



## Article

# Effects of Clamshell Versus Gluteal Bridge Exercises on Low Back Pain, Gluteal Strength, and Disability Due to Prolonged Sitting in Females with Gluteal Amnesia

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## ABSTRACT

**Background:** Gluteal amnesia, characterized by impaired neuromuscular activation of the gluteal muscles, is a growing concern among sedentary females and contributes significantly to low back pain and disability. Despite the widespread use of gluteal strengthening exercises in clinical practice, limited evidence exists comparing the functional outcomes of clamshell versus gluteal bridge exercises in this population.

**Objective:** To compare the effects of clamshell and gluteal bridge exercises on low back pain, gluteal strength, and disability due to prolonged sitting in females with gluteal amnesia. **Methods:** This randomized clinical trial included 38 females (n = 38), aged 20–50 years, diagnosed with gluteal amnesia and meeting predefined inclusion criteria. Participants were randomly assigned to either clamshell or gluteal bridge exercise groups, both receiving baseline treatment over six weeks (18 sessions). Pain and disability were assessed using the Numeric Pain Rating Scale (NPRS) and Modified Oswestry Disability Index (ODI), respectively. Data were analyzed using SPSS version 25 with non-parametric tests following normality assessment. Ethical approval was obtained from the Riphah Ethical Review Board (Ref. No. REC/RCR & AHS/23/048823) in accordance with the Declaration of Helsinki. **Results:** Both groups showed significant within-group reductions in NPRS and ODI scores ( $p < 0.001$ ). The gluteal bridge group demonstrated greater post-treatment improvement in ODI (median: 9.00 vs. 12.00,  $p = 0.003$ ), indicating superior functional recovery. **Conclusion:** Both clamshell and gluteal bridge exercises are effective in reducing pain and disability in females with gluteal amnesia; however, gluteal bridge exercises yield greater improvements in functional outcomes, underscoring their clinical utility in rehabilitation settings.

**Keywords:** Gluteal Amnesia, Low Back Pain, Clamshell Exercise, Gluteal Bridge, Disability, Rehabilitation, Female Health.

## INTRODUCTION

Gluteal amnesia, often described as the diminished neuromuscular recruitment of the gluteal muscle complex—primarily the gluteus maximus—leads to compensatory overactivation of the hamstrings and lumbar musculature during movement (1). This neuromuscular inhibition disrupts normal biomechanics and places increased stress on the lumbar spine, contributing to low back pain (2). The condition is particularly prevalent among individuals with sedentary lifestyles, where prolonged sitting fosters muscle imbalances and postural dysfunctions. This cascade of musculoskeletal adaptations results in what is clinically referred to as Lower Crossed Syndrome (LCS), characterized by tight hip flexors and

lumbar extensors, alongside weak abdominal and gluteal muscles (3). Such imbalances not only contribute to chronic low back pain but are also implicated in altered gait mechanics and increased risk of injury to the knee, hip, and ankle joints (4).

Among the muscles impacted, the gluteus medius (GMed) plays a crucial role in pelvic stability during locomotion. Weakness in the GMed contributes to compensatory movement patterns that affect the lumbopelvic complex and can manifest as biomechanical inefficiencies during daily activities, including walking and prolonged sitting (5). Research suggests that activation and strengthening of this muscle group are essential

for restoring functional movement and reducing discomfort associated with gluteal weakness. According to Bolgia et al., weight-bearing exercises are especially effective in targeting the GMed and improving neuromuscular control (5). Stabilization exercises have been widely advocated for patients with chronic low back pain, as they enhance muscular coordination, strength, and endurance while promoting optimal spinal alignment (6). Moreover, impaired motor control has been identified as a major contributor to recurrent back pain, necessitating the inclusion of targeted interventions to retrain muscle activation patterns (7).

Despite numerous studies underscoring the efficacy of hip-focused interventions, the literature lacks direct comparisons between specific gluteal-strengthening exercises such as clamshells and gluteal bridges in populations with diagnosed gluteal amnesia. Clamshell exercises, known for their targeted activation of the hip abductors—particularly the GMed—are often used in clinical settings to correct dysfunctional recruitment patterns (9). In contrast, gluteal bridge exercises emphasize hip extension and posterior chain activation, thereby addressing weakness in the gluteus maximus and enhancing pelvic stability (9). While both exercises are widely employed, it remains unclear which offers superior outcomes in reducing low back pain and disability in female patients experiencing gluteal amnesia due to prolonged sitting.

Given the rising incidence of sedentary behavior and associated musculoskeletal disorders in women, a focused exploration of exercise-specific benefits is both timely and clinically relevant. This study seeks to bridge the existing knowledge gap by comparing the effects of clamshell and gluteal bridge exercises on low back pain, gluteal strength, and disability in females diagnosed with gluteal amnesia. By identifying the more efficacious intervention, this research aims to inform clinical practice and optimize therapeutic strategies for managing gluteal dysfunction. The hypothesis driving this study is that while both exercises are effective in reducing symptoms, one may result in significantly better improvements in pain and functional outcomes among patients with gluteal amnesia.

## MATERIAL AND METHODS

This study was designed as a single-blind randomized clinical trial conducted at the District Headquarters Hospital, Nankana Sahib, from January 2023 to June 2023. A total of 38 female participants, aged between 20 and 50 years, clinically diagnosed with gluteal amnesia were included. Consecutive sampling was used for participant recruitment. The inclusion criteria required females with low back pain associated with prolonged sitting and a Numeric Pain Rating Scale (NPRS) score below 7, and a Modified Oswestry Disability Index (ODI) score between 21–40%. Participants were excluded if they had a history of osteoporosis, malignancy, vertebral fracture, trauma, prior or scheduled spinal surgery, pregnancy, or psychological illness. Informed consent was obtained from all participants prior to enrollment, and confidentiality was maintained throughout the study in accordance with the Declaration of Helsinki.

Ethical approval for the study was granted by the Research Ethical Committee of Riphah International University, Lahore Campus (Ref. No. REC/RCR & AHS/23/048823), and the study

was registered in the Clinical Trials Registry with identifier F21C14G92017.

Participants were randomly allocated into two groups using a computer-generated randomization sequence. Allocation was concealed using sealed, opaque envelopes labeled “1” for Group A and “2” for Group B. Group A received baseline treatment along with clamshell exercises, whereas Group B received the same baseline treatment combined with gluteal bridge exercises. Baseline treatment for both groups consisted of a hot pack applied to the lower back for 10 minutes and quadriceps and hamstring stretches, each held for 30 seconds, repeated three times. Both interventions were administered three times per week for six consecutive weeks, totaling 18 treatment sessions.

The primary outcomes were pain and functional disability, measured using the Numeric Pain Rating Scale (NPRS) and the Modified Oswestry Disability Index (ODI), respectively. Assessments were conducted at baseline and after six weeks of intervention. The clamshell exercise involved side-lying hip abduction with knees bent and feet together, progressing from 1 set of 10 repetitions in the first week to 3 sets of 10 repetitions from the third week onward. The gluteal bridge exercise was performed in a supine position with knees bent at 90 degrees, focusing on hip elevation while keeping the knees aligned over the toes. Each session included three sets of 15 repetitions or 30-second holds.

Data analysis was performed using SPSS version 25. Normality of data was tested using the Shapiro-Wilk test. As the data were not normally distributed ( $p < 0.05$ ), non-parametric tests were employed. Within-group comparisons were analyzed using the Wilcoxon signed-rank test, while between-group differences were assessed with the Mann-Whitney U test. The significance level was set at  $p < 0.05$  for all analyses.

## RESULTS

A total of 38 female participants diagnosed with gluteal amnesia were enrolled and randomized into two intervention arms: Group A (Clamshell Exercise,  $n = 19$ ) and Group B (Gluteal Bridge Exercise,  $n = 19$ ). Due to attrition, 18 participants from each group completed the intervention and post-treatment assessments. Baseline demographic characteristics were comparable across groups, confirming successful randomization (Table 1).

Pain intensity and functional disability were assessed using the Numeric Pain Rating Scale (NPRS) and the Modified Oswestry Disability Index (ODI), respectively. Both groups demonstrated statistically significant improvements in NPRS and ODI from baseline to six weeks ( $p < 0.001$ ), indicating clinically meaningful reductions in pain and disability. The within-group changes are detailed in Table 2. The clamshell group showed a reduction in NPRS from a median of 7.00 to 4.00 and in ODI from 27.00 to 12.00. The gluteal bridge group showed a reduction in NPRS from 7.00 to 3.00 and in ODI from 26.00 to 9.00. Between-group comparisons using the Mann-Whitney U test indicated a statistically significant difference in ODI scores post-treatment ( $p = 0.003$ ), favoring the gluteal bridge group. However, the difference in NPRS post-treatment approached but did not reach statistical significance ( $p = 0.052$ ), suggesting a possible trend

favoring the gluteal bridge group for pain reduction as well (Table 2). These findings suggest that while both interventions are

effective, gluteal bridge exercises may have a greater impact on improving disability associated with gluteal amnesia.

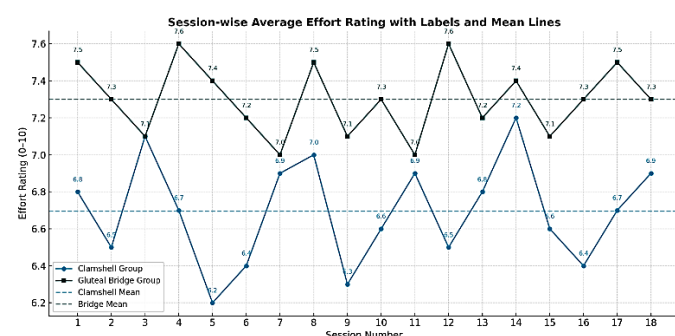
**Table 1: Baseline Demographic Characteristics of Participants**

Parameter	Group A: Clamshell ( <i>n</i> =19)	Group B: Gluteal Bridge ( <i>n</i> =19)
Age (years)	46.95 ± 7.74	48.84 ± 5.70
Height (cm)	158.99 ± 4.65	158.91 ± 4.33
Weight (kg)	64.94 ± 6.15	65.42 ± 5.38
BMI (kg/m <sup>2</sup> )	25.69 ± 2.26	26.06 ± 2.06

**Table 2: Within-Group and Between-Group Comparisons of NPRS and ODI Scores**

Outcome	Group	Time Point	Median	IQR	z-value (Within)	p-value (Within)	z-value (Between)	p-value (Between)
NPRS	Clamshell	Pre-Treatment	7.00	2.00	-3.901	<0.001	-0.201 (Pre)	0.840 (Pre)
		Post-Treatment	4.00	2.00			-1.943 (Post)	0.052 (Post)
	Bridge	Pre-Treatment	7.00	2.00	-3.948	<0.001		
		Post-Treatment	3.00	2.00				
Modified ODI	Clamshell	Pre-Treatment	27.00	8.00	-3.839	<0.001	-2.733 (Pre)	0.006 (Pre)
		Post-Treatment	12.00	5.00			-2.998 (Post)	0.003 (Post)
	Bridge	Pre-Treatment	26.00	8.00	-3.828	<0.001		
		Post-Treatment	9.00	10.00				

Both clamshell and gluteal bridge exercises were effective in significantly reducing pain and disability in females with gluteal amnesia following six weeks of intervention. While within-group improvements were statistically and clinically significant in both groups, the gluteal bridge group showed greater gains, particularly in disability reduction as measured by Modified ODI.



**Figure 1 Session-wise Average**

The trend toward improved pain relief in the gluteal bridge group, although not statistically significant at the 0.05 threshold, warrants further investigation with larger sample sizes. These results support the integration of gluteal bridge exercises into rehabilitation protocols aimed at managing low back pain and functional limitations associated with gluteal amnesia.

## DISCUSSION

The present study compared the effects of clamshell and gluteal bridge exercises on pain intensity and disability in females suffering from gluteal amnesia associated with prolonged sitting. Both exercise regimens produced statistically significant improvements in pain and functional outcomes over a six-week intervention period, as measured by the Numeric Pain Rating Scale (NPRS) and the Modified Oswestry Disability Index (ODI). While both groups showed within-group improvements, the gluteal bridge group demonstrated greater post-treatment reductions in ODI scores, suggesting superior efficacy in addressing functional disability. These findings highlight the

importance of targeted gluteal strengthening in managing neuromuscular dysfunction and chronic low back pain resulting from sedentary behavior.

The study's findings are in line with previous literature suggesting that impaired gluteal activation plays a central role in the etiology of low back pain, particularly in the context of lower crossed syndrome and muscle imbalance patterns (3). Gluteal amnesia, characterized by reduced neuromuscular recruitment of the gluteus maximus and medius muscles, contributes to compensatory overuse of the hamstrings and lumbar extensors, thereby exacerbating lumbar discomfort and biomechanical inefficiency (1,2). In this context, both clamshell and gluteal bridge exercises serve as neuromuscular retraining tools aimed at restoring functional integrity of the posterior chain.

The observed superiority of gluteal bridge exercises in reducing disability scores may be attributed to the biomechanical and neuromuscular demands of this movement. The gluteal bridge involves hip extension against gravity with core stabilization, activating not only the gluteus maximus but also engaging the pelvic floor and abdominal musculature, which may lead to greater improvements in lumbo-pelvic stability (9). This supports findings from earlier studies that demonstrated the benefits of closed-chain weight-bearing activities in enhancing gluteal strength and reducing functional limitations in individuals with chronic low back pain (5,11). Moreover, the gluteal bridge may offer a more functional, compound movement pattern compared to the clamshell, which is primarily an isolated hip abduction exercise.

In contrast, clamshell exercises are effective in targeting the gluteus medius, particularly its posterior fibers, and are frequently employed to improve pelvic alignment and hip stability in early-stage rehabilitation (9). A study by Jeong et al. supported the effectiveness of clamshell modifications in isolating the gluteus medius and reducing the contribution of anterior hip flexors, thereby enhancing the specificity of muscle activation (5). In the current study, while the clamshell group

showed substantial pain reduction, their relative improvement in ODI was less than that observed in the gluteal bridge group, suggesting that while clamshells are beneficial for pain modulation, they may not be sufficient alone to address broader functional impairments.

From a clinical standpoint, the findings reinforce the role of exercise-based rehabilitation in addressing the underlying neuromuscular deficits in gluteal amnesia and chronic low back pain. Given the growing incidence of sedentary lifestyles, particularly among working-age females, clinicians should consider incorporating gluteal bridge exercises into core stabilization and postural correction programs. The practical application of these exercises, requiring minimal equipment and space, further enhances their utility in both clinical and home-based settings.

Despite its strengths, including a randomized design and use of validated outcome measures, the study is not without limitations. The relatively small sample size and short duration limit the generalizability of the findings. The study was also restricted to female participants, which may constrain its applicability to broader populations, including males and older adults. Additionally, the lack of long-term follow-up precludes conclusions about sustained functional improvements or recurrence prevention. The single-blinded design, while pragmatic, may also introduce some risk of performance bias.

Future research should focus on larger, multicenter trials with extended follow-up durations to evaluate the long-term impact of these interventions. It would also be beneficial to explore combined protocols incorporating both gluteal bridge and clamshell exercises, or integrating other functional strengthening and mobility strategies. Further studies may also investigate neuromuscular activation patterns using electromyography (EMG) to elucidate specific mechanisms underlying the observed clinical effects.

This study adds to the growing body of evidence supporting targeted gluteal strengthening for managing pain and disability in females with gluteal amnesia. Both clamshell and gluteal bridge exercises were effective; however, gluteal bridge training demonstrated greater impact on functional recovery. These findings have practical relevance for designing effective, evidence-based rehabilitation strategies for individuals experiencing chronic low back pain linked to gluteal dysfunction.

## CONCLUSION

This study concluded that both clamshell and gluteal bridge exercises significantly reduced low back pain and disability in females with gluteal amnesia due to prolonged sitting; however, gluteal bridge exercises demonstrated greater effectiveness in improving functional outcomes. These findings highlight the clinical relevance of targeted gluteal activation strategies in rehabilitating patients with neuromuscular deficits contributing to chronic low back pain. Incorporating gluteal bridge exercises into rehabilitation protocols may enhance recovery by restoring pelvic stability and muscular coordination. The results also support further research into long-term outcomes, gender-specific responses, and the integration of combined gluteal

strengthening approaches to optimize patient care in musculoskeletal and postural dysfunctions.

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