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Research Article

Mutifidus in Spinal Stability: Analysis of Inhibition with Muscle Activation Techniques

Abstract

Objectives: To (1) study the relationship between multifidus muscle activation and perception, (2) to explore the correlation between the failure of the multifidus and back pain, when (3) tested with the MAT technique and back pain questionnaire.

Design: Three months prospective before/after quality improvement project.

Participants: The participant sample consisted of 34 volunteers (30.5 ± 8.2 years).

Intervention: Lumbar disability was calculated using the Oswetry test, along with a neuropropioceptive multifidus response test and perceived exertion (Borg Scale).

Results: The results of this study show a high correlation (p =.000) between back pain and the failure of multifidus in the women studied, and also between the failure of the multifidus and perceived exertion in both men and women.

Conclusions: The perception of effort is higher when the muscle fails according to the measure made by the muscle activation techniques.

Introduction

In developed countries, a relatively high percentage of people (80%) experience low back pain episodes at some time during their lives [1,2]. For instance McGill (2007) considered Back Pain to be the epidemy of 20th century [3]. And whilst these pathologies have been linked with deformations or structural changes, in the last decade more than 96 % have been linked to causes that are difficult to specify [3,4].

Among these possible causes, the Multifidus Muscle deserves special attention, since it extends along the entire spine, from the second cervical disc to the sacrum. The stabilizing role of the Multifidus is its principal function, in order to maintain the lumbar lordosis [5-7]. In addition, Aspden (1992) and Rosatelli (2010) suggest that the contraction of the multifidus increases lumbar lordosis, since this contraction produces force that increases the resistance of lumbar spine and torsion forces, thereby increasing stability [8,9]. It is important to note the multifidus can influence agonist co-contraction, in this case abdominal muscles [1,2]. Thus, the multifidus can produce spinal extension through bilateral contraction, lateral flexion, and opposite rotation by means of unilateral contraction [9].

Furthermore, various authors have linked lumbar pain to possible multifidus atrophy [11-15]. Given this link, it is unsurprising that multifidus alterations can be predictive of different spinal injuries [9]. Habitual techniques used to measure multifidus activation [16-19] are electromyography, ultrasound, MRI, manual techniques. Among the latter, we have identified the technique that will form the focus of the current study, namely that of muscular activation (MAT®). This technique has been created for the testing and treatment of muscle imabalances with the aim of restablishing the contractile capacities of muscle. MAT® attempts to locate the cause of muscular debility or muscular inhibition.

The procedure used to detect muscular weakness is:

1. Assesment of the joint range (ROM) with the aim to detect Movements limitations, looking for asymmetries in joint movements.
2. Evaluation of muscular debility with a specific neuropropioceptive response test. This test is performed in a shorthening muscle position, because this position is more sensible to the detection of neuropropioceptive vulnerability. The aim of this position is to detect the co-activation alpha-gamma motoneurone.
3. Use of MAT® technique in order to regulate neuromuscular debilities. There are two ways: Palpation Muscular Test (origin and muscular insertion) and Isometrics Correctives Exercises (4-6 seconds).
4. Re-Test: ROM and neuropropioceptive response test to evaluate if muscle debility has disappeared.
5. Although MAT® has been widely applied, at the moment, there isn't any formal demonstration of its use.

Method

Participants

In the study there were 34 participants, of which 21 were women (30.5 ± 13.4 years), and 13 men (30.2 ± 7.4 years). Sample percentages

of physically active men and women were 69.2% and 85.7% respectively, while 23.8% of women and 15.4% of men had some associated pathologies. The recruitment of the sample was carried out by a convenience sampling technique, by a note in the clinic, where all participants were informed about the study and gave their consent to participate. This investigation was carried out according to the principles stipulated in the Declaration of Helsinki, concerning investigations with human beings.

Instruments

In order to monitor multifidus activation, the use of the neuropropioceptive technique MAT® was performed on a stretcher. In addition, to measure effort perception we used The Borg Scale [20,21] to adjust the intensity of effort. In order to assess lumbar pain, we employed The Owestry Scale [22], a 10-item questionnaire designed to ascertain the limitations of everyday life and provide an incapacity index associated with back pain [23].

Procedure

First, the Owestry questionnaire was administered before beginning the subsequent neuropropioceptive test. This test was performed in a shortening muscular position, increasing muscular tension, in order to focus on the maximum line of action of the muscle force. Main differences between neuropropioceptive technique MAT® and other analytical tests are the initial position (muscle shorthening) and timing (inmediately). If the test is positive, this indicates failure of the tested muscle, the subject not being able to manually hold a resistance of 10 kg for two seconds.

This test was carried out with the subject lying in a supine position on the stretcher, where the subject was required to perform an external hip rotation and an inverse spine rotation, along with a lateral spine flexion which is the side on which the neuropropioceptive test was conducted. In this position, we asked the subject to oppose the applied force, thus making the force move towards the experimenter. The activator caught the subject by the ankles and then placed his other hand at the height of the pelvis. Thus, the activator was able to generate in this position two forces with the aim of producing a challenge to the lateral flexor lumbar musculature.

Upon completion of the neuropropioceptive test, the subject completed the Borg Scale. Once the questionnaire was filled in we proceeded to conduct the corresponding statistical analysis.

Analysis of results

Given the specificity of the sample, along with the limited number of participants, Kolmogorov-Smirnov's test was conducted to determine the normal distribution of the variables of the inventory. All variables analyzed present a normal distribution, thus permitting the use of parametric statistics. We then proceeded to calculate the frequencies of the variables, as well as a Pearson's correlation between the different variables analyzed. All analyses have been developed by the statistical package SPSS version 22 (IMB, Somers, NY, USA) for Windows.

Results

As can be seen in the following table, the studied variables show the following frequencies depending on the analyzed variable. First the frequencies are presented as a function of gender. The table shows that 61.9% of women suffer from back pain, being full back the most affected area (51.9%). Instead, only 53.8% of men suffer from back pain, particularly in lumbar region (50%). For this pain, both women (71.4%) and men (76.9%) present a high score of minimum rate limitation, while 19% of women present an intense rate limitation and a 15.4% of men presents a moderate rate limitation. Is important to note that 66.7% of women have a positive test in the multifidus muscle, while this percentage is only 61.5% for men (Table 1).

Having described the information obtained in the analyzed values, we conducted a Pearson's correlation analysis in which we obtained the following results. The correlation analysis was carried out with multifidus activation and the scores obtained on the Borg Scale. As can be seen, we found a significant correlation between multifidus failure and effort perception in both, men and women. In particular when the multifidus fails, effort perception is higher, and vice versa (Table 2).

Therefore, there appears to be a positive correlation between spine pain and multifidus dysfunction but only in the case of women, both with the right and left multifidus. As can be seen, the back pain is related both to the atrophy of the right and left multifidus. This was not the case for the men studied in our investigation (Table 3).

Discussion

To our knowledge, MAT® represents a new technology that has not yet been studied scientifically in order to demonstrate it is relevance. Additionally, the present study prove the use of instruments such as the Borg Scale [20] that has been used in many other articles in the literature [21,24].

The chief finding to emerge from this novel study is that when the multifidus fails, there is a higher perception of effort. This result could be due to the inability of the subject to assert force, because the muscle was found to be weak or inhibited. Therefore, when the multifidus shows no failure, the effort perception is lower, which can be interpreted as high efficiency. In this situation, the subject can

Table 1: Frequency Analysis.

	BACK PAIN	AREA OF PAIN				INDEX OF LIMITATION			RPN TEST POSSITIVE MULTIFIDUS	
		LUMBAR	CERVICAL	LUMBAR & CERVICAL	ALL	MINIMUM	MODERATE	INTENSE	RIGHT	LEFT
WOMEN	61,9 %	21,4 %	14,3 %	7,1 %	57,1 %	71,4 %	9,5 %	19 %	42,9 %	57,1 %
MEN	53,8 %	50 %	12,5 %	--------	37,5 %	76,9 %	15,4 %	7,7 %	38,5 %	46,2 %

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Table 2: Correlation Borg Scale and Multifidus Muscle Inhibition.

MAT Test		EFFORT PERCEPTION
Right Multifidus	Women	-. 878 ** *p* =.000
	Men	-. 878 ** *p* =.000
LeftMultifidus	Women	-. 864 ** *p* =.000
	Men	-. 886 ** *p* =.000

Table 3: Correlation Back Pain and Multifidus Muscle Inhibition in Women.

MAT Test		BACK PAIN
Right Multifidus	Women	. 481* *p* =.027
LeftMultifidus	Women	. 510 ** *p* =.018

hold the applied force without any kind of complications, thereby producing a lower perceived effort

Given the importance of the multifidus in spinal stability [6,7,9], along with the range of motion itself and its relationship with potential pathologies, it might be supposed that inhibition of this muscle could create compensation patterns. These compensatory mechanisms could, in time, lead to the excessive wear and overload of other structures. Thus the failure of the multifidus muscle might indicate that motor control is not operating at an optimum level, and therefore, other structures are covering its role over time.

In reference to this failure, we can also highlight the failure rate of at least one of the two multifidus, this being 66, 7 % in women and 61, 5 % in men. These high percentages may be worthy of special attention, since they could be predictors of a range of diseases or pathologies. In addition, it should also be noted that we have obtained a significant correlation between multifidus failure and back pain. a finding which is in accord with previous studies which have linked low back pain with possible atrophy of the multifidus muscle [11-15], a finding which we have also been able to confirm (in women) in the present study.

Conclusion

The main finding of our study is that higher effort perception is correlated with failure of the multifidus muscle. Besides, women have higher back pain when the test is positive. This type of manual technique may therefore be a potentially useful tool for the detection of various pathologies that are related to the functioning of the multifidus muscle.

Limitations

The MAT technique is very new so there is a lack of scientific references. Also a specialist in MAT technique is needed in order to do a neuropropioceptive response test and there aren't many of them. That's why a small sample has been used in the present study.

Conflicts of Interest

We the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

We wish to draw the attention of the Editor to the following facts which may be considered as potential conflicts of interest and to significant financial contributions to this work.

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

We further confirm that any aspect of the work covered in this manuscript that has involved either experimental animals or human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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