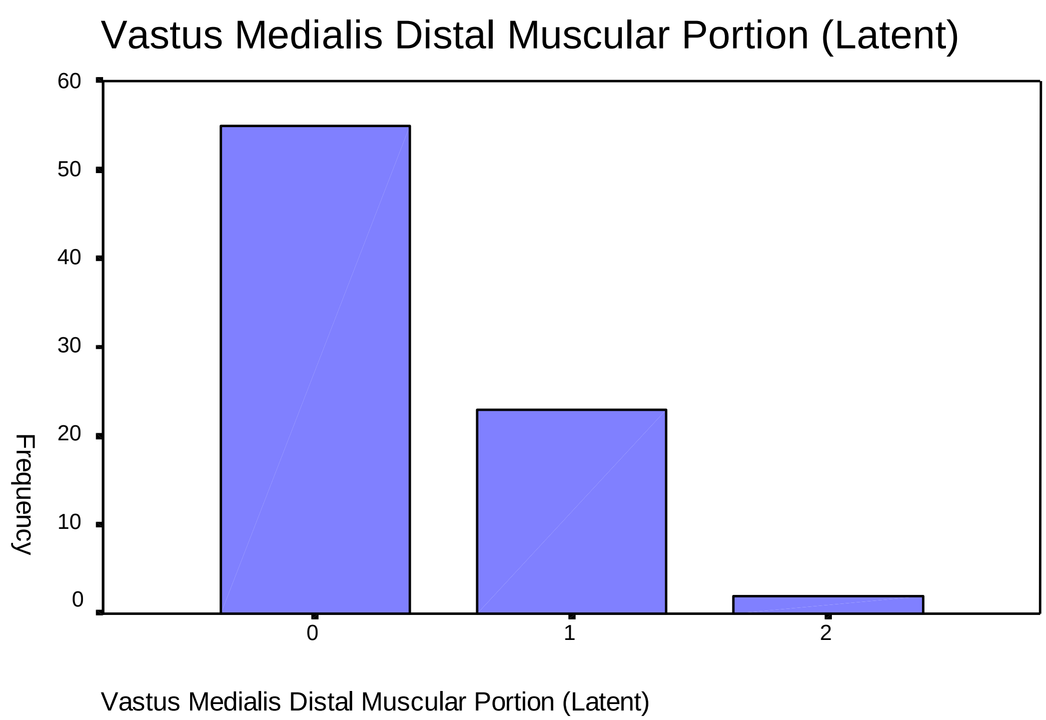

Figure 4.3.4.1.b.

Vastus Medialis Mid Belly of Muscle (Latent)

Table 4.3.4.1.c

Vastus Medialis Mid Belly of Muscle (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	74	92.5	92.5	92.5
1	6	7.5	7.5	100.0
Total	80	100.0	100.0	

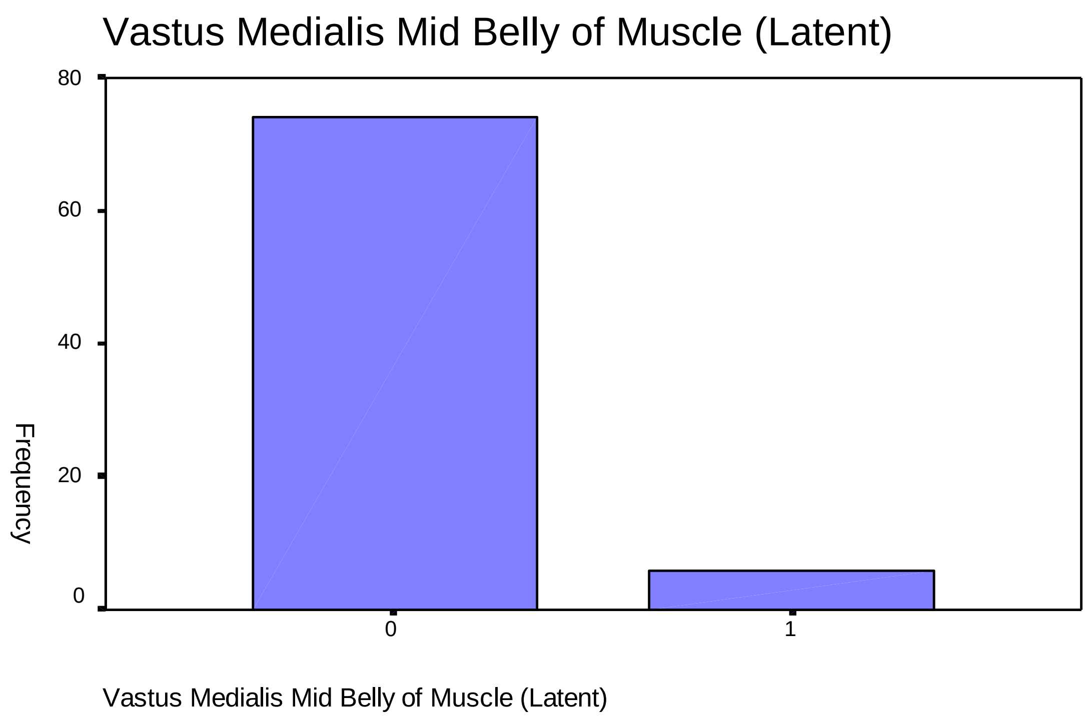

Figure 4.3.4.1.c

2. The Vastus Lateralis Muscle

Vastus Lateralis Tendinous Portion (Latent)

Table 4.3.4.2.a

Vastus Lateralis Tendinous Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	61	76.3	76.3	76.3
1	19	23.8	23.8	100.0
Total	80	100.0	100.0	

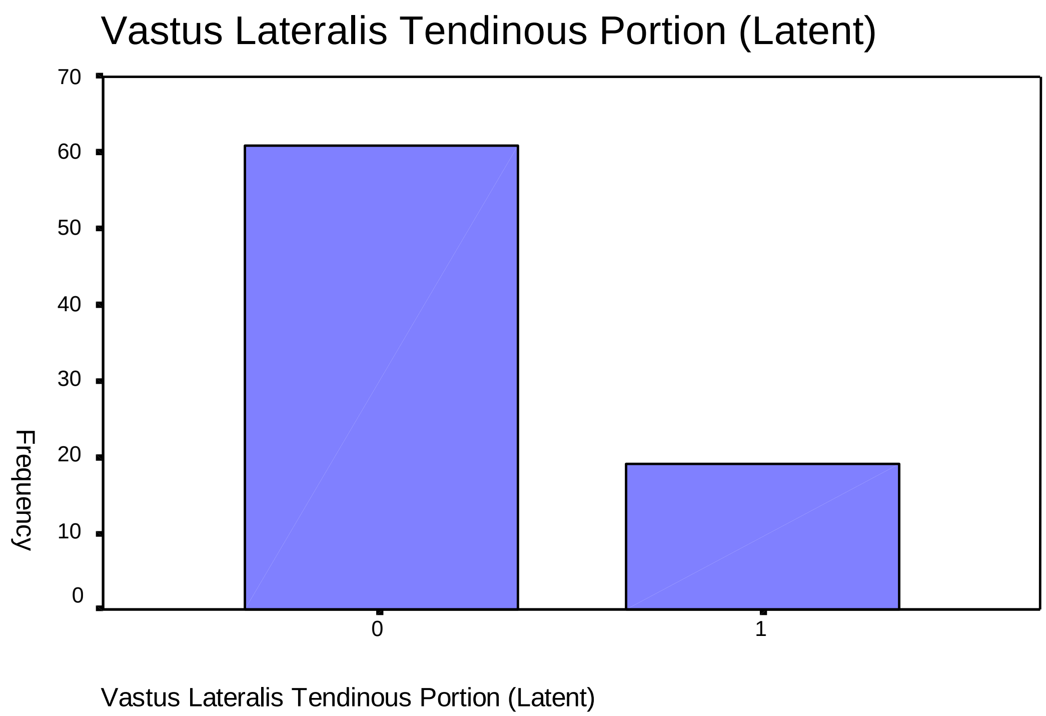

Figure 4.3.4.2.a

Vastus Lateralis Distal Muscular Portion (Latent)

Table 4.3.4.2.b

Vastus Lateralis Distal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	43	53.8	53.8	53.8
1	32	40.0	40.0	93.8
2	5	6.3	6.3	100.0
Total	80	100.0	100.0	

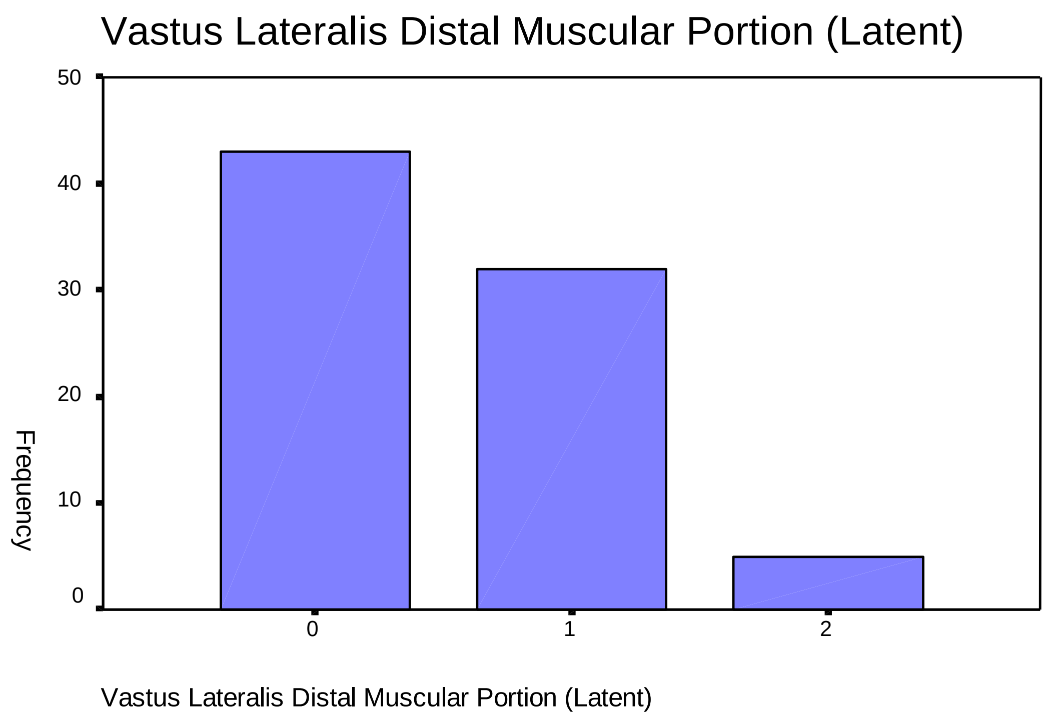

Figure 4.3.4.2.b

Vastus Lateralis Mid Belly of Muscle (Latent)

Table 4.3.4.2.c

Vastus Lateralis Mid Belly of Muscle (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	32	40.0	40.0	40.0
1	20	25.0	25.0	65.0
2	21	26.3	26.3	91.3
3	7	8.8	8.8	100.0
Total	80	100.0	100.0	

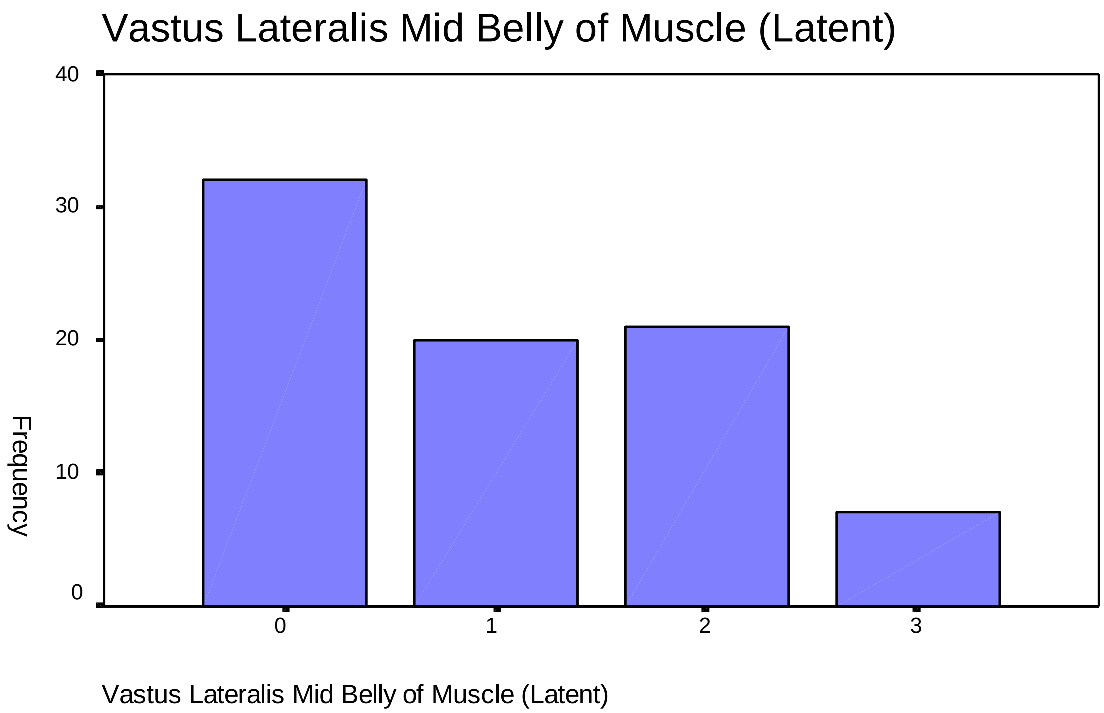

Figure 4.3.4.2.c

Vastus Lateralis Proximal Muscular Portion (Latent)

Table 4.3.4.2.d

Vastus Lateralis Proximal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	66	82.5	82.5	82.5
1	13	16.3	16.3	98.8
2	1	1.3	1.3	100.0
Total	80	100.0	100.0	

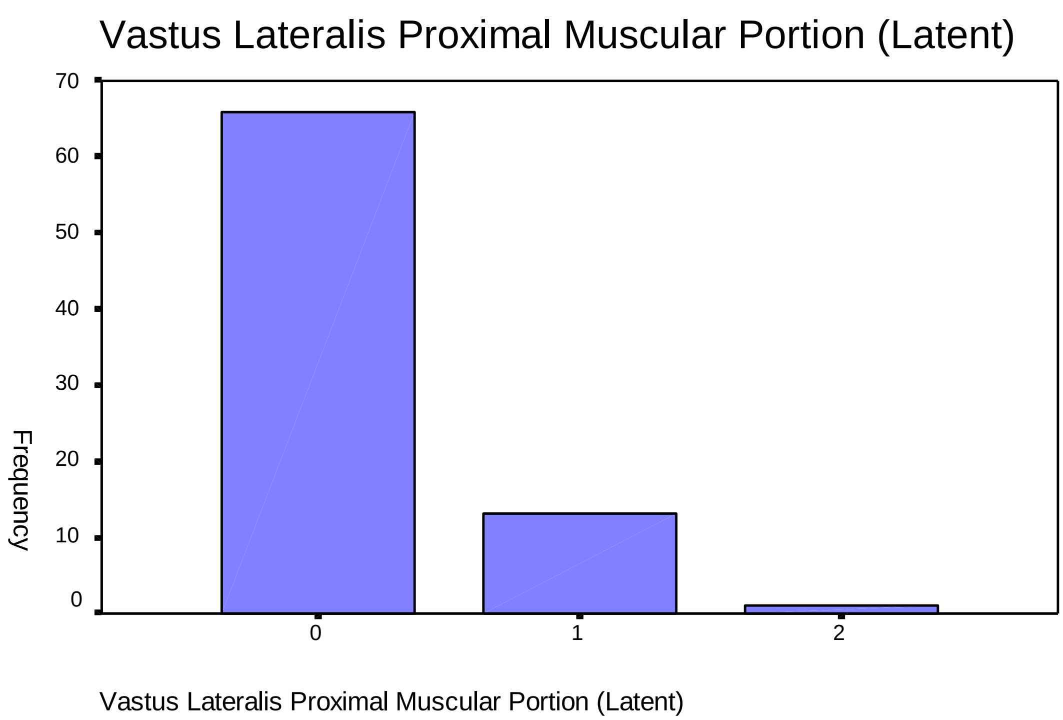

Figure 4.3.4.2.d

3. The Vastus Intermedialis Muscle

Vastus Intermedialis Mid Belly of Muscle (Latent)

Table 4.3.4.3.c

Vastus Intermedialis Mid Belly of Muscle (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	75	93.8	93.8	93.8
1	5	6.3	6.3	100.0
Total	80	100.0	100.0	

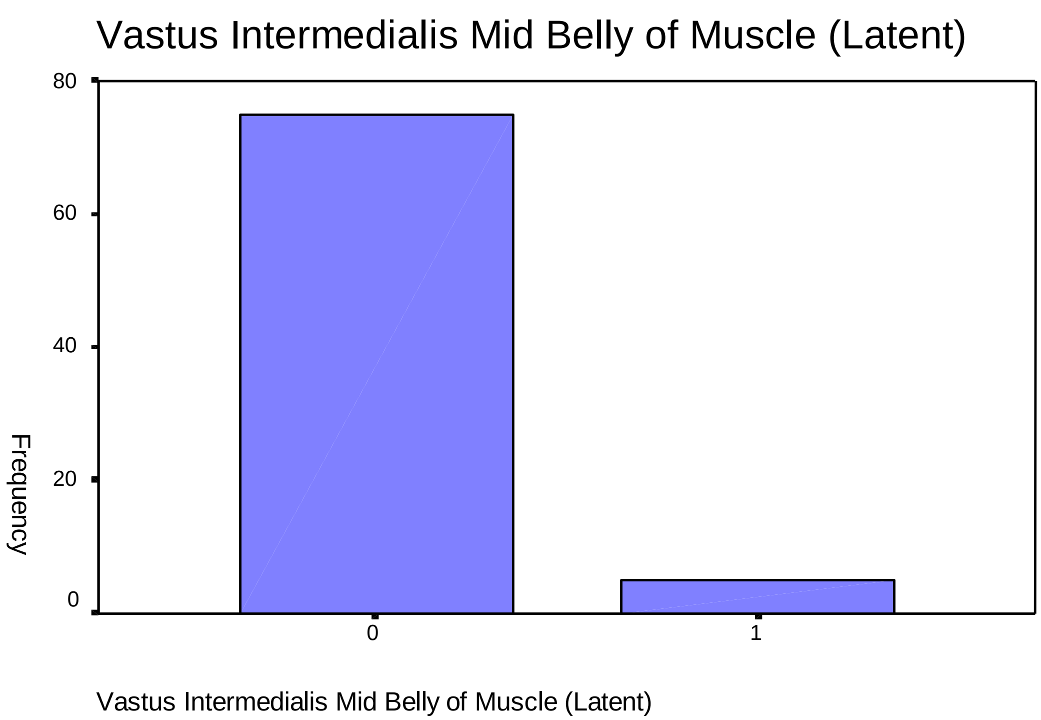

Figure 4.3.4.3.c

4. The Rectus Femoris Muscle:

Rectus Femoris Distal Muscular Portion (Latent)

Table 4.3.4.4.b

Rectus Femoris Distal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	79	98.8	98.8	98.8
1	1	1.3	1.3	100.0
Total	80	100.0	100.0	

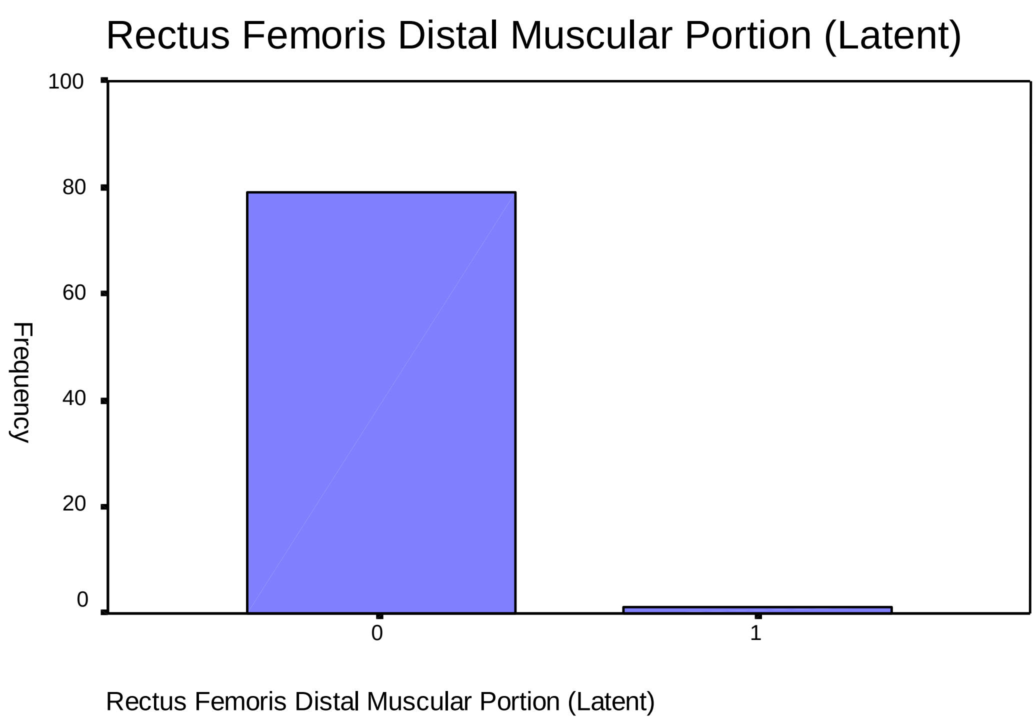

Figure 4.3.4.4.b

Rectus Femoris Mid Belly of Muscle (Latent)

Table 4.3.4.4.c

Rectus Femoris Mid Belly of Muscle (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	79	98.8	98.8	98.8
1	1	1.3	1.3	100.0
Total	80	100.0	100.0	

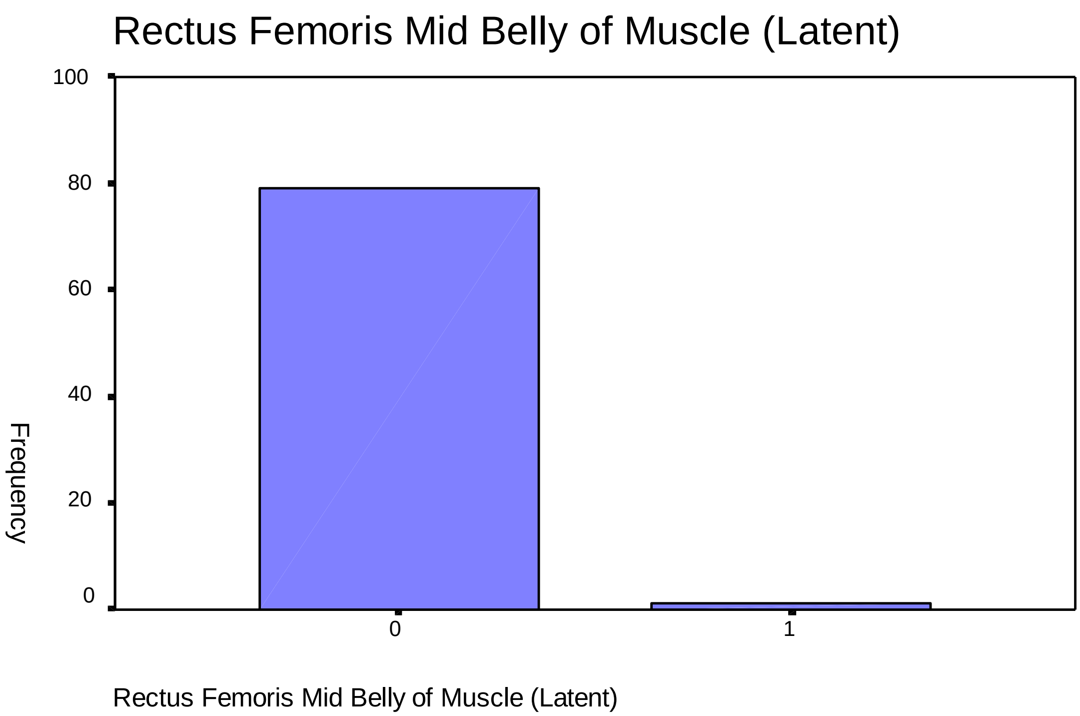

Figure 4.3.4.4.c

Rectus Femoris Proximal Muscular Portion (Latent)

Table 4.3.4.4.d

Rectus Femoris Proximal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	61	76.3	76.3	76.3
1	19	23.8	23.8	100.0
Total	80	100.0	100.0	

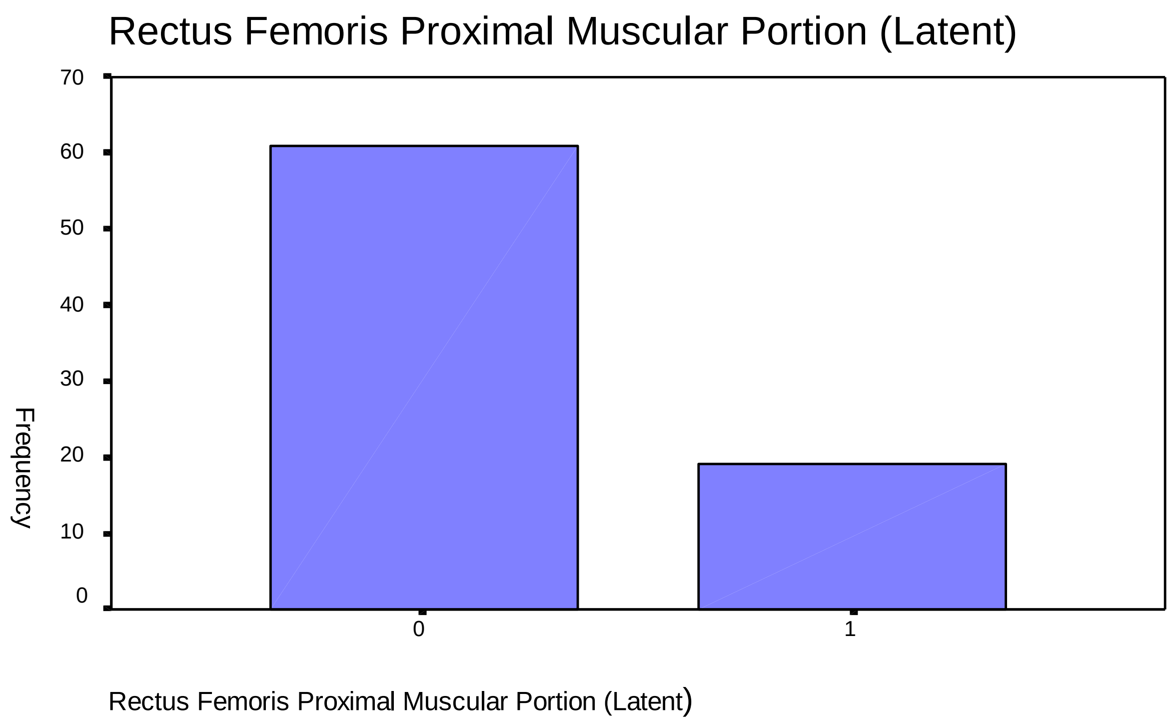

Figure 4.3.4.4.d

4.3.5 Location of Active MTrp's:

Active MTrp's were found in the following muscle components:

- Vastus Medialis Tendinous Portion (Active)
- Vastus Medialis Distal Muscular Portion (Active)
- Vastus Medialis Mid Belly of Muscle (Active)
- Vastus Lateralis Tendinous Portion (Active)
- Vastus Lateralis Distal Muscular Portion (Active)
- Vastus Lateralis Mid Belly of Muscle (Active)
- Vastus Lateralis Proximal Muscular Portion (Active)
- Vastus Intermedialis Mid Belly of Muscle (Active)
- Rectus Femoris Proximal Muscular Portion (Active)

No Active MTrp's were found in the following muscle components:

(Appendix 12)

- Vastus Medialis Proximal Muscular Portion (Active)
- Vastus Intermedialis Tendinous Portion (Active)
- Vastus Intermedialis Distal Muscular Portion (Active)
- Vastus Intermedialis Proximal Muscular Portion (Active)
- Rectus Femoris Tendinous Portion (Active)
- Rectus Femoris Distal Muscular Portion (Active)
- Rectus Femoris Mid Belly of Muscle (Active)

1. The Vastus Medialis Muscle:

Vastus Medialis Tendinous Portion (Active)

Table 4.3.5.1.a

Vastus Medialis Tendinous Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	77	96.3	96.3	96.3
1	3	3.8	3.8	100.0
Total	80	100.0	100.0	

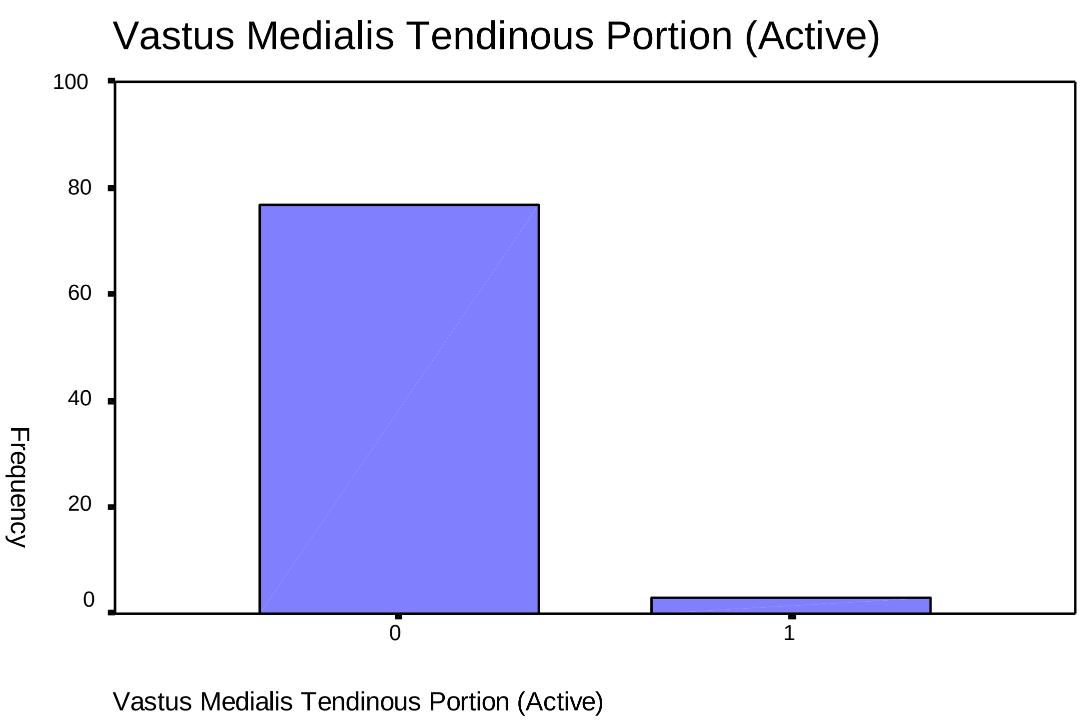

Figure 4.3.5.1.a

Vastus Medialis Distal Muscular Portion (Active)

Table 4.3.5.1.b

Vastus Medialis Distal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	75	93.8	93.8	93.8
1	4	5.0	5.0	98.8
2	1	1.3	1.3	100.0
Total	80	100.0	100.0	

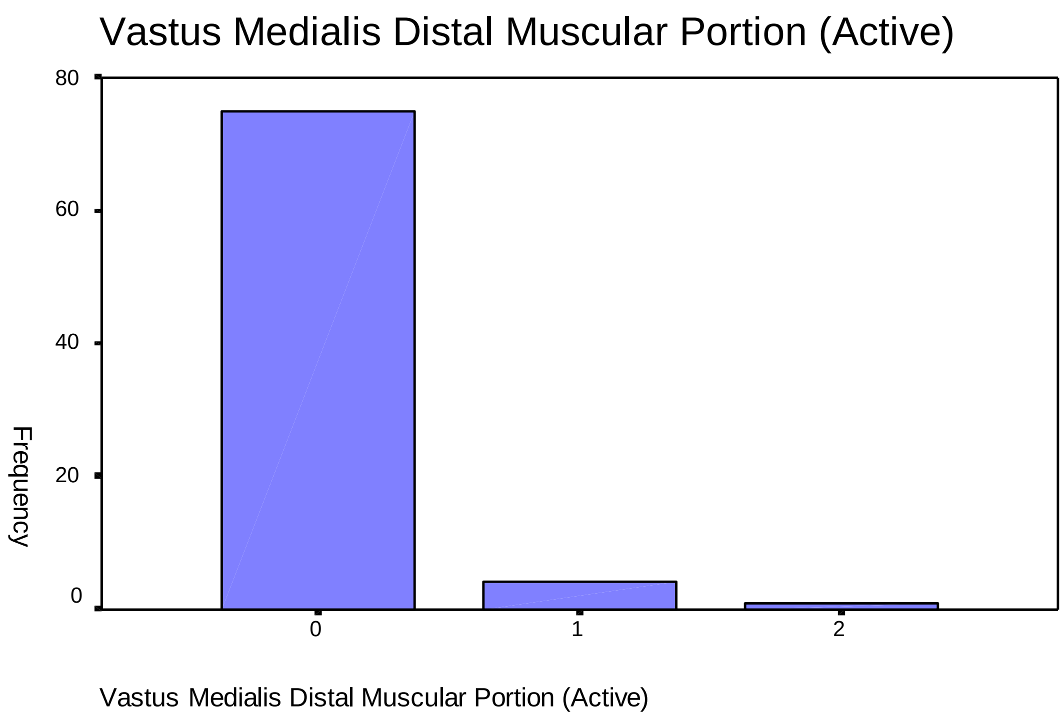

Figure 4.3.5.1.b

Vastus Medialis Mid Belly of Muscle (Active)

Table 4.3.5.1.c

Vastus Medialis Mid Belly of Muscle (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	79	98.8	98.8	98.8
1	1	1.3	1.3	100.0
Total	80	100.0	100.0	

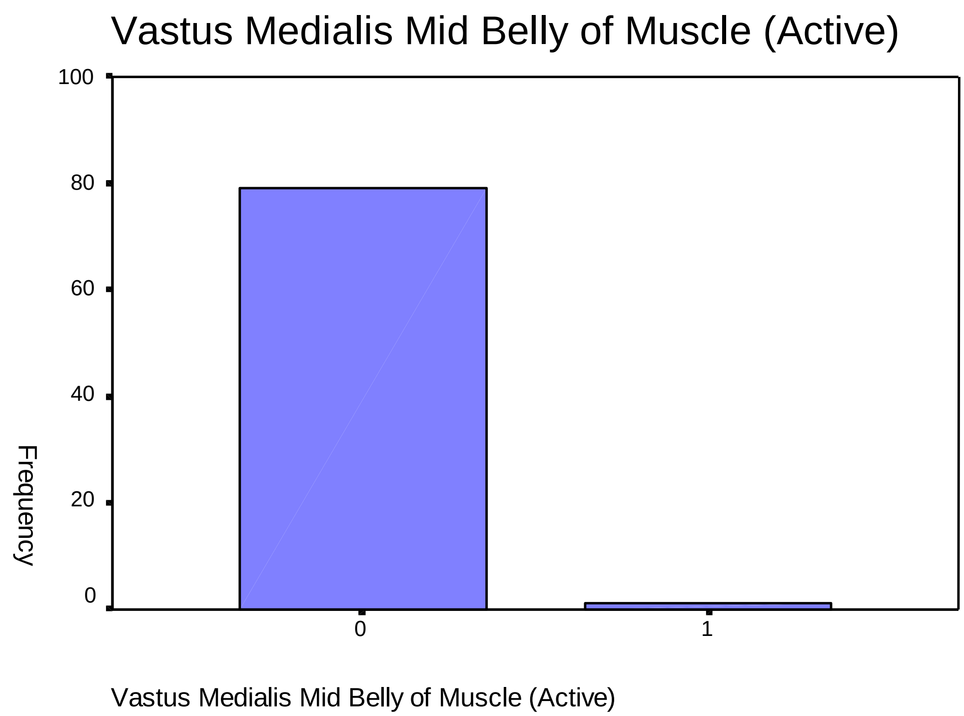

Figure 4.3.5.1.c

2. The Vastus Lateralis Muscle:

Vastus Lateralis Tendinous Portion (Active)

Table 4.3.5.2.a

Vastus Lateralis Tendinous Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	71	88.8	88.8	88.8
1	9	11.3	11.3	100.0
Total	80	100.0	100.0	

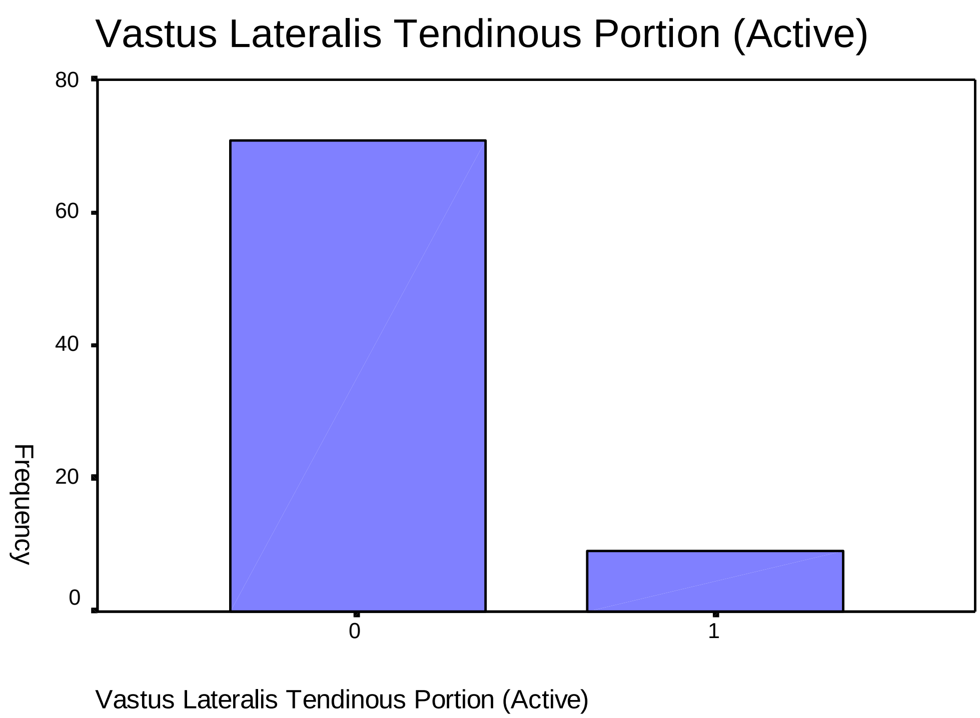

Figure 4.3.5.2.a

Vastus Lateralis Distal Muscular Portion (Active)

Table 4.3.5.2.b

Vastus Lateralis Distal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	59	73.8	73.8	73.8
1	16	20.0	20.0	93.8
2	5	6.3	6.3	100.0
Total	80	100.0	100.0	

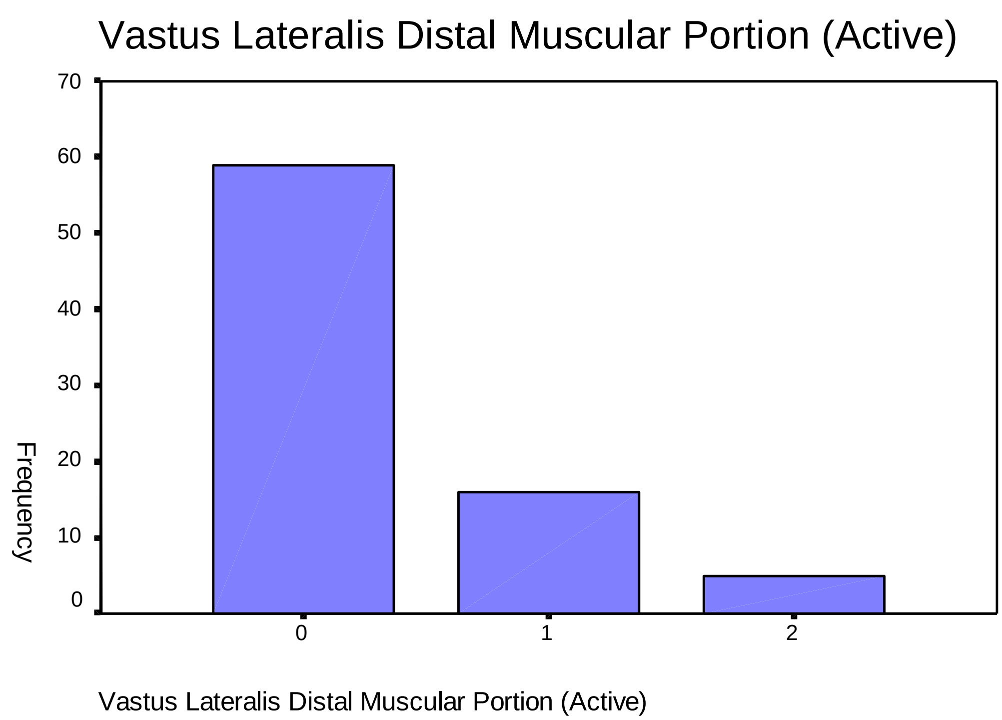

Figure 4.3.5.2.b

Vastus Lateralis Mid Belly of Muscle (Active)

Table 4.3.5.2.c

Vastus Lateralis Mid Belly of Muscle (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	50	62.5	62.5	62.5
1	18	22.5	22.5	85.0
2	11	13.8	13.8	98.8
3	1	1.3	1.3	100.0
Total	80	100.0	100.0	

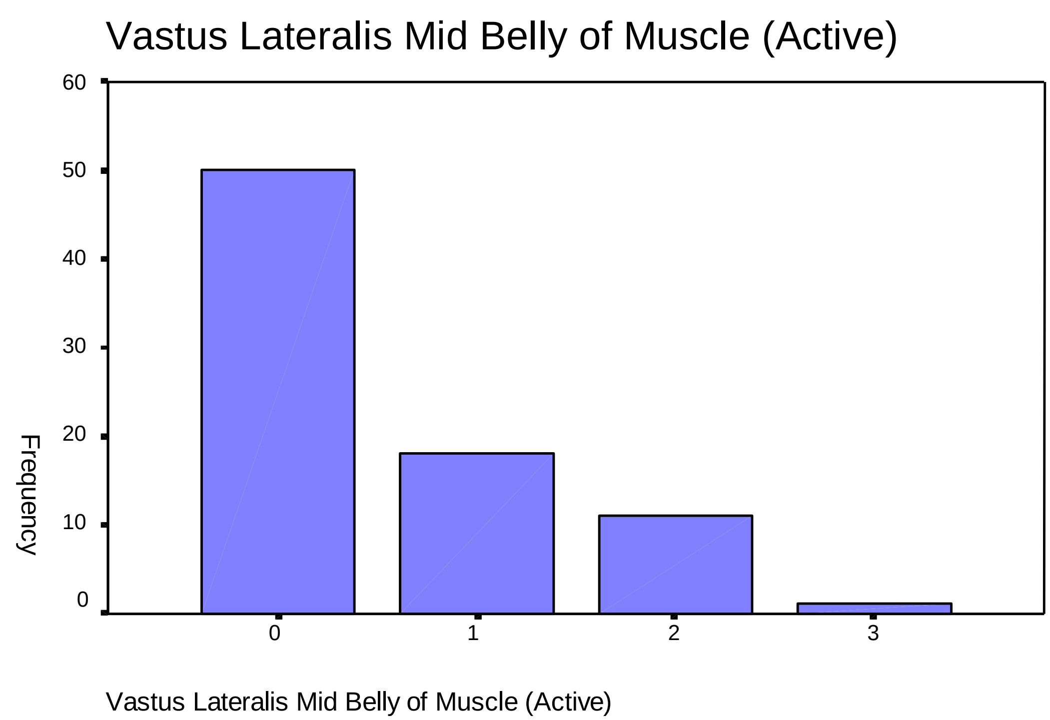

Figure 4.3.5.2.c

Vastus Lateralis Proximal Muscular Portion (Active)

Table 4.3.5.2.d

Vastus Lateralis Proximal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	75	93.8	93.8	93.8
1	5	6.3	6.3	100.0
Total	80	100.0	100.0	

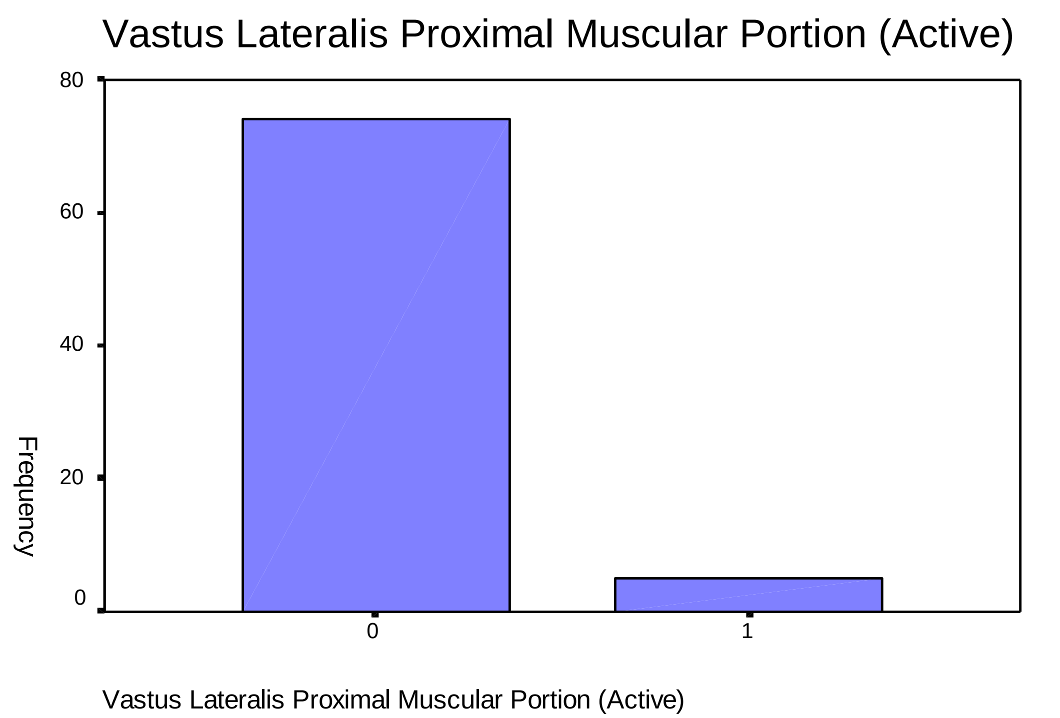

Figure 4.3.5.2.d

3. **The Vastus Intermedialis Muscle:**

Vastus Intermedialis Mid Belly of Muscle (Active)

Table 4.3.5.3.c

Vastus Intermedialis Mid Belly of Muscle (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	79	98.8	98.8	98.8
1	1	1.3	1.3	100.0
Total	80	100.0	100.0	

Vastus Intermedialis Mid Belly of Muscle (Active)

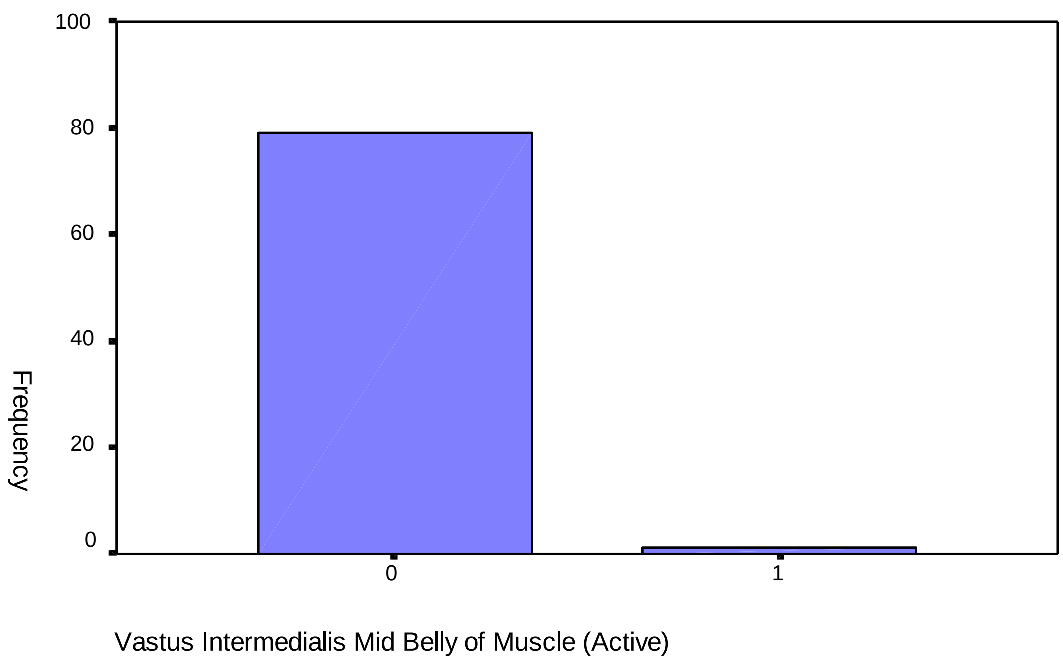

Figure 4.3.5.3.c

4. The Rectus Femoris Muscle:

Rectus Femoris Proximal Muscular Portion (Active)

Table 4.3.5.4.d

Rectus Femoris Proximal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	74	92.5	92.5	92.5
1	6	7.5	7.5	100.0
Total	80	100.0	100.0	

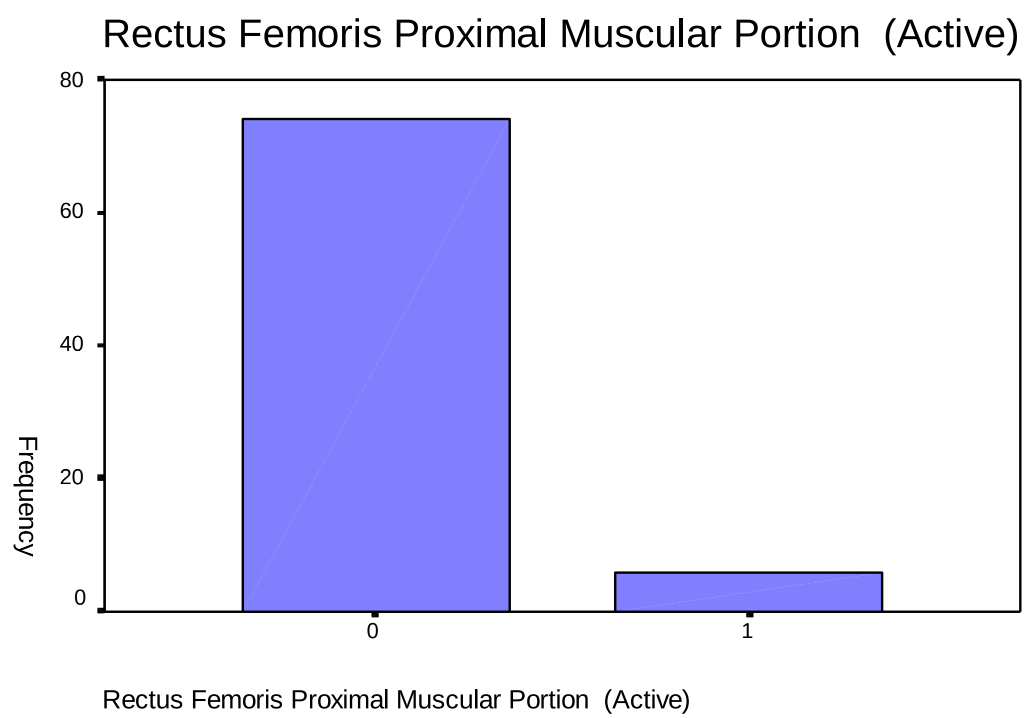

Figure 4.3.5.4.d

4.4 Statistical Results for Correlation Comparison:

4.4.1 Correlation between the Total Number of MTrp's and the Number of Latent and Active MTrp's:

Table 4.4.1

		Total Number of MTrp's
Number of Latent MTrp's	Correlation Coefficient	**.616****
	Sig. (2-tailed)	**.000**
	N	80
Number of Active MTrp's	Correlation Coefficient	**.739****
	Sig. (2-tailed)	**.000**
	N	80

4.4.2 Correlation between NRS and the Subjective Component of the PPSS:

Table 4.4.2

		Numerical Rating Scale
Pain on Prolonged Sitting	Correlation Coefficient	**.316****
	Sig. (2-tailed)	**.004**
	N	80
Pain on Ascending or Descending Stairs	Correlation Coefficient	.133
	Sig. (2-tailed)	.246
	N	78
Pain Worsened with Physical Activity	Correlation Coefficient	.189
	Sig. (2-tailed)	.092
	N	80
Pain on deep squats	Correlation Coefficient	.188
	Sig. (2-tailed)	.095
	N	80
Pain on kneeling	Correlation Coefficient	**.388****
	Sig. (2-tailed)	**.000**
	N	80
Pain on isometric quadriceps contraction	Correlation Coefficient	.170
	Sig. (2-tailed)	.132
	N	80
Pain is experienced around or behind the kneecap	Correlation Coefficient	.200
	Sig. (2-tailed)	.075
	N	80
Pain is mild	Correlation Coefficient	**-.549****
	Sig. (2-tailed)	**.000**
	N	80
Pain is moderate	Correlation Coefficient	.178
	Sig. (2-tailed)	.113
	N	80
Pain is severe	Correlation Coefficient	**.431****
	Sig. (2-tailed)	**.000**
	N	80

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.3.0 Correlation between NRS and the Objective Component of the PPSS:

Table 4.4.3.0

		Numerical Rating Scale
Objective Evaluation of Pain on Prolonged Sitting	Correlation Coefficient	-.092
	Sig. (2-tailed)	.416
	N	80
Objective Evaluation of Pain on Ascending or Descending Stairs	Correlation Coefficient	-.026
	Sig. (2-tailed)	.818
	N	80
Objective Evaluation of Pain worsened with Physical Activity	Correlation Coefficient	**-.309****
	Sig. (2-tailed)	**.005**
	N	80
Objective Evaluation of Pain on Deep Squat	Correlation Coefficient	**-.226***
	Sig. (2-tailed)	**.044**
	N	80
Objective Evaluation of Pain on Kneeling	Correlation Coefficient	**-.389****
	Sig. (2-tailed)	**.000**
	N	80
Objective Evaluation of Pain on Isometric Quadriceps Contraction	Correlation Coefficient	-.158
	Sig. (2-tailed)	.161
	N	80
Objective Evaluation of Pain around or behind the Kneecap	Correlation Coefficient	-.161
	Sig. (2-tailed)	.154
	N	80

		Numerical Rating Scale
Objective Evaluation of Pain is Mild	Correlation Coefficient	**.561****
	Sig. (2-tailed)	**.000**
	N	80
Objective Evaluation of Pain is Moderate	Correlation Coefficient	-.096
	Sig. (2-tailed)	.399
	N	80
Objective Evaluation of Pain is Severe	Correlation Coefficient	**-.471****
	Sig. (2-tailed)	**.000**
	N	80

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.3.1 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Prolonged Sitting:

Table 4.4.3.1

Numerical Rating Scale	Objective Evaluation of Pain on Prolonged Sitting		Total
	Yes	No	
2	1	1	2
3	9	2	11
4	10	4	14
5	11	5	16
6	15	3	18
7	12	2	14
8	5		5
Total	63	17	80

4.4.3.2 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Ascending or Descending Stairs:

Table 4.4.3.2

Numerical Rating Scale	Objective Evaluation of Pain on Ascending or Descending Stairs		Total
	Yes	No	
2	2		2
3	10	1	11
4	8	6	14
5	15	1	16
6	16	2	18
7	11	3	14
8	5		5
Total	67	13	80

4.4.3.3 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain worsened with Physical Activity:

Table 4.4.3.3

Numerical Rating Scale	Objective Evaluation of Pain worsened with Physical Activity		Total
	Yes	No	
2	2		2
3	9	2	11
4	9	5	14
5	13	3	16
6	17	1	18
7	14		14
8	5		5
Total	69	11	80

4.4.3.4 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Deep Squat:

Table 4.4.3.4

Numerical Rating Scale	Objective Evaluation of Pain on Deep Squat		Total
	Yes	No	
2	1	1	2
3	10	1	11
4	12	2	14
5	16		16
6	17	1	18
7	14		14
8	5		5
Total	75	5	80

4.4.3.5 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Kneeling:

Table 4.4.3.5

Numerical Rating Scale	Objective Evaluation of Pain on Kneeling		Total
	Yes	No	
2	1	1	2
3	5	6	11
4	9	5	14
5	12	4	16
6	14	4	18
7	14		14
8	5		5
	60	20	80

4.4.3.6 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Isometric Quadriceps Contraction:

Table 4.4.3.6

Numerical Rating Scale	Objective Evaluation of Pain on Isometric Quadriceps Contraction		Total
	Yes	No	
2		2	2
3	2	9	11
4	4	10	14
5	6	10	16
6	8	10	18
7	5	9	14
8	2	3	5
Total	27	53	80

4.4.3.7 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain around or behind the Kneecap:

Table 4.4.3.7

Numerical Rating Scale	Objective Evaluation of Pain around or behind the Kneecap	Total
	Yes	
2	2	2
3	11	11
4	14	14
5	16	16
6	18	18
7	14	14
8	5	5
Total	80	80

4.4.3.8 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain is Mild:

Table 4.4.3.8

Numerical Rating Scale	Objective Evaluation of Pain is Mild		Total
	Yes	No	
2	2		2
3	8	3	11
4	6	8	14
5	4	12	16
6	1	17	18
7		14	14
8		5	5
Total	21	59	80

4.4.3.9 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain is Moderate:

Table 4.4.3.9

Numerical Rating Scale	Objective Evaluation of Pain is Moderate		Total
	Yes	No	
2		2	2
3	3	8	11
4	8	6	14
5	12	4	16
6	16	2	18
7	6	8	14
8	2	3	5
Total	47	33	80

4.4.3.10 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain is Severe:

Table 4.4.3.10

Numerical Rating Scale	Objective Evaluation of Pain is Severe		Total
	Yes	No	
2		2	2
3	1	10	11
4		14	14
5		16	16
6	1	17	18
7	8	6	14
8	3	2	5
	13	67	80

4.4.4 Correlation between NRS and the Myofascial Diagnostic Scale:

Table 4.4.4.

		Myofascial Diagnostic Scale
Numerical Rating Scale	Correlation Coefficient	**.434****
	Sig. (2-tailed)	**.000**
	N	80

** Correlation is significant at the .01 level (2-tailed).

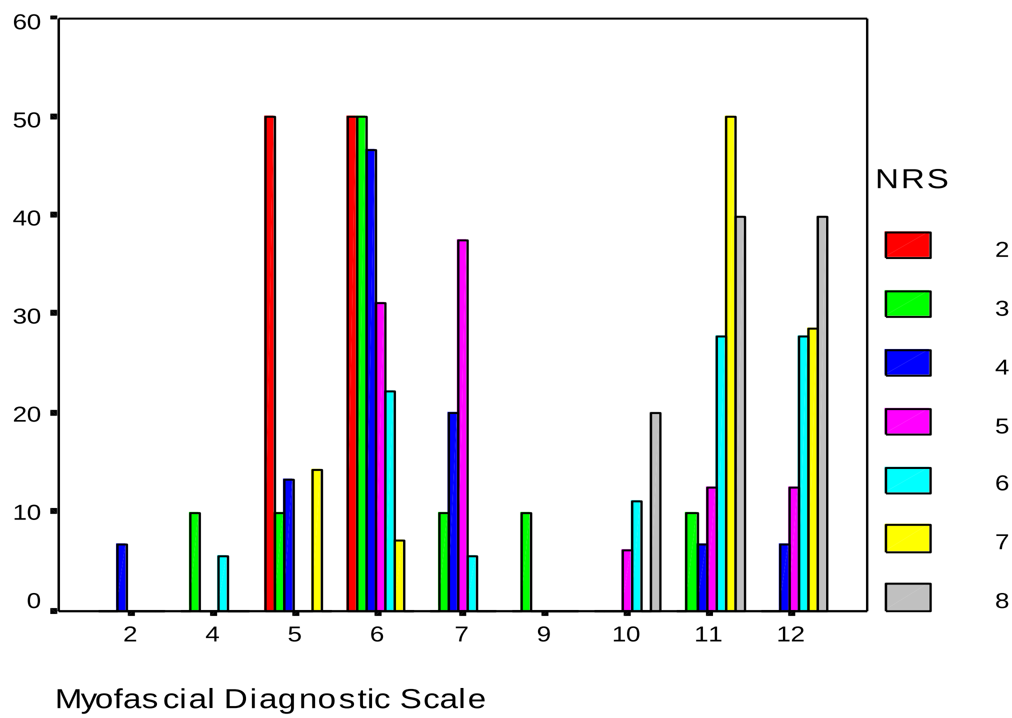

Figure 4.4.4

4.4.5 Correlation between NRS and the Location of Latent MTrp's in the QF Muscle Group:

Table 4.4.5

		Numerical Rating Scale
Vastus Medialis Tendinous Portion (Latent)	Correlation Coefficient	-.183
	Sig. (2-tailed)	.105
	N	80
Vastus Medialis Distal Muscular Portion (Latent)	Correlation Coefficient	.138
	Sig. (2-tailed)	.222
	N	80
Vastus Medialis Mid Belly of Muscle (Latent)	Correlation Coefficient	.089
	Sig. (2-tailed)	.433
	N	80
Vastus Medialis Proximal Muscular Portion (Latent)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Vastus Lateralis Tendinous Portion (Latent)	Correlation Coefficient	**-.421****
	Sig. (2-tailed)	**.000**
	N	80
Vastus Lateralis Distal Muscular Portion (Latent)	Correlation Coefficient	.094
	Sig. (2-tailed)	.408
	N	80
Vastus Lateralis Mid Belly of Muscle (Latent)	Correlation Coefficient	.167
	Sig. (2-tailed)	.138
	N	80
Vastus Lateralis Proximal Muscular Portion (Latent)	Correlation Coefficient	**.259****
	Sig. (2-tailed)	**.021**
	N	80

		Numerical Rating Scale
Vastus Intermedialis Tendinous Portion (Latent)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Vastus Intermedialis Distal Muscular Portion (Latent)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Vastus Intermedialis Mid Belly of Muscle (Latent)	Correlation Coefficient	.188
	Sig. (2-tailed)	.096
	N	80
Vastus Intermedialis Proximal Muscular Portion (Latent)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Rectus Femoris Tendinous Portion (Latent)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Rectus Femoris Distal Muscular Portion (latent)	Correlation Coefficient	.059
	Sig. (2-tailed)	.600
	N	80
Rectus Femoris Mid Belly of Muscle (Latent)	Correlation Coefficient	-.193
	Sig. (2-tailed)	.086
	N	80
Rectus Femoris Proximal Muscular Portion (latent)	Correlation Coefficient	.015
	Sig. (2-tailed)	.896
	N	80

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.6 Correlation between NRS and the Location of Active MTrp's in the QF Muscle Group:

Table 4.4.6

		Numerical Rating Scale
Vastus Medialis Tendinous Portion (Active)	Correlation Coefficient	**.225***
	Sig. (2-tailed)	**.045**
	N	80
Vastus Medialis Distal Muscular Portion (Active)	Correlation Coefficient	**.244***
	Sig. (2-tailed)	**.029**
	N	80
Vastus Medialis Mid Belly of Muscle (Active)	Correlation Coefficient	.059
	Sig. (2-tailed)	.600
	N	80
Vastus Medialis Proximal Muscular Portion (Active)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Vastus Lateralis Tendinous Portion (Active)	Correlation Coefficient	**.344****
	Sig. (2-tailed)	**.002**
	N	80
Vastus Lateralis Distal Muscular Portion (Active)	Correlation Coefficient	**.401****
	Sig. (2-tailed)	.000
	N	80
Vastus Lateralis Mid Belly of Muscle (Active)	Correlation Coefficient	**.250****
	Sig. (2-tailed)	**.025**
	N	80
Vastus Lateralis Proximal Muscular Portion (Active)	Correlation Coefficient	.192
	Sig. (2-tailed)	.088
	N	80

		Numerical Rating Scale
Vastus Intermedialis Tendinous Portion (Active)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Vastus Intermedialis Distal Muscular Portion (Active)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Vastus Intermedialis Mid Belly of Muscle (Active)	Correlation Coefficient	.139
	Sig. (2-tailed)	.220
	N	80
Vastus Intermedialis Proximal Muscular Portion (Active)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Rectus Femoris Tendinous Portion (Active)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Rectus Femoris Distal Muscular Portion (Active)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Rectus Femoris Mid Belly of Muscle (Active)	Correlation Coefficient	.
	Sig. (2-tailed)	.
	N	80
Rectus Femoris Proximal Muscular Portion (Active)	Correlation Coefficient	.178
	Sig. (2-tailed)	.115
	N	80

* Correlation is significant at the .05 level (2-tailed).
** Correlation is significant at the .01 level (2-tailed).

4.4.7 Correlation between NRS and the Number of MTrp's (total, active and latent):

Table 4.4.7

		Numerical Rating Scale
Total Number of MTrp's	Correlation Coefficient	**.436****
	Sig. (2-tailed)	**.000**
	N	80
Number of Latent MTrp's	Correlation Coefficient	.133
	Sig. (2-tailed)	.239
	N	80
Number of Active MTrp's	Correlation Coefficient	**.442****
	Sig. (2-tailed)	**.000**
	N	80

** Correlation is significant at the .01 level (2-tailed).

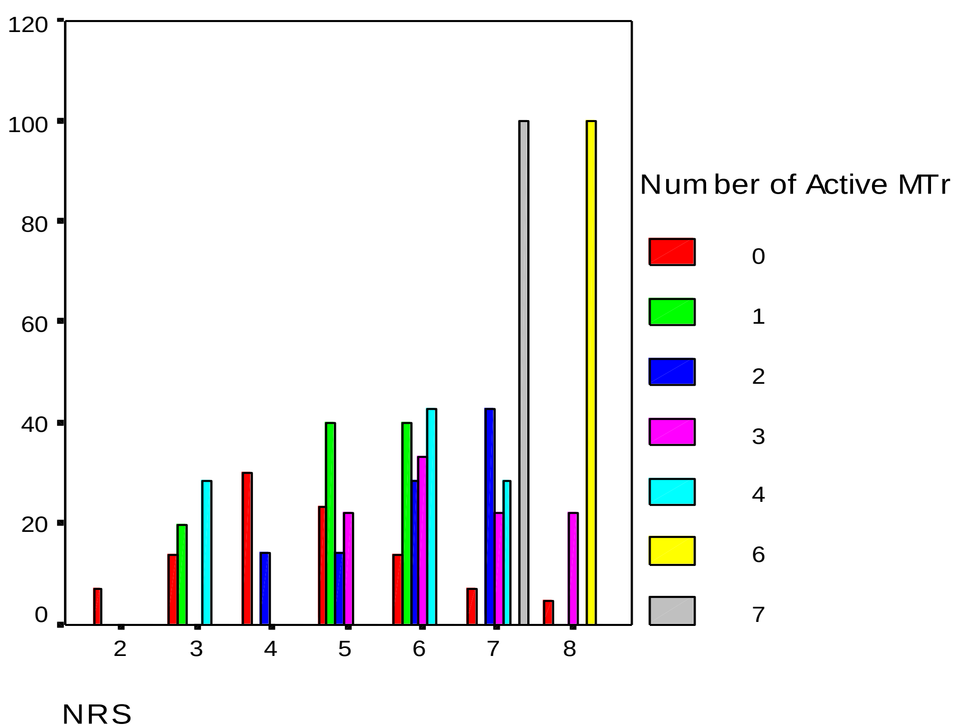

Figure 4.4.7

4.4.8 Correlation between NRS and the Mean Algometer readings of the QF muscle:

Table 4.4.8

		Numerical Rating Scale
Vastus Medialis Mean Algometer Readings	Correlation Coefficient	-.054
	Sig. (2-tailed)	.751
	N	37
Vastus Lateralis Mean Algometer Readings	Correlation Coefficient	-.169
	Sig. (2-tailed)	.175
	N	66
Vastus Intermedialis Mean Algometer Readings	Correlation Coefficient	.077
	Sig. (2-tailed)	.857
	N	8
Rectus Femoris Mean Algometer Readings	Correlation Coefficient	-.279
	Sig. (2-tailed)	.177
	N	25
Quadriceps Femoris Mean Algometer Readings	Correlation Coefficient	-.207
	Sig. (2-tailed)	.075
	N	75

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.9 Correlation between Subjective Pain perception from the PPSS and the Myofascial Diagnostic Scale:

Table 4.4.9

		Pain is mild	Pain is moderate	Pain is severe
Myofascial Diagnostic Scale	Correlation Coefficient	**-.310****	.041	**.312****
	Sig. (2-tailed)	**.005**	.721	**.005**
	N	80	80	80

** Correlation is significant at the .01 level (2-tailed).

4.4.10 Correlation between Subjective Pain perception from the PPSS and the Location of the Latent MTrp's:

Table 4.4.10

		Pain is mild	Pain is moderate	Pain is severe
Vastus Medialis Tendinous Portion (Latent)	Correlation Coefficient	-.063	-.024	-.016
	Sig. (2-tailed)	.576	.835	.889
	N	80	80	80
Vastus Medialis Distal Muscular Portion (Latent)	Correlation Coefficient	-.150	.017	-.023
	Sig. (2-tailed)	.185	.883	.841
	N	80	80	80
Vastus Medialis Mid Belly of Muscle (Latent)	Correlation Coefficient	-.083	.156	.039
	Sig. (2-tailed)	.465	.167	.728
	N	80	80	80
Vastus Medialis Proximal Muscular Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Lateralis Tendinous Portion (Latent)	Correlation Coefficient	**.390****	-.161	-.112
	Sig. (2-tailed)	**.000**	.153	.321
	N	80	80	80
Vastus Lateralis Distal Muscular Portion (Latent)	Correlation Coefficient	-.060	.090	-.077
	Sig. (2-tailed)	.599	.426	.499
	N	80	80	80
Vastus Lateralis Mid Belly of Muscle (Latent)	Correlation Coefficient	-.062	.005	.030
	Sig. (2-tailed)	.588	.963	.789
	N	80	80	80
Vastus Lateralis Proximal Muscular Portion (Latent)	Correlation Coefficient	**-.278***	.122	.013
	Sig. (2-tailed)	**.013**	.281	.909
	N	80	80	80

Vastus Intermedialis Tendinous Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Distal Muscular Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Mid Belly of Muscle (Latent)	Correlation Coefficient	-.163	-.063	**.238***
	Sig. (2-tailed)	.150	.580	**.034**
	N	80	80	80
Vastus Intermedialis Proximal Muscular Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Tendinous Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Distal Muscular Portion (latent)	Correlation Coefficient	-.097	.015	-.003
	Sig. (2-tailed)	.393	.894	.981
	N	80	80	80
Rectus Femoris Mid Belly of Muscle (Latent)	Correlation Coefficient	.184	-.152	-.003
	Sig. (2-tailed)	.103	.179	.981
	N	80	80	80
Rectus Femoris Proximal Muscular Portion (latent)	Correlation Coefficient	.079	-.214	.053
	Sig. (2-tailed)	.485	.056	.641
	N	80	80	80

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.11 Correlation between Subjective Pain perception from the PPSS and the Location of Active MTrp's:

Table 4.4.11

		Pain is mild	Pain is moderate	Pain is severe
Vastus Medialis Tendinous Portion (Active)	Correlation Coefficient	-.094	-.098	.114
	Sig. (2-tailed)	.407	.389	.314
	N	80	80	80
Vastus Medialis Distal Muscular Portion (Active)	Correlation Coefficient	-.104	.106	.058
	Sig. (2-tailed)	.357	.350	.609
	N	80	80	80
Vastus Medialis Mid Belly of Muscle (Active)	Correlation Coefficient	-.097	.015	-.003
	Sig. (2-tailed)	.393	.894	.981
	N	80	80	80
Vastus Medialis Proximal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Lateralis Tendinous Portion (Active)	Correlation Coefficient	**-.236***	.101	.149
	Sig. (2-tailed)	**.035**	.370	.186
	N	80	80	80
Vastus Lateralis Distal Muscular Portion (Active)	Correlation Coefficient	**-.246***	-.050	.188
	Sig. (2-tailed)	**.028**	.661	.096
	N	80	80	80
Vastus Lateralis Mid Belly of Muscle (Active)	Correlation Coefficient	**-.229***	.086	.146
	Sig. (2-tailed)	**.041**	.448	.196
	N	80	80	80
Vastus Lateralis Proximal Muscular Portion (Active)	Correlation Coefficient	**-.266***	.146	.119
	Sig. (2-tailed)	**.017**	.195	.293
	N	80	80	80

		Pain is mild	Pain is moderate	Pain is severe
Vastus Intermedialis Tendinous Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Distal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Mid Belly of Muscle (Active)	Correlation Coefficient	-.097	-.152	.195
	Sig. (2-tailed)	.393	.179	.083
	N	80	80	80
Vastus Intermedialis Proximal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Tendonis Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Distal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Mid Belly of Muscle (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Proximal Muscular Portion (Active)	Correlation Coefficient	-.138	.141	.039
	Sig. (2-tailed)	.223	.212	.728
	N	80	80	80

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

4.4.12 Correlation between Subjective Pain perception from the PPSS and the Number of the MTrp's:

Table 4.4.12

		Pain is mild	Pain is moderate	Pain is severe
Total Number of MTrp's	Correlation Coefficient	**-.337****	.073	.157
	Sig. (2-tailed)	**.002**	.520	.163
	N	80	80	80
Number of Latent MTrp's	Correlation Coefficient	-.105	.008	.016
	Sig. (2-tailed)	.354	.946	.886
	N	80	80	80
Number of Active MTrp's	Correlation Coefficient	**-.312****	.049	**.232***
	Sig. (2-tailed)	**.005**	.664	**.038**
	N	80	80	80

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.13 Correlation between Duration in Months and Number of MTrp's (total, latent and active):

Table 4.4.13

		Duration in Months
Total Number of MTrp's	Correlation Coefficient	.079
	Sig. (2-tailed)	.488
	N	80
Number of Latent MTrp's	Correlation Coefficient	-.037
	Sig. (2-tailed)	.747
	N	80
Number of Active MTrp's	Correlation Coefficient	.158
	Sig. (2-tailed)	.163
	N	80

** Correlation is significant at the .01 level (2-tailed).

4.4.14 Correlation between Myofascial Diagnostic Scale and Number of MTrp's (total, latent and active):

Table 4.4.14

		Myofascial Diagnostic Scale
Total Number of MTrp's	Correlation Coefficient	**.715****
	Sig. (2-tailed)	**.000**
	N	80
Number of Latent MTrp's	Correlation Coefficient	.146
	Sig. (2-tailed)	.196
	N	80
Number of Active MTrp's	Correlation Coefficient	**.846****
	Sig. (2-tailed)	**.000**
	N	80

** Correlation is significant at the .01 level (2-tailed).

4.4.15 Correlation between Myofascial Diagnostic Scale and Algometer readings of the QF muscle:

Table 4.4.15

		Myofascial Diagnostic Scale
Vastus Medialis Mean Algometer Readings	Correlation Coefficient	-.061
	Sig. (2-tailed)	.718
	N	37
Vastus Lateralis Mean Algometer Readings	Correlation Coefficient	**-.328**
	Sig. (2-tailed)	**.007**
	N	66
Vastus Intermedialis Mean Algometer Readings	Correlation Coefficient	-.089
	Sig. (2-tailed)	.833
	N	8
Rectus Femoris Mean Algometer Readings	Correlation Coefficient	-.263
	Sig. (2-tailed)	.203
	N	25
Quadriceps Femoris Mean Algometer Readings	Correlation Coefficient	**-.313**
	Sig. (2-tailed)	**.006**
	N	75

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.16 Correlation between the Number of the MTrp's and the Location of Latent MTrp's in the QF muscle:

Table 4.4.16

		Total Number of MTrp's	Number of Latent MTrp's	Number of Active MTrp's
Vastus Medialis Tendinous Portion (Latent)	Correlation Coefficient	.042	.203	-.041
	Sig. (2-tailed)	.715	.071	.721
	N	80	80	80
Vastus Medialis Distal Muscular Portion (Latent)	Correlation Coefficient	**.258***	.177	**.244***
	Sig. (2-tailed)	**.021**	.116	**.029**
	N	80	80	80
Vastus Medialis Mid Belly of Muscle (Latent)	Correlation Coefficient	**.293****	**.315****	**.302****
	Sig. (2-tailed)	**.008**	**.004**	**.006**
	N	80	80	80
Vastus Medialis Proximal Muscular Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Lateralis Tendinous Portion (Latent)	Correlation Coefficient	.021	.048	-.048
	Sig. (2-tailed)	.851	.675	.673
	N	80	80	80
Vastus Lateralis Distal Muscular Portion (Latent)	Correlation Coefficient	**.248***	**.379****	-.066
	Sig. (2-tailed)	**.027**	**.001**	.558
	N	80	80	80
Vastus Lateralis Mid Belly of Muscle (Latent)	Correlation Coefficient	**.296***	**.705****	**-.223***
	Sig. (2-tailed)	**.008**	**.000**	**.046**
	N	80	80	80
Vastus Lateralis Proximal Muscular Portion (Latent)	Correlation Coefficient	**.441****	.155	**.456****
	Sig. (2-tailed)	**.000**	.171	**.000**
	N	80	80	80

		Total Number of MTrp's	Number of Latent MTrp's	Number of Active MTrp's
Vastus Intermedialis Tendinous Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Distal Muscular Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Mid Belly of Muscle (Latent)	Correlation Coefficient	.241	.294	.108
	Sig. (2-tailed)	.031	.008	.342
	N	80	80	80
Vastus Intermedialis Proximal Muscular Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Tendonis Portion (Latent)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Distal Muscular Portion (latent)	Correlation Coefficient	.121	.020	.141
	Sig. (2-tailed)	.285	.860	.212
	N	80	80	80
Rectus Femoris Mid Belly of Muscle (Latent)	Correlation Coefficient	-.141	-.087	-.099
	Sig. (2-tailed)	.213	.441	.385
	N	80	80	80
Rectus Femoris Proximal Muscular Portion (latent)	Correlation Coefficient	.006	.094	-.020
	Sig. (2-tailed)	.959	.404	.859
	N	80	80	80

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

4.4.17 Correlation between the Number of the MTrp's and the Location of Active MTrp's in the QF:

Table 4.4.17

		Total Number of MTrp's	Number of Latent MTrp's	Number of Active MTrp's
Vastus Medialis Tendinous Portion (Active)	Correlation Coefficient	**.286***	.177	**.237***
	Sig. (2-tailed)	**.010**	.117	**.035**
	N	80	80	80
Vastus Medialis Distal Muscular Portion (Active)	Correlation Coefficient	**.320***	.048	**.414****
	Sig. (2-tailed)	**.004**	.670	**.000**
	N	80	80	80
Vastus Medialis Mid Belly of Muscle (Active)	Correlation Coefficient	.121	-.087	.184
	Sig. (2-tailed)	.285	.441	.103
	N	80	80	80
Vastus Medialis Proximal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Lateralis Tendinous Portion (Active)	Correlation Coefficient	**.446****	**.253***	**.398****
	Sig. (2-tailed)	**.000**	**.024**	**.000**
	N	80	80	80
Vastus Lateralis Distal Muscular Portion (Active)	Correlation Coefficient	**.558***	-.004	**.721****
	Sig. (2-tailed)	**.000**	.972	**.000**
	N	80	80	80
Vastus Lateralis Mid Belly of Muscle (Active)	Correlation Coefficient	**.574****	-.131	**.870****
	Sig. (2-tailed)	**.000**	.248	**.000**
	N	80	80	80
Vastus Lateralis Proximal Muscular Portion (Active)	Correlation Coefficient	**.277***	-.093	**.345****
	Sig. (2-tailed)	**.013**	.413	**.002**
	N	80	80	80

		Total Number of MTrp's	Number of Latent MTrp's	Number of Active MTrp's
Vastus Intermedialis Tendinous Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Distal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Vastus Intermedialis Mid Belly of Muscle (Active)	Correlation Coefficient	.077	.020	.080
	Sig. (2-tailed)	.500	.860	.481
	N	80	80	80
Vastus Intermedialis Proximal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Tendinous Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Distal Muscular Portion (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Mid Belly of Muscle (Active)	Correlation Coefficient	.	.	.
	Sig. (2-tailed)	.	.	.
	N	80	80	80
Rectus Femoris Proximal Muscular Portion (Active)	Correlation Coefficient	**.328****	.074	**.420****
	Sig. (2-tailed)	**.003**	.516	**.000**
	N	80	80	80

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

CHAPTER FIVE:

DISCUSSION OF THE RESULTS

5.0 Introduction:

This chapter involves the discussion of the demographic data and the results after statistical analysis of the data obtained from the subjective (NRS and the Patellofemoral Pain Severity Scale component) and objective (algometer readings, Myofascial Diagnostic Scale readings, Patellofemoral Pain Severity Scale component, duration of condition and location of MTrp's readings) correlation tests. Problems encountered through the course of this study are also discussed in this chapter.

The results will be discussed in two parts:

- Demographic data
- Correlation comparisons

5.1 Demographic Data:

5.1.1 Age distribution:

See table 4.2.1

The results show that of the 80 patients that participated in the study the highest percentage 36.3% of participants were in the age group of 26 – 35 years. It does not appear to correlate well with the general picture of PFPS, which is frequently seen in young adults with subjects mostly between the ages of 10-20 years (Kannus et al., 1999), however this is also a function of the age restrictions that where used as part of this study. Further research should reconsider this age group restriction and incorporate subjects younger than 18 years of age.

In terms of the MPS, there seems to be a greater correlation, which supports the hypotheses that people of any age can develop active myofascial trigger points, which leads to Myofascial Pain Syndrome, but people between the ages of 30-49 are more commonly plagued by the condition, which then decreases with age (Han and Harrison, 1997:90). With advancing age comes reduced activity and the stiffness and restricted range of motion of latent myofascial trigger points becomes more prominent than the pain of active myofascial trigger points (Travell, Simons and Simons, 1999 1:13).

5.1.2 Gender Distribution:

See table 4.2.2

The results show that 63.1 % of participants were male and 38.8 % were female. This result does not appear to correlate with either the PFPS or the MPS.

Hou et al., (2002:1411-1412) report that Myofascial Pain Syndrome occurs in both sexes however it appears to be more common in females as found in their study where of the 119 individuals treated for Myofascial Pain Syndrome, 107 were female.

This predominance of female presentations seems to be prevalent in PFPS as well, where it is significantly common in female athletes (Salem and Powers, 2001). This is supported by Davidson (1993), who also commented on the higher incidence amongst women.

The possibility may be that men delay in seeking treatment for their condition, which therefore increases the chances of a worsened clinical presentation. The higher percentage of males participating in this study does however correlate with findings in other South African studies on PFPS (Stakes, 2000; Clifton, 2003).

This does not however conclusively explain the high prevalence of males in this study which maybe as a result of a relatively small sample size, when looking at incidence / prevalence and correlation studies.

5.1.3 Sport Distribution:

See table 4.2.3

Running was the most common form of exercise with 18.8% of patients. Cycling and other (aerobics, dancing, yoga, karate and fencing) each had 13.8% of patients.

The higher incidence of runners appears to correlate with both PFPS and MPS, as indicated by Salem and Powers (2001), who found that athletes who participate in sports that involve running activities are at greater risk of developing patellofemoral joint related injuries. Travell and Simons (1983:266) found that the QF muscle is likely to develop MTrp's as a result of strenuous athletic activity such as running.

The high percentage associated with swimming maybe attributed to the time of the study, prior to the annual Midmar Mile swim. Had the study been conducted at another time of the year it is the researcher's opinion that this percentage would not be as high. Other sports such as rugby or basketball may have featured more strongly had the study been conducted during these sports seasons.

It is noted that a high percentage of participants did not participate in any form of exercise. Walsh (1994) stated that the patellofemoral joint is a major source of pain and dysfunction in both the sedentary and athletic population. It is hypothesized that this high percentage of inactive participants could be due to prior injury, incorrect / no treatment and / or rehabilitation and persistence of the condition (for example faulty ergonomics).

This is supported by the fact that the mean duration of condition was noted at 39.8 months (3.31 year), which indicates the persistence of the presenting condition. An inverse relationship between the increase in months of duration and sporting activities (or lack thereof) (see table 5.1.3) lends further support in terms of this theory, however this relationship is insignificant possibly due to the small sample size of the respective subgroup (inactive persons). Further research into this area is recommended.

		Duration in Months
Sporting Activities	Correlation Coefficient	-.059
	Sig. (2-tailed)	.600
	N	80

Table 5.1.3

5.1.4 Duration of Condition:

See table 4.2.4

The range of presentation of patients presenting for the study indicated a minimum duration in any one patient of 0.25 months (1 week) and the maximum duration of 360 months (30 years).

The mean was therefore calculated at 39.8 months (3.3 years), with a standard deviation of 72.8 months (6.06 years).

This concurs with the definition of PFPS which indicates that it is a chronic condition (Blond and Hansen, 1998) as well as the hypothesis that myofascial pain syndrome can be a chronic overuse syndrome in its presentation (Chaitow and Delany, 2002:20).

Previous South African studies into treatment protocols in PFPS have not noted the duration of PFPS in the study (Stakes, 2000; Clifton, 2003). However the findings in this study appear to correlate with one South African based study on PFPS (Rowlands, 1999), where the mean duration of PFPS amongst subjects was found to be 3.7 years

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5.2. Demographics of the MTrp’s:

5.2.1 Total Number of MTrp’s:

See table 4.2.5.1a

The range of number of MTrp’s of patients presenting for the study indicated a minimum number in any one patient of 0 and the maximum number was 12.

The mean was therefore calculated at 4.11 MTrp’s, with a standard deviation of 2.21 MTrp’s.

The results show that 95% of patients presented with MTrp’s.

5.2.2 Number of Active MTrp’s:

See table 4.2.5.2a

The range of number of active MTrp’s of patients presenting for the study indicated a minimum number in any one patient of 0 and the maximum number was 7.

The mean was therefore calculated at 1.26 MTrp’s, with a standard deviation of 1.64 MTrp’s.

The results show that 46.2% of patients presented with active MTrp’s.

5.2.3 Number of Latent MTrp's:

See table 4.2.5.3a

The range of number of latent MTrp's of patients presenting for the study indicated a minimum number in any one patient of 0 and the maximum number was 7.

The mean was therefore calculated at 2.86 MTrp's, with a standard deviation of 1.42 MTrp's.

The results show that 95% of patients presented with latent MTrp's

In summary, this high proportion of myofascial trigger points (active and latent) could potentially account for the presence of the following within the quadriceps femoris muscle group:

- Characteristic referred pain and referred tenderness
- Muscular Weakness
- Stiffness of the effected muscle.
- Decreased stretch range of motion.

[Travell, Simons and Simons, 1999:1-5]

The above-mentioned signs and symptoms could be misinterpreted / misdiagnosed as PFPS, due to the fact that they would cause an extensor mechanism dysfunction (Juhn, 1999).

5.2.4 Location of Latent MTrp's:

1. **The Vastus Medialis Muscle (VM):**

   The most common location was the distal muscular portion of the VM with 31.3%.

2. **The Vastus Lateralis Muscle (VL):**

   The common location was the mid belly of the VL with 60 %.

3. <u>The Vastus Intermedialis Muscle (VIM):</u>

MTrp's were only noted in one area of this muscle, the mid belly of the muscle with 6.3%

4. **<u>The Rectus Femoris Muscle (RF):</u>**

The most common location was the proximal muscular portion with 23.8%.

5.2.5 Location of Active MTrp's:

1. **The Vastus Medialis Muscle:**

   The most common location was the distal muscular portion with 6.3%.

2. **The Vastus Lateralis Muscle:**

   The mid belly of the muscle was the most common location with 37.6%.

3. **The Vastus Intermedialis Muscle:**

   Only the mid belly of the muscle was found to contain MTrp's with 1.3%

4. **The Rectus Femoris Muscle:**

   The only location to contain MTrp's is the proximal muscular portion with 7.5%.

The above locations of myofascial trigger points result in the signs and symptoms noted in the following table, which compares these signs and symptoms to that of Patellofemoral Pain Syndrome.

MTrp Location	Patellofemoral Pain Syndrome
Vastus Medialis • Pain referral to the anterior knee, medial aspect of the knee and some to deep within the knee joint. • Prolonged kneeling on a hardened floor may aggravate VM MTrp's	• Peripatella or retropatella pain • Pain on kneeling
Vastus Lateralis • Pain around the lateral boarder of the patella • MTrp's in the distal end of the VL can immobilize the patella. Partial loss of normal patella movement can result in difficulty in straightening or bending the knee.	• Peripatella pain • Patella mobility restriction
Vastus Intermedialis • Pain on climbing stairs	• Pain worsened with ascending stairs

Rectus Femoris • Pain at the knee, in and around the patella and occasionally deep within the knee joint • Pain on descending stairs	• Peripatella or Retropatella pain • Pain worsened with descending stairs
Quadriceps Femoris • MTrp's are likely to be aggravated by strenuous athletic activity such as running, basketball, football or skiing. • Deep knee bends may perpetuate MTrp's in all muscle groups • When a muscle with an active MTrp is strongly contracted against resistance the patient feels pain.	• Pain worsened with physical activity • Pain on deep squats • Pain on isometric quadriceps femoris contractions

Table 5.2.5

The above MPS table is compiled with references from: Travell and Simons, 1983:248-288; Travell, Simons and Simons; 1999 1:19; Chaitow and Delany, 2002:20.

The above PFPS table is compiled with references from: Davidson, 1993; Delee and Drez, 1994; Walsh, 1994; Powers, Landel and Perry, 1996; Suter et al., 1998; Juhn,1999; Salem and Powers, 2001.

Although myofascial trigger points were found in all four-component muscles of the quadriceps, the most common location of active myofascial trigger points was the mid belly and the distal muscular portion of the vastus lateralis.

The lateral retinaculam and the vastus lateralis muscle stabilize the patella laterally (Bose et al., 1980; Moore and Dalley, 1999: 619). The proximal end of the deep lateral retinaculum fibers interdigitate with the vastus lateralis insertion into the patella forming the epicondylopatellar band (Fulkerson, 1989).

Papagelopoulos and Sim (1997), Blond and Hansen (1998) and Post (1998), state that a tight lateral retinaculam may result in abnormal patella tracking.

MTrp tension in the distal portion of the vastus lateralis muscle may result in loss of normal patella movement especially in a medial direction (Travell and Simons, 1983:267; Chaitow and Delany, 2002:484).

A similar picture can be seen on the medial aspect. The distal muscular portion of the vastus medialis also contained a significant amount of active MTrp's. Medially the stability of the patella is provided by the medial retinaculam and the vastus medialis obliquus (Bose et al., 1980; Moore and Dalley, 1999: 619).

MTrp's in the vastus medialis muscle may restrict normal lateral mobility of the patella (Travell and Simons, 1983:267).

It is there for recommended that further studies examine the effect that MTrp's have on mobility of the patella, using Kolowich et al. (1990) patella mobility grading system and therefore comparing patella tracking in PFPS to the presence of MTrp's.

5.3 Statistical Results for Correlation Comparison:

For all correlation statistics the following level of significance have been applied and indicated:

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

5.3.1 Correlation between the Total Number of MTrp's and the Number of Latent and Active MTrp's:

		Total Number of MTrp's
Number of Latent MTrp's	Correlation Coefficient	**.616****
	Sig. (2-tailed)	**.000**
	N	80
Number of Active MTrp's	Correlation Coefficient	**.739****
	Sig. (2-tailed)	**.000**
	N	80

Taken from table 4.4.1

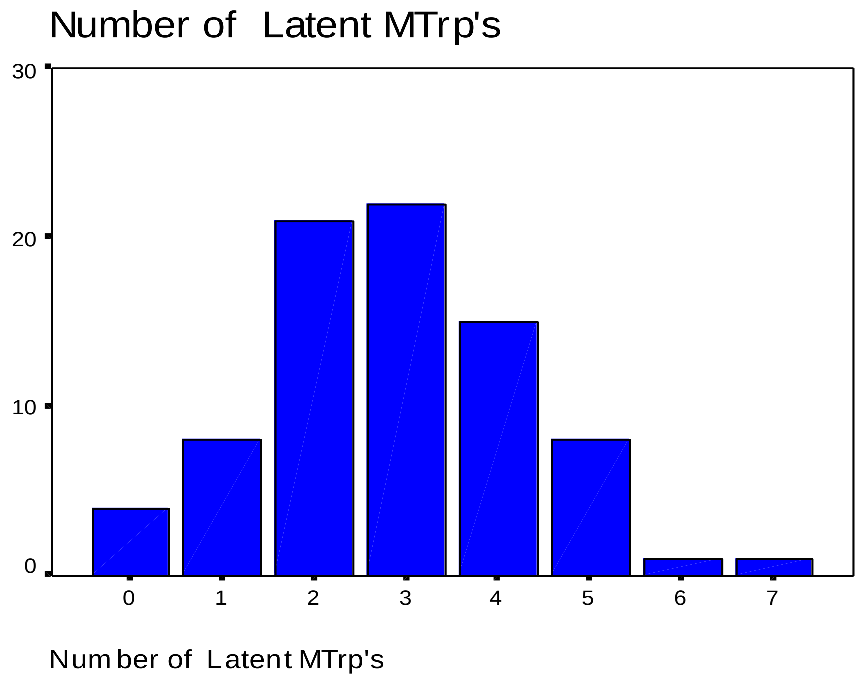

Figure 4.3.5.3

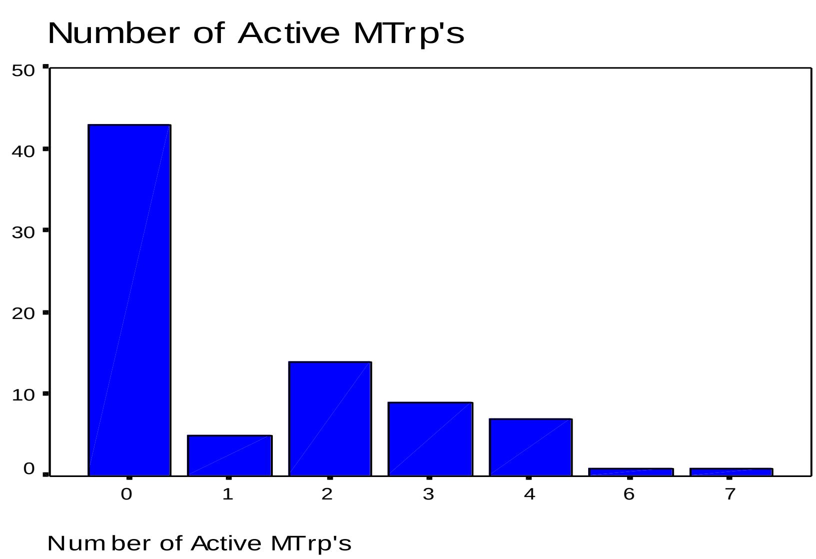

Figure 4.3.5.2

A positive correlation exists between both active and latent MTrp's and the total number of MTrp's found, indicating that as the total number of MTrp's increased, the number of active MTrp's increased significantly. Interestingly however the latent MTrp's did present significantly as well.

This indicates that as the frequency of active MTrp's increases (and the number increases) there is a concomitant initial increase and then a decrease in the frequency and number of latent MTrp's.

According to Travell, Simons and Simons (1999 1:19) and Chaitow and Delany (2002:20), this phenomenon appears as the musculature first develops latent MTrp's in response to overuse. As this overuse becomes more severe the latent MTrp's become active (therefore a decrease in latent presentation) and the patient presents with overt clinical symptoms. At this point the patient inevitably seeks treatment and the number of presenting patients with active MTrp's decreases.

Patellofemoral Pain Syndrome is defined as a syndrome that may develop due to repetitive trauma (Davidson, 1993), which indicates that prior to the musculature developing overt clinical signs and symptoms, there is inherent musculature overload (or repetitive overuse). This would, in theory, support the development of latent MTrp's in the initial sub-clinical overload phase of the condition and the presence of active MTrp's at that point where the PFPS becomes an overt clinical syndrome.

5.3.2 Correlation between NRS and the Subjective Component of the PPSS:

		Numerical Rating Scale
1-Pain on Prolonged Sitting	Correlation Coefficient	**.316****
	Sig. (2-tailed)	**.004**
	N	80
2-Pain on kneeling	Correlation Coefficient	**.388****
	Sig. (2-tailed)	**.000**
	N	80
3-Pain is mild	Correlation Coefficient	**-.549****
	Sig. (2-tailed)	**.000**
	N	80
4-Pain is severe	Correlation Coefficient	**.431****
	Sig. (2-tailed)	**.000**
	N	80

Taken from table 4.4.2

With points 1,2,4, there is a correlation between NRS and prolonged sitting, kneeling and severe pain. Patients therefore reported increased pain with increased active MTrp's as well as the PFPS severity (as the NRS is a subjective pain rating scale (Liggins, 1989) and does not distinguish between pain of PFPS or MTrp's origin).

However this table above seems to indicate that the NRS reading reports myofascial involvement, because of the inverse relationship of the mild pain, indicating that there is an increase in one of the syndromes. This cannot be the PFPS as this definition (Wood, 1998) indicates that a patient should report increased peripatella or retropatella pain as the syndrome increases in severity. Therefore the inference made is that the NRS indicates that it reads the myofascial pain, as there is an increase in the number of latent MTrp's (explaining the inverse relationship).

This inference concurs with Travell, Simons and Simons (1999:4), who describe a latent MTrp as one that is clinically quiescent with respect to spontaneous pain and only refers pain when palpated. Therefore there is no spontaneous pain referral and no perception of pain by the patient, which by default can therefore not be recorded on the NRS.

The researcher therefore questions whether the above tests (pain on prolonged sitting and pain on kneeling) indicate a positive diagnosis of PFPS or do they indicate MTrp's associated with PFPS?

5.3.3.0 Correlation between NRS and the Objective Component of the PPSS:

		Numerical Rating Scale
1-Objective Evaluation of Pain worsened with Physical Activity	Correlation Coefficient	**-.309****
	Sig. (2-tailed)	**.005**
	N	80
2-Objective Evaluation of Pain on Deep Squat	Correlation Coefficient	**-.226***
	Sig. (2-tailed)	**.044**
	N	80
3-Objective Evaluation of Pain on Kneeling	Correlation Coefficient	**-.389****
	Sig. (2-tailed)	**.000**
	N	80
4-Objective Evaluation of Pain is Mild	Correlation Coefficient	**.561****
	Sig. (2-tailed)	**.000**
	N	80
5-Objective Evaluation of Pain is Severe	Correlation Coefficient	**-.471****
	Sig. (2-tailed)	**.000**
	N	80

Taken from table 4.4.3.0

For interpretation purposes, it should be noted that the data was captured with 1=yes and 2=no responses by the researcher.

Therefore in objective 1 above, where there is an increase in the reported Objective Evaluation of Pain, which is worsened with Physical Activity, that there is an associated increase in the NRS. The inverse relationship indicated by the correlation (i.e. decrease in the recorded response by the researcher) can be explained by the fact that all “Yes” responses where marked with a 1 in the data coding process.

This indicates that the objective 1 was present and significant in correlating with the NRS.

The inverse relationship and explanation thereof are applicable to the objective evaluations (2-5).

Travell and Simons (1983:248-288) and Chaitow and Delany (2002:483-486), indicate in their etiologies that 1,2,3 are factors that predispose patients to the development and perpetuation of MTrp's and that such tests could perceivably cause an irritation of the trigger points in PFPS and therefore lead the patient to report and the researcher to record such an increase in pain.

The above activities that have been linked with Patellofemoral Pain Syndrome, have also been shown to increase the likelihood / aggravate myofascial trigger points, this is especially true of the MTrp's of the quadriceps that result from strenuous athletic activity such as running, basketball, football or skiing (Travell and Simons, 1983:266). Further to this, deep knee bends and prolonged kneeling on a hardened floor have been associated with the aggravation / perpetuation of MTrp's in the QF muscle (Travell and Simons, 1983:265).

The researcher therefore questions whether the above tests (Objective Evaluation of Pain worsened with Physical Activity, Objective Evaluation of Pain on Deep Squat, Objective Evaluation of Pain on Kneeling) indicate a positive diagnosis of PFPS or do they indicate MTrp's associated with the syndrome? Could these tests represent a mixture of the two syndromes? It is the researchers opinion that this test indicates a mixture of both syndromes.

5.3.3.1 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Prolonged Sitting:

Numerical Rating Scale	Objective Evaluation of Pain on Prolonged Sitting		Total
	Yes	No	
2	1	1	2
3	9	2	11
4	10	4	14
5	11	5	16
6	15	3	18
7	12	2	14
8	5		5
Total	63	17	80

Taken from Table 4.4.3.1

There appears to be a correlation between the NRS and the “yes” answer. Pain worsened with prolonged sitting has been shown to aggravate both PFPS and MPS (Powers et al., 1996; Travell and Simons, 1983:248-288). Does this test then indicate MTrp’s associated with the syndrome?

Therefore the question arises as to whether MTrp’s are precipitated by, concomitant with or a cause of PFPS? As this research did not attempt to identify precipitating factors, causative factors and only established one concomitant factor; further research into the role of MTrp’s in PFPS may help to answer this question.

5.3.3.2 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Ascending or Descending Stairs:

Numerical Rating Scale	Objective Evaluation of Pain on Ascending or Descending Stairs		Total
	Yes	No	
2	2		2
3	10	1	11
4	8	6	14
5	15	1	16
6	16	2	18
7	11	3	14
8	5		5
Total	67	13	80

Taken from Table 4.4.3.2

No definitive presentation is noted.

5.3.3.3 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain worsened with Physical Activity:

Numerical Rating Scale	Objective Evaluation of Pain worsened with Physical Activity		Total
	Yes	No	
2	2		2
3	9	2	11
4	9	5	14
5	13	3	16
6	17	1	18
7	14		14
8	5		5
Total	69	11	80

Taken from Table 4.4.3.3

There appears to be a correlation between the NRS and the “yes” answer. Pain worsened with physical activity has been shown to aggravate both PFPS and MPS (Juhn, 1999; Travell and Simons, 1983:248-288).

Further research should focus on whether this test indicates MTrp’s associated with the syndrome or a mixture of the two syndromes.
It is the researchers opinion that this test indicates a mixture of both syndromes.

5.3.3.4 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Deep Squat:

Taken from Table 4.4.3.4

Numerical Rating Scale	Objective Evaluation of Pain on Deep Squat		Total
	Yes	No	
2	1	1	2
3	10	1	11
4	12	2	14
5	16		16
6	17	1	18
7	14		14
8	5		5
Total	75	5	80

Taken from Table 4.4.3.4

Objectively 93% of subjects experienced pain on a deep squat.

There appears to be a correlation between the NRS and the “yes” answer.

Pain worsened with a deep squat has been shown to aggravate both PFPS and MPS (Powers et al., 1996; Travell and Simons, 1983:248-288). This raises the question of whether the test indicates the presence of MTrp’s associated with PFPS as appose to the test being an indication of only PFPS?

Further research in this regard is necessary.

5.3.3.5 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Kneeling:

Numerical Rating Scale	Objective Evaluation of Pain on Kneeling		Total
	Yes	No	
2	1	1	2
3	5	6	11
4	9	5	14
5	12	4	16
6	14	4	18
7	14		14
8	5		5
	60	20	80

Taken from Table 4.4.3.5

There appears to be a correlation between the NRS and the “yes” answer. Pain worsened with kneeling has been shown to aggravate both PFPS and MPS (Powers et al., 1996; Travell and Simons, 1983:248-288). Does this test then indicate MTrp’s associated with the syndrome?

Further research in this regard is necessary.

5.3.3.6 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain on Isometric Quadriceps Contraction:

Numerical Rating Scale	Objective Evaluation of Pain on Isometric Quadriceps Contraction		Total
	Yes	No	
2		2	2
3	2	9	11
4	4	10	14
5	6	10	16
6	8	10	18
7	5	9	14
8	2	3	5
Total	27	53	80

Taken from Table 4.4.3.6

Latent myofascial trigger points are reported to cause muscular weakness and dysfunction (Travell, Simons and Simons, 1999:1), thus even though the patient may not have severe pain, there could well be evidence of muscular weakness, which can be recorded objectively in terms of the isometric contraction of the quadriceps muscle (Suter et al., 2000). Further to this the patient with active myofascial trigger points will also not demonstrate an increased isometric contraction due to muscular pain inhibition (Suter et al., 2000). These two clinical scenarios were recorded by the researcher as no pain on an isometric contraction.

5.3.3.7 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain around or behind the Kneecap:

Numerical Rating Scale	Objective Evaluation of Pain around or behind the Kneecap	Total
	Yes	
2	2	2
3	11	11
4	14	14
5	16	16
6	18	18
7	14	14
8	5	5
Total	80	80

Taken from Table 4.4.3.7

For patients to participate in the study one of the diagnostic inclusion criteria was that they presented with retro or peri-patella pain, therefore the objective findings would have reflected this criterion.

The above correlation also gives an indication of the severity of the condition. The correlation appears to be more between the mild and moderate pain as oppose to severe pain. This may be due to the nature of the condition, only 6 % of subjects reported having severe pain (NRS 8-10).

5.3.3.8 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain is Mild:

Numerical Rating Scale	Objective Evaluation of Pain is Mild		Total
	Yes	No	
2	2		2
3	8	3	11
4	6	8	14
5	4	12	16
6	1	17	18
7		14	14
8		5	5
Total	21	59	80

Taken from Table 4.4.3.8

As the patient's perception of pain increased, the objective value allocated to mild pain (NRS allocation 1-3) decreased.

5.3.3.9 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain is Moderate:

Numerical Rating Scale	Objective Evaluation of Pain is Moderate		Total
	Yes	No	
2		2	2
3	3	8	11
4	8	6	14
5	12	4	16
6	16	2	18
7	6	8	14
8	2	3	5
Total	47	33	80

Taken from Table 4.4.3.9

An inverse correlation was noted. As the patient's perception of pain increased, the objective value allocated to moderate pain (NRS 4-7) decreased.

5.3.3.10 Cross tabulation of Numerical Rating Scale and Objective Evaluation of Pain is Severe:

Numerical Rating Scale	Objective Evaluation of Pain is Severe		Total
	Yes	No	
2		2	2
3		11	11
4		14	14
5		16	16
6	1	17	18
7	8	6	14
8	3	2	5
Total	12	68	80

Taken from Table 4.4.3.10

A positive correlation is noted. As the patient's perception of pain increased, the objective value allocated to severe pain (NRS 7-9) increased.

5.3.4 Correlation between NRS and the Myofascial Diagnostic Scale:

		Myofascial Diagnostic Scale
Numerical Rating Scale	Correlation Coefficient	**.434****
	Sig. (2-tailed)	**.000**
	N	80

Taken from table 4.4.4

The above results indicate that there is a high correlation between the MDS and the NRS.

With reference to the results generated in 5.3.2, 5.3.3 and the high correlation found here, the inference that the subjective NRS measures MFTP more closely than it measures the intensity of the pain associated with PFPS becomes stronger.

However, this would be an inference and correlation that would require further clinical studies to gain added support.

5.3.5 Correlation between NRS and the Location of Latent MTrp's in the QF Muscle Group:

		Numerical Rating Scale
1-Vastus Lateralis Tendinous Portion (Latent)	Correlation Coefficient	**-.421****
	Sig. (2-tailed)	**.000**
	N	80
2-Vastus Lateralis Proximal Muscular Portion (Latent)	Correlation Coefficient	**.259****
	Sig. (2-tailed)	**.021**
	N	80

Taken from table 4.4.5

See discussion under 5.3.6.

5.3.6 Correlation between NRS and the Location of Active MTrp's in the QF Muscle Group:

		Numerical Rating Scale
3-Vastus Medialis Tendinous Portion (Active)	Correlation Coefficient	**.225***
	Sig. (2-tailed)	**.045**
	N	80
4-Vastus Medialis Distal Muscular Portion (Active)	Correlation Coefficient	**.244***
	Sig. (2-tailed)	**.029**
	N	80
5-Vastus Lateralis Tendinous Portion (Active)	Correlation Coefficient	**.344****
	Sig. (2-tailed)	**.002**
	N	80
6-Vastus Lateralis Distal Muscular Portion (Active)	Correlation Coefficient	**.401****
	Sig. (2-tailed)	**.000**
	N	80
7-Vastus Lateralis Mid Belly of Muscle (Active)	Correlation Coefficient	**.250****
	Sig. (2-tailed)	**.025**
	N	80

Taken from table 4.4.6

This table indicates that there is an increase in NRS, which is associated with an increase in number of latent MTrp's in the vastus lateralis tendinous portion and the vastus lateralis proximal muscular portion and active MTrp's in the vastus medialis tendinous portion, vastus medialis distal muscular portion, vastus lateralis tendinous portion, vastus Lateralis distal muscular and the vastus lateralis mid belly of muscle

1-Interestingly, vastus lateralis tendinous portion can be seen to have negative correlation in respect of the latent myofascial MTrp's (indicating that as the pain becomes less the latent MTrp's increased in number). This is possibly because latent trigger points do not produce spontaneous pain (Chaitow and Delany, 2002:124). However there is a positive correlation with active MTrp in the vastus lateralis tendinous portion, which indicates that there is an increase in the number of active trigger points with increased pain on the NRS.

2-The vastus lateralis proximal muscular portion however shows that there is a positive correlation between the increase in MTrp's and pain increase (NRS). However latent trigger points do not produce spontaneous pain that can be recorded by the patient or the researcher (Chaitow and Delany, 2002:124). Therefore the inference that is to be made is that as there is an increase in the numbers of active MTrp's in other areas of the quadriceps muscle, the number of latent MTrp's in the vastus lateralis proximal muscular portion increases, but not to the point of becoming active.

According to Travell and Simons (1983:251-272), the proximal portion of the vastus lateralis is not a common area for MTrp presentation (latent or active) and therefore will only be present when the rest of the muscle is overexerted. This proximal portion of the vastus lateralis then becomes engaged in compensating for the loss of ability in the distal vastus lateralis / muscle belly of the vastus lateralis. This relative over activity will result in the development of latent

myofascial trigger points in the proximal vastus lateralis whilst the distal vastus lateralis / muscle belly contain active myofascial trigger points.
This correlates with table 4.4.1, which indicates that as the frequency of active myofascial trigger points increases (and the total number increases) and that there is a concomitant initial increase.

1-7: It is also interesting to note that latent myofascial trigger points only have a significance for latent MTrp's in the VL, followed by an increase in the development of active MTrp's in the VL and concomitant with the VM. Therefore the implication that arises is that the presentation of VM signs and symptoms may actually be secondary to the development of the myofascial component of the VL.

It is therefore recommended that further research into this area (VM rehabilitation), where the focus of the research is directed at the correction of VL, with outcomes measuring the response from VM.

5.3.7 Correlation between NRS and the Number of MTrp's (total, active and latent):

		Numerical Rating Scale
Total Number of MTrp's	Correlation Coefficient	**.436****
	Sig. (2-tailed)	**.000**
	N	80
Number of Active MTrp's	Correlation Coefficient	**.442****
	Sig. (2-tailed)	**.000**
	N	80

Taken from table 4.4.7

As inferred above, the NRS seems to only measure the active MTrp's and therefore a high correlation is naturally expected. This indicates that the NRS is a measure of the active MTrp pain production as opposed to the PFPS pain.
But this should not be interpreted such that the latent are insignificant as seen in table 4.4.1.

It is therefore recommended that further research is needed for correlating the recorded pain scores of the NRS with the number of active MTrp's and their pain production.

5.3.8 Correlation between NRS and the Mean Algometer readings of the QF muscle:

In theory the hypothesis is that with an increase in the NRS (pain rating), there should be a decrease in the mean algometer reading, however no correlations were found. The following reasons given could contribute in part to this insignificance.

Algometer is better for pre and post measurements (Fischer, 1987:207) on a single subject and inter-subject comparisons, as a baseline reading for the subjects under study can be achieved.

In this study the algometer readings where complicated by:

- Pain threshold of the various subjects
- Sensitivity of the subjects
- BMI of the subjects
- Psychosocial background of the subjects.
- No baseline reading being available for the subjects under study and therefore intra-patient comparisons cannot be captured and effectively compared. The use of inter-patient comparisons decreases the sensitivity and reliability of the algometer as different patients respond differently to the use of the algometer in once off readings.

It is thus recommended that future studies in this respect should not use the algometer as a measurement tool in the severity of MTrp’s. Further to this, it is recommended that future studies look at developing another tool for the measurement of objective pain rating.

5.3.9 Correlation between Subjective Pain perception from the PPSS and the Myofascial Diagnostic Scale:

		Pain is mild	Pain is moderate	Pain is severe
Myofascial Diagnostic Scale	Correlation Coefficient	**-.310****	.041	**.312****
	Sig. (2-tailed)	**.005**	.721	**.005**
	N	80	80	80

Taken from table 4.4.9

From the table above, it can be seen that patients reported increased pain with increased active myofascial trigger point severity as well as the subjective PFPS severity (table 4.4.2). When this is combined with table 4.4.4, it shows that the NRS, which is a subjective pain rating questionnaire / scale (Liggins, 1989), does not distinguish between pain of PFPS or MTrp origin.

This confirms that the NRS reads the pain of myofascial origin. This assumption is strengthened by the significant inverse relationship indicated between the pain recording (subjective PPSS) and the increase in the rating of the MDS.
This correlation indicates that even though pain decreases, the presentation of the MTrp's as recorded in the MDS increases, because the numbers of active MTrp's decreases and latent MTrp's increase (Travell, Simons and Simons, 1999:4).

This is also true when looking at the significant positive relationship between the MDS and the increase in severity as now the patient could report the an increase in pain with the associated increase in active MTrp's (Travell, Simons and Simons, 1999:4).

These results again indicate that with respect to pain, the MDS, NRS and subjective pain perception of the PPSS are highly correlated and seem to measure MTrp's activity rather than PFPS presentation. In this respect further research is needed.

5.3.10 Correlation between Subjective Pain perception from the PPSS and the Location of the Latent MTrp's:

		Pain is mild	Pain is moderate	Pain is severe
1-Vastus Lateralis Tendinous Portion (Latent)	Correlation Coefficient	**.390****	-.161	-.112
	Sig. (2-tailed)	**.000**	.153	.321
	N	80	80	80
2-Vastus Lateralis Proximal Muscular Portion (Latent)	Correlation Coefficient	**-.278***	.122	.013
	Sig. (2-tailed)	**.013**	.281	.909
	N	80	80	80
3-Vastus Intermedialis Mid Belly of Muscle (Latent)	Correlation Coefficient	-.163	-.063	**.238***
	Sig. (2-tailed)	.150	.580	**.034**
	N	80	80	80

Taken from table 4.4.10

In the Vastus Lateralis muscle the significance indicates that there is a high correlation.

1- Vastus Lateralis Tendinous Portion: as the pain becomes milder the number of active MTrp's decrease, which decreases the pain, but also results in increased latent myofascial trigger points.

2- Vastus Lateralis Proximal Muscular Portion: as the pain decreases the number of active MTrp's decrease, but in this instance the number of latent MTrp's also decrease.

3- Vastus Intermedialis Mid Belly of Muscle: there must be other active MTrp's to register the patient's pain before this muscle gets latent MTrp's.

5.3.11 Correlation between Subjective Pain perception from the PPSS and the Location of Active MTrp's:

		Pain is mild	Pain is moderate	Pain is severe
Vastus Lateralis Tendinous Portion (Active)	Correlation Coefficient	**-.236***	.101	.149
	Sig. (2-tailed)	**.035**	.370	.186
	N	80	80	80
Vastus Lateralis Distal Muscular Portion (Active)	Correlation Coefficient	**-.246***	-.050	.188
	Sig. (2-tailed)	**.028**	.661	.096
	N	80	80	80
Vastus Lateralis Mid Belly of Muscle (Active)	Correlation Coefficient	**-.229***	.086	.146
	Sig. (2-tailed)	**.041**	.448	.196
	N	80	80	80
Vastus Lateralis Proximal Muscular Portion (Active)	Correlation Coefficient	**-.266***	.146	.119
	Sig. (2-tailed)	**.017**	.195	.293
	N	80	80	80

Taken from table 4.4.11

Patients will only report active MTrp's; therefore the correlation with the decreased active MTrp's will indicate that there will be an increased likelihood of mild pain.

This inverse relationship however is not significant for moderate or severe pain. This change in pain status does not however indicate that the increased number of latent MTrp's, as these do not produce overt clinical signs and symptoms (Travell, Simons and Simons, 1999:1-4).

5.3.12 Correlation between Subjective Pain perception from the PPSS and the Number of the MTrp's:

		Pain is mild	Pain is moderate	Pain is severe
Total Number of MTrp's	Correlation Coefficient	**-.337****	.073	.157
	Sig. (2-tailed)	**.002**	.520	.163
	N	80	80	80
Number of Active MTrp's	Correlation Coefficient	**-.312****	.049	.232
	Sig. (2-tailed)	**.005**	.664	.038
	N	80	80	80

Taken from table 4.4.12

Patient will only report active MTrp's; therefore the correlation with the decreased active MTrp's will indicate that there will be an increased likelihood of mild pain. This inverse relationship however is not significant for moderate or severe pain. This change in pain status does not however indicate the increased number of latent MTrp's, as these do not produce overt clinical signs and symptoms (Travell, Simons and Simons, 1999:1-4).

Of the patients that presented 95 % had latent MTrp's therefore the majority of the trigger points did not produce pain and therefore were perceived (by the patient) as mild rather than severe.

5.3.13 Correlation between Duration of Conditions in Months and the Number of MTrp's:

There does not appear to be a correlation between the duration of the condition and the number of latent or active MTrp's, therefore the hypothesis of acute patients having active MTrp's and chronic patients having latent MTrp's is obscured either by:

A. Perpetuating factors (Travell, Simons and Simons, 1999:110-112), in the PFPS such as:
   - Mechanical stresses: for example as skeletal asymmetry (short leg or small hemi pelvis), poor posture, prolonged immobility or muscular abuse.
   - Miscellaneous factors: such as fatigue, cold or damp weather, allergy.

B. By the condition(s) that underlie the pathology of PFPS.
   Davidson (1993) states that PFPS appears to develop under one of two circumstances: anatomical abnormalities or repetitive trauma, which are both seen as perpetuating factors for MTrp's as well (Travell, Simons and Simons, 1999 1:110-112).

5.3.14 Correlation between Myofascial Diagnostic Scale and Number of MTrp's of the QF Muscle:

		Myofascial Diagnostic Scale
Total Number of MTrp's	Correlation Coefficient	**.715****
	Sig. (2-tailed)	**.000**
	N	80
Number of Active MTrp's	Correlation Coefficient	**.846****
	Sig. (2-tailed)	**.000**
	N	80

Taken from table 4.4.14

The positive correlation appears to indicate that as the MDS increases, the number of both active (more significant correlation) and the total number (lesser significant correlation due to larger number of latent MTrp's giving a lower MDS reading) of MTrp's increased significantly.

The MDS has been compiled so as to assess only one MTrp, therefore the results seem to indicate that as the severity of the assessed MTrp increases the number of active and total number of trigger points increases.

Further studies should consider applying the MDS to all MTrp's within a muscle although this is not practical and would be fairly time consuming. A scale that measured the severity of MPS as appose to the severity of a MTrp may be more appropriate.

5.3.15 Correlation Myofascial Diagnostic Scale and Algometer readings of the QF muscle:

		Myofascial Diagnostic Scale
Vastus Lateralis Mean Algometer Readings	Correlation Coefficient	**-.328**
	Sig. (2-tailed)	**.007**
	N	66
Quadriceps Femoris Mean Algometer Readings	Correlation Coefficient	**-.313**
	Sig. (2-tailed)	**.006**
	N	75

Taken from table 4.4.15

The inverse correlation seen above appears to indicate that as the MDS readings increased (the more active the MTrp's became) the algometer readings decreased (the more sensitive the MTrp became), as the patient allowed for lesser pressure (kilogram per square centimeter) via the algometer.

This is explained by the fact that the algometer functions by exerting pressure to the muscle, thereby exacerbating the already sensitive tissues. Therefore on active (acutely painful) MTrp's the algometer gave a decreased algometer (pressure) reading.

The VL muscle was found to contain the most MTrp's and therefore would contain the most active MTrp's (giving the higher MDS readings).

5.3.16 Correlation between the Number of the MTrp's and the Location of Latent MTrp's in the QF muscle:

		Total Number of MTrp's	Number of Latent MTrp's	Number of Active MTrp's
Vastus Medialis Distal Muscular Portion (Latent)	Correlation Coefficient	**.258***	.177	**.244***
	Sig. (2-tailed)	**.021**	.116	**.029**
	N	80	80	80
Vastus Medialis Mid Belly of Muscle (Latent)	Correlation Coefficient	**.293****	**.315****	**.302****
	Sig. (2-tailed)	**.008**	**.004**	**.006**
	N	80	80	80
Vastus Lateralis Distal Muscular Portion (Latent)	Correlation Coefficient	**.248***	**.379****	-.066
	Sig. (2-tailed)	**.027**	**.001**	.558
	N	80	80	80
Vastus Lateralis Mid Belly of Muscle (Latent)	Correlation Coefficient	**.296***	**.705****	**-.223***
	Sig. (2-tailed)	**.008**	**.000**	**.046**
	N	80	80	80
Vastus Lateralis Proximal Muscular Portion (Latent)	Correlation Coefficient	**.441****	.155	**.456****
	Sig. (2-tailed)	**.000**	.171	**.000**
	N	80	80	80

Taken from table 4.4.16

The most significant concentrations of latent MTrp's were found in the following muscles and associated with a significant number of active trigger points in the quadriceps muscle:

- Vastus Medialis Distal Muscular Portion (Latent)
- Vastus Medialis Mid Belly of Muscle (Latent)
- Vastus Lateralis Proximal Muscular Portion (Latent)

The most significant concentrations of latent MTrp's were found in the following muscles and associated with a significant number of latent trigger points in the quadriceps muscle:

- Vastus Medialis Mid Belly of Muscle (Latent)
- Vastus Lateralis Mid Belly of Muscle (Latent)
- Vastus Lateralis Distal Muscular Portion (Latent)

The Vastus Lateralis Mid Belly of Muscle (Latent) indicates that with an increase in active MTrp's there is a decrease in latent MTrp's.

<u>To Summarize:</u>

These results indicate that when a patient presents with overt clinical signs and symptoms of Patellofemoral Pain Syndrome, the patient should be assessed for the presence and treated for the following myofascial trigger points so as to eliminate them as a diagnosis as well as limit the effects of the dysfunctional muscles on the Patellofemoral Pain Syndrome:

- Vastus Medialis Distal Muscular Portion (Latent)
- Vastus Medialis Mid Belly of Muscle (Latent)
- Vastus Lateralis Proximal Muscular Portion (Latent)

The patient must then also be rehabilitated effectively with due concern for the following muscles in respect of minimizing the following latent trigger points which could be a cause / perpetuating factor in patellofemoral pain syndrome

- Vastus Medialis Mid Belly of Muscle (Latent)
- Vastus Lateralis Mid Belly of Muscle (Latent)
- Vastus Lateralis Distal Muscular Portion (Latent)

5.3.17 Correlation between the Number of the MTrp's and the Location of Active MTrp's in the QF:

		Total Number of MTrp's	Number of Latent MTrp's	Number of Active MTrp's
Vastus Medialis Tendinous Portion (Active)	Correlation Coefficient	**.286***	.177	**.237***
	Sig. (2-tailed)	**.010**	.117	**.035**
	N	80	80	80
Vastus Medialis Distal Muscular Portion (Active)	Correlation Coefficient	**.320***	.048	**.414****
	Sig. (2-tailed)	**.004**	.670	**.000**
	N	80	80	80
Vastus Lateralis Tendinous Portion (Active)	Correlation Coefficient	**.446****	**.253***	**.398****
	Sig. (2-tailed)	**.000**	**.024**	**.000**
	N	80	80	80
Vastus Lateralis Distal Muscular Portion (Active)	Correlation Coefficient	**.558***	-.004	**.721****
	Sig. (2-tailed)	**.000**	.972	**.000**
	N	80	80	80
Vastus Lateralis Mid Belly of Muscle (Active)	Correlation Coefficient	**.574****	-.131	**.870****
	Sig. (2-tailed)	**.000**	.248	**.000**
	N	80	80	80
Vastus Lateralis Proximal Muscular Portion (Active)	Correlation Coefficient	**.277***	-.093	**.345****
	Sig. (2-tailed)	**.013**	.413	**.002**
	N	80	80	80
Rectus Femoris Proximal Muscular Portion (Active)	Correlation Coefficient	**.328****	.074	**.420****
	Sig. (2-tailed)	**.003**	.516	**.000**
	N	80	80	80

Taken from table 4.4.17

The most significant concentrations of active MTrp's were found in the following muscles and associated with a significant number of active trigger points in the quadriceps muscle:

- Vastus Medialis Tendinous Portion (Active)
- Vastus Medialis Distal Muscular Portion (Active)
- Vastus Lateralis Distal Muscular Portion (Active)
- Vastus Lateralis Mid Belly of Muscle (Active)
- Vastus Lateralis Proximal Muscular Portion (Active)
- Rectus Femoris Proximal Muscular Portion (Active).

The most significant concentrations of active MTrp's found in the following muscle is associated with a significant number of latent and active trigger points in the quadriceps muscle:

- Vastus Lateralis Tendinous Portion (Active).

<u>To Summarize:</u>

These results indicate that when a patient presents with PFPS, the patient should be assessed for the presence and treated for the following myofascial trigger points so as to eliminate them as a diagnosis as well as limit the effects of the dysfunctional muscles on the PFPS:

- Vastus Medialis Tendinous Portion (Active)
- Vastus Medialis Distal Muscular Portion (Active)
- Vastus Lateralis Distal Muscular Portion (Active)
- Vastus Lateralis Mid Belly of Muscle (Active)
- Vastus Lateralis Proximal Muscular Portion (Active)

- Rectus Femoris Proximal Muscular Portion (Active).

The patient must then also be rehabilitated effectively with due concern for the following muscle in respect of minimizing the following latent MTrp's which could be a cause / perpetuating factor in PFPS, as this muscle was highly correlated with active and latent presentations:

- Vastus Lateralis Tendinous Portion (Active).

5.3.18 Discussion of the PPSS:

The PPSS was developed from a range of signs and symptoms that have been recorded as indicating the presence of PFPS (Davidson, 1993; Delee and Drez, 1994; Powers et al., 1996, Rowlands and Brantingham, 1999 and Juhn, 1999).

It was however noted in this study, that of these signs and symptoms noted by the above authors, the following where more closely related to a possible myofascial component in the PFPS:

Subjective : Pain on prolonged sitting and kneeling
Objective : Pain worsened with physical activity, pain on deep squats and kneeling.

Therefore one of 2 questions have arisen in terms of the validity of the scale and its relationship to the PFPS:

1. PFPS either has a significant myofascial component or
2. The signs and symptoms that are currently associated with PFPS are indicative of another predominantly myofascial condition outside of PFPS but mimicking its presenting signs and symptoms.

CHAPTER SIX

CONCLUSIONS AND RECOMENDATIONS

6.1 Conclusions:

The results show that ninety five percent (95%) of subjects presented with active and / or latent myofascial trigger points of the quadriceps femoris muscle. Active myofascial trigger points accounted for symptoms in 46.2% of the patients that presented, whereas 95% of the patients presenting had evidence of latent myofascial trigger points. Although myofascial trigger points were found in all four-component muscles of the quadriceps, the most common location of active myofascial trigger points was the mid belly of the vastus lateralis muscle with the second most common location being the distal muscular portion of the vastus lateralis. The distal muscular portion of the vastus medialis contained a significant amount of MTrp's.

There is a large overlap in the signs and symptoms of the two syndromes. Both present with the following signs and symptoms:

- Peripatella or retropatella pain
- Pain on prolonged sitting
- Pain worsened with ascending or descending stairs
- Pain worsened with physical activity
- Pain on deep squats
- Pain on kneeling
- Pain on isometric quadriceps femoris contractions
- Patella mobility restriction

According to Travel and Simons (1983), myofascial trigger points in the QF muscle produces the following referred pain pattern:

- The anterior knee
- The medial aspect of the knee
- The lateral aspect of the patella
- Deep within the knee joint

This coincides with the classic pain pattern of PFPS of peri or retropatellla pain (Wood, 1998).

The pain recorded by the NRS was significantly related to the myofascial component of the syndrome (MDS) (table 4.4.4) as opposed to the pain normally recorded as that for PFPS (PPSS) (table 4.4.2) and significant in terms of the subjective evaluations of pain on prolonged sitting and kneeling and the objective evaluations of pain on deep squat, kneeling and pain worsened with physical activity.

This therefore indicates that there is a high degree of overlap between the presence of myofascial trigger points (MDS) and Patellofemoral Pain Syndrome (PPSS), when the patients present with diagnosed PFPS. Thus it can be concluded that Myofascial Pain Syndrome is a positive predictive factor in the development of Patellofemoral Pain Syndrome.

6.2 Recommendations:

a. The prevalence of MTrp's of the QF muscle in asymptomatic patients is unknown. Further research into the prevalence of MTrp's in asymptomatic subjects is necessary

b. This research looked solely at the presence and extent of MTrp's of the QF muscle group. However during examination the researcher noted the presence of MTrp's in the gastrocnemius, peroneus, tibialis anterior, adductor, hamstring muscles and the retinaculum. Travell and Simons (1983:252), state that ligamentous MTrp's may also refer pain to the lateral aspect of the knee. Further research should focus on the contribution made by these MTrp's to this syndrome.

c. Special note must be made of the large number of MTrp's noted in the hamstring muscle, the antagonist to the QF muscle. Travell and Simons (1983:272-231), state that antagonists to the QF muscle may develop secondary MTrp's. Clifton (2003) questioned the role of the hamstring muscle in PFPS after noting the presence of concentric hamstring weakness in subjects with PFPS. Could the hamstring muscle possibly be causing secondary MTrp's in the QF muscle? Further research should focus on the contribution of the hamstring muscle and its MTrp's to PFPS.

d. During the course of this research it was noted that a large majority of the MTrp's where located in the vastus lateralis muscle. This muscle is closely associated with the Iliotibial band (Moore and Dalley. 1999: 564). As a result the researcher questions whether the diagnosis of Iliotibial band friction syndrome is precipitated by, concomitant with or a cause of the MTrp's that were found in the generic PFPS population.

e. The palpation of the MTrp's was performed by the researcher, a sixth year chiropractic student. An experienced chiropractor would have been able to provide more reliable palpation findings especially in muscles such as the Vastus Intermedialis.

f. Further research should focus on treatment of MTrp's in management of PFPS. This would help to establish whether they are perpetuating, causative or concomitant factors in the syndrome.

g. Further studies should try to focus on specific populations. For example limit the study to long distance runners or cyclists.

h. The Myofascial Diagnostic Scale should have been applied to each trigger point individually as it would have give deeper insight into the extent of the MTrp's. A Scale that measures the severity of MPS would be more appropriate.

i. The Patellofemoral Pain Severity Scale should contain Likert scales in both the subjective and objective components. This will allow for greater comparisons when correlating.

j. Mention must be made of the vague criteria required to diagnose PFPS. Many low grade or chronic knee conditions are likely to be diagnosed as PFPS due to the non-specific nature of the diagnostic criteria. More sensitive and accurate measures such as diagnostic ultrasound, radiographic examination should be considered for use in further studies.

k. Future studies could look at flexibility deficits of the QF muscle as a possible objective measure as it relates to the presence of myofascial trigger points and their shortening effect on musculature.

I. This study was structured such that it only addressed the functional component(s) of PFPS, therefore no inferences can be made as regards the affect of structural changes on PFPS. Therefore it is suggested that future studies include or further examine or compare these structural factors to myofascial involvement.

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APPENDIX 10

Questions to be asked during telephonic interview:

Inclusion Criteria:

Are you between the ages of 18 and 40?

Is the pain you are experiencing underneath or around your kneecap?

Do any of the following aggravate your pain?

- Squatting,
- Stair climbing,
- Kneeling,
- Prolonged sitting
- Physical activity

Exclusion Criteria:

Have you had any history of any of the following that you know of?

- Traumatic kneecap dislocation,
- Any neurological problem effecting the way you walk,
- Have you undergone any knee surgery over the past 2 years,
- A cartilage tear
- Injury causing instability, does your knee give way under you
- Arthritis in your knees

Are you pregnant or breast-feeding at present?

APPENDIX 1

Patellofemoral Pain Severity Scale:

Patellofemoral Pain Severity Scale	Points awarded by researcher	
History:	Yes	No
I experience pain on prolonged sitting (30-90 mins) Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
I experience pain on ascending or descending stairs Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
My pain is worsened with physical activity Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
Signs:		
I experience pain on deep squatting Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
I experience pain on kneeling Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
I experience pain on tightening my thigh muscle Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
Symptoms:		
I experience pain behind or around my knee cap Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
My pain is mild Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
My pain is moderate Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0
My pain is severe Strongly agree 5 | Agree 4 | Unsure 3 | Disagree 2 | Strongly disagree 1	1	0

APPENDIX 2

Myofascial Diagnostic Scale:

Numerical Rating Scale:

0	1	2	3	4	5	6	7	8	9	10

APPENDIX 3

Duration of Condition in Months:

1	2	3	4	5	6	7	8	9	10	11	>11

Location of MTrp's:

	Vastus medialis	Vastus lateralis	Vastus intermedialis	Rectus femoris
Tendinous portion				
Distal muscular portion				
Mid belly of muscle				
Proximal muscular portion				
Other				

APPENDIX 4

Algometer Readings:

	Tendinous Portion				Distal muscle				Mid-belly				Proximal muscle				Other				Total
Vastus Medialis																					
Vastus Lateralis																					
Vastus Inter-medialis																					
Rectus Femoris																					

Total number of MTrp's ___________________________

Mean weight (kg) ___________________________

APPENDIX 9

Informed Consent Form

Title of research project: The role of myofascial trigger points of the Quadriceps femoris muscle group in the clinical presentation of Patellofemoral Pain Syndrome.

Name of supervisor:	Dr. C. Korporaal	(031-2042205)
	Dr. A. Jones	(031-2042244) (Wednesday)
Name of research student:	Donna Dippenaar	(031-2042205)
Name of institution:	Durban Institute of Technology	

This study involves research on 80 patients, assessing whether people with a condition commonly known as Runners' Knee have any myofascial trigger points in their Quadriceps Femoris (thigh) muscle.

Please circle the appropriate answer

1. Have you read the patient information sheet? YES / NO
2. Have you had opportunity to ask questions regarding this study? YES / NO
3. Have you received satisfactory answers to your questions? YES / NO
4. Have you had an opportunity to discuss this study? YES / NO
5. Have you received enough information about this study? YES / NO
6. Who have you spoken to?_______________________________________
7. Do you understand the implications of your involvement in this study? YES / NO
8. Do you understand that you are free to withdraw from this study? YES / NO
   a) at any time?
   b) Without having to give a reason for withdrawing, and
   c) Without affecting your future health care.
9. Do you agree to voluntarily participate in this study? YES / NO

PATIENT/SUBJECT
Name________________________Signature________________

WITNESS Name_______________Signature________________

RESEARCH STUDENT
Name_____________________Signature_______________

If you have answered NO to any of the above questions, please do not hesitate to contact my supervisor who will be able to assist you.

APPENDIX 8

LETTER OF INFORMATION.

Dear Patient

Welcome to my study. Thank you for your interest.

The title of my study is: **The association between myofascial trigger points of the quadriceps femoris muscle and the clinical presentation of patellofemoral pain syndrome.**

Name of Supervisors:	Dr. C. Korporaal	(031-2042205)
	Dr. A. Jones	(031-2042244) (Wednesday)
Name of student:	Donna Dippenaar	(031-2042205)
Name of institution:	Durban Institute of Technology	

This study will involve research on 80 patients; testing for the presence of myofascial trigger points (hyperirritable knots within a muscle) in the Quadriceps Femoris (thigh) muscle in patients suffering from a condition commonly known as Runners Knee.

You will be required to undergo a consultation during which a case history, relevant physical and knee regional examinations. These examinations will assist in identifying any trigger points in the quadriceps femoris muscle. You will also be required to fill out a pain questionnaire and answer some questions regarding your knee pain. The consultation will take approximately an hour and a half. This information will be gathered for the purpose of establishing correlations between the hyperirritable knots within thigh muscle and the condition commonly known as Runners Knee. You may experience slight transient discomfort during or after the examination, however the utilisation of an algometer (a tool used to measure your pain levels) may also be beneficial as it mimics a therapeutic intervention.

Two free treatments are offered at the Chiropractic Day Clinic subsequent to the completion of your participation in the study. All treatment is free of charge and your participation is voluntary and you are free to withdraw at any point in time.

All patient information is confidential and the results will be used for research purposes only, although supervisors and senior clinic staff may be required to inspect records. You have the right to be informed of any new findings that are made. You may ask questions of an independent source if you wish to (my supervisors are available on the above numbers). If you are not satisfied with any area of the study please feel free to forward any concerns to the Durban Institute of Technology Research Ethics Committee.

Thank you for your interest and participation.

Yours faithfully,

Donna Dippenaar	**Dr. C. Korporaal**	**Dr. A. Jones**
(Chiropractic Intern)	(Supervisor)	(Supervisor)

APPENDIX 11

Are you suffering from

Knee Pain?

You are invited to participate in research being conducted at Durban Institute of Technology Chiropractic Day Clinic

FREE TREATMENT

is available on completion of the study

For more information contact:

Donna

031-2042205 or 031-2042512

at the Chiropractic Day Clinic

APPENDIX 5

APPENDIX 6

APPENDIX 7

APPENDIX 12

4.3.4 Location of Latent MTrp's:

1. Vastus Medialis

Vastus Medialis Proximal Muscular Portion (Latent)

Table 4.3.4.1.d

Vastus Medialis Proximal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

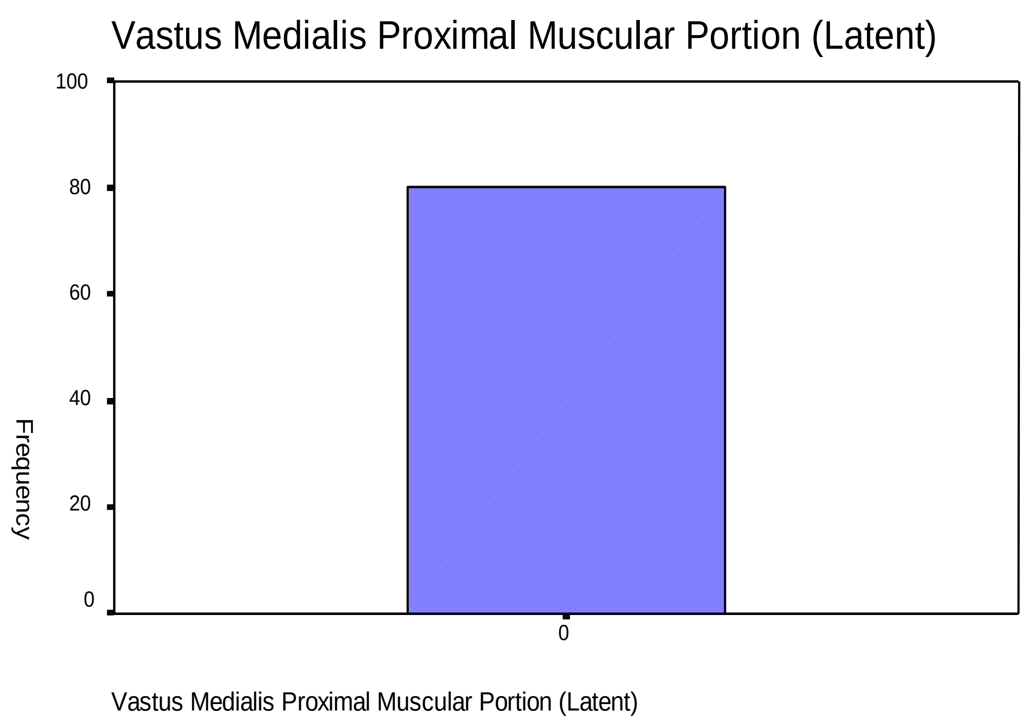


Figure 4.3.4.1.d

3. Vastus Intermedialis

Vastus Intermedialis Tendinous Portion (Latent)

Table 4.3.5.4.3.a

Vastus Intermedialis Tendinous Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

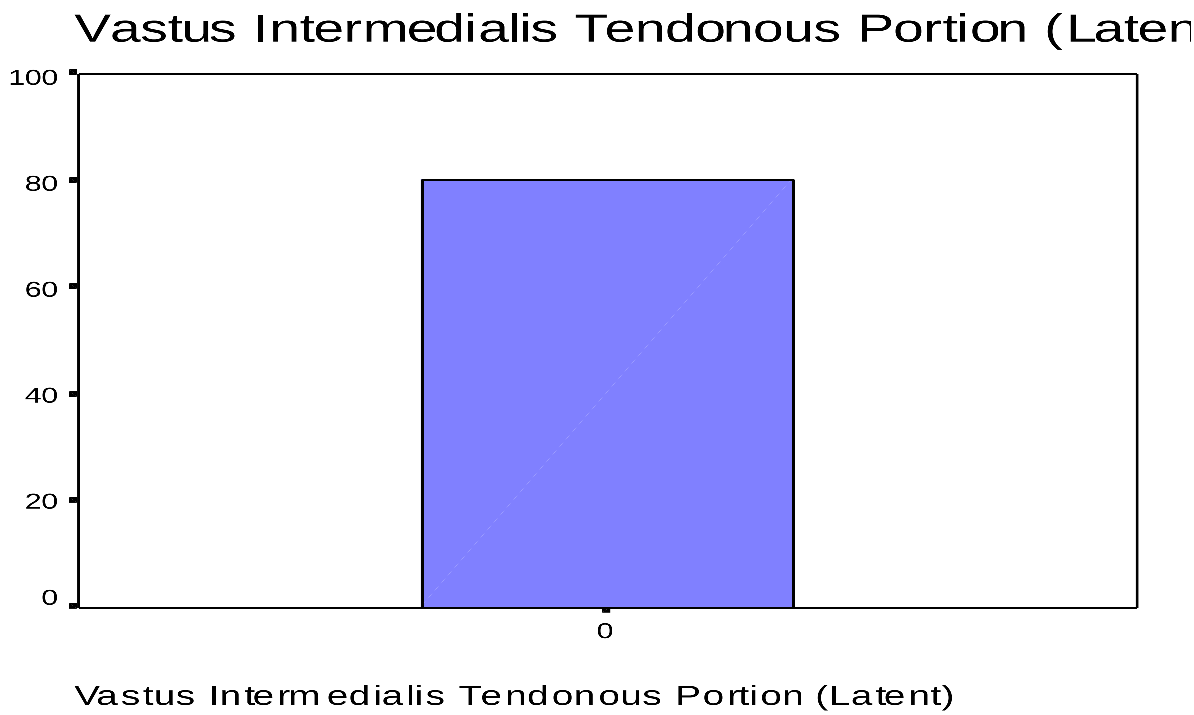


Figure 4.3.5.4.3.a

Vastus Intermedialis Distal Muscular Portion (Latent)

Table 4.3.4.3.b

Vastus Intermedialis Distal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

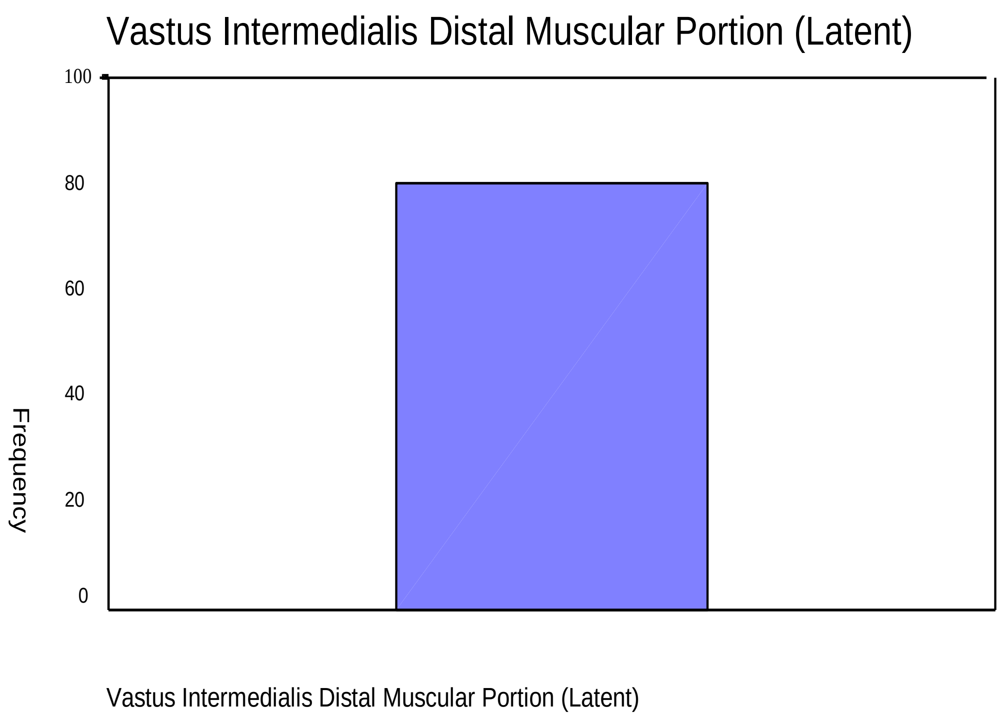
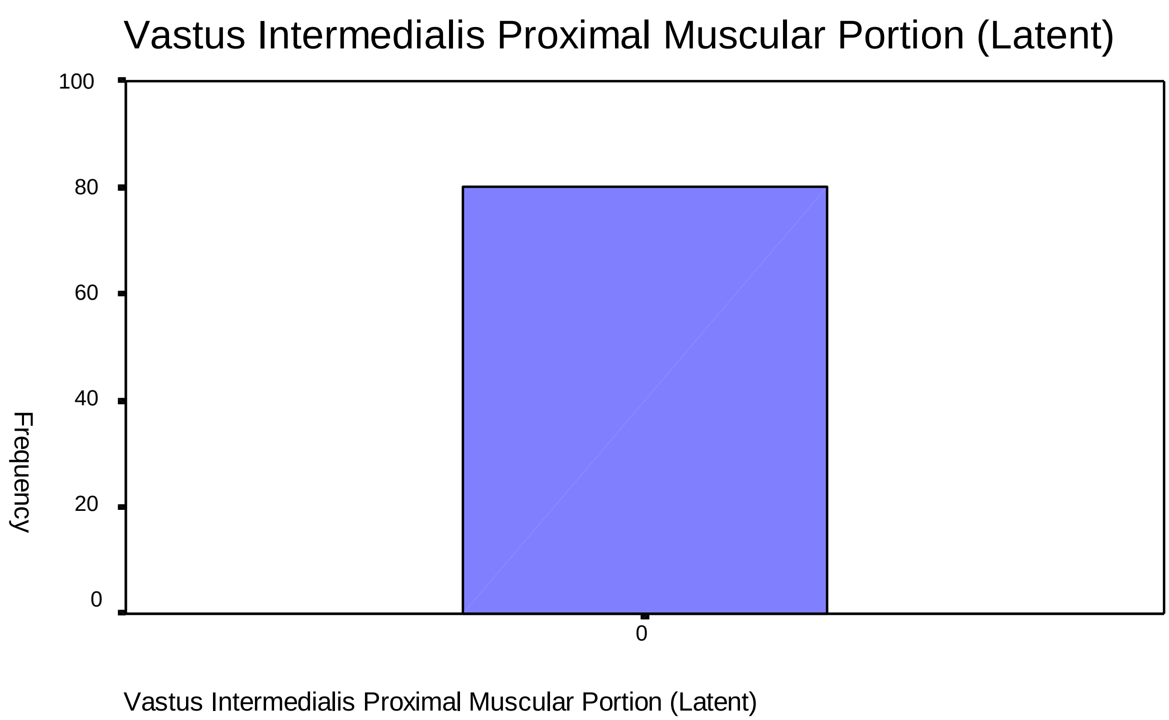


Figure 4.3.4.3.b

Vastus Intermedialis Proximal Muscular Portion (Latent)

Table4.3.4.3.d

Vastus Intermedialis Proximal Muscular Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0



4. The Rectus Femoris Muscle:

Rectus Femoris Tendinous Portion (Latent)

Table 4.3.4.4.a

Rectus Femoris Tendinous Portion (Latent)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

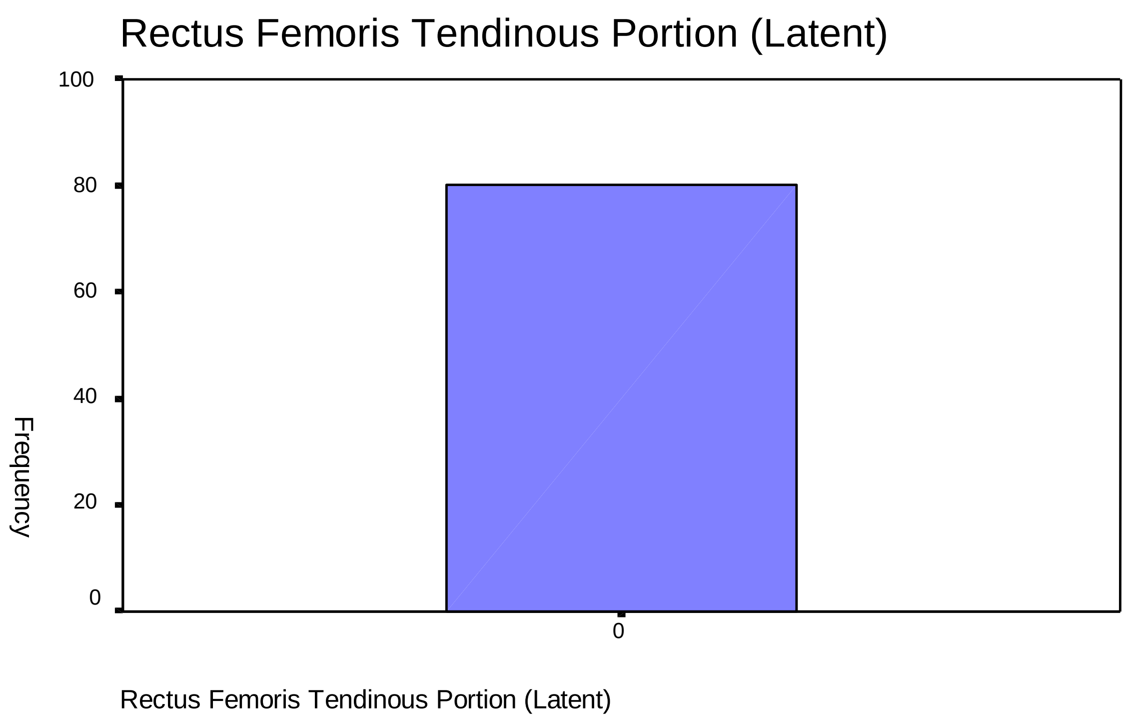


Figure 4.3.4.4.a

4.3.5 Location of Active MTrp's:

1. Vastus Medialis

Vastus Medialis Proximal Muscular Portion (Active)

Table 4.3.5.1.d

Vastus Medialis Proximal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

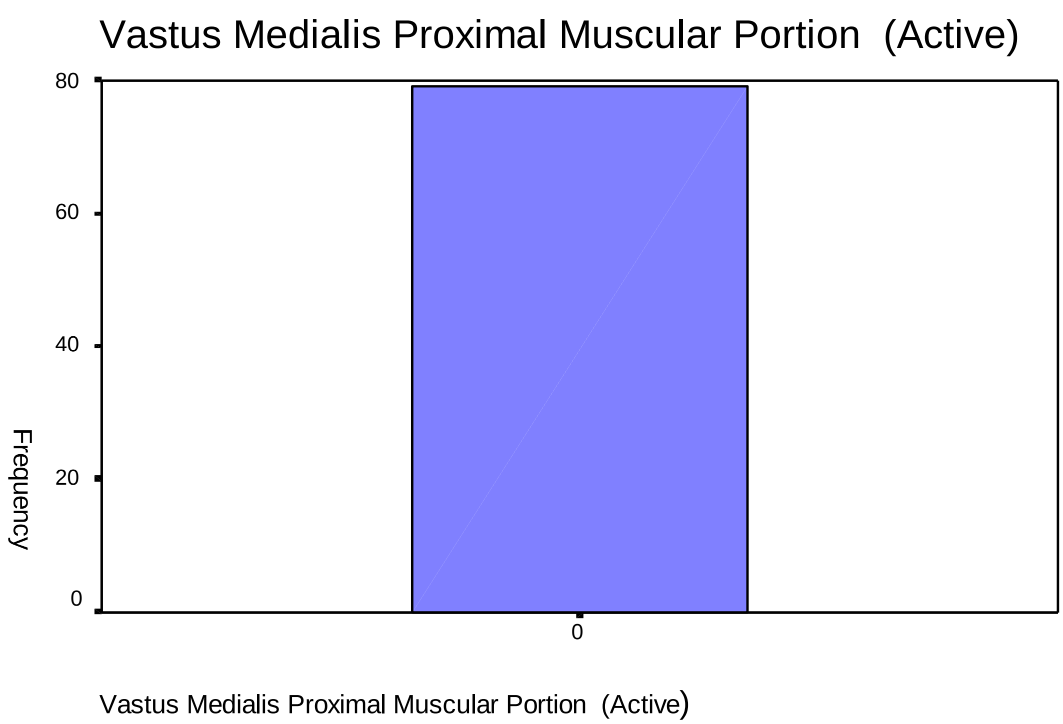


Figure 4.3.5.1.d

3. The Vastus Intermedialis Muscle:

Vastus Intermedialis Tendinous Portion (Active)

Table 4.3.5.3.a

Vastus Intermedialis Tendinous Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

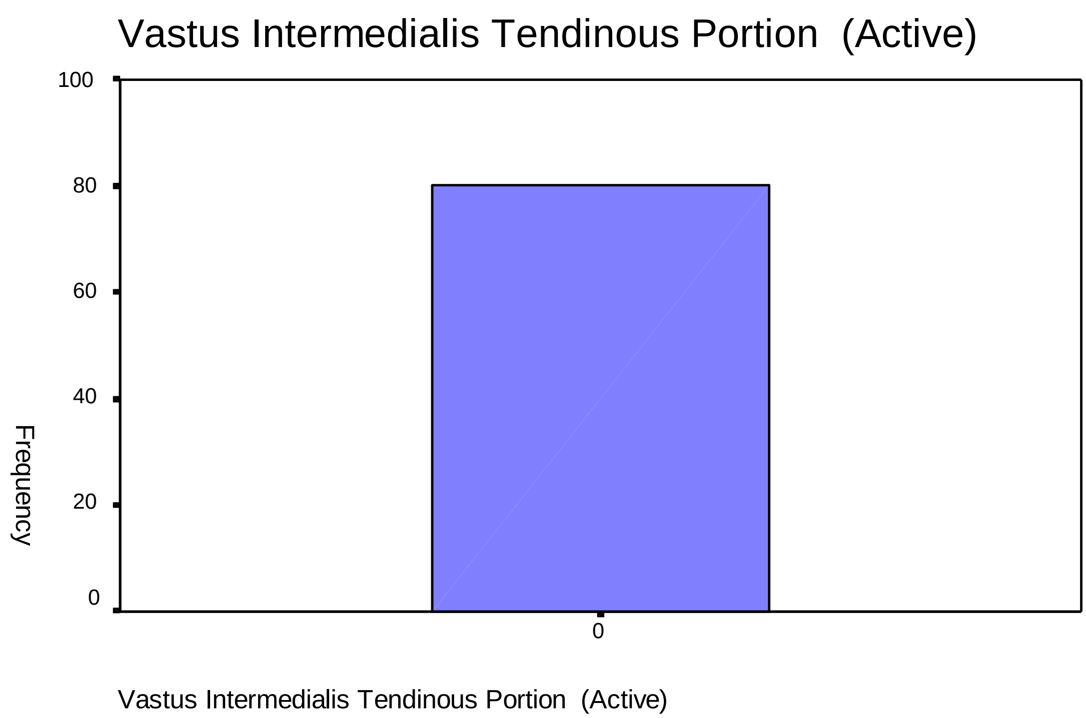


Figure 4.3.5.3.a

Vastus Intermedialis Distal Muscular Portion (Active)

Table 4.3.5.5.3.b

Vastus Intermedialis Distal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

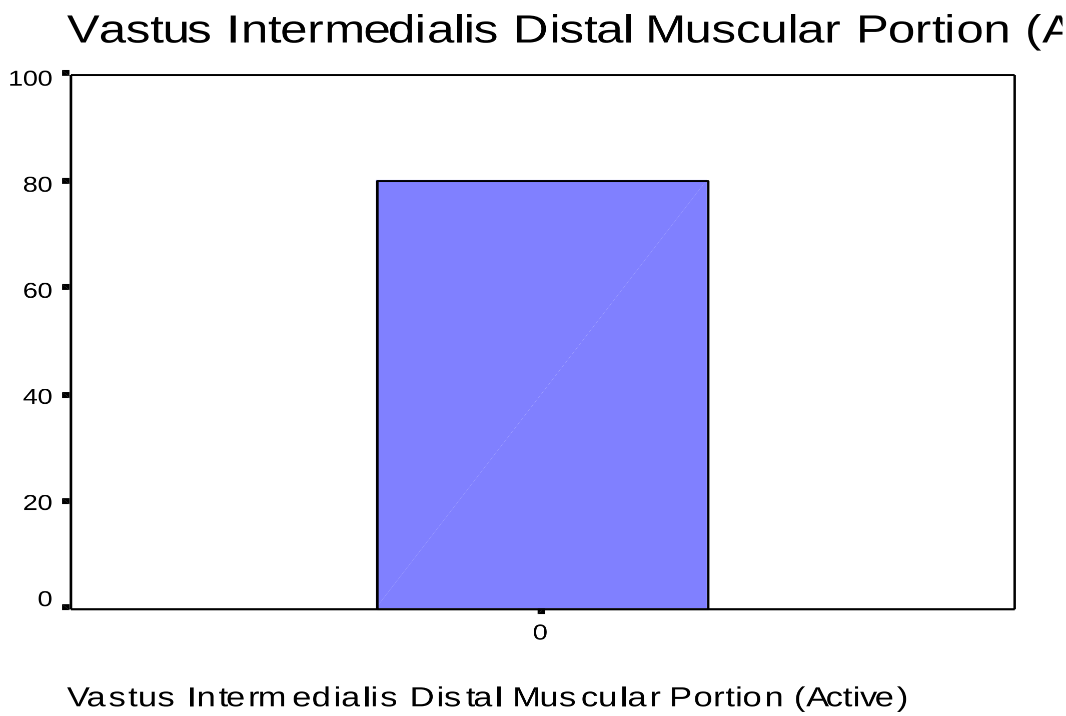


Figure 4.3.5.5.3.b

Vastus Intermedialis Proximal Muscular Portion (Active)

Table 4.3.5.5.3.d

Vastus Intermedialis Proximal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

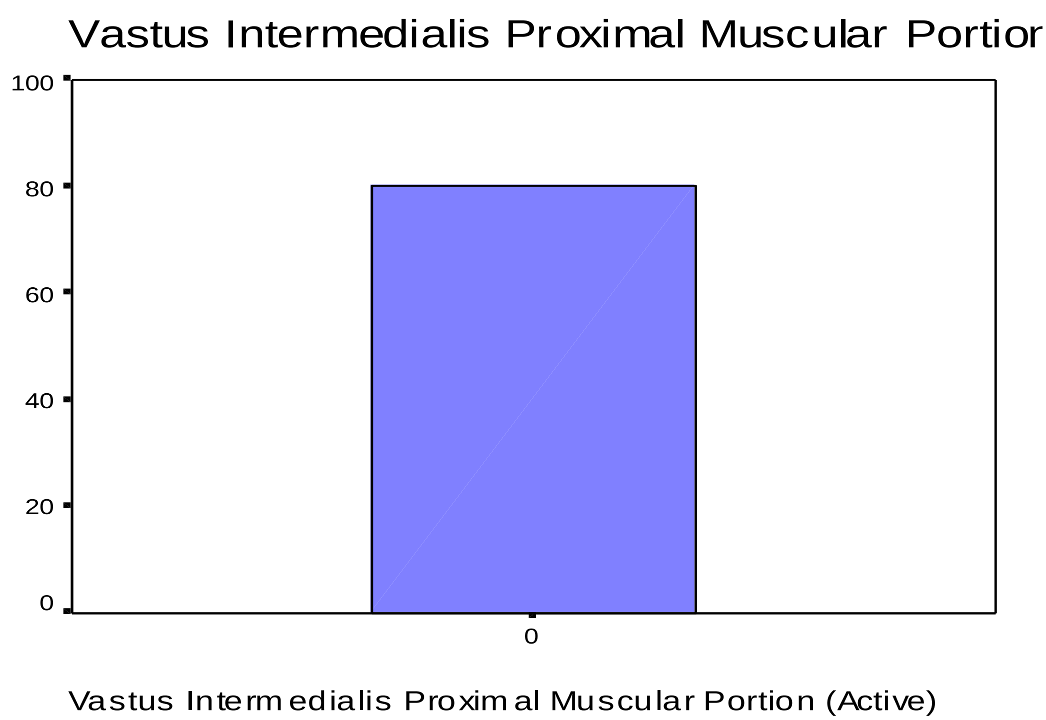


Figure 4.3.5.5.3.d

Rectus Femoris Tendinous Portion (Active)

Table 4.3.5.5.4.a

Rectus Femoris Tendinous Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

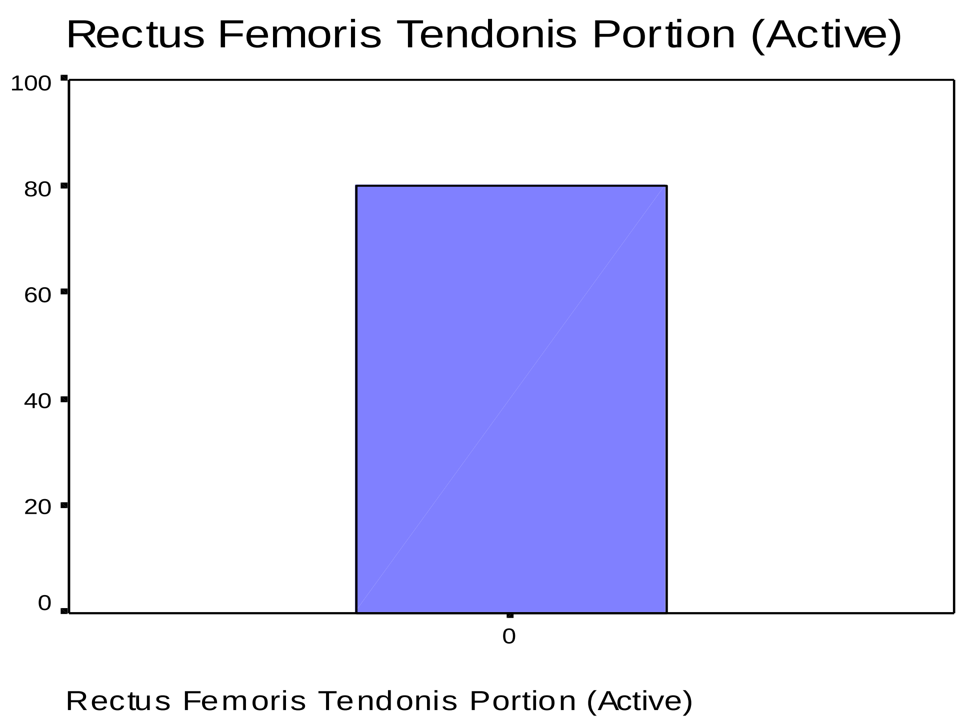


Figure 4.3.5.5.4.a

Rectus Femoris Distal Muscular Portion (Active)

Table 4.3.5.5.4.b

Rectus Femoris Distal Muscular Portion (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

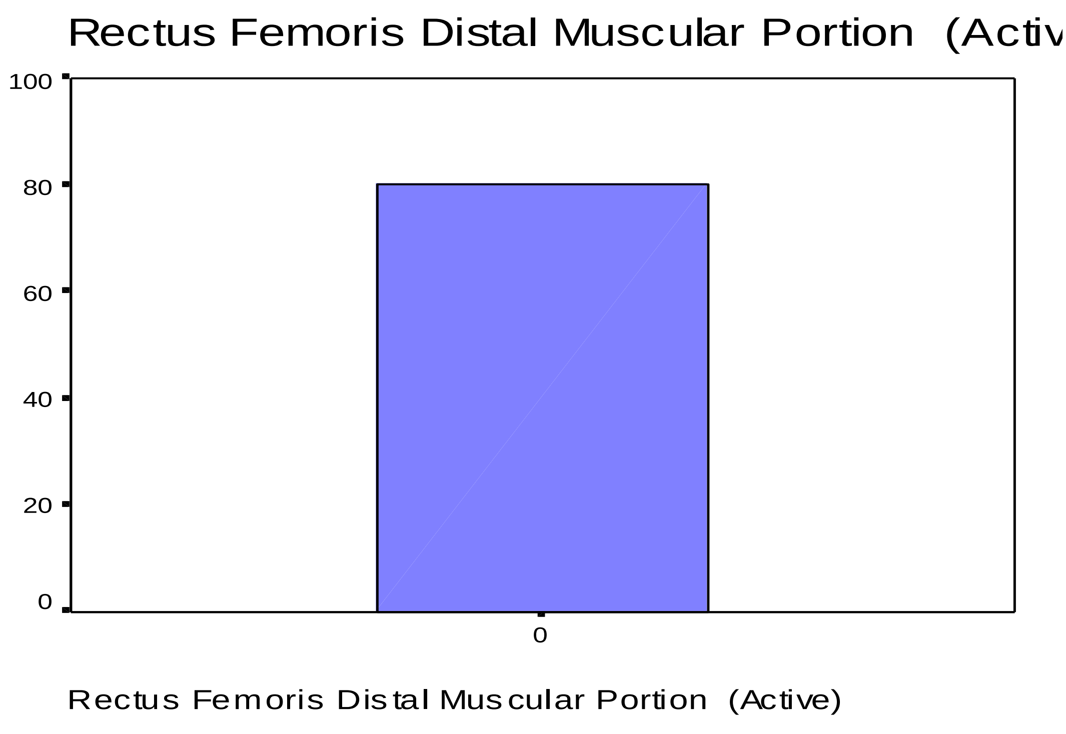


Figure 4.3.5.5.4.b

Rectus Femoris Mid Belly of Muscle (Active)

Table 4.3.5.5.4.c

Rectus Femoris Mid Belly of Muscle (Active)	Frequency	Percent	Valid Percent	Cumulative Percent
0	80	100.0	100.0	100.0

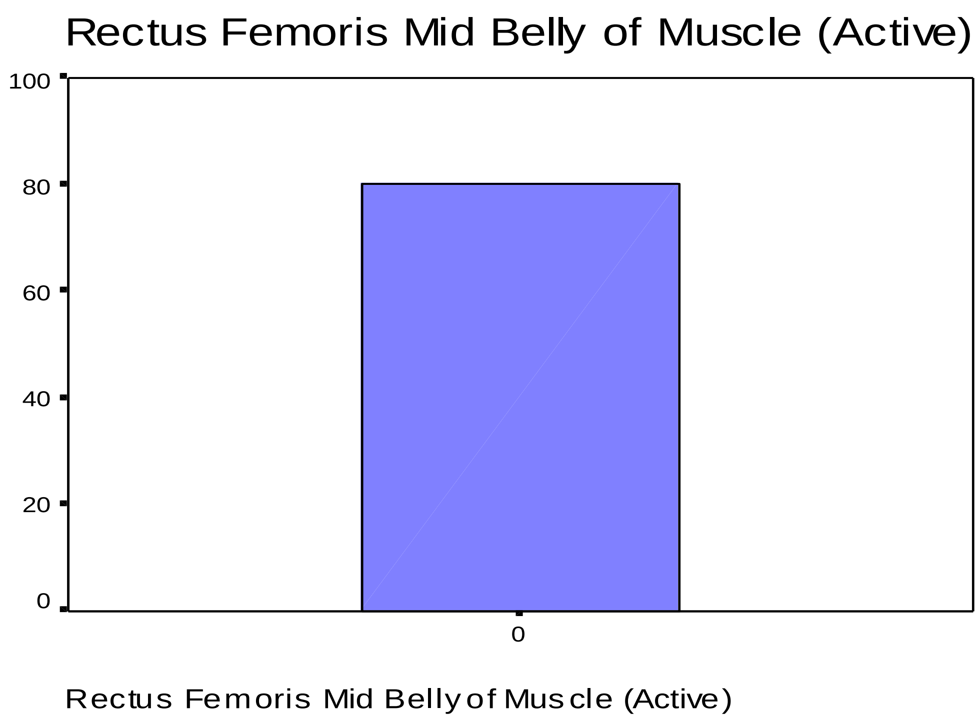


Figure 4.3.5.5.4.c