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Myofascial Dysfunction and Its Relationship to Laparoscopy

John Jarrell
University of Calgary, Calgary, AB, Canada

1. Introduction

The specific objective of this review is to describe the elements of myofascial dysfunction particularly as they relate to visceral disease of the pelvis and how the awareness of myofascial dysfunction might affect the management of certain visceral diseases by the procedure of laparoscopy. The specific areas to be reviewed are among the most common gynecological conditions – chronic pelvic pain and endometriosis.

Although diagnostic and operative laparoscopy has brought about significant improvements to women's health, there is growing concern that this procedure might be over-utilized. Increased rates of the procedure may influence the health of women in a deleterious manner as there are significant complications associated with the procedure. This is then a cautionary chapter that seeks to provide the clinician with tools to appreciate the presence of myofascial dysfunction and its ramifications.

2. Case history

Miss C.M. is a 24 year old woman who presents with the development of severe chronic pelvic pain in the right and left lower quadrant of the abdomen for approximately one year. The pain began as a cyclic pain which resulted in an operative laparoscopy during which she had a number of areas of endometriosis cauterized in the *cul de sac*. The pain seemed to abate for a number of months but came back suddenly and progressed to the point she was unable to work. She experienced painful urination, painful defecation and a complete inability to have penetrative sexual relations. She was advised to have a hysterectomy. Before the procedure was undertaken a second opinion was requested.

At the second opinion, the examination demonstrated *cutaneous allodynia* in the lower abdomen and two myofascial trigger points in the right and left lower quadrants (Figure 1). When the myofascial trigger points were compressed the woman's pain was replicated. Pain radiated into her chest and back in a manner similar to the sudden onset of her pain. When released, the pain dissipated. Examination of the perineum showed *cutaneous allodynia* of the perineum and was also associated with a trigger point in the perineal body that allowed only a single digit examination. Digital examination of the *cul de sac* and uterus did not demonstrate tenderness to motion or pressure. Using a Von Frey Electroanesthesiometer, reduction in pain thresholds was recorded in the right (56 gm)and left lower (45 gm) quadrants and in particular the perineal body (26 gm) where normal tissues were >100 gm.

This chapter is directed to an evaluation of this common clinical situation.

3. Benefits of laparoscopy

Diagnostic and operative laparoscopy has added significantly to the management of many surgical conditions[1-4]. These have extended to improved management of certain gynecological conditions [5-7]. In addition to diagnosis, laparoscopy has evolved to more invasive procedures to include ovarian cystectomy, oophorectomy, assisted hysterectomy, total hysterectomy, radical hysterectomy and pelvic and paraaortic lymph node dissection [8-15]. There is general acceptance that the procedure has immense benefits for the management of acute pain conditions such as those related to the management of ovarian torsion, ovarian cyst hemorrhage and the diagnosis of pelvic inflammatory disease[16-18]. Laparoscopic surgery has resulted in reduced hospital admissions, and operating time thereby increasing efficiencies in health service provision[19;20].

4. Laparoscopy for chronic pelvic pain

Although marked benefits for some conditions are substantial the same cannot be said for its use in the diagnosis and treatment of chronic pelvic pain. This condition is very common

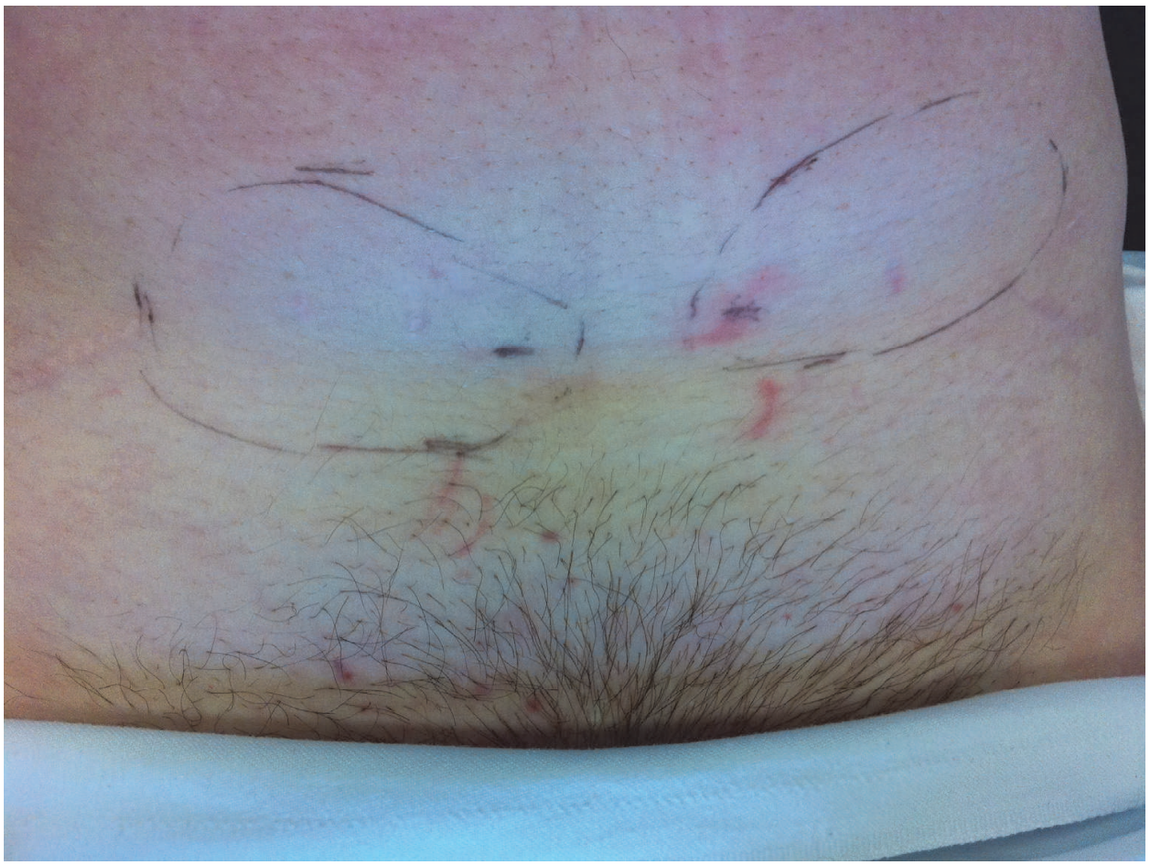

Fig. 1. This photograph demonstrates the presence of cutaneous allodynia in the lower abdomen of a young woman presenting with recurrent pain following a laparoscopic cautery of endometriosis. Within the highly repetitive areas of cutaneous allodynia re two myofascial trigger points indicated by dots. Pressure on the dots completely reproduces the woman's pain.

among women and is responsible for significant disability and personal suffering[21]. Much of the distress of the condition is associated with a difficulty in "being believed". The condition is defined as pain in the abdomen, pelvis or lower back lasting six months. However, the concept that there is an operational definition for the condition has been challenged[22]. The absence of a pattern that permits categorization of the condition in terms of pain duration, location, co morbidities has been identified as a barrier to appropriate research [22].

Despite this important limitation, there have been a large number of studies with a variety of results that have explored the relationship of chronic pelvic pain and laparoscopy. In some cases, the benefits have been identified as the diagnosis of chronic pelvic inflammatory disease. Although often not noted, these benefits seem to be associated with the first laparoscopy[23-28]. More recently, reports have indicated that the ability to identify a pathological condition are not as high as previously reported[29]. It has been estimated that 25-40% of women having laparoscopies for chronic pain conditions do not have a reliable diagnosis identified[29;30]. Among the identifiable conditions associated with chronic pelvic pain, one condition is readily identified as a potential cause in 65% of cases and one third of these will have endometriosis[31]. Additional causes identified are reported to be pelvic inflammatory disease, ovarian cysts, hernias, pelvic congestion syndrome, ovarian remnant syndrome, post-operative peritoneal inclusion cysts and endosalpingeosis[31]. The remainder appears to have no obvious cause of the pain and can extend to a total of 40% of cases. These "negative" procedures are often quite upsetting to patients looking for a specific problem that can be solved in the manner associated with the treatment of acute illness.

5. Laparoscopy for endometriosis

One of the major indications in gynecology for diagnosis and treatment through the means of laparoscopy is directed to the management of endometriosis[32]. Space does not permit a comprehensive review of this condition but a brief summary will introduce its relationship to laparoscopy and myofascial dysfunction[33-35]. Endometriosis is a developmental abnormality in which there is endometrium-like tissue in ectopic locations of the pelvis and rarely in other areas of the body and requires pathological review for the confirmations of diagnosis[36]. It has been reported that the disease can occur in any area of the body with the exception of the spleen. The condition is associated with pain and infertility although these associations are not always present. In some cases of severe disease, there is no pain whatsoever while in other women, small amounts of endometriosis are associated with severe pain and disability[37]. Also, the presence of endometriosis does not preclude infertility as the disease is not uncommonly identified at the time of sterilization[38]. The condition is common and is seen in approximately 15% of women in the reproductive age group. It is increasingly being recognized in adolescents and appears to decrease after the menopause although here are exceptions to this.

Although there is a classification of the stages of endometriosis by the American Fertility Society, this classification is seen as helpful in the area of fertility but of a lesser benefit to pain considerations[39;40]. More recently the disease is classified with respect to four categories: peritoneal in location, nodular and invasive, ovarian endometriomas and uterine adenomyosis[41-44]. This latter condition represents a developmental abnormality in which the abnormal endometrial location is within the actual wall of the uterus. The epidemiology of

the condition indicates risk factors to be delayed pregnancy, pelvic pain, pelvic mass, early menarche and frequent menses[43;45-47].

Pain from endometriosis has been largely associated with the ectopic endometrium[40]. This tissue produces agents that can stimulate nocicepetive pain and drugs that inhibit inflammatory activity are often of benefit. The traditional approach to specific therapy has been to reduce estrogen as it stimulates the growth of the tissue. From a medical therapeutic perspective this has involved the use of progesterone, danazol and GnRH agonists that result in an ovarian suppression and a reduction in ovarian estrogen release[48].

Prior to laparoscopy the surgical approach meant removal of the ovaries and uterus often in young women thereby eliminating their fertility. In recent years laparoscopy has afforded another approach. The operative removal of endometriosis at the time of laparoscopy has remained controversial. There has been several randomized controlled trial of the excision of endometriosis compared to sham surgery during operative laparoscopy. This approach was heralded as a highly effective prior to the randomized trials[49]. The randomized studies vary in terms of pain assessment and tend to be small in size and in some cases there is evidence of effectiveness [50;51]. In another study, pain was measured during the entire menstrual cycle and was tested prior to and quarterly post-operatively for a year and there was no difference in pain between the excision group and the sham operated group. Most of the cases had early disease, identified as stage 1 or 2 by the American Fertility Society and peritoneal in location. Long term follow- up of the study indicated there was no difference in the time to the next operation undertaken for pelvic pain by survival analysis[53]. One of the interesting features was the observation that the level of pain from the first Pre-operative assessment predicted the time of subsequent surgery. Although this might seem self evident it has not been reported previously. In relation to the excision of endometriomas of the ovary, there is evidence of effectiveness[54]

There is a growing concern that the operations undertaken for endometriosis are not directed to the actual problem of pain[55]. This has been reviewed from the perspective of the limitations of surgery recently[56]. Also, there are recent reports that indicate the source of the pain which has been assumed to be the ectopic sites of endometriosis may in fact not represent the sole source of the pain[33;57]. The data that raise these concerns can be summarized as follows:

In addition to these studies of pain physiology, there is evidence from clinical utilization studies that operative laparoscopy is heavily used in the management of problems associated with endometriosis and adhesions. A review of the diagnostic and operative laparoscopies was undertaken in the Province of Alberta, Canada between the years 1994 and 2007[58]. The data were collected on individual women over these years so that the frequency of repeated surgery on one woman could be assessed and then aggregated for the span of the study. The results indicated there was a significant repeat rate of surgery among 24,473 women (Figure 2). In addition, a statistical process control chart indicated the repeat rates were out of statistical control for both diagnostic and operative procedures for the years 1999-2000 (Figure 3)[59]. The interpretation is that there was a bias to operate during these years as it is highly unlikely that there was a sudden change in the rate of disease. Also, as there is a cut off in this study by the years 1999 and 2007 it is recognized these rates are limited as some women would have had procedures before and after these dates.

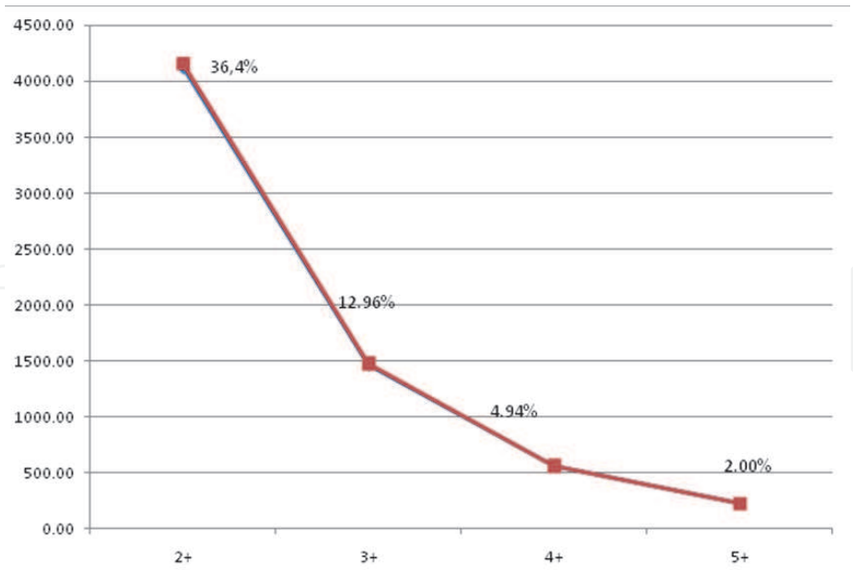

Fig. 2. The rates of repeated operative laparoscopy among 24473 women with operative laparoscopies undertaken between the years 1994-2007 in The Province of Alberta Canada where virtually all operative laparoscopies are collected in this database as the province has a comprehensive health insurance Program[60]

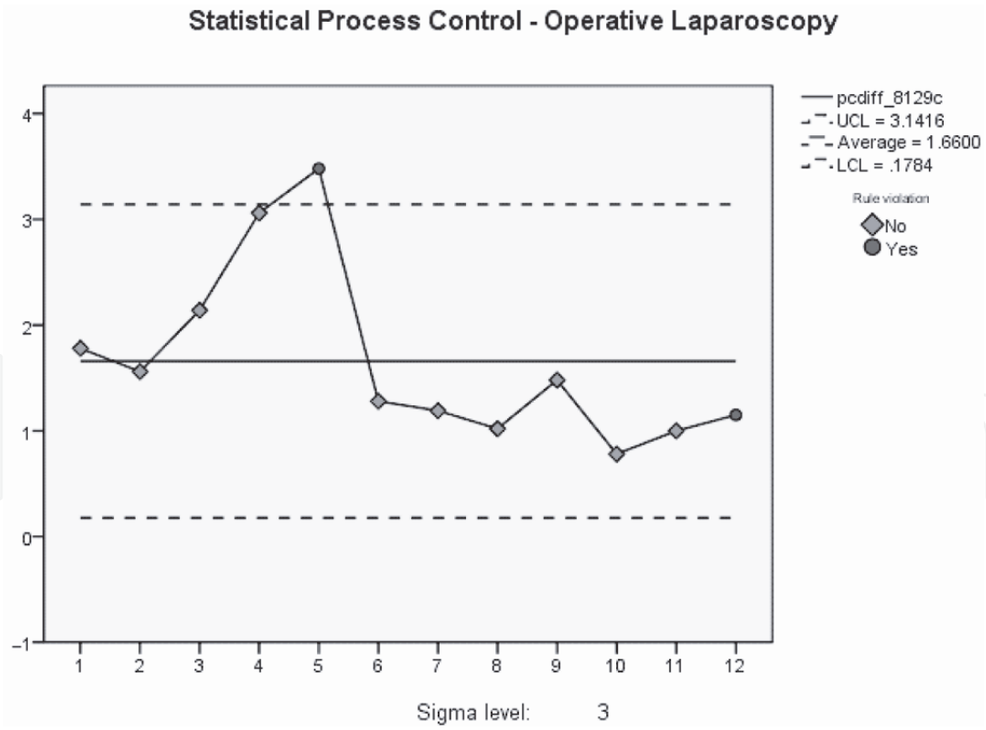

Fig. 3. Statistical Process Control Charts of the aggregated annual rates of repeat laparoscopies on a fiscal basis from 1994-2007 among 24000 women. The charts indicate the rates are "out of control" or represent a "special cause" where the probability of occurrence is <0.001[59]

6. Myofascial dysfunction

Pain associated with muscle and fascia actually has a long history, going back to the seminal work of Sir Henry Head who recognized there were tender areas on the skin that consistently appeared in relation to disorders of the underlying viscera[61]. He called these Head zones and they were the basis for the recognition of the dermatomes. More recently these areas of pain were associated with both injury and trauma and were called trigger points. These are small areas of persistent contracture of muscle fibers that can cause severe pain and disability but are not generally appreciated among medical specialties with the exception of rehabilitation medicine. Since 1945 there have only been 1191 references in PubMed although there has been a significant increase in recent years. Recent reviews of myofascial pain and its relationship to trigger points have indicated the areas remains very complex[62;63]. Interest in the physiology of trigger points in relations to brain activity as well as muscle physiology is expanding[64-67].

Myofascial pain syndrome is a muscle condition that has the characteristics of having local and referred pain originating in a myofascial trigger point[68]. This term describes a nodule or band of muscle that can produce intense pain when spontaneously or when stimulated. There are two aspects of the trigger point: a motor component that is palpable and a sensory component that produces pain locally and in an area of referred pain. The diagnosis of the presence of a trigger point is based on the palpation of a tender nodule or band that reproduces the patient's symptoms and can be confirmed if there is a local twitch response as a result of manipulation of the taut band[68]. The pain is often referred to distant locations such as the back, chest or legs when considering pelvic trigger points.

Investigations of myofascial trigger points have focused on alterations in the synaptic cleft of the neuromuscular junction, the spinal cord and the brain response to myofascial pain[68-70]. The trigger point has been characterized as a local area of sensory and motor activity. The motor activity is based on the presence of the nodule or taut band. The area not maintained by persistent a motor activity as there are no motor action potentials present. Instead there are a variety of altered electrical observation that can be made including spontaneous small voltage activity, and spike discharges[71]. More recent studies have indicated that electrophysiological responses are commonly found when an electrode is placed in the trigger point for therapy[72]. There are also evoked changes in electrical activity in association with the local twitch response. These changes are not eliminated by an upper cord transaction indicating there is a spinal arc involved in their maintenance. Spontaneous discharges fropm a trigger point in the rabbit can be inhibited with phentolamine, an a blocker indicating the potential role of the sympathetic nervous system in the maintenance of these electrical discharges[73].

The sensory component of the trigger point is based on changes in the intracellular environment. There is an increased synaptic level of acetylcholine activity, local ischemia as evidenced by biochemical changes of a lowered pH, and an increased concentration of Substance P, CGRP, bradykinin, serotonin, prostaglandins and potassium[74]. These areas act to stimulate nociceptors that are present in muscle tissue. Local ischemia has been identified as the cause of pain and is a result of the metabolic crisis that occurs in these areas.

Clinically the causes of myofascial trigger points have focused primarily on primary or secondary causes. The primary causes are identified as single or recurrent episodes of micro or macrotrauma or from muscle overload[75]. Overuse, postural stress and altered mechanics can produce trigger points in the neck and back. Secondary causes have included cervical

whiplash, migraine headache, temporomandibular pain, frozen shoulder, radicular pain, postlaminectomy syndrome and viscero-somatic pain[76]. This chapter is directed to the application of the secondary trigger points associated with disorders of the viscera that produce pain.

7. Visceral causes of myofascial pain

There are a number of conditions that have resulted in myofascial trigger points. Diseases of the gall bladder have produced shoulder pain and trigger points in the right upper quadrant of the abdomen. Angina-like pain can be produced on the chest from cardiac ischemia and can lead to diagnostic confusion. Flank pain and trigger points can be produced by ureterolithiasis. One of the characteristics of these trigger points is that they may dissipate after the original condition has resolved but they may also remain for significant periods of time[77;78].

The most common cause of myofascial pain has been trauma but in recent years there is an appreciation that visceral disease can produce somatic muscle pain and myofascial trigger points[79;80]. Examples in which there is an interaction of the viscera with somatic tissues include somatic hyperalgesia[81;82], trophic changes in tissue[83;84]. In the rat, intense stimulation of the intrauterine cavity is associated with neurogenic extravasation of administered dye in the region of the dermatomes innervating the pelvic[85]. In visceral pain as well as migraine, there are reports that in addition to myofascial trigger points, there is a development of cutaneous allodynia in the respective dermatomal regions[86;87].

On important aspect of the physiology of viscero-somatic pain referral has been undertaken in relation to the gall bladder. Diseases of the gall bladder were found to produce changes in pain thresholds in the skin, subcutaneous tissues and muscle, reduction in muscle thickness and cutaneous allodynia on the side of the gall bladder when compared to the contralateral side[83]. There was a direct negative correlation between the number of colicky aspects and the measurement of pain threshold.

These findings are also relevant in relation to the pelvis. The pelvic viscera include the uterus, ovaries, Fallopian tubes, pelvic peritoneum, bladder and rectum. Disorders such as endometriosis can potentially affect all of these structures. Disorders such as interstitial cystitis and irritable bowel syndrome are also disorders that affect the visceral tissues. It is now known the viscera contain nociceptors. It is now being recognized that visceral pain is a specific syndrome associated with alterations in the pelvic structures [88]. As an example of human research related to visceral pain, the administration of capsaicin, an activator of the heat sensitive receptor TRPV1[89] to the intestinal stomata of volunteers with ileostomy or colostomy resulted in dramatic changes in the referral of pain and the temperature of the same areas of skin[90].

8. Visceral pain in the pelvis

These changes have been studied in the abdomen and pelvis of women with chronic pelvic pain. A cross-sectional study of women with chronic pelvic pain for at least six months was done that included an assessment of the number of areas of myofascial pain, including the abdomen, perineum, *levator ani* and *obturator internus* muscles. This number was assessed in terms of clinical variables of age, gravidity, parity, pain duration number of laparoscopies and laparotomies. The duration of pain and number of laparoscopies significantly predicted

the number of areas of trigger points[91]. These findings would suggest that in a similar mechanism to the gall bladder, the extent of pain is an important factor in the genesis of chronic pelvic pain due to myofascial trigger points[83]. Also, the presence of laparoscopy as a predictor of the number of areas of trigger points could be considered another proxy for the duration of pain but it also suggests that the surgical procedure itself might affect ongoing pain experience.

It is recognize that the diagnosis of chronic pelvic pain can be very misleading[22]. To attempt to partially address this, a cross-sectional study of bedside testing of *cutaneous allodynia*, myofascial trigger points and reduced pain thresholds is being undertaken among women presenting with a variety of apparent causes to determine if these tests were helpful in the identification of visceral disease[92]. The subjects are categorized in a manner that is appropriate to a clinician involved in chronic pain – those with previously documented visceral disease, those with no clinical evidence of visceral disease, including those women with no prior laparoscopy.

Briefly, *cutaneous allodynia* is tested among women with chronic pelvic pain by the use of a simple cotton-tipped applicator or culture stick[93]. The stick is drawn down the abdomen from the mid-clavicular line on both sides of the abdomen and the woman is asked if there is a sudden change in the sensation or a sudden painful sensation. The areas can be small or large. They are commonly associated with the region where the lower anterior branches of the lumbar cutaneous nerves enter the *rectus abdominis* muscle, just above the pubic triangle bilaterally. These areas can also be large to involve the regions of the T11-L1 dermatomes or small and localized as shown in Figure 3. The test is highly reproducible and has significant inter-rater validity.

A test for myofascial dysfunction involves the palpation of a myofascial trigger point that is usually located within the area of *cutaneous allodynia*. These areas appear as a small knot in the muscle although they often feel closer to the skin as a small lipoma. When pressed they cause severe pain and referred pain into unusual locations such as the chest, back and legs. When the pressure is released, the pain decreases. Women commonly can direct the examining finger to the exact site.

The identification of reduced pain thresholds was undertaken using the Von Fry Anesthesiometer[95;96]. This instrument has a variety of threshold adaptors but for these tests a 90 gram threshold was selected. Women were tested for pain in the deltoid muscle as an internal control for central pain an then in the right and left upper quadrant, right and left lower quadrants and the perineal body for a measure of intra-pelvic sensitivity.

The results of these tests indicate at least on a preliminary basis, an ability to differentiate women with pre-existing or concurrent visceral disease from women without such a condition. The most significant test to be undertaken was the simple use of a cotton-tipped applicator, a device that is available in every clinician's office. Although the discrimination of these groups may not be perfect, it is an approach that is recognizable from clinicians.

The clinical importance of these preliminary findings is that they may identify an important potential confounder in the clinical determination of the cause of pain, particularly the recurrent pain associated with women presenting with recurrent pain following operative laparoscopy. It is entirely possible that the reasons for many of the "negative" laparoscopies associated with chronic pelvic pain may be due to high frequencies of myofascial dysfunction. Traditionally, clinicians have been trained in gynecology to undertake a clinical examination for a pelvic mass. The bimanual examination is one that places a lot of stress on the abdominal wall exactly over the most common areas of trigger points. It also

places a great deal of pressure on the perineum and the vaginal barrel that is the product of the tone of the *levator ani* muscles. It is instructive to note the pressures that are identified as causing pain are quite small. In some cases the weight of pressure causing pain in the lower abdomen and perineum can be as low as 15 grams – the weight of two Canadian one dollar coins. It is entirely possible that pressure placed in these areas can be appreciated as disorders of the adnexa, resulting in further laparoscopic surgery of no particular benefit to the woman. Arguably, this is the case with our case presentation.

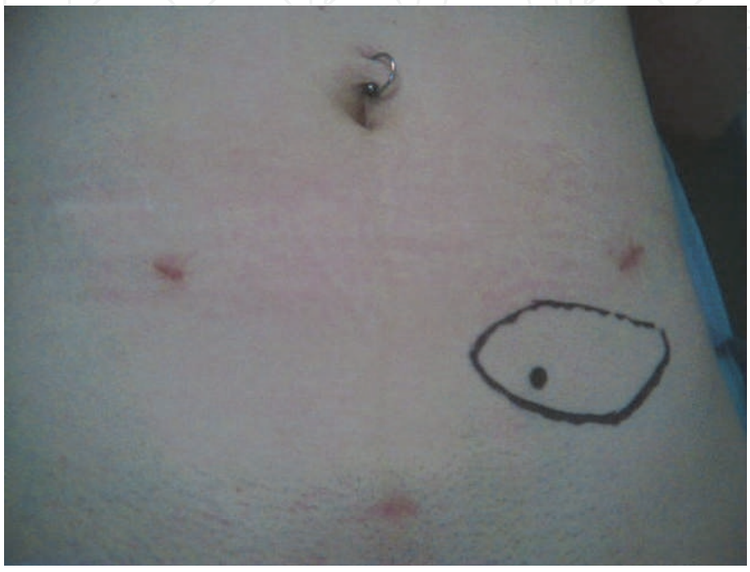

Fig. 3. A demonstration of *cutaneous allodynia* containing a myofascial trigger point in a woman complaining of persistent pain in the left lower quadrant of the abdomen following an operative laparoscopy that treated the presence of endometriosis on the left ovary. The persistent pain was resolved by management of the trigger point – exercise, pressure, stretching and occasional trigger point injections.

Briefly in the evaluation of a woman with chronic pelvic pain, the presence of *cutaneous allodynia* has a significant ability to detect the presence of visceral disease. This documentation indicates that in addition to further medical interventions, an important aspect of care should be undertaken. In many cases, this will represent an alternative to further laparoscopic surgery.

9. Alternatives to laparoscopy

Women with chronic pelvic pain will benefit from multidisciplinary care. There is Level 1 Evidence of its effectiveness. The approach is based on the shift from the traditional acute medical model directed to a "cure" to the recognition that cures in chronic pain are extremely rare and the more appropriate approach is to manage pain in a rehabilitative sense. The elements of such rehabilitation are first and foremost education in the change in concept that is not always accepted by the woman seeking care. Women who seek the cure at all costs have been identifies as pre-contemplative to the rehabilitative model and unlikely to benefit from this type of management. Similarly catastrophic thinking or approaches to the pain have been recognized as risk factors for failure. In addition to

education, cognitive behavioral therapy has Level 1 Evidence of effectiveness. This involves self monitoring of pain, pacing activities carefully and ensuring a restorative sleep pattern is possible. Smoking is strongly discouraged.

Myofascial pain is often effectively managed by physiotherapy self exercise and muscle injections with local anesthetic or botulinum toxin[97]. One must be cautious in the use of botulinum toxin in the abdomen as cases of its migration into the hip casuing temporary difficulties in ambulation have occurred. It is highly effective however in the perineum where it improves aspects of sexual function. Use in the *levator ani* and *obturator internus* muscles is also effective in this regard, particularly for pain that follows intercourse for several days or pain associated with orgasm. Medical management is directed to the suppression of menstrual bleeding with oral contraceptives, GnRH agonists or medicated intrauterine contraceptive devices[98;99]. The medicated intrauterine contraceptive device has been identified as a particularly effective treatment when inserted at the time of operative laparoscopy for endometriosis[99].

Management also assists at times with pain relief that some times requires opiate medication to permit a reduction in hyperalgesia to allow physiotherapists access to areas of myofascial tenderness. Psychological assessment is critical in the approaches to managing stress and the early detection of depression that occurs in approximately 50% of women with chronic pain. Depression is an important barrier to clinical improvement[100]. Occupational therapy is involved in the assessment of capability in working and ergonomic assessments of the worksites[101]. One of key concepts is the development of self directed management of pain[102]. Group therapy can be extremely beneficial in providing access to approaches to intimacy for women who have sexual pain[103]. Groups directed to generating pelvic muscle stretch and strengthening of core muscles are also beneficial[104].

10. Summary

While laparoscopy has demonstrative evidence of effectiveness in many situations, its position in relation to chronic conditions requires additional consideration. Viscero-somatic pain referral is very common. It can be identified in association with endometriosis, pelvic inflammatory disease and other pelvic visceral diseases. It can be identified with simple bedside tests, the most helpful being the recognition of cutaneous allodynia with a simple culture stick. Its recognition help to identify alternative mechanisms of pain and potentially reduced unnecessary surgery.

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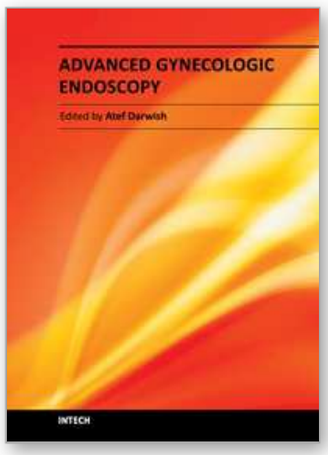

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The main purpose of this book is to address some important issues related to gynecologic laparoscopy. Since the early breakthroughs by its pioneers, laparoscopic gynecologic surgery has gained popularity due to developments in illumination and instrumentation that led to the emergence of laparoscopy in the late 1980's as a credible diagnostic as well as therapeutic intervention. This book is unique in that it will review common, useful information about certain laparoscopic procedures, including technique and instruments, and then discuss common difficulties faced during each operation. We also discuss the uncommon and occasionally even anecdotal cases and the safest ways to deal with them. We are honored to have had a group of world experts in laparoscopic gynecologic surgery valuably contribute to our book.

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
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中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
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