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Exercises to Increase Vastus Medialis Oblique Activity: A Review

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ABSTRACT

Patellofemoral pain syndrome (PFPS) is one of the mostprevalent musculoskeletal conditions of the lower limb. The muscle imbalance between the vastus medialis oblique (VMO) and vastus lateral is (VL) muscles is one of the main factorsleading to thedevelopment of PFPS. The aim of this study is to conclude the most effective exercise to increase (VMO) activity. Fifteen papers reviewing exercises to activate VMO were reviewed. Generally, the studies reported that closed kinetic exercises is the best type of exercise to strengthen the quadriceps. Looking at a more detailed view, it can seen that squad exercise with hip adduction to be the exercise that produced the most significant difference when it comes to VMO: VL ratio. Accordingly, well designed studies evaluating large samples of patients with Patellofemoral joint disorders are required, to rectify the present limitations in the evidence-base, and to thoroughly investigate this topic.

Keywords: *Patellofemoral pain syndrome, vastus medialis oblique, vastus lateralis*

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is a disorder related to per patellar or retro patellar pain and it is one of the most prevalent musculoskeletal conditions of the lower limb, with incidences estimated as high as 25% within the general population and 60%within the athletic population(Hyong and Kang, 2013). Vastus medialis oblique (VMO) and vastus lateral is (VL) are the 2 principle muscles that work synergistically to stabilize the patella during dynamic knee extension. (Yoo, 2015).The ratio of VMO:VL has a theoretical ideal of 1:1, and research has shown this ratio to be as low as 0.54:1 in people with PFPS(Christou, 2004).Any disturbance in the VMO:VL ratio, owing to a decreased medial pull, may lead to patella mal tracking and consequently inflammation, pain, premature cartilage degeneration, and ultimately PFPS. It has been suggested that re-establishing this imbalance can be achieved by strengthening exercises specifically targeting VMO. The existing evidence base supports this as a successful method of preventing and reducing PFPS, and current literature is flooded with research concerning the best exercises to preferentially activate VMO. Nonetheless, debate still remains as to an agreed ‘‘gold standard’’ exercise and controversy litters the evidence base.

METHODOLOGY

Study Selection

Papers were included if they were primary research directly comparing the EMG activity ofthe VMO, or VM, to the VL, human studies recruiting either healthy asymptomatic subjects or symptomatic subjects presenting with Patellofemoral musculoskeletal disorders; full text, English language publications; nonspecific with respect to subject gender or age. Papers assessing the EMG activity of VM were included in this review to ensure that we did not omit any publications assessing the distal portion of VM (i.e., VMO), which may have been termed VM.

The following papers were excluded: papers that only assessed altered knee flexion-extension angulations; non-English language papers;

animal studies; unpublished material such as university theses and dissertations; comments, letters, editorials, protocols, guidelines, abstracts, conference proceedings, or review papers. Review papers were excluded to permit a critical appraisal of each original publication. Reference lists identified from such review articles were examined fo papers that were not identified by the search strategy. Studies that assessed the proximal VM or VML, or studies that did not specifically compare EMG activity of the VMO or VM to the VL muscle were excluded.

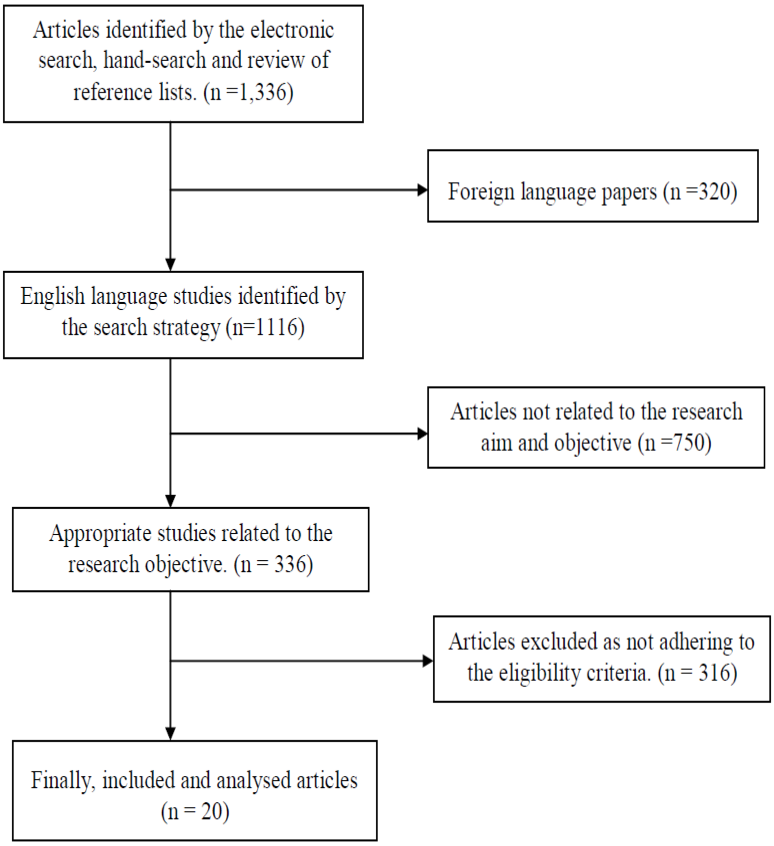

Figure1. *QUORUM Chart*

RESULTS

Table1. *A summary of the studies included in this systematic review, investigating the best exercises to increase muscle activity of VMO*

Study	**Sample size and diagnosis**	**Population characteristics gender; mean and SD age (years) and height (cm)**	**Type of exercise**	**Electrode type;**	**Conclusion (pvalue) VMO activation**
(Inetic et al., 2010)	22 healthy, asymptomatic	M/F: 11/11 Age: 25.06±4.67 Height:173± 9	1)Open-chain knee extension exercise 2) Double leg squat with isometric hip Adduction 3) Lunge exercise	Surface electrode	1) $p > 0.05$ 2) $p < 0.05$ 3) $p > 0.05$
(Peng et al., 2013)	10 healthy, asymptomatic	M/F: 10/0 Age: 21.0 ± 1.4 Height: 174.4 ± 7.1	1) conventional leg press (LP), 2) leg press with sub maximal isometric hip adduction (LP+) 3) leg press with vigorous isometric hip adduction (LP++).	Surface Electrode	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$

(Hyong and Kang, 2013)	14 healthy, asymptomatic	M/F: 5/9 Age: 21.4 Height: 167	1) Squat on Hard plate 2)Squat on Foam 3) Squat on Rubber air disc	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$ 3) $p < 0.05$
Gregersen et al (2006)	14 asymptomatic	M/F: no data Age: 28.0 (range 18–30) Height: 182.0 (range 173–191)	Cycling with foot attached to pedal at 10-degree, 5 degree, 0 degree of ankle supination or pronation	Surface electrode;	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$
Herrington et al (2006)	43 asymptomatic	M/F: 20/23 Age: 22.8±2.3 Height: no data	Isokinetic knee extension and SS to 90 degree knee flexion, with hip in either neutral; 30 degree internal; or 30degree external rotation. All exercises performed against a load equivalent to 10%	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$
Hertel et al (2004)	8 asymptomatic	M/F: 5/3 Age: 24.0 ±2.5 Height: 169.5±4.7	SS on 301 slopes at 60 degree knee flexion with and without maximal isometric hip abduction and adduction	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$
Hung and Gross (1999)	20 asymptomatic	M/F: 10/10 Age: 29.4 ± 5.7 Height: 168.9 ± 8.0	Isometric knee extension in 0 degree knee flexion or a SS at 501 knee flexion with: forefoot neutral; 10 degree supination; or 10 degree pronation, by standing on a lateral or medial wedges	Surface electrode;	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$
Serra˜o et al (2005)	15 asymptomatic	M/F: 10/5 Age: 21.9 ± 1.6 Height: no data	Sub maximal isometric knee extension (at 10 rep max force level) with 90-degree knee flexion against a horizontal leg press and tibia in maximum internal, maximal external, or neutral rotation	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$
Willis et al (2005)	18 PFPS 22 asymptomatic	PFPS M/F: 9/9 Age: 31.4 ± 5.4 Height: no data Asymptomatic M/F: 13/9 Age: 26.6 ± 10.4 Height: no data	Cycling on static bike with foot in tibial external rotation or neutral	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$
(Kushion, 2012)	34 asymptomatic	M/F: 16/18 Age: 22-28 Height: no data	1)straight leg raise with neutral position 2)straight leg raise with externally rotated hip position 3) short arc quadriceps extension with a neutral position 4) short arc quadriceps extension with externally rotated foot position	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$ 3) $p > 0.05$ 4) $p > 0.05$
(Tang et al., 2001)	10 PFPS 10 asymptomatic	PFPS M/F: 4/10 Age: 19–48 Height: no data	1) open kinetic knee extension 2) closed kinetic squad with different angles	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$

		Asymptomatic M/F: 5/5 Age: 21–32 Height: no data			
(Earl et al., 2001)	20 asymptomatic	M/F: 10/10 Age: 8.10□ 5.91 Height: 70.94±11.03	1) squat exercises without isometric hip adduction 2) squat exercises with isometric hip adduction	Surface electrode	1) $p > 0.05$ 2) $p < 0.05$
(Choi et al., 2011)	18 asymptomatic	M/F: 13/5 Age: 20–31 Height: no data	Isometric knee extension with hip adduction (KEWHA)	Surface electrode	1) $p > 0.05$
(Lam and Ng, 2001)	18 PFPS	M/F: 5/11 Age: 33.9±5.4 Height: no data	bilateral static knee extension exercise in a semisquat position	Surface electrode	1) $p < 0.05$
Laprade et al (1998)	9 PFPS 20 asymptomatic	PFPS M/F: 0/9 Age: 24.0 Height:165.8 Asymptomatic M/F: 0/20 Age: 24.0 Height:165.6	1)Isometric knee extension with knee at 601 flexion. 2) Maximal isometric hip adduction with knee flexed at 50 degrees isometric knee extension.	Surface electrode	1) $p > 0.05$ 2) $p > 0.05$

CONCLUSION

Closed kinetic chain exercises such as the squat or leg press have been widely used in rehabilitation and neuromuscular training programs to promote functional movement performance and reduce anterior knee pain (Herrington & Al-Sherhi, 2007; Hopkins, Ingersoll, Sandrey, & Bleggi, 1999; Miller et al.) while minimizing the Patellofemoral compressive forces and tibiofemoral anterior shear forces compared to other exercises (Escamilla et al., 2001; Hopkins et al., 1999). Closed kinetic chain exercise has been reported to promote a greater VMO/VL balance compared to open kinetic chain exercise (Irish, Millward, Wride, Haas, & Shum, 2010).

Moreover, these exercises have been used as one of the primary exercise modalities by athletes to strengthen their lower limbs for sports performance and to develop muscular power based on the biomechanical and neuromuscular similarities to many typical athletic movements (Escamilla et al., 1998).Various studies have been conducted on exercises that increases the muscle activity of vastus medialis oblique as this muscle has proven to be one of the best options to decrease pain from Patellofemoral pain syndrome. Based on the results that have been gathered from multiple studies that have been done in the past two decades on increasing the muscle activity of vastus medialis oblique, it can be seen that squat exercises with hip adduction has shown significant increase in muscle activity of VMO compared to other exercises. Hence, further study can be done focusing on this exercise to produce better results in terms of VMO: VL ratio and exploring further the chances of preferentially activating the VMO muscle.

REFERENCES

[1] Choi, B., Kim, M., and Jeon, H. S. (2011). The effects of an isometric knee extension with hip adduction (KEWHA) exercise on selective VMO muscle strengthening. Journal of Electro myography and Kinesiology, 21(6), 1011–1016. https://doi.org/10.1016/j.jelekin.2011.08.008

[2] Christou, E. A. (2004). Patellar taping increases vastus medialis oblique activity in the presence of patellofemoral pain. Journal of Electro myography and Kinesiology, 14(4), 495–504. https://doi.org/ 10.1016/j.jelekin.2003 .10.007

[3] Earl, J. E., Schmitz, R. J., and Arnold, B. L. (2001). Activation of the VMO and VL during dynamic mini-squat exercises with and without isometric hip adduction. Journal of Electro myography and Kinesiology, 11(6), 381–386. https://doi.org/10.1016/S1050-6411(01)00024-4

[4] Hyong, I. H., and Kang, J. H. (2013). Activities of the Vastus Lateralis and Vastus Medialis Oblique Muscles during Squats on Different Surfaces. Journal of Physical Therapy Science, 25(8), 915–917. https://doi.org/10.1589/jpts.25.915

[5] Inetic, O. P. E. N., Xercise, C. H. E., and The, O. N. (2010). The effect of closed-kinetic chain exercises and open-kinetic chain exercise on the muscle activity of vastus medialis oblique and vastus lateralis, (14), 1256–1262.

[6] Kushion, D. (2012). EMG Activation of the Vastus Medialis Oblique and Vastus Lateralis During Four Rehabilitative Exercises. The Open Rehabilitation Journal, 5(1), 1–7. https://doi.org/10.2174/18749 43701205010001

[7] Lam, P. L., and Ng, G. Y. F. (2001). Activation of the quadriceps muscle during semisquatting with different hip and knee positions in patients with anterior knee pain. American Journal of Physical Medicine and Rehabilitation, 80(11), 804–808. https://doi.org/10.1097/00002060-200111000-00003

[8] Peng, H. Te, Kernozek, T. W., and Song, C. Y. (2013). Muscle activation of vastus medialis obliquus and vastus lateralis during a dynamic leg press exercise with and without isometric hip adduction. Physical Therapy in Sport, 14(1), 44–49. https://doi.org/10.1016/j.ptsp.2012.02.006

[9] Tang, S. F. T., Chen, C. K., Hsu, R., Chou, S. W., Hong, W. H., and Lew, H. L. (2001). Vastus medialis obliquus and vastus lateralis activity in open and closed kinetic chain exercises in patients with patellofemoral pain syndrome: An electromyographic study. Archives of Physical Medicine and Rehabilitation, 82(10), 1441–1445. https://doi.org/10.1053/apmr.2001. 26252

[10] Yoo, W.-G. (2015). Effects of the slow speed-targeting squat exercise on the vastus medialis oblique/vastus lateralis muscle ratio. Journal of Physical Therapy Science, 27(9), 2861–2862. https://doi.org/10.1589/jpts.27.2861

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