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Are there side effects from medial branch neurotomy interventions for treating low back pain? A critical review

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This thesis is dedicated to my father and mother who constantly motivated me to step up. It is because of their persuasion that I began and concluded this journey. I thank NUMSS for the opportunity to study this PhD remotely and online, as it was not possible to step into it otherwise.

Introduction

Low back pain is a common reason for disability (CDC 1999). Lumbar facet joints are one of the major causes and sources of nociceptive input in low back pain (Boswell, 2007 Hancock 2007). Prevalence studies of lumbar facet joint pain in chronic low back pain have shown the frequency of facet joint pain to range from as low as 4.8% in the multicenter National Low Back Pain Survey evaluating final diagnoses of 2374 patients with low back pain referred to an orthopedic or neurosurgical spine surgeon, to over 50% in systematic reviews and prevalence studies using varying criteria for diagnostic blocks performed by interventional pain physicians (Cohen wt al 2020).

Facet joints were first considered a source of nociceptive input and low back pain more than a century ago (Goldthwait, 1911).'Facet syndrome', was considered to be caused by nerve root impingement from hypertrophy of the facet joint (Ghormly, 1933). The source of the pain in facet syndrome is believed to lie in one or more of the lumbar zygapophysial joints that are innervated by the medial branches of dorsal ramus (Bogduk and Long 1979). Facet joints receive sensory innervation from the medial branch at that spine level and one segment more cranial (Bogduk 1997, Cohen 2007).

Repetitive chemical and mechanical stress on lumbar facet joints may cause osteoarthritis and subsequently pain (Tailor 1986, Cohen 2007). It can also cause inflammation and narrowing of the capsule, resulting in axial chronic low back pain (Van Kleef 2010).

Diagnosis of facet–induced low back pain is shown to be inconclusive with clinical examination. The gold standard diagnosis for facet joint pain is by nerve blocking particular medial branches temporarily, using injection of anesthetic solutions which relieves patient's pain immediately. This procedure is done to confirm a facet joint as source of pain prior to an intervention called medical branch neurotomy. Facet nerve lock is performed in operating room and under radiologic fluoroscopy guidance. To perform the medial branch block, the patient is placed prone on the fluoroscopy table and an anteroposterior image is obtained to identify the desired spinal level and side. Then a special gauge needle is advanced under intermittent radiographic/ fluoroscopic guidance until bone is contacted. At the target points a small amount of local anesthetic are injected. The injection of limited volumes of local anesthetic is imperative to minimize its spread to surrounding nerves in other areas and therefore to minimize the incidence of false positive results (Wall & Melzack, 1994) . Often a well-known pain is provoked at the beginning of the injection. Approximately 2 hours post injection, patients are asked to rate the percentage of relief of their pain.

In a comprehensive systematic study by Cohen et al in 2020 it was stated that there are no pathognomonic physical examination or historical signs that can reliably predict response to facet joint blocks in individuals with mechanical chronic LBP, although pain that is not predominantly in the midline, and possibly tenderness overlying the facet joints, appear to be weakly associated with a positive response to facet joint interventions.

The latest and most widely utilized imaging modality to detect potentially painful facet joints is SPECT, a nuclear medicine imaging technique that requires intravenous administration of a gamma-emitting radioisotope and involves substantial radiation exposure of the patient compared with conventional X-rays.

Using external detectors, two-dimensional projections are acquired in multiple planes and reconstructed to form a three-dimensional image. The quantity of emissions detected from the radionuclide provides a measure of biological activity; thus, SPECT scans can identify active inflammation involving facet and other joints. There is moderate evidence supporting the use of SPECT for identifying painful lumbar facet joints prior to medial branch block test (grade C recommendation, moderate level of certainty).
For scintigraphy, MRI and CT, there is weak or no evidence supporting the use of these imaging modalities for identifying painful lumbar facet joints prior to block or intra-articular facet joint injections (grade D recommendation, low level of certainty), (Cohen et al 2020).

Once medial branch nerve block test is positive for removing facet pain, then the pain can be treated by lumbar medial branch neurotomy. The paradigm for this treatment is that if diagnostic medial branch blocks relieve the pain temporarily, then coagulating or damaging those nerves with a lesion should provide comparable, longer-lasting relief.
The wide disparity in reported prevalence studies raises questions regarding the accuracy of diagnostic testing in the absence of any non-interventional diagnostic reference standard. The poor correlation between facet joint pathology on imaging and low back pain further fuels the debate (Kalichman and Kim 2010)

Neurotomy of the medial branch dennervates the facet joint. Ablation of this afferent innervation has been reasoned to remove the potential for peripheral nociceptive input from the facet joint (Bogduk 1980) and is argued to be best applied to patients carefully selected on the basis of pain relief achieved by anaesthetic (Bogduk; Manchikanti 2002).
To proceed with neurotomy, pain improvement of greater than 50% is considered within active and passive motion during expected duration of the local anesthetic, without leg numbness and weakness.

Management of low back pain by neurotomy of medial branch nerve is increasing. If successful, there is possibility that pain may recur if and when the nerves regenerate, in that case, relief can be reinstated by repeating the neurotomy.

Lumbar facet interventions comprise the second most common procedure performed in interventional pain practices, with millions per year being performed in the USA alone. For lumbar radiofrequency ablasion, a recent review of the Marketscan commercial claims and encounters databases from 2007 to 2016 demonstrated a 130.6% overall increase in utilization (9.7% annually). Along with increasing utilization, there was also a reciprocal increase in cost, with the cost per 100 000 enrollees increasing from US$94 570 in 2007 to US$266 680 in 2016 (12.2% annual increase). In addition, the high number of blocks is inconsistent with the most commonly cited prevalence rates, which are generally <15% in
the non-elderly, but increase with age.(Cohen et al 2020).

The Spine Intervention Society has published guidelines on the performance of lumbar facet blocks and radiofrequency neurotomy, but these rigorous criteria have not been followed in recent randomized controlled trials, and are not adhered to in local and international guidelines. Whereas strict selection criteria have been associated with high radiofrequency ablation success rates,(Dreyfuss etl 2000) the increased false-negative rate, and a host of other factors have resulted in an urgent need for guidelines to inform facet joint interventions in clinical practice and trials. These factors include the absence of safer and more effective alternatives for facetogenic low back pain; the publication of large clinical trials that have been widely criticized for poor conduct, and rising utilization of neurotomy procedures, which alters the risk:benefit ratio and calculations of cost-effectiveness (Dreyfuss 2000, Manchikanti 2016, Starr 2019).

Neurotomy techniques for pain relief that denervates facet joint or destroy the medial branch include rhizotomy or nerve cut, cyberknife rhizotomy, pulsed or thermal radiofrequency and kryorhizotomy. In all techniques the target nerve is first confirmed using diagnostic nerve block and once the result is positive, the nerve is damaged using any of the techniques by cutting, burning or freezing it.

All procedures must be performed in operating room equipped with C-arm or O-arm radiography ,CT or SPECT equipment. There will be substantial radiation received by patient, and there is a high possibility of exposure by treating physician. During the procedure patient is positioned prone with a pillow under the abdomen. Generally, all techniques are performed after injection of a local anesthetic. The skin overlying the target point is anesthesized, and for nerve ablasion, a cannulated needle is advanced toward the target point, again under intermittent fluoroscopy to perform the neurotomy.

The procedure most commonly used is conventional thermal radiofrequency, in which the nerve is coagulated with electrodes that produce a heat lesion at 80–90 centigrades using a monopolar needle. All techniques aim to cause denervation, and complete disruption of medial branch, to achieve pain relief.

Medial branch which innervates facet joint, also innervates multifidus muscles in the spine. Multiple fascicles of Multifidus arise from the lamina, facet joint capsule and spinous process of L1 to L5 and descend caudally over 2 to 5 intervertebral articulations to attach to mamillary processes (Mackintosh and Bogduk 1986). Fascicles from a specific lumbar vertebra are innervated by the medial branch of the dorsal ramus with the same segmental number (Mackintosh et al 1986). At any lumbar level the overlapping multifidus fascicles are innervated by medial branches from several consecutive lumbar levels.
Although there is moderate evidence for face pain relief by neurotomy of medial branch in the short- and long-term (Boswell et al 2007) ,the neurotomy method also removes the motor and sensory innervation of the multifidus muscle. In pigs injury to a single medial branch reduces multifidus size at 3 levels (the maximal extent of the muscle fascicles in pigs) (Hodges et al 2006).

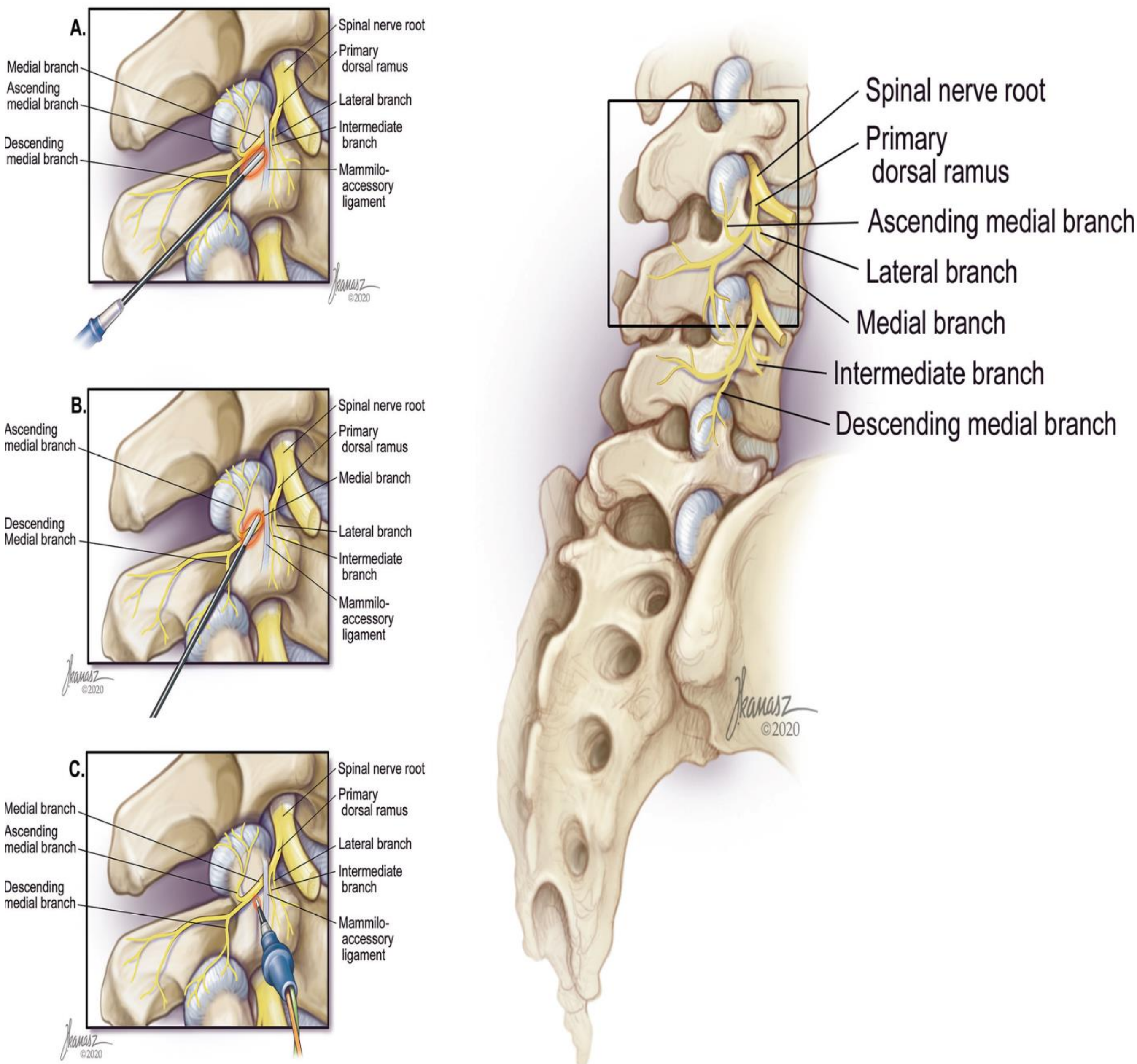

Image demonstrates ablation of medial branch during radiofrenquency techniques using different insertion of needle (Cohen 2020)

The accuracy of the neurotomy technique may be confirmed by electromyographic (EMG) evidence of motor denervation of multifidus (Oudenhoven 1977).

Multifidus muscle is a major contributor to stability and control (motor and sensory aspects) of spine movement and stiffness. It controls segmental stiffness and motion in humans (Macintosh and Bogduk 1986, Panjabi 1989 and 1992, Wilke et al 1995, Kiefer et al 1997 and 1998, Ward et al 2009), is activated when the spine is challenged (Moseley et al 2003, 2002 MacDonald and Mosley 2006, Leinonen et al 2002, Wilder et al 1996), and provides sensory information regarding spine position and motion (Brumagne 2004, 1999). Dysfunction of the multifidus muscle is associated with spinal pain and injury. Atrophy of multifidus is common in low back pain when the muscle is measured with magnetic resonance imaging (Kang et al 2007,Barker et al 2004, Kayder et al 2000, Campbell et al 1998, Parkkola et al 1993), computerized tomography (Danneels et al 2000, Campbell 1998), and real-time ultrasound imaging (Hides 1994,1996). Atrophy occurs within three days of interverterbal disc injury in pigs (Hodges et al 2006) and is present in humans with acute pain on the side and spinal level of pain (Hides et al 2008, Zhao et al 2000).

The reduced sensory, loss of innervation of this muscle and/or the mechanical contribution of this muscle to spine control from dorsal ramus neurotomy may negatively affect control of the spine with consequences for spinal health and function. This would be compounded if the procedure is performed at multiple spinal levels, as is commonly performed (Dreyfuss et al 2009, Gofeld et al 2007).

Present literature however disregards the effects of denervation and is assuming that denervation of multifidus is unimportant and has no negative consequences (Dreyfuss 2009), but it remains unclear whether this is substantiated by data.

Consideration of negative side effects of the procedure in the literature has generally focused on evidence of increased pain, major motor or sensory nerve root injury (i.e. unintended interruption of peripheral nerve supply to the lower limbs), or infection. Most studies report no such complications (North 1994, Dreyfuss 2000, Burton 1976-77, Gallagher 1994, Van Kleef 1999, Le Claire 2001). However it is unclear whether the medial branch damage by neurotomy and subsequent multifidus denervation has no impact on spinal function or such opinion is founded on studies of sufficient quality using appropriate methods.

This study aimed to review the literature to explore the available data on denervation of multifidus by facet neurotomy and whether its effect on the function of the spine has been investigated. The specific questions addressed were; whether physical outcome measures have been used in studies of facet neurotomy. And there is any study on multifidus denervation caused by medial branch neurotomy and its side effect on spine.

Method

All relevant published experimental observational, physiological studies and randomized clinical trial studies regarding the medial branch neurotomy/rhizotomy of the lumbar region using radiofrequency, kryoneurolysis, laser or nerve root sectioning, were considered for inclusion in the review if they included physical measures of relevance to spinal health. There was no restriction on study population, method of denervation of the facet joint or year of the study. Only English language papers were included. Multiple publication of a single study was identified and included once. Full text of all relevant and eligible papers were retrieved. A comprehensive search of database and literature in MEDLINE (OvidSP, PubMed, ScienceDirect, IngentaConnect), EMBASE, CINHAL database, CENTRAL (Cochrane Central Register of Controlled Trials) was conducted. Combined search of MEDLINE and EMBASE is recommended to ensure a comprehensive literature search, and in the field of LBP, EMBASE has been shown to retrieve more clinical trials than MEDLINE (Furlan et al, 2009).

Multiple search terms were used to ensure maximum retrieval. The search terms consisted of "facet" or "zygapophaseal" joint, "medial branch" or "facet nerve", "neurotomy", "radiofrequency neurotomy" or "cryoneurolysis", "lumbar" or "back". To ensure complete data search, reference lists of all relevant papers on neurotomy of medial branch of lumbar spine were scanned and additional studies were included for review.

All studies were reviewed to determine if they included detail of physical outcomes. Full text of compliant studies was obtained. Papers that did not include a physical outcome measure in the methods or results were excluded.

Studies were screened to identify the physical measures they included: (1) Specific effects on anatomy or function of the multifidus muscle after the denervation in comparison to before (e.g. EMG recordings or imaging methods); (2) Functional capacity of the lumbar spine (e.g. lumbar spine range of motion or lumbar muscle strength); or (3) General functional capacity or disability measures nonspecific to the spine (e.g. functional capacity evaluation). Other outcome measures related to disability, quality of life, pain and the course of follow up and clinical outcomes were also reviewed.

Each study was also reviewed to determine whether techniques were used to confirm the accuracy/completeness of the denervation such as multifidus denervation by intraoperative electromyography or imaging guidance of the intervention (i.e. fluoroscopy).

Results

The search of databases and available literature on medial branch neurotomy for treatment of low back pain related to the facet joint, from all selected resources, identified 71 studies. Of these, 30 studies had assessed physical outcome measures, and were eligible for inclusion in analysis.

Nine studies (Ma 2011, Cohen 2010, Nath et al 2008, Van Wijk et al 2005, Le Claire et al 2001, Van Kleef et al 1999, Sanders and Arie Zuurmond 1999) were randomized controlled clinical trials. The other 21 studies were observational studies. No human non-clinical studies of physiological effects of dennervation were identified.

There was a large variation among studies regarding patient populations included and some used broad selection criteria, such as including patients with history of lumbar surgeries [e.g. Ignelzi and Cummings 1980, Katz and Savitz 1986, Masala et al 2011]. Most studies, except few (Gocer et al 1997, Cho et al1997, Katz and Savitz 1986, Ignelzi and Cumming 1980, Burton 1976-7), restricted the study population to individuals with confirmation of facet pathology using diagnostic facet block

To guide accurate placement of the electrode for application of the denervation procedure (i.e. radiofrequency or cryodenervation) most studies used Fluoroscopy, few used computerized tomography (Wolter et al 2011, Li et al 2007, Staender et al 2005) and 23 studies used electrical stimulation (sensory or motor) of the medial branch too.

Three studies (Masala et all 2011, Dreyfuss el al 2000 and 2009) performed electromyography to confirm multifidus denervation after the procedure as a proof for neurotomy and denervation.
Radiofrequency methods to injure the lumbar medial branch at one or more lumbar levels was used in 25 studies , including all randomized controlled clinical trials. Sanders and ArieZuurmond (1999) evaluated the effects of intra-articular versus extra-articular facet radiofrequency denervation techniques. Intra-articular,approach would only affect the articular nerve endings and not the innervation of multifidus. Unfortunately that study did not include specific measures of the muscle outcome. Others used cryoneurolysis or cryodenervation (n=3; Wolter 2011, Birkenmaier et al 2007, Staender et al 2005) which freezes the nerve and Cyberknife (Li et al 2007), which delivers beams of radiation to the targeted tissue.

Physical outcome measures

One study provided data of physical outcomes that are specific to multifidus. A prospective study by Dreyfuss et al (2009, 2000) of 5 participants measured morphology of multifidus using magnetic resonance imaging .The outcome measure in this study was whether a radiographer, blinded to the presentation of the patient, could not reliably detect the site of denervation from observation of the muscle. This method as a measure of changes in multifidus is of questionable validity for several reasons. First, images were made 17 to 26 months after the medial branch denervation and no magnetic resonance images were taken before the procedure for comparison, thus the extent of pre-existing atrophy and change following the procedure could not be determined. Second, as multiple fascicles with innervation from separate levels will be present within an MRI slide taken at any lumbar level, the images at multiple levels would include fascicles that were dennervated as well as multiple fascicles with no interruption of innervation. As the assessors were blinded to the patient presentation they would not have been able to determine whether there was any localized change within the specific affected fascicle.
This paper reported a denervation in the segmental bands innervated by the injured nerve in EMG(electromyography) of multifidus after the radiofrequency ablation. It is unclear how the specific band of multifidus was differentiated in EMG study. Authors maintained that while there is a diffuse muscle atrophy in MR images, denervation of multifiidus does not lead to atrophy of this muscle. Authors in earlier study (2000) stated that at 6 weeks post-procedure, denervation rate in 11 out of 15 patients was 100% and in 4 patients, 65% ,while VAS maximally improved in sixty 60% of the patients.
Burton (1976-7) argued that electromyography is the only objective measure to prove the efficacy of denervation, however there was no EMG data in his paper.
Barendse (2011) and Oudenhoven (1979) had performed EMG assessment after neurotomy , but were excluded from our data, as they had not measured any physical outcome.

Three studies assessed some functions of the lumbar spine; Nath et al. (2008) in a randomized double-blind trial reported improvements in hip and back movements and mostly lumbar extension, compared to a placebo group, 6 months after RF neurotomy . They had not assessed the medial branch nerve injury using EMG or electrical stimulation. Quality of life measures, and some back, leg and generalized pain was better in treatment group at follow up. As there was no information on the accuracy or extent of denervation, physical or clinical data cannot be interpreted in relation to medial branch nerve injury and its consequence which could be multifidus loss.

Le claire et al (2001) in a RCT study measured lumbar spine movements and strength using dynamometry to compare the effects of RFN with a placebo treatment (PEDro score=10). These measures were not different between the groups at 4 weeks post-op. Roland Morris questionnaire, which evaluates how the pain affects patients' daily activities, was marginally better in treatment group, while pain intensity (measured with a 10-cm visual analog scale) or the Oswestry questionnaire, another measure of effect of pain on ADL functioning were not different. It is not clear whether and to what extent the medial branch nerve injury had been applied, as no EMG study had been performed.

Dreyfuss et al (2000) evaluated the effects of facet joint RFN treatment through performance of push and pull and lifting tasks (according to Functional Capacity Evaluation for disability assessment) before and after neurotomy. The performance was not different after RFN. There was no report on the quality of performance (e.g experience of pain).VAS, Roland-Morris and SF- 36 (short form of general health questionnaire) for physical functions was better at follow up points compared to pre-op. There was no data on the number of levels of neurotomy. (EMG results are discussed in previous section)

Burton (1976-7) in a review of his RFN experience, mentioned improvements in trunk range of motion as the most immediate post-op change, however he had not presented any data on this.

All included papers (n=30) had assessed general measures of functional outcome and/or disability after the neurotomy, using a range of questionnaires, scales and scores. Most of the studies showed a positive outcome following RFN. However only Dreyfuss et al (2009, 2000) had confirmed the medial branch neurotmy using EMG. In 2009 study authors showed a better SF-36 outcomes in all 5 patients at follow up, within 1 year post RFN. In their earlier paper, all outcome measures had improved after RFN, while improvements were not correlated with EMG data. Dreyfuss et al related this improvement to a 100% denervation in bands of multifidus corresponding to the coagulated medial branches which wasn't corresponding to EMG muscle function loss.

Seventeen out of 30 included papers had used a validated functional outcome measure such as Oswestry disability Index, Roland Morris or SF-36, however mostly had not explained in which domain (i.e. physical domain) the improvements had achieved. In a randomized trial by Van wijk et al[2005, there was no difference between RFN and control group for physical activities domain. Van Kleef et al (1999) reported a better Oswestry score in lesion group but not quality of life score [COOP/WONCA; Dartmouth COOP Functional Health Assessment Charts/World Organization of Primary Care Physicians (WONCA) chart] between sham and treatment groups. Some studies [Ignelzi and Cummings (1980), Katz and Savitz (1986),Cho et al (1997) ,Gofeld et al(2007),and Cohen et al (2008), Dragovic and Trainer (2011)] used non-standard scales to compare patient's level of daily functioning, before and after neurotomy. In a general sense in most studies, symptoms had improved, but no data was presented to conclude an improved physical performance. Therefore the findings are not able to evaluate the possible compromises resulted from multifidus dysfunction.

For pain outcome measures, most of the included studies had used valid pain outcome measures such as Numeric scale or VAS. Few studies [(Dragovic (2011), Burnham et al (2009),Cho et al (1997), Ignelzi and Cummings (1980)] had developed grading systems for post-op assessment including questions about pain and its affect on daily function which had not been validated before.

Discussion

Although many authors argue that there is no consequence after neurotomy of medial branch at spine(i.e. loss of multifidus muscle), it is clear from this review that there is insufficient evidence upon which to evaluate this claim. One study (Dreyfuss et al, 2009) investigated magnetic resonance images of a small sample of 5 subjects after 21 months, and claimed that there was no specific multifidus atrophy, however the foundation for their argument is not strong.
Further review of studies which had measured some physical outcomes, imply they are not able to make judgement on affect of denervation on multifidus muscle and lumbar function. There is no evidence that the EMG findings are accurate, as they may not correspond to the specified medial branch segment denervated. Further, the utilized outcome measures are not specific measures of lumbar function and they are unable to assess for the compromises resulted from multifidus dysfunction.

All included studies had evaluated the effect of patient's pain on daily activities, before and after neurotomy. Function improves as pain decreases following medial branch neurotomy, or due to a placebo effect. However this should be distinguished from other compromises such as multifidus loss and atrophy, as it might be a pre-existing condition in patient with back pain (Hides et al 2008). Therefore a subjective improvement in function can not justify that multifidus loss has no effect on lumbar spine performance. Van wijke et al (2005) showed no difference between active and sham groups in pain and functional activity. This study is criticized over accuracy and results of its denervation method (Boswel 2007).
There are few aspects to keep in mind; multifidus performance can be reliably measured through specific tasks (O'Sullivan et al 2002), imaging guidance (Ferreira et al 2004, Hides et al 2006) and fine EMG techniques. Three studies assessed multifidus denervation using EMG. Therefore no conclusion on the effect of facet denervation and multifidus loss on lumbar spine function can be drawn from most studies. Also denervation at one or two segment unilaterally, minimizes the affect of multifidus loss on spine, as the other muscles can compensate for the minor loss. Zotti and Osti (2010) report that results of multiple RFNs are better than a single RFN, suggesting that the nerve may not be completely injured during RFN, leaving the findings on physical performance inaccurate.
Further the effect of exercise therapy during the evaluation of physical outcomes should not be underestimated as it improves specific function and global perceived effects (Ferriera et al 2007). Only Vad et al (2003) and North et al (1994) pointed that patients went through an extensive exercise program after the procedure. No other paper reported about any form of therapy throughout the course of data collection.

Three studies had assessed the effect of neurotomy on lumbar function. Nath et al. (2008) had assessed lumbar ROM pre and post-neurotomy and reported an increase in lumbar extension. This is a favorable outcome after facet joint treatment, as facet pain is worse with extension

(Barlocher et al 2003, Beresford et al 2010, Schendel et al 1993), due to an increased compressive load (El-Bohy et al 1989). They reported slight increase in flexion movement. As multifidus resist and control bending movement in the lumbar spine (Macintosh and Bogduk 1986), increased flexion due to a reduced muscle tone is plausible. This study has weaknesses; with a delayed post-op assessment at 6 months, it is not acceptable to relate the results solely to RFN as patients' condition might have been better or worse by other factors such as medication, engagement in a rehabilitation or general exercise program or a possible nerve re-growth (Schofferman and Kine 2004). In this study back pain did not differ between groups at 6 months. Most importantly as investigators had not confirmed accuracy of denervation by EMG, it is not possible to attribute the changes in movements or pain to medial branch denervation or loss of multifidus.

In other paper, Le claire et al (2001) reported no difference between sham and treatment group in lumbar tasks measured by dynamometry and functional disability measures except for Roland Morris. They had denervated at least 2 segments unilaterally or bilaterally, which leaves other segments and muscle fascicles potentially intact. Multifidus muscle has a short length (Mackintosh and Bogduk 1986, Ward et al 2009) and is not able to produce torque and extension movement. Further, spared mutifidus fascicles, and other paravertebral muscles may compensate the minor loss and so, strength of lumbar spine may not change in dynamometry. This study is criticized for its patient inclusion criteria (Boswel 2007) and as there was no proof of denervation without a valid and reliable tool such as EMG, technical errors in localizing the MB nerve and accurate denervation were likely. Therefore findings from this study can not help understanding how a loss of multifidus affect lumbar spine performance.

Dreyfuss et al (2000) in another study did not find a difference between pre and post-neurotomy, in some push-pull and lifting tasks, which are general measures of physical ability. These tasks do not measure specific lumbar function nor multifidus performance. The study was observational and lacked a group comparison. The authors performed pre and post-neurotomy EMG study but without imaging, and argued that EMG testing was specific to segment. One, though is a skilled electromyographer, may not be able to reliably locate a specific band of the muscle, as multifidus bulk at each segment/level comprises of overlapping fascicles arising from multiple levels, each innervated by a medial branch of the same segmental level. So author's techniques lack accuracy.

Therefore few existing studies on physical outcomes related to lumbar function with positive or negative clinical outcomes, can not provide sufficient evidence on physical consequences of multifidus denervation resulted from lumbar medial branch neurotomy.

Two studies by Dreyfuss et al(2009, 2000) performed EMG to assess multifidus denervation after RFN. In 2009, they availed MR images of 5 patients in differing times post-RFN and argued that the neurotmy had not effected the muscles, as they could not detect the side or segment of the atrophy in the images. Patients with back pain have generalized multifidus atrophy, and this is more specific at the site of pain (Kayder et al 2000, Hides et al 1994, 1996, 2008, and Barker 2004). With a pre-exisiting atrophy, detecting a new atrophy is not empirical, when there is no pre-procedure image for comparison. Dreyfuss et al (2009) supported earlier argument that RFN had no consequences as patients had not seeked care for back pain until re-assessment date and that " long term segmental atrophy of the multifidi does not occur, and multifidus denervation or atrophy has no consequences". There is no evidence to support such conclusion . Size (i.e. cross sectional area) of multifidus in pigs reduces in 3-6 days locally and specific to the site with a disc injury, presumably due to pain, and it happens at multiple levels when medial branch is injured (Hodges et al 2006), compared with a sham procedure. This confirms an acute atrophy of multifidus following nerve injury and its multilevel innervations.

The relationship between findings in EMG and clinical outcome as well has been unclear; Barendse et al (2001) in a randomized trial reported insignificant difference between the EMG data of the lesion and control group at 3 weeks post-op, and no relation between decrease in pain and denervation signs (i.e. spontaneous muscle fiber activity) in the paraspinal muscles.

However patients' back pain may be of other origins than facet joint.

In Oudenhoven (1979), EMG abnormalities at 4-6 weeks post-rhizotomy, directly correlated with relief of pain, although they did not present a statistical analysis. Campbell et al (1998) believe that in EMG study of multifidus after a single nerve injury, fibrillation potentials can not be detected, or if did, prove that is from a specific segment.

Had these authors assessed the muscles before the nerve injury, or used imaging techniques, to confirm which paraspinal muscle and at which level was assessed, comparing results before and after the procedure, then their results would have been more reliable. Studies have shown abnormal denervation EMG potentials in back muscles and atrophy in CT images corresponding to the operated site, (Sihvonen 1993) in patients with failed back syndrome, and atrophy is more prominent in patients with recurrences. This further confirms the pre-existing muscle atrophy and importance of a pre-procedure EMG or imaging assessment, before a conclusion can be made.

Barendse et al suggest that EMG findings in sham patients might be result of nerve injury and affected by infiltration of anesthetizing medicine during the diagnostic block. Nath et al (2008) excluded 105 patients from neurotomy as they had long term pain relief after nerve block and Oudenhoven (1977) observed similar finding. So this issue requires further investigation.

From the review of current literature It is clear that existing studies lack accurate measurement techniques and methods to suggest what are the consequences of the facet and medial branch neurotomy for pain relief and consequent multifidus loss and to makes the foundation for a reliable conclusion on the denervation outcomes.

Conclusion

Review of the current literature shows that there is insufficient evidence to determine the physical consequences following lumbar medial branch neurotomy or to suggest that multifidus denervation caused by this neurotomy has no effect on spinal function. The physical outcomes assessed in the few studies are not specific measures of multifidus performance; but measures of general function of the lumbar region which is a complex movement, resulted from various muscles. Few studies which investigated the paraspinal or multifidus muscle had methological flaws which negatively affected their conclusions. Further studies with meticulous techniques and methods are needed to investigate the consequences of medial branch neurotomy for facet joint pain , on lumbar spine.

Furthermore we need to bear in mind that Medial branch neurotomy is a costly procedure and an economic burden in any country. Future studies of pain management for facet joint should include a trial 3-month course of physical treatment along with medication management before facet joint interventions. These therapies may include physical treatments (exercise, heat or cold therapy, massage), integrative treatments (acupuncture, spinal mobilization or manipulation if indicated) and others such as spinal load management, posture correction, activity modification, nutrition, weight loss, and sleep hygiene to name a few. Although current research does not provide clear answers regarding the optimal timing of facet joint interventional procedures for chronic low back pain, or the appropriate duration of conservative care before consideration of facet interventions, prospective studies of facet joint interventions should generally require a trial of conservative treatment before study enrollment. This is consistent with the recommendations of multiple clinical practice guidelines. Results of such approach will provide an opportunity for a non-interventional treatment option for patient before they are offered a block or neurotomy, which reduces the harm of exposures to substantial radiations during procedures, being subjected to a needle insertion to spine, among other benefits for them while tremendously affects the cost-benefits of these procedures and reducing the total burden on government and organizations.

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