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Review Article

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Effectiveness of Electromyographic (EMG) Biofeedback in Osteoarthritis of the Knee joint: A Brief Narrative Review

Chaudhary Sapna

Assistant Professor, Vidhyadeep Institute of Physiotherapy, Gujarat, India

ABSTRACT

Introduction: After knee osteoarthritis (OA), the patient will have a varying degree of quadriceps weakness, affecting the joint range of motion and physical function. Therefore, effective physical therapy is a common therapy for clinicians. Recently, there has been increased interest in the use of biofeedback approaches in rehabilitation interventions, and it is progressively being regarded as a helpful strategy to reduce pain and boost the effectiveness of major therapies.

Methodology: Studies on the topic of the effect of using EMG biofeedback (EMGBF) in osteoarthritis of the knee joint were reviewed so the findings of those articles were used to explore the additive effect of EMG biofeedback training that would affect quadriceps pain and Vastus medialis Oblique (VMO) thickness in patients with osteoarthritis of the knee joint.

Results: In terms of the results of this approach in patients with knee OA, some studies have discovered that it has a favorable impact on pain alleviation, function, and muscular strength in patients treated with exercise with Electromyographic (EMG) biofeedback, while others have found that it has no extra effects on patients.

Conclusion: Employing EMGBF has certain benefits, and the decision to utilize it or not is based on its ease of access, cost-effectiveness, and physician-patient desire.

Key Words: Knee Osteoarthritis, Biofeedback, EMG biofeedback, Quadriceps strength, VMO strength, Knee extensor

INTRODUCTION

The western population is susceptible to osteoarthritis (OA), a degenerative joint condition. The knee is the peripheral joint that is most frequently damaged, leading to a gradual loss of function, pain, and stiffness.[1] Roughly one in ten people over the age of 50 are anticipated to be affected.[2] Pain and muscle wasting are the two most prevalent signs and symptoms of knee osteoarthritis.[3] Weakness in the quadriceps muscles is assumed to be brought on by disuse atrophy, which is brought on by joint pain.[4] One of the earliest clinical findings in individuals with knee OA, occurring before symptoms and impairment are observed, is reduced quadriceps strength, and it may be crucial to the course of the disease.[5,6] Research shows that thigh muscle strength may offer protection against joint injury and the progression of pre-existing OA. Quadriceps weakness has been connected to the development of pre-existing knee OA. [7-11]

Feedback is described as sensory information resulting from numerous movements.[12] This input might be sensory (intrinsic) or enhanced (extrinsic).[13,14] Extrinsic feedback is biological information delivered in a treatment situation when the patient is given supplemental information beyond what is normally accessible to them.[13-17] Biofeedback enables the patient to consciously regulate these physiological processes, which are considered automatic reactions of the autonomic nervous system.[18] The technique of using equipment to reveal to humans some of their internal physiologic events, both normal and abnormal, in the form of visual and audible signals in order to teach them how to control these otherwise involuntary or unfelt events by manipulating the displayed signals is defined as EMG-biofeedback.[19] Exercise regimens with EMG biofeedback are recommended because they boost patient motivation and compliance.[20] Electromyographic biofeedback (EMGBFB) is a method that allows a person to detect and magnify electrical activity in the muscles. The patient is provided visual and audio feedback on the increased muscular tension.[21] EMG biofeedback is often used in situations of muscular weakness to offer muscle re-education and to recover muscle strength.[22] The use of EMG

Corresponding Author:
Dr. Chaudhary Sapna (PT), 132, Madhav Baug row house, Morabhagal, Surat- 395005, Gujarat, India.
Email: sapnachaudhary1324@gmail.com

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biofeedback in rehabilitation regimens can improve patient adherence to exercise. [23] The EMGBF has been postulated to enhance the muscular strength and neuromuscular control of the quadriceps muscle group; [24,25,26] as a result, clinicians may find it important to understand the real effect EMGBF has on quadriceps muscle strength in order to correctly treat quadriceps weakness. EMG-biofeedback has been shown to be effective in the rehabilitation of patients with vastus medialis atrophy caused by knee osteoarthritis. There is minimal evidence that it works in knee OA. The goal of this research is to investigate the additive effect of EMG biofeedback in the rehabilitation of knee osteoarthritis.

METHODOLOGY

MATERIAL AND METHODOLOGY

DATABASE:

A computer-based literature search was done using the PUBMED, PUBMED CENTRAL, and GOOGLE SCHOLAR

INCLUSION CRITERIA:

Relevant articles with a full text published in English between the years 2010 to 2021 were screened and included.

- To be included, a study needed to meet the following criteria:

(a) Design: Only randomized controlled trials were included.
(b) Interventions: The EMGBF and a comparative exercise-only and/or placebo intervention used to increase quadriceps strength were included.
(c) Study population: Participants having OA of knee joint
(d) Outcome measure: The study needed to investigate isometric quadriceps strength in response to the previously stated interventions.

EXCLUSION CRITERIA:

- Editorials, Commentaries, Discussion papers, Conference abstracts, Reviews, and Duplicates were excluded.

Figure 1 shows the search strategy for this review. The characteristic of the reviewed article is summarized in table 1.

All studies have examined the association between real-time EMGBF & OA of the knee. Out of 4 studies, 1 study demonstrated that EMGBF may be a useful rehabilitative tool for patients with OA knee. One study demonstrated that EMGBF was not better than exercise without biofeedback in any variables. And other three studies demonstrated improvement in OA knee treated with real EMGBF accompanied by isometric exercises and significant improvement in knee pain, joint stiffness, and function of patients with knee OA treated with isometric exercise accompanied by EMGBF. The effect of this method did not significantly exceed those of exercise without biofeedback, and also the patient with exercise and motivation increased when EMGBF was accompanied by exercises, and it is very important to keep them motivated to their exercise program

SUMMARY OF REVIEWED ARTICLES

Seyed Ahmad Raeissadat et al. (2018)[27]

The goal of this research was to see how integrating electromyographic biofeedback (EMGBF) to isometric training altered pain, function, thickness, and maximal electrical activity in the vastus medialis oblique (VMO) muscle during isometric contraction in patients with knee osteoarthritis (OA). The case group included 23 patients who engaged in EMGBF-associated exercise, whereas the control group included just 23 patients who engaged in isometric exercise. Variables in each group and between the two groups were compared before and after the exercise program. Isometric exercises with EMGBF and the same activities without biofeedback both resulted in substantial improvements in pain and function in individuals with knee OA after two months. Except for the VAS score, real EMGBF was not better than exercise without biofeedback in any of the assessed variables.

Yun lak choi et al. (2015)[28]

The goal of this research was to see whether EMGBF and USBF training will improve quadriceps MVIC, pain, and VMO thickness in individuals with knee OA. The EMGBF and USBF training groups got the relevant physical training exercise program targeting the Vastus medialis oblique, whilst the control group received standard physical therapy such as ultrasound, hot pack and transcutaneous electrical nerve stimulation. The MVIC in the EMGBF and USBF training groups was considerably higher than in the control group, whereas the VAS score (for measuring pain) in the EMGBF and USBF training groups was significantly lower than in the control group. Only the EMGBF training group has substantially increased VMO thickness compared to the control group. While EMGBF and USBF training dramatically enhanced the MVIC of the VMO and decreased pain on the afflicted side, conventional physical therapy had no effect on the MVIC of the quadriceps. Surprisingly, only the EMGBF training group exhibited a substantial increase in VMO thickness, whilst the other two groups showed no change.

Shahnawaz Anwer, S. et al. (2011)[29]

The goal of this randomized controlled experiment was to assess the efficacy of electromyographic biofeedback as an adjunct treatment to isometric exercise on quadriceps strengthening in patients with knee osteoarthritis. Thirty-three individuals with knee osteoarthritis, ten men and 23 women,

took part in the research. For 5 weeks, the biofeedback group got an electromyographic biofeedback-guided isometric exercise program, while the control group received merely an exercise program. In between-group comparisons, the maximal isometric quadriceps strength in the biofeedback group was substantially larger than that of the control group at the end of the fifth week (p 0.004). When compared to the exercise program alone, the addition of electromyographic biofeedback to a 5-week isometric training program showed to enhance quadriceps muscle strength in adults with knee osteoarthritis.

Ozlen O. et al. (2010) [30]

The authors conducted a study on "The efficiency of EMG biofeedback in knee OA" In knee OA, the authors compared an EMG-biofeedback-assisted strengthening exercise program to a regular strengthening exercise program. As a consequence, both groups saw statistically significant improvements in pain ratings and WOMAC pain, disability, and functional status scores. In addition, both groups showed considerable improvement in isometric and isokinetic muscular strength following therapy. However, no statistically significant difference between groups was seen in these evaluations. In terms of quality of life aspects, the strengthening exercise group improved physical mobility and pain. However, there was an improvement in the measures of physical activity, pain, sleep, and energy in the EMG biofeedback strengthening aided exercise group. Finally, it should be highlighted that the incorporation of biofeedback during strengthening activities increased the quality of life even more. However, no statistically significant difference was found in terms of the other assessed parameters. These findings might be attributed to the short sample size.

CONCLUSION

In conclusion, our study found no significant superiority of an EMGBF-assisted strengthening exercise regime over a strengthening exercise program without EMG biofeedback. When exercise treatment is carried out correctly and on a regular basis, it is an effective therapeutic strategy that improves pain, function, and muscular strength.

This research emphasizes the usefulness of quadriceps strengthening activities in reducing pain and enhancing function in individuals with knee OA. When EMGBF was followed with exercises, patients' compliance and motivation rose, and as we know in older patients, it is critical to keep them motivated to stick to their exercise regimen. One of the primary goals of rehabilitation in patients with knee OA is pain reduction, as as previously stated, patients experience less pain when EMGBF is used. To summarise, employing EMGBF has certain benefits, and the decision to utilize it or not is based on its ease of access, cost-effectiveness, and physician-patient desire.

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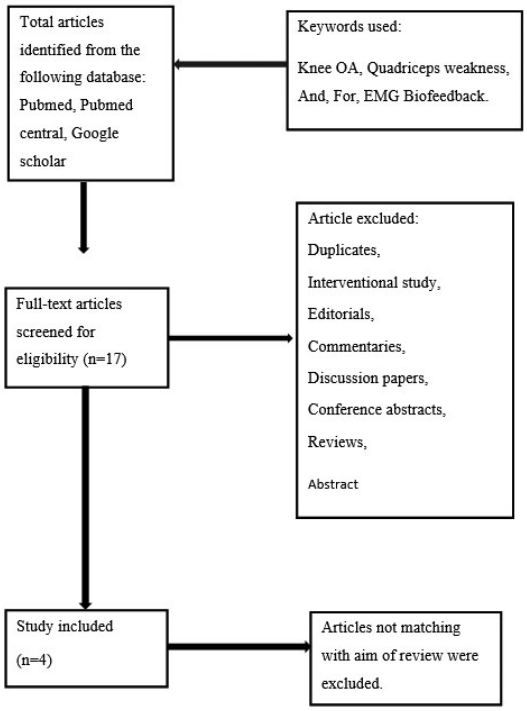

Figure 1: Searching strategy: A total of 45 articles were identified from the computer-based literature search. After excluding the duplicates, interventional studies, editorials, commentaries, discussion papers, conference abstracts, reviews, and abstracts 17 full-text articles were screened. Out of that, only 4 articles were included as matched with the aim.

Table 1: Summary of reviewed articles

No.	Author (Year)	Research Design	Aim	Key Finding
1.	Seyed Ahmad Raeissadat et al. (2018)	Randomized Controlled trial	The purpose of this study was to see how introducing electromyographic biofeedback (EMGBF) into isometric exercise affected pain, function, thickness, and maximal electrical activity in the vastus medialis oblique (VMO) muscle in patients suffering from knee osteoarthritis (OA).	Despite considerable improvements in knee pain, joint stiffness, and function in individuals with knee OA treated with isometric exercises accompanied with EMGBF, the results of this technique did not outperform those of exercise alone.
2.	Yun lak choi et al. (2015)	Randomized Controlled trial	The purpose of this study was to look at how isometric exercises with electromyographic biofeedback (EMGBF) & ultrasound biofeedback (USBF) affected maximum voluntary isometric contraction (MVIC), pain as evaluated by the Visual Analogue Scale (VAS), as well as vastus medialis oblique (VMO) thickness in knee osteoarthritis patients (OA).	USBF training is useful in treating patients with knee OA and is similar to EMGBF training in terms of efficacy. Only the EMGBF training group had substantially greater VMO thickness than before training.
3.	Shahnawaz Anwer, S. et al. (2011)	Randomized Controlled trial	To determine the efficacy of EMG biofeedback as an addition to quadriceps muscle strength training in individuals with knee OA.	The study's findings revealed that combining EMG biofeedback with isometric training resulted in better improvements in isometric quadriceps strength.
4.	Ozlen O. et al. (2010)	Randomized Controlled trial	To investigate the additive effect of biofeedback in OA of knee rehabilitation.	There was no significant difference between the EMG biofeedback-assisted strengthening exercise program and the strengthening exercise program without EMG biofeedback. When exercise treatment is conducted correctly and on a regular basis, it is an effective therapeutic strategy that improves pain, function, and muscular strength.