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Determining the Effectiveness of Core Strengthening Exercise Therapies in Treating Nonspecific Low Back Pain: A Critically Appraised Topic

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Clinical Scenario: Nonspecific low back pain is a condition which impacts athletes of all calibers and sports. It has been found that a total of 68% of top athletes from multiple sports have been affected by nonspecific low back pain at some point in their career. Clinicians have discussed that tight hamstrings and weak core muscles are a major cause of nonspecific low back pain. A myriad of program exist to reduce nonspecific low back pain caused from hamstring tightness, however a standardized rehabilitation protocol for strengthening the core muscles to reduce nonspecific low back pain is not as well established. Many different treatment options have been utilized, such as medications, biopsychosocial interventions, physical and electrical modalities, manual therapies, and exercise therapies. Included in these exercise therapies are stretching and mobility exercises, cardiovascular endurance, and strengthening exercises, specifically core stability exercises. **Focused Clinical Question:** Is there evidence to suggest which type of core strengthening rehabilitation would best reduce pain and increase function in athletes? **Clinical Bottom Line:** To best reduce pain and increase overall function caused by nonspecific low back pain, a combination of motor control exercises, general exercises, graded activities, sling exercises, segmental stabilization, and spinal manipulative therapy should be utilized. **Strength of Recommendation:** According to the Oxford Centre for Evidence-based Medicine (CEBM) Levels of Evidence. There is moderate evidence, level 2b and higher, suggesting that an exercise program should be created that is tailored to the individual athlete's flaws. **Key Words:** *Low back, pain, motor control, stabilization, manipulative therapy.*

CLINICAL SCENARIO

Nonspecific low back pain is a condition which impacts athletes of all calibers and sports[1]. It has been found that a total of 68% of top athletes from multiple sports have been affected by nonspecific low back pain at some point in their career[1]. Clinicians have discussed that tight hamstrings and weak core muscles are a major cause of nonspecific low back pain[1-3]. A myriad of program exist to reduce nonspecific low back pain caused from hamstring tightness, however a standardized rehabilitation protocol for strengthening the core muscles to reduce nonspecific low back pain is not as well established[1]. Many different treatment options have been utilized, such as medications, biopsychosocial interventions, physical and electrical modalities, manual therapies, and exercise therapies[1]. Included in these exercise therapies are stretching and mobility exercises, cardiovascular endurance, and strengthening exercises, specifically core stability exercises[1].

FOCUSED CLINICAL QUESTION

Is there evidence to suggest which type of core strengthening rehabilitation would best reduce pain and increase function in athletes?

SUMMARY of Search, "Best Evidence" appraised and Key Findings:

- A review of three randomized control trials[2-4] and one comparative study[5], was performed in order to create a summary of current and prevalent evidence to determine which type of core strengthening would best reduce pain and increase function among athletes with nonspecific low back pain.
- This review of the literature resulted in a wide variety of exercise programs that were found to be effective in treating nonspecific low back pain.

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- The exercises found to be the most effective in treating nonspecific low back pain include motor control exercises, graded activities, sling exercises, segmental stabilization, and spinal manipulative therapy.

One of the studies found that motor control exercises targeting the strengthening of the transverse abdominis and lumbar multifidus produced a greater reduction in pain, and an increase in overall function when compared to other exercise interventions[3,]. The other two studies found that no significant differences in pain reduction or increased function resulted from implementing a specific exercise program over another, but rather individual factors, such as availability of the program, insurance coverage, and personal preference of each athlete, should be the determining factor when deciding which exercise program to implement[2, 4].

One comparative (cohort) study found that segmental stabilization exercises that focus on targeting the strengthening of the transverse abdominis and lumbar multifidus produce a greater reduction in pain and increase in function[5].

CLINICAL BOTTOM LINE

To best reduce pain and increase overall function caused by nonspecific low back pain, a combination of motor control exercises, general exercises, graded activities, sling exercises, segmental stabilization, and spinal manipulative therapy should be utilized[2-5].

Strength of Recommendation

According to the Oxford Centre for Evidence-based Medicine (CEBM) Levels of Evidence[6]. There is moderate evidence, level 2b and higher, suggesting that an exercise program should be created that is tailored to the individual athlete's flaws[4].

SEARCH STRATEGY

Terms Used to Guide Search Strategy

- **P**atient/Client Group: Athletes with nonspecific low back pain
- **I**ntervention: Motor control exercises, Graded activities, Sling exercises, Segmental Stabilization, Spinal Manipulative therapy
- **C**omparison: General exercises
- **O**utcomes: Increased function secondary to decreased pain

Sources of Evidence Searched

- PubMed
- EBSCOhost
- Science Direct

INCLUSION and EXCLUSION CRITERIA

Inclusion criteria

- Limited to the last 10 years (2007-2017)
- Limited to peer reviewed articles
- Limited to studies on human participants
- Limited to English language
- Level 2b evidence or higher
- Limited to athletes with nonspecific low back pain
- Prospective or retrospective published studies investigating the effectiveness of core strengthening exercises when trying to reduce pain and increase function

Exclusion criteria

- Research studies involving nonspecific low back pain that was present for less than 3 months

RESULTS OF SEARCH

A total of four relevant studies[2-5] were located and categorized as shown in Appendix A and Appendix B (based on Levels of Evidence, Centre for Evidence Based Medicine, 2011).

SUMMARY OF BEST EVIDENCE

Three randomized control trials[2-4] and one comparative study[5] were determined to be the best sources of evidence to answer the above clinical question, and therefore, were chosen to be included in this critically appraised topic. These four articles[2-5] were chosen because of the high level of evidence they possess, they show comparisons between different types of exercise therapies all thought to be effective in treating

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nonspecific low back pain, and they measure the effects that these exercise therapies have on pain reduction and increased overall function.

IMPLICATIONS FOR PRACTICE, EDUCATION, and FUTURE RESEARCH

The four published papers[2-5] reviewed in this CAT provide moderate evidence for specific exercise therapies that should be utilized to increase overall function and reduce pain in patients with nonspecific low back pain. The results of the research studies[2-5] reviewed in this CAT show that a combination of motor control exercises, general exercises, graded activities, sling exercises, segmental stabilization, and spinal manipulative therapy should be utilized to improve overall function and reduce the pain that is brought on by nonspecific low back pain. Motor control exercises are defined as exercises that enable the patient to regain control and coordination of the spine and pelvis to maintain stability by using segmentation and simplification[4]. Segmentation and simplification are parameter within motor control and are methods of learning or relearning a task. Segmentation is the process of breaking movements/tasks into smaller parts, whereas simplification is the process in which a difficult task is made easier by adjusting smaller pieces of the task[7]. The patient works to improve activity of muscles assessed to have poor control (commonly the deeper muscles, such as the transverse abdominis (TrA), lumbar multifidus (LM), pelvic floor, and diaphragm) and reduce activity of overactive muscles (commonly the superficial muscles, such as the obliquus externus abdominis) to improve overall function of inter-segmental movements of the spine [4]. Graded activity programs are activity-focused rather than injury focused and have a primary goal of increasing activity tolerance by performing individualized and submaximal exercises, in addition to ignoring illness behaviors and reinforcing wellness behaviors[4]. Cognitive-behavioral principles and positive reinforcement were utilized to help overcome the biopsychosocial factors such as natural anxiety associated with pain and the activities that cause this pain[4]. Sling exercises consist of unloading elastic bands attached to the pelvis that are used to help the participant maintain a neutral, stable position of the lumbar spine while progressing through a range of leg and arm positons and movements[2]. By requiring the lumbar region to remain in a stable position for the duration of the exercise, while the extremities were moving, both the deep and superficial abdominal muscle groups were activated and strengthened[2]. Segmental stabilization is defined as exercises that are focused on activation of the TrA and LM[5]. It is important to strengthen the TrA and LM because they are primary stabilizers of the lumbar segment of the spinal column, and have the ability to greatly reduce the compressive forces that act of the spinal structures[5]. Spinal manipulative therapy is utilizing joint mobilization or manipulation techniques on the spine and pelvis[1]. When comparing these exercises individually, it can be noted that motor control exercises, spinal manipulative therapy, and segmental stabilization have the best results in reducing pain and increasing overall function in athletes with nonspecific low back pain[5]. However, these improvements are only minimal when these therapeutic exercises are not performed concurrently with one another[4]. In addition, there has been research to suggest that the type of exercise is not so important, but rather the quality of exercise implementation is directly related to positive outcomes[4]. That is, better results were observed in exercise programs that were individually designed and delivered with supervision[4]. Creating a combination of the above therapeutic exercises that are individually designed and that will be directly supervised when implemented would allow for an extremely effective rehabilitation protocol to be designed that could possibly become the new standard of practice in treating individuals with nonspecific low back pain.

Srivastav and Nayak (2016) conducted a study designed to prevent low back pain from

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occurring. They determined certain exercises were best strengthen the core muscles and prevent nonspecific low back pain from reoccurring. Exercises were chosen based on the specific muscle or group of muscles that they target. Exercises that solely targeted the TrA, LM, pelvic floor, and diaphragm were gathered and put into a functional core stability maintenance program. It was found that the TrA can be strengthened through prone planks, swiss ball planks, swiss ball rollouts, swiss roll jackknives, stability ball bridge, swiss ball hip raise, and crunches[9]. The LM can be strengthened through coordinating trunk and limb movements, improving posture, and improving movement patterns[10]. Although the pelvic floor consists of a variety of muscles, the entire muscle group can be strengthened via the same exercises; these exercises being dead bugs, glute bridges, assisted heal drops, and resisted clam shells[9]. Finally, the diaphragm can be strengthened specifically through stomach vacuums ("sucking in the gut")[11], but this muscle may also be strengthened through proper breathing techniques while performing all other exercises[8]. Combining these exercises in a maintenance program that is being implemented under direct supervision, that gradually increases in intensity can ensure proper core strengthening is occurring, ultimately resulting in decreased nonspecific low back pain.

Randomized control trials with assessor blinding need to be conducted to compare these five therapeutic exercises, specifically in athletes with nonspecific low back pain, to determine which exercise or combination of exercises would have the best results in decreasing pain and increasing overall function in high caliber individuals. Currently, no trials exist that focus solely on athletes, which could ultimately change the results that have been seen up until this point. In addition, studies that focus on the prevention of nonspecific low back pain in all individuals should be conducted to reduce the occurrence rates of this injury. With more than 68% of the top athletes among multiple sports being affected by this disabling injury more needs to be done to determine the most effective treatment and prevention[1]. This CAT should be reviewed in two years to determine if new evidence has been established regarding which therapeutic exercises have the greatest impact on athletes with nonspecific low back pain. If additional information is discovered, this could ultimately affect and change the clinical bottom line for this focused clinical question.

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Appendix A: Summary of Study Designs of Articles Retrieved

Level of Evidence	Study Design	Number Located	Authors
1b	Randomized Control Trial	3	Unsgaard-Tondel et al.[2] Costa et al.[3] Macedo et al. [4]
2b	Comparative (Cohort) Study	1	Franca et al. [5]

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Appendix B: Characteristics of Included Studies

	Authors			
Characteristics	Unsgaard-Tondel et al.[2]	Costa LOP. et al.[3]	Macedo et al.[4]	Franca et al.[5]
Study Design	Randomized controlled trial	Randomized controlled trial	Randomized controlled trial	Comparative (cohort) study
Participants	109 individuals total. 36 in MCE group: 7M 29F, Age 40.9±11.5 y, Height 171.4±7.7 cm, Weight 73.3±11.6 kg. 36 in SE group: 13M 23F, Age 43.4±10.2 y, Height 172.6±7.7 cm, Weight 74.5±11.6 kg. 37 in GE group: 13M 24F, Age 36±10.3 y, Height 171.2±8.7 cm, Weight 71.1±9.9 kg. All presenting with nonspecific low back pain for 3 months or longer.	154 individuals total. 77 in MCE group: 45F 58M, Age 54.6±13 y, Height 1.65±0.09 m, Weight 74.5±17.5 kg. 77 in placebo group: 48F 62M, Age 52.8± 12.7 y, Height 1.64±0.10 m, Weight 75.9±15.3 kg. All presenting with nonspecific low back pain for 12 weeks or longer.	172 individuals total. 86 in GE group: 41M 45F, Age 49.6±16.3 y, Height 168.5±10.1 cm, Weight 80.8±16.2 kg. 86 in MCE group: 29M 57F, Age 48.7±13.7 y, Height 166.9±9.2 cm, Weight 75.5±19.3 kg. All with chronic nonspecific low back pain lasting longer than 3 months	30 individuals total. 15 in SS group: Age 42.07±8.15 y, Height 1.67±.11 m, Weight 74.61±16.26 kg. 15 is ST group: Age 41.73±6.42 y, Height 1.65±.08 m, Weight 73.60±12.26 kg. All with chronic low back pain lasting longer than 3 months.
Interventions	Low-load motor control exercises, high-load sling exercises, general exercises for 8 weeks	Motor control exercises, placebo for 8 weeks	Motor control exercises, graded activity for 14 sessions	Segmental stabilization, superficial strengthening for 6 weeks
Outcome Measures	Pain reported on the Numeric Pain Rating Scale, self-reported activity limitation, clinically examined function, and fear avoidance beliefs after treatment and 1 year following	Primary: pain intensity, activity (patient-specific functional scale), and patient's global impression of recovery measured at 2 months. Secondary: pain, activity (patient-specific functional scale), patient's global impression of recovery measured at 6 and 12 months, activity limitations (roland-morris disability questionnaire) at 2, 6, 12 months, and risk of persistent or recurrent pain at 12 months.	Primary: average pain over the previous week (numeric rating scale) and function (Patient-Specific Functional Scale) Secondary: disability (24-item Roland-Morris Disability Questionnaire), global impression of change (Global Perceived Effect Scale), and quality of life (SF-36)	Pain (visual analogical scale and McGill pain questionnaire), functional disability (Oswestry disability questionnaire), and Transverse Abdominis muscle activation capacity (Pressure Biofeedback Unit = PBU).
Main Findings	There is no significant differences in decrease in pain or any outcome measures when comparing motor control exercises, sling exercises, or general exercises.	The motor control exercise group improved activity and the patient's global impression of recovery but did not clearly reduce pain at 2 months.	A linear mixed models analysis showed that there were no significant differences between treatment groups at any of the time points for any of the outcomes studied.	As compared to baseline, both treatments were effective in relieving pain and improving disability. Those in the segmental stabilization group had significant gains

				for all variables when compared to the strengthening of abdominal and trunk muscle group, including Transverse abdominis activation.
Level of Evidence	1b	1b	1b	2b
PEDro Score	8/11	10/11	9/11	N/A
Conclusion	This study gave no evidence that motor control exercises or sling exercises were superior to general exercises for chronic low back pain	Motor control exercise produced short-term improvements in global impression of recovery and activity, but not pain, for people with chronic low back pain. Most of the effects observed in the short term were maintained at the 6- and 12-month follow-ups.	The results of this study suggest that motor control exercises and graded activity have similar effects for patients with chronic nonspecific low back pain.	Both techniques lessened pain and reduced disability. Segmental stabilization is superior to superficial strengthening for all variables. Superficial strengthening does not improve Transverse Abdominis activation capacity.

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