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Influence of improper mechanical posture in occurance of lower crossed syndrome: A literature review

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Abstract
Lower crossed syndrome/pelvic crossed syndrome is a condition that results due to muscle imbalances over thelower segment of body. It involves weakness of oblique rectus abdominis, gluteus maximus, gluteus medius, and hamstring, whereas iliopsoas, rectus femoris, tensor fascia lata, adductor group, gastrocnemius, and soleus muscles gets tightened.

Keywords: Lower crossed syndrome, poor muscular balance, work related injury, prolonged posture, muscle imbalance

1. Introduction
Lower crossed syndrome is also known as distal or pelvic crossed syndrome. It is a condition that results due to muscle imbalances over the lower segment of the body. These imbalances result in anterior pelvic tilt, SI joint and hip joint tightness, joint dysfunction in lumbosacral segment and over activity of the hip flexors and the low back extensors and the compensatory hyperlordosis of the lumbar spine [1]. It involves weakness of oblique rectus abdominis, gluteus maximus, gluteus medius, and hamstring, whereas iliopsoas, rectus femoris, tensor fascia latae, adductor group, gastrocnemius, and soleus muscles gets tightened [2]. Lifetime prevalence of back pain due to lower crossed syndrome is in the range of 32-51% [3].
LCS is caused by an overly sedentary lifestyles, prolonged sitting posture, poor posture, wearing high heeled shoes, pregnancy, and obesity. Prolonged sitting is one of the main predisposing factor thatleads to lower crossed syndrome. Prolonged sitting postures cause the hip flexors to shorten or tighten. The brain will stop the activity of the muscles. The anterior pelvic tilt and over activity of hip flexors helps compensate for the weak abdominal muscles, which leads to increased lordosis [5].
It is also caused due to prolonged daily activities and lack of regular exercises in young people. Muscle imbalance in today's society is compounded by stress, fatigue and insufficient movement through regular physical activity as well as a lack of variety of movement [6].Overtraining certain parts of the body could be a cause. Various types of sitting posture have been adapted by the individuals during sitting, and forward lean sitting and slouched sitting postures are mostly observed [7]. The forward lean sitting posture is explained by the anterior pelvic rotation, thoracolumbar spine extension, and the trunk being bent forward by more than 10 degree from erect sitting [8]. The trunk is reclined against the back rest in a sitting posture that allows the pelvis to be positioned in the middle of the seat. The hip flexors become shortened or tight when sitting at a desk all day [9].
The changes occurring due to these muscle imbalances lead to specific postural changes within the body. These changes include increased lumbar lordosis, lateral lumbar shift, anterior pelvic tilt, lateral lower limb rotation, and knee hyperextension. Chronic mechanical pain results from bad habits, such as poor posture, poorly designed seating, and incorrect bending and lifting motions [10].

2. Material and Methods

The studies were identified through PubMed, Google scholar, Research Gate, NCBI, SCI-HUB Elsevier was conducted for publication between the years 1983 and 2022. The key words used for searching the articles were, Lower crossed syndrome, Poor muscular balance, Work related injury, prolonged posture, Muscle imbalance. The selected articles include cross sectional study, Randomized controlled trial, Systematic review, Experimental study, non-randomized clinical effectiveness trial and Pilot study.

3. Results

A total of 32 articles were searched for the given topic. Out of which 27 articles were selected for the review as per the inclusion and exclusion criteria. Some are mentioned below.

No.	Title and year of publication	Authors	Sampling methods	Conclusion
	Screening for lower cross syndrome in asymptomatic individuals [2] 2021	Priyanka Sahu, Pratik Phansopkar	Sampling- Simple random sampling. Methods-The 300 people that were included in the study were screened for inclusion and exclusion criteria. The volunteers warmed up under the direction of the therapist. 10 reps of side bending and rotation followed by a walk around the study site at your own speed. Outcome measures were used to assess muscles.	The prevalence of lower crossed syndrome was higher for females than for boys in the same age group. There is a significant difference in the strength of the muscles between boys and girls of the same age group.
	Prevalence of Lower Crossed Syndrome in School Going Children of Age 11 To 15 Years [5] 2019	Shrikrushna Shripad Kale1, Sayali Gijare	Method- 369 children with the consent from parents have been assessed into different rooms. MMT of the abdominalis and gluteus muscle is done and Thomas test was done to identify the tightness of hip flexors.	The study concludes that there is 21% of school going students of age 11 to 15 years have incidence of lower cross syndrome and 32% are at risk of having lower crossed syndrome in near future.
	Prevalence of Lower crossed syndrome in young adults: A cross sectional study [6]. 2017	Shriya Das, Bibhuti Sarkar, Rachana Sharma, Malika Mondal, Pravin Kumar, Pallavi Sahay.	Sampling-Stratified purposive sampling. Method-A total of 230 volunteers were selected and evaluated as per inclusion or exclusion criteria and 200 were including, measurement of length of iliopsoas, length of spinal extensors, strength of abdominals, strength of gluteus maximus were assessed.	This study shows that prevalence of LCS are higher in females than males of the same age group. There is significant difference in spinal extensor length, abdominals strength and bilateral gluteus Maximus strength.
	Relationship between Hip Extensor Strength and Back Extensor Length in Patients With Low Back Pain[11]. 2017	Amir Massoud Arab, Manijeh Soleimanifar, and Mohammad Reza Nourbakhsh	Cross-Sectional Study	Sampling – Simple random sampling Method - In 266 patients with LBP and 215 matched controls, back extensor length and hip extensor strength were measured and compared in the 2 groups using an independent t test. To determine correlation between these 2 variables, Pearson correlation coefficient was used. Multivariate logistic regression was used to test the risk of sustaining LBP with having these muscle insufficiencies.
	Effects of the sitting position on the body posture of children aged 11 to 13 years[12] 2013	Grabiec, Sławomir Snela, Justyna Rykała, Justyna Podgórska and Maciej Rachwal	Cross-sectional study	Sampling- Simple random sampling Method – A observational, cross-sectional study involving 91 primary school children aged 11-13 years was conducted and the children's backs were photographed in standing position and sitting positions. The values of selected parameters were calculated using photogrammetric examination based on the Moire projection phenomenon.
	Effect of restricted hip flexor muscle length on hip extensor muscle activity and lower extremity biomechanics in college- aged female soccer players[13]. 2015	Matthew Mills, Barnett Frank, Shiho Goto, Troy Blackburn, Samantha Cates, Michael Clark, Alain Aguilar, Nicole FavaA, Darin Padua	Causal-comparative cross-sectional laboratory study	Using modified Thomas test 40 female soccer athletes were assigned to a restricted or normal hip flexor muscle length group test. The hip and knee extension moments were measured during a double-leg squat. Handheld dynamometry was used to assess Isometricgluteus maximus strength.
	The Postural and Biomechanical Effects of High Heel Shoes: A Literature Review[14]. 2012	Shavonda L. Pannell	Literature Review	The resources included journals, text and reference books. PubMed, Chiroweb, Chiroaccess and Mantis were databases that were used to find journal articles and publications related to the effects of posture and high heels.

	Do Muscle Strength Imbalances and Low Flexibility Levels Lead to Low Back Pain? A Brief Review[15]. 2017	Cassio Victora Ruas and Adriane Vieira	Review of literature	Method- This review was based on 14 studies, published between 1983 and 2016. By accessing the databases PubMed and Google Scholar using the following search terms: "Spine" or "Hips" or "Trunk" and "Muscle" and/or "Strength" and/or "Flexibility" and "Levels" or "Imbalance" and "Chronic low back pain" or "Low back pain",the articles were found.
	Efficacy of Janda's approach versus bruegger's exercise in pelvic cross syndrome and its impact on quality of life[16]. 2020	Rajalaxmi V, Nandhini G, Senthilnathan C V, Mohan kumar G, Yuvarani G, Tharani G.	Experimental study design.	Sampling-lottery method Method-30 samples were included in the study among the age group of 20 to 30 years. Group A received Janda's approach for sensory moderate training. Duration of the treatment lasted for 30 minutes,group B received burgers exercise. Pre and post test outcome measures was taken and analyzed.
10.	Comparing the Effect of Stretching and Muscle Energy Technique in the Management of Lower Cross Syndrome[17]. 2022	Nouman Khan, Munazza Nouman, Muhammad Affan Iqbal, Kinza Anwar, Abdul Ghafoor Sajjad, Syed Ali Hussain	Randomized controlled trial	Sampling- Lottery method Method- The sample size of 58 patients were included in the study between the age group of 20-50 years, both male and females and positive prone hip extension movement pattern test was taken. Group A (Stretching Group) and Group B (MET Group), received Moist heating pad prior treatment for 10 minutes in order to prepare the muscle for treatment.
11.	Effect of Janda's Approach on Pain and Function in Patients with Non-Specific Low Back Pain[18]. 2020	Sapna Nandlal Tank, Yagna Shukla	An Interventional study	Sampling- Convenient sampling Method- 34 individuals with age between 25 – 45 years were divided into two groups. Group A performed conventional exercise and Group B performed stretching of tight muscles and strengthening of weak muscles along with conventional exercise for 6 days a week for 2 weeks. Data were taken prior and at the end of 2 weeks for pain and function.

4. Discussion

Priyanka Sahu *et al*, in the year 2021 have done their study aiming on screening for lower crossed syndrome in asymptomatic individuals. Randomized controlled trial was used and found that females has higher prevalence of lower crossed syndrome than boys in same age group and there is a great difference in spinal extensor length, abdominal strength, gluteus maximus strength and they are more prone to weakness of these muscles.

In the year 2006 Mohammad Reza Nourbakhsha *et al*, conducted a study to find out the relationship among pelvic crossed syndrome, degree of lumbar lordosis and chronic low back pain and concluded by saying that there is no difference in the degree of lumbar lordosis in subject with different pattern of muscle impairment and there is a significant difference in the length and strength of some of the muscles in the lumbo-pelvic area.

In the year 2013 Justyna Drzał-Grabiec *et al*, conducted a study aiming to compare selected parameters describing body posture and scoliosis among children in sitting and standing positions and found that there were differences for the parameters of the anteroposterior curves of the spine. Maintaining a sitting position for a long period of time results in asymmetries of the trunk and scoliosis, which leads to decrease in lumbar lordosis and kyphosis of a child's spine. Also in another study done by Pooriput Waongenngarm *et al*, (2015), 30 workers sat for 1 hour in one of three sitting postures (i.e., upright, slumped, and forward leaning postures) was assessed using Body Perceived Discomfort scale and Electromyography. This study shows prolonged sitting led to increased body discomfort in the neck, shoulder, upper back, low back and prolonged slumped sitting may relate to Transverse abdominus muscle fatigue.

Mathew Mills *et al*, in the year 2015 has done their study aiming to compare hip extensor muscle activation, internal hip and knee extension moments during double-leg squatting, and gluteus maximus strength in those with and without clinically restricted hip flexor muscle length using modified Thomas test and surface electromyography. It showed individuals with tightness of hip flexor muscle appears to utilize different neuromuscular strategies to control lower extremity motion.

In the year 2020 Rajalaxmi V *et al*, conducted a study to determine the Efficacy of Janda's Approach Versus Bruegger's Exercise in Pelvic Cross Syndrome and the quality of its impact in life. 30 samples were included with the help of lottery method in which SF-12 Scale, Visual analogue scale and Goniometer were used. The study concluded by saying Janda's Approach is more effective exercise in reducing pain and improving range of motion in individuals with pelvic cross syndrome.

Nouman Khan *et al*, in the year 2022 aimed to compare the effects of stretching exercises & muscle energy techniques in the management of lower cross syndrome and found out that Stretching treatment and MET treatment are both equally effective and the MET treatment group showed more improvement in the management of lower crossed syndrome.

5. Conclusion

This narrative review concludes stating that there is dearth in literature to provide a strong review if improper mechanical posture had an influence in occurrence of lower

crossed syndrome. With the minimal literature available we can only conclude saying that there would be an influence of improper mechanical posture on pain which in affecting the quality of life in patients with pelvic pain syndrome.
Although there was significant difference in hip extensor strength and back extensor strength among the one's with low back pain. As the prevalence rate of lower crossed syndrome is considerably high in low back pain with improper mechanical posture, this would have a high scope of study in the future.

6. Conflicts of Interest: None

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