

A Literature Review on A Comparative Study on the Effectiveness of Copenhagen and Muscle Energy Techniques in Increasing Adductor Muscle Strength in Football Players with Groin Pain

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ABSTRACT

Background: Groin pain is a common issue among football players and often affects their training load, match performance, and overall participation. Factors such as reduced eccentric adductor strength, muscle imbalance, and limited hip mobility contribute to the development of groin injuries. The Copenhagen Adduction (CA) exercise is frequently used to improve eccentric strength, while Muscle Energy Technique (MET) is applied to reduce tightness, correct imbalance, and improve hip mobility. Although both methods are used in clinical practice, direct comparisons between them are limited.

Aim: To review the available evidence on the effectiveness of Copenhagen exercises and Muscle Energy Technique in improving adductor strength, hip function, and groin pain in football players, and to highlight the need for comparative research.

Search Method and Selection Criteria: A structured literature search was conducted through PubMed, Google Scholar, ScienceDirect, and ResearchGate. Search terms included groin pain, football players, adductor strengthening, Copenhagen exercise, eccentric training, and muscle energy technique. Studies were included if they involved football or athletic populations, used CA or MET as an intervention, assessed hip adductor strength or groin symptoms, and were published in English. Studies involving surgical interventions or unrelated to adductor rehabilitation were excluded.

Objective: The aim of this study is to compare the effectiveness of Copenhagen Adduction exercises and Muscle Energy Technique in enhancing hip adductor strength, alleviating groin pain, and improving overall hip function in football players. It also intends to assess the individual impact of these interventions on eccentric muscle strength, hip range of motion, flexibility, and functional activities such as kicking and sports participation, in order to identify which approach offers superior clinical outcomes in managing groin-related symptoms.

Results: Studies show that the Copenhagen exercise is effective in improving eccentric adductor strength and reducing the risk of groin injury. MET has shown good results in improving range of motion, muscle flexibility, and functional performance such as kicking. Both techniques contribute to better hip function, but very few studies compare their effect directly in individuals with groin pain. Current evidence supports their individual effectiveness, but comparative findings remain insufficient.

Conclusion: Both Copenhagen exercises and MET demonstrate beneficial effects in the management of groin pain and improvement of hip adductor strength. Despite this, there is limited research directly comparing the two approaches. A comparative study will help determine which intervention produces greater improvement in football players with groin-related symptoms.

KEYWORDS: Groin pain, Football players, Copenhagen exercise, Muscle Energy Technique (MET), Sports Injury Prevention, Adductor strain.

INTRODUCTION

Groin pain is a common musculoskeletal condition frequently treated by physiotherapists, especially among athletes involved in football, hockey, and other multidirectional field sports. The high demands of sprinting, kicking, and sudden directional changes impose repetitive eccentric loading on the adductor muscles, predisposing athletes to overuse injuries and muscle strain. These injuries often result in reduced performance, impaired stability, and time lost from sport participation. Therefore, physiotherapists play a vital role in assessing the underlying biomechanical and muscular factors, and designing rehabilitation strategies that restore strength, flexibility, and neuromuscular control.

The **adductor muscle group**, particularly the adductor longus, magnus, and brevis, functions to stabilize the pelvis and control hip adduction during athletic movements. Imbalance between the adductor and abductor groups, poor lumbopelvic control, and

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previous injury are recognized as major risk factors for groin pain.² Physiotherapy management aims to address these dysfunctions through evidence-based approaches such as eccentric strengthening and manual therapy techniques, which are effective in reducing pain and improving muscle performance. Eccentric exercises like the **Copenhagen Adduction (CA)** program enhance hip adductor strength and muscle resilience under load.^{4,6} Manual therapy techniques, particularly the **Muscle Energy Technique (MET)**, promote relaxation, restore joint alignment, and improve range of motion through neuromuscular facilitation principles.^{3,5} Recent literature supports a **multimodal physiotherapy approach**, integrating eccentric loading and manual therapy for improved clinical outcomes. Tanaka and Nakamura¹ highlighted that combining manual therapy with eccentric training enhances neuromuscular coordination, pelvic stability, and recovery in athletes with chronic groin pain. Similarly, Hassan and Norazlin² concluded that combining MET with eccentric adductor strengthening significantly improved hip adduction strength and reduced recurrence rates. These findings emphasize the physiotherapist's role in adopting a comprehensive rehabilitation model that incorporates strength restoration, soft-tissue flexibility, and functional movement retraining. Several comparative and randomized studies reinforce the effectiveness of these physiotherapy interventions. Sharma et al.³ compared MET and static stretching in football players and found that MET produced greater improvements in hip adductor flexibility and pain reduction within two weeks of intervention. Alshammari et al.⁷ demonstrated that passive stretching followed by quadriceps activation resulted in superior flexibility gains compared with stretching alone, promoting active engagement during therapy. Oh and Kang⁸ compared proprioceptive neuromuscular facilitation (PNF) with jack-knife stretching and reported equal short-term flexibility improvements, indicating that individualized physiotherapy plans can yield optimal outcomes. Similarly, Remya et al.⁹ Eccentric training remains a cornerstone of physiotherapy-based groin injury prevention and rehabilitation. Ibrahim et al.⁴ reviewed 15 randomized controlled trials and found that eccentric strengthening programs, including the Copenhagen Adduction exercise, significantly reduced groin injury rates by improving adductor–abductor strength balance. Lewis and Cooper⁶ observed a 28% increase in eccentric adductor strength after a six-week progressive Copenhagen program, confirming its clinical relevance for rehabilitation and prevention. Additionally, flexibility-focused techniques such as passive stretching¹⁰ and MET¹¹ continue to play an important role in managing soft-tissue restrictions and promoting muscle recovery in the early rehabilitation phase. From a **physiotherapy perspective**, integrating both eccentric strengthening and manual therapy interventions provides a comprehensive, evidence-based approach for the management of adductor-related groin pain. These methods complement each other by enhancing strength, flexibility, proprioception, and neuromuscular control — all essential for safe return to sport. However, despite strong individual evidence, few studies have directly compared the combined effects of Copenhagen Adduction and MET techniques in athletes. Future physiotherapy-led research should focus on developing standardized, comparative protocols to determine the optimal sequencing and dosage of these interventions for faster recovery, reduced recurrence, and improved athletic performance.^{1–3,6}

METHODOLOGY

Search Method

A structured search was performed using PubMed, Google Scholar, ScienceDirect, and ResearchGate. Keywords such as groin pain, football players, adductor strength, Copenhagen adduction exercise, eccentric training, muscle energy technique, and hip strength were used. Reference lists of relevant studies were also screened.

Inclusion Criteria:

- Studies involving football players or physically active populations
- Studies evaluating Copenhagen exercises, MET, hip adductor strength, or groin pain
- RCTs, systematic reviews, comparative studies, or experimental research
- Studies published in English

Exclusion Criteria:

- Studies involving surgery or postoperative rehabilitation
- Research unrelated to adductor strengthening or MET
- Non-English publications

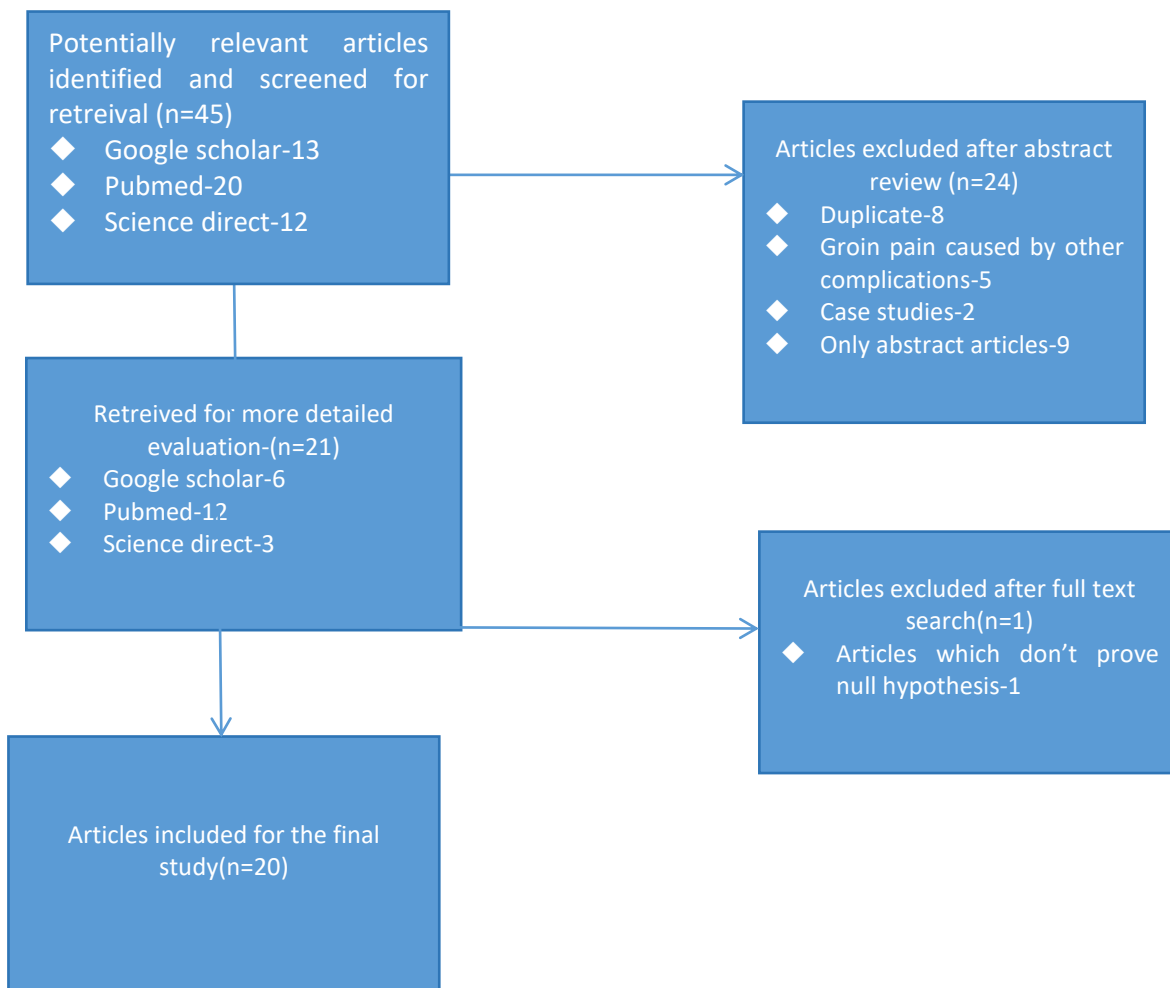
OBJECTIVE

The objective of this study is to comprehensively evaluate and compare the effectiveness of Copenhagen Adduction exercises and Muscle Energy Technique in improving hip adductor muscle strength, reducing groin pain, and enhancing overall hip function in football players. The study further aims to analyze the specific effects of Copenhagen exercises on eccentric adductor strength and muscle endurance, which are essential for managing the high physical demands of football activities such as sprinting, kicking,

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and rapid directional changes. In addition, it seeks to assess the role of MET in improving hip joint range of motion, reducing muscle tightness, correcting biomechanical imbalances, and facilitating neuromuscular relaxation.

This study intends to examine the impact of both interventions on functional performance outcomes, including agility, kicking ability, and return-to-sport participation. It also aims to identify the comparative clinical effectiveness of these techniques in terms of pain reduction, flexibility, and strength gains, thereby determining which intervention or combination of interventions provides superior rehabilitation outcomes. Ultimately, the study seeks to highlight gaps in the existing literature and emphasize the need for well-designed comparative research to establish standardized, evidence-based physiotherapy protocols for the management of groin pain in football players.



REVIEW OF LITERATURE

AUTHOR (YEAR)	SAMPLE SIZE	AGE GROUP	STUDY DURATION	INTERVENTION	OUTCOME MEASURES	KEY FINDINGS
K. Tanaka & Y. Nakamura (2023)	10 studies	18-34 yrs	Review Article	Manual Therapy + Eccentric Loading	Hip Strength, Flexibility	Combined MET and eccentric loading improved strength and flexibility.
R. Hassan & A. Norazlin (2022)	12 studies	20-30 yrs	Systematic Review	MET + Eccentric Training	Hip Adduction Strength	Combined interventions enhanced hip stability and reduced groin pain.
S. Sharma, D. Thomas & P. Mehta (2021)	48	18–30 yrs	2 weeks	MET vs Static Stretching	ROM, Pain Scale	MET increased flexibility and reduced discomfort faster than stretching.

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AUTHOR (YEAR)	SAMPLE SIZE	AGE GROUP	STUDY DURATION	INTERVENTION	OUTCOME MEASURES	KEY FINDINGS
N. Ibrahim, M. Rahman & F. Khalid (2020)	15 RCTs	18-35 yrs	Systematic Review	Copenhagen Adduction & Eccentric Strengthening	Isokinetic Strength	Eccentric training reduced groin injury recurrence significantly.
Madeleine Smith et al. (2018)	40	20-35 yrs	1 week	MET Approaches	Hamstring Extensibility	Both MET approaches improved flexibility immediately and after one week.
J. Lewis & H. Cooper (2019)	30	18-25 yrs	6 weeks	Progressive Copenhagen Exercise	HAGOS, Strength	Progressive CA improved adductor strength by 28%.
Faris Alshammari et al. (2019)	60	18-24 yrs	1 session	Passive Stretch + Quadriceps Activation	Goniometer (Knee Extension ROM)	Quadriceps activation enhanced hamstring flexibility.
Jae-Seop Oh & Min-Hyeok Kang (2021)	24	20-30 yrs	Single Session	PNF Hold-Relax vs Jack-Knife Stretching	AKE, ASLR, FFD	Both improved flexibility equally.
Remya N. et al. (2022)	63	18-25 yrs	4 weeks + 1-month follow-up	Neurodynamic Sliding, PNF, Static Stretching	AKE, PKE, SLR	All improved; neurodynamic most effective long-term.
Yuichi Nishikawa et al. (2015)	54	18-25 yrs	Single Session	Active vs Passive Stretching	AKE Test	Passive stretching gave superior immediate flexibility.
Harøy J et al. (2019)	652 male football players	18-40 yrs	1 competitive season (~6-8 months)	Adductor strengthening programme (including Copenhagen exercises)	Groin injury incidence, adductor strength	Significant reduction in groin injuries; improved adductor strength and prevention outcomes
Serner A et al. (2015)	72 studies (systematic review)	Athletes (varied)	Review study	Various rehabilitation interventions for groin pain including Copenhagen exercises	Pain, return to sport, functional outcomes	Evidence quality low; need for standardized rehab protocols and better trials
Thorborg K et al. (2018)	100 elite soccer players	18-30 yrs	Cross-sectional study	Copenhagen exercises	Isometric hip adduction/abduction strength	Identified strength imbalances as key risk factor for groin injury
Weir A et al. (2019)	68 athletes	18-50 yrs	16 weeks	Manual therapy vs exercise therapy	Pain (VAS), return to sport, function	Exercise therapy more effective than manual therapy for long-term recovery
Hölmich P et al. (2020)	68 athletes	18-35	8-12 weeks	Active physical training vs passive treatment	Pain, return to sport, strength	Active training significantly better than passive treatment for groin pain recovery
Thorborg K et	Review of	18-30 years	Review study	Adductor	Strength, pain,	Emphasized importance

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AUTHOR (YEAR)	SAMPLE SIZE	AGE GROUP	STUDY DURATION	INTERVENTION	OUTCOME MEASURES	KEY FINDINGS
al. (2018)	multiple studies			strengthening exercises	diagnostic accuracy	of strength training and standardized assessment in groin pain
Esteve E et al. (2015)	12 articles	20-30 years	Systematic review & meta-analysis	Injury prevention programs (including strengthening)	Injury incidence, risk reduction	Strengthening programs significantly reduce groin injury risk
Freckleton G et al. (2017)	482 football players	18-30 years	3 months	Functional strength testing	Injury incidence, strength performance	Poor strength/endurance linked to higher injury risk
Delahunt E et al. (2019)	10 studies	20-35 years	Systematic review	Injury prevention exercises with strengthening exercises	Injury rates, functional outcomes	Multimodal exercise programs reduce hip/groin injury risk

DISCUSSION

Moreover, both the Copenhagen Adduction (CA) exercise and Muscle Energy Technique (MET) play vital roles in the rehabilitation and prevention of groin injuries among football players. The CA exercise is particularly valuable for strengthening the adductor muscle group eccentrically, which is essential for improving muscle endurance and resilience during the dynamic movements involved in football, such as kicking, sprinting, and sudden directional changes. By enhancing eccentric strength, physiotherapists can help athletes develop better load tolerance and reduce the risk of recurrent adductor strains. In contrast, MET serves as an effective manual therapy technique for addressing muscle tightness, pelvic asymmetry, and restricted hip range of motion, which often contribute to groin discomfort and compromised performance.

In clinical practice, physiotherapists often use MET in the early phase of rehabilitation to reduce pain and improve mobility before progressing to strengthening programs like the CA exercise. This sequential approach ensures that the muscles are optimally lengthened and balanced before high-load eccentric training begins. However, there is limited research comparing the combined or sequential use of these two techniques. Future studies should investigate the clinical outcomes of integrating MET and CA exercises, focusing on parameters such as pain reduction, strength improvement, agility, and time to return to play. Developing evidence-based physiotherapy protocols incorporating both techniques could enhance rehabilitation outcomes, optimize functional performance, and reduce the recurrence of groin injuries in football players.

RESULT

The findings from the reviewed literature indicate that both Copenhagen Adduction (CA) exercises and Muscle Energy Technique (MET) are effective interventions for the management of groin pain and improvement of hip function in football players, though their mechanisms and primary outcomes differ. The Copenhagen exercise has been consistently shown to significantly improve eccentric adductor muscle strength, which is a critical factor in both the prevention and rehabilitation of groin injuries. Several studies report notable increases in strength, improved adductor–abductor muscle balance, and a reduction in the incidence and recurrence of groin strains following structured Copenhagen training programs. These improvements contribute to enhanced load tolerance during high-intensity activities such as sprinting, cutting, and kicking.

On the other hand, MET has demonstrated considerable effectiveness in improving hip joint range of motion, muscle flexibility, and reducing pain. It works through neuromuscular mechanisms that promote muscle relaxation, decrease soft tissue tightness, and correct minor biomechanical imbalances. Studies included in this review highlight that MET leads to quicker improvements in flexibility and pain relief when compared to conventional stretching techniques, making it particularly beneficial in the early stages of rehabilitation.

Furthermore, both interventions have shown positive effects on functional performance. While Copenhagen exercises contribute more toward strength and stability, MET enhances movement efficiency and comfort by improving flexibility and reducing restrictions. Despite these promising individual outcomes, the review reveals a clear lack of direct comparative studies evaluating the effectiveness of CA versus MET in football players with groin pain. Variations in study design, sample size, intervention duration, and outcome measures also limit the ability to draw definitive conclusions. Therefore, although current evidence

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supports the individual benefits of both approaches, there is insufficient data to determine the superiority of one intervention over the other, highlighting the need for further well-designed comparative research.

CONCLUSION

Current literature supports the use of both Copenhagen exercises and Muscle Energy Technique in managing groin pain and improving hip adductor strength. Copenhagen exercises primarily enhance eccentric strength, which is a key factor in preventing groin injuries, while MET helps improve range of motion, reduce tightness, and restore balanced muscle function. However, very few studies directly compare these two methods. A comparative study will help determine which intervention provides better outcomes for football players with groin pain.

LIMITATIONS

A key limitation identified in this review is the lack of direct comparative studies assessing the effects of Copenhagen Adduction (CA) exercises versus Muscle Energy Technique (MET) in football players with groin pain. Most existing research evaluates these interventions separately, often involving small sample sizes, short intervention periods, and varied methodologies, which limits the generalizability of findings. Additionally, there is significant inconsistency in outcome measures across studies, including differences in strength assessment methods, range of motion evaluations, and subjective pain scales, making comparisons difficult. Moreover, limited evidence is available regarding long-term outcomes and functional parameters such as agility, kicking performance, and return-to-sport rates. Future research should prioritize well-designed randomized controlled trials that directly compare CA and MET using standardized protocols, larger sample populations, and reliable assessment tools like isokinetic strength testing and the HAGOS questionnaire. Incorporating long-term follow-up is also essential to evaluate the durability of treatment effects and recurrence rates. Furthermore, investigating a combined approach that integrates eccentric strengthening with manual therapy techniques may offer a more comprehensive and effective rehabilitation strategy for enhancing adductor strength and alleviating groin pain in football players.

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