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# Anatomical Analysis of the Subscapular and Axillary Nerves Originating from the Posterior Cord of the Brachial Plexus and Their Functional Relevance to Shoulder Pain Relief in Dancers

## Análisis Anatómico de los Nervios Subescapular y Axilar Originados en el Fascículo Posterior del Plexo Braquial y su Relevancia Funcional para el Alivio del Dolor de Hombro en Bailarines

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**KIM, H-J.; JEON, A.; LEE, J-H. & CHOI, H. K.** Anatomical analysis of the subscapular and axillary nerves originating from the posterior cord of the brachial plexus and their functional relevance to shoulder pain relief in dancers. *Int. J. Morphol., 44(2)*:493-497, 2026.

**SUMMARY:** This study aimed to investigate the anatomical morphology of the subscapular and axillary nerves originating from the posterior cord of the brachial plexus and to evaluate their potential clinical relevance in the management of shoulder pain among dancers. Ten cadaveric shoulders were dissected to identify the branching patterns of the subscapular and axillary nerves, followed by an 8-week exercise intervention involving eight female dancers experiencing mild shoulder discomfort. The results revealed four major types of posterior cord branching patterns. Post-intervention assessment demonstrated a marked decrease in shoulder pain, suggesting that strengthening muscles innervated by posterior cord branches may contribute to pain reduction and improved shoulder stability. These findings indicate that anatomical understanding of nerve distribution can inform exercise-based rehabilitation strategies for shoulder dysfunctions in dancers.

**KEY WORDS: Subscapular nerve; Axillary nerve; Shoulder pain; Brachial plexus; Cadaver dissection.**

## INTRODUCTION

Dancers are frequently prone to physical injuries or discomfort resulting from repetitive joint movements and rigorous training aimed at building endurance. These issues can often hinder their ability to perform at their best on stage. Among the most common musculoskeletal problems faced by dancers, injuries to the lower limbs are particularly prevalent. Studies indicate that approximately 20 % of dancers experience thigh-related injuries, with even higher rates reported for general musculoskeletal discomfort and pain (Cho & Kim, 2021). Excessive stretching, in particular, has been identified as a major cause of hamstring injuries in dancers, with recurrence rates ranging from 12 % to 31 % (Pandey & Madi, 2021). Additionally, another study highlighted that injury in the lower body often involve areas such as the quadriceps, adductors, iliotibial band, and even bone structures (Dias *et al*., 2005).

In addition to injuries and pain in the lower limbs, which have been widely reported in the literature, the shoulder is also a frequent site of musculoskeletal issues in both dancers and the general population (Crookes *et al*., 2023). Shoulder pain is commonly reported even in professional dancers, and may be associated with muscular weakness, skeletal irregularities, or other unclear etiologies (Khoury *et al*., 2009; Chokshi & Kiprovski, 2022).

Shoulder conditions such as frozen shoulder, rotator cuff disorders, or SLAP lesions are often associated with reduced range of motion and pain. In such cases, sympathetic nervous system involvement may lead to increased tightness in flexion and internal rotation. This pattern is also considered applicable in cases of spasticity. It is frequently occurs in the flexor muscles, and this is often observed in muscles innervated by nerves originating from the anterior divisions or cords of the brachial plexus (Yang *et al*., 2016). This led to the question of whether targeting muscles innervated by nervesarising from the posterior cord might be beneficial for dancers experiencing shoulder pain.

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Representative nerves originating from the posterior cord include the subscapular nerve, axillary nerve, and suprascapular nerve. Although previous studies (Tubbs *et al*., 2007; Paraskevas *et al*., 2016) have investigated the branching patterns and origins of these nerves, their results often vary, and differences may exist depending on the population studied. These inconsistencies highlight the need for further anatomical research. Moreover, combining such anatomical investigations with studies examining the rehabilitative outcomes of exercises targeting muscles innervated by posterior cord nerves could lead to a more comprehensive understanding and meaningful clinical applications.

This study aims to analyze the anatomical morphology of the subscapular and axillary nerves, which branch from the posterior cord of the brachial plexus, and to evaluate the therapeutic effects of activating the muscles innervated by these nerves in patients experiencing shoulder pain.

## MATERIAL AND METHOD

For the anatomical component of this study, 10 fixed cadavers (male 6, female 4; age 46-99) were dissected. Dissection began with the removal of the skin and the pectoralis major and minor muscles in the shoulder region to expose the brachial plexus. The posterior cord was identified, and the main branches, including the radial and axillary nerves, were traced. Subsequently, meticulous dissection was carried out to investigate the smaller branches arising from these nerves. A morphological study was conducted to examine the origin and branching patterns of the nerves innervating the subscapularis muscle (Fig. 1). The findings were documented through photographs and anatomical drawings to ensure accurate representation and analysis.

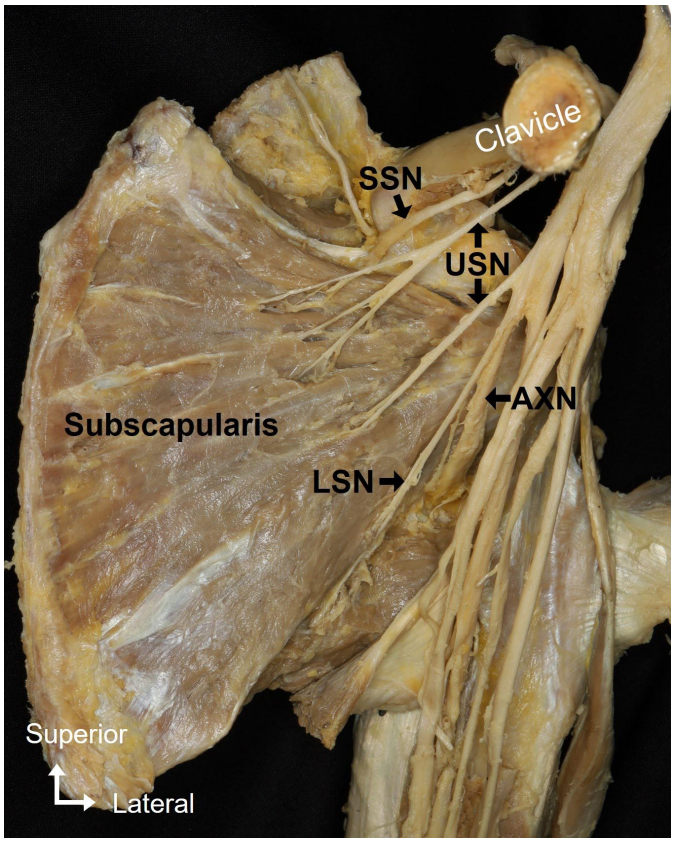


Fig. 1. A detailed dissection image of the subscapularis muscle and the nerve branches originating from the brachial plexus innervating the subscapularis. SSN: suprascapular nerve, USN: upper subscapular nerve, LSN: lower subscapular nerve, AXN: axillary nerve.

Out of 20 university students majoring in dance, 8 female participants (age 20-23) who reported experiencing mild shoulder discomfort were identified. Exercise interventions were administered to these individuals following informed consent. Participants performed theraband exercises with their elbows kept close to the torso and shoulders in a depressed position. Each exercise session consisted of 5 sets of 15 repetitions. Medial and lateral rotations of the shoulder joint were performed while maintaining the elbow in close proximity to the trunk to minimize compensatory movements (Figs. 2 and 3). In the present study, medial rotation of the shoulder was applied with the hypothesis that activating the subscapularis and teres major muscles—innervated by the subscapular nerves branching from the posterior cord of the brachial plexus—would be facilitated through movement. Lateral rotation was incorporated with the expectation that strengthening the posterior shoulder muscles could help prevent muscle weakening and have a positive effect on shoulder pain. To test this hypothesis, an anatomical analysis of the nerves originating from the posterior cord was conducted.

This intervention was conducted over a period of 8 weeks, with assessments taken both before and after the training program. At the end of the 8-week intervention, participants were instructed to document the condition of their initial shoulder pain, allowing for a comparison between pre- and post-intervention pain levels. To evaluate the effect of the intervention, the degree of shoulder discomfort was assessed using the Visual Analog Scale (VAS), with scores ranging from 0 (no pain) to 10 (worst pain imaginable), both before and after the exercise program. Ethical approval for this study was obtained from the Institutional Review Board of our university.

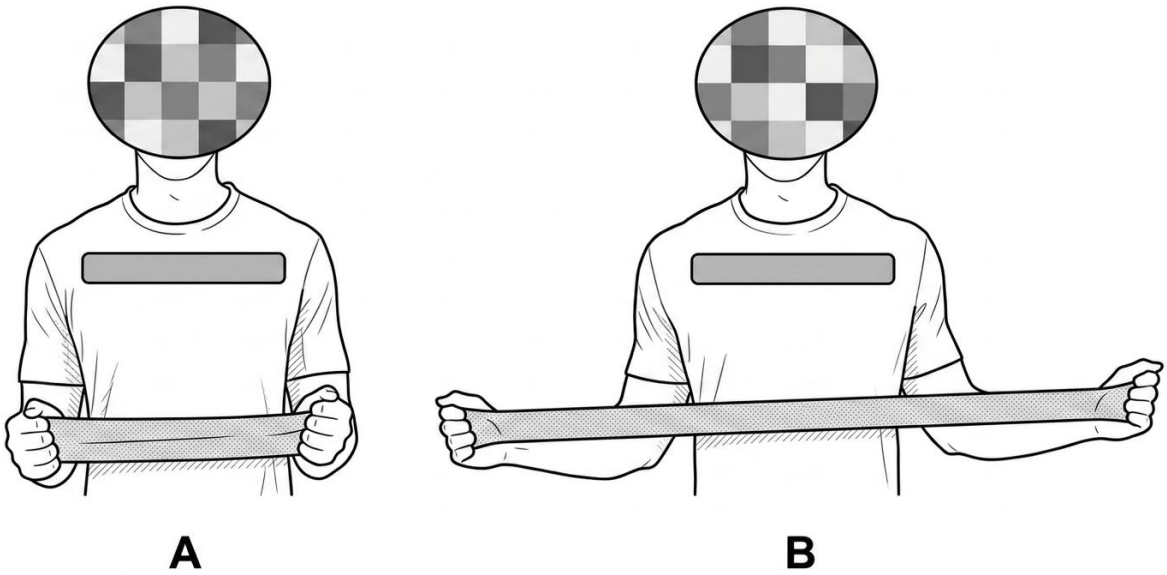


Fig. 2. Exercise Intervention Protocol Used in This Study. (A) Starting position, (B) lateral rotation position.

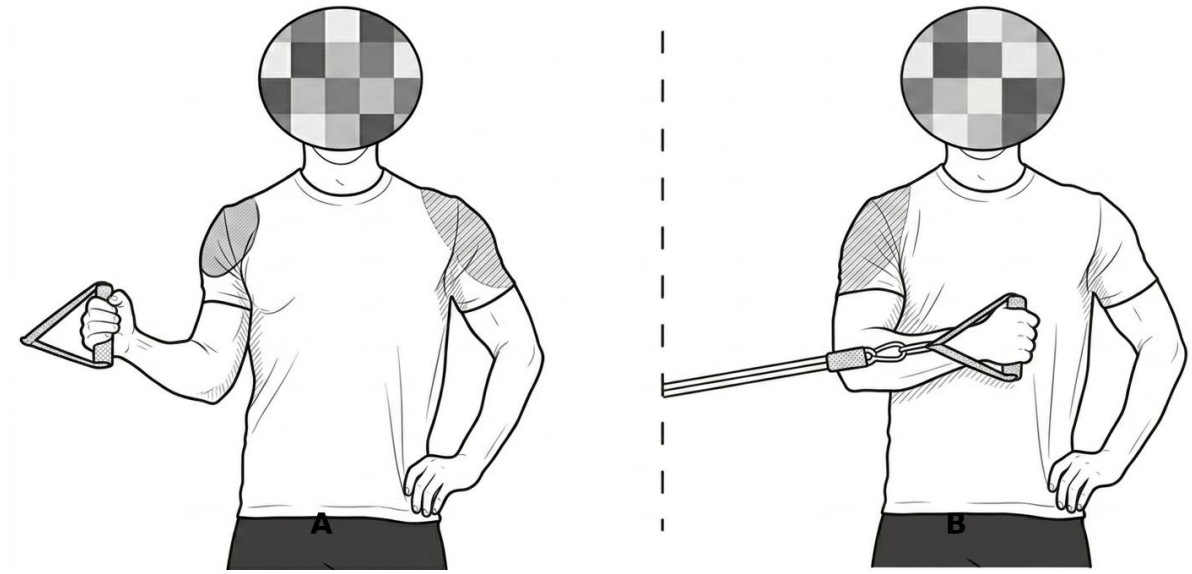


Fig. 3. Exercise Intervention Protocol Used in This Study. (A) Starting position, (B) medial rotation position.

## RESULTS

In this study, the anatomical variations of the posterior cord were classified into four distinct types. Type I was characterized by the radial and axillary nerves branching off together, following the prior branching of two subscapular nerve branches, which are typically referred to as the upper subscapular nerve and the lower subscapular nerve, directly from the posterior cord. This pattern was observed in nine cases. Type II involved a common trunk comprising the radial nerve, axillary nerve, and one branch of the subscapular nerve, while the remaining subscapular nerve branch arose separately from the posterior cord prior to the formation of the common trunk. This pattern was identified in three cases. Type III was defined as a pattern in which the radial nerve, axillary nerve, and both branches of the subscapular nerve originated independently from a single point on the posterior cord. This configuration was observed in two cases. Type IV was characterized by the radial nerve, axillary nerve, and one branch of the subscapular nerve arising together from a common point, while the remaining

subscapular nerve branch originated from the axillary nerve itself. This pattern was identified in six cases (Fig. 4).

Prior to the exercise intervention, four out of eight participants reported a VAS score of 3, and the other four reported a score of 4. After the intervention, seven participants reported complete resolution of pain (VAS = 0), while one participant reported minimal residual pain (VAS = 1) (Table I).

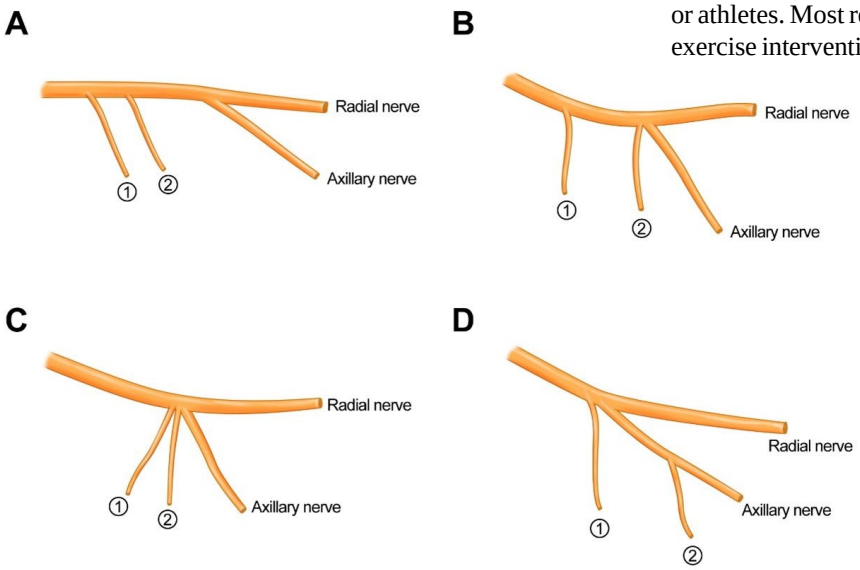


Fig. 4. Illustration of the classification of nerve branching patterns. 1,2: subscapular nerve.

Table I. Changes in pain intensity Pre- and Post- exercise.

| | VAS score (number) | VAS score (number) |
|---|---|---|
| Pre exercise | 3 (4) | 4 (4) |
| Post exercise | 0 (7) | 1 (1) |

VAS: visual analogue scale.

## DISCUSSION

According to a previous study (Tubbs *et al*., 2007), the subscapularis nerve originates from the posterior cord of the brachial plexus in 97 % of cases, while in the remaining 3 %, it branches directly from the axillary nerve. Among these, a single upper subscapular nerve was observed in 90.3 % of cases, two independent nerves in 8 %, and three separate nerves in 1.6 %. Another study (Paraskevas *et al*., 2016) reported a variation in which one nerve supplying the subscapularis originated from the suprascapular nerve, and the other from the posterior division of the brachial plexus. In the present study, a case with three nerves innervating the subscapularis was identified. Although a branch from the axillary nerve was observed, no branches arising from the radial or suprascapular nerves were found. Furthermore, in all observed cases, both the axillary nerve and the subscapular nerves originated from the posterior cord. Given that these nerves innervate muscles responsible for lateral and medial rotation of the shoulder, respectively, the favorable outcomes observed in this study with respect to pain relief suggest the possibility of functional interaction between these nerves.

It is rare to find studies that evaluate the effects of exercise based specifically on nerve distribution, regardless of whether the participants are general individuals, dancers, or athletes. Most rehabilitation-focused studies tend to apply exercise interventions based on broad concepts of movement analysis, specific motions, or perceived pain, rather than targeting neural anatomy. In this study, however, we hypothesized that even in cases of pain—whether it occurs during movement or at rest—muscles innervated by nerves branching from the posterior division of the brachial plexus may be involved (Berg *et al*., 2021). While it is acknowledged that different cutaneous and articular branches of nerves are responsible for specific regions of the shoulder joint, we focused on strengthening the muscles innervated by the posterior division (Ebraheim *et al*., 2011; Eckmann *et al*., 2017). The results suggest that this approach may help correct shoulder imbalances through improved movement control.

Previous studies have investigated the anatomical classification of the brachial plexus, particularly focusing on variations in the divisions and cords (Rastogi *et al*., 2013; Ghosh *et al*., 2022). These studies have reported variations in the number of main trunks forming the divisions, as well as anatomical differences observed in the cords. However, the present study did not primarily aim to classify such structural variations. Instead, it focused on identifying from which main trunk the nerves innervating the subscapularis muscle arise. As a result, while a number of cases showed that these nerves branched from the axillary or radial nerves, the findings suggest that the axillary nerve is more anatomically relevant due to its proximity. Given this, the application of exercises targeting the teres minor and deltoid muscles—both innervated by the axillary nerve—along with medial rotation of the shoulder with the elbow held close to the body, which is the initial movement associated with subscapularis activation, may have contributed positively to the outcomes. This approach supports the idea of a functional relationship between these muscles in shoulder stabilization and pain reduction.

From a circulatory perspective, rotational movements of the shoulder are thought to enhance collateral circulation among the dorsal scapular artery, suprascapular artery, and circumflex scapular artery. This improved blood flow may contribute to recovery in cases of shoulder pain or restricted mobility. The findings of this study may be beneficial for individuals experiencing shoulder pain or limited range of motion, and it is hoped that the anatomical insights presented here will contribute to medical education, particularly in the fields of musculoskeletal anatomy and shoulder-related clinical training.

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**RESUMEN:** Este estudio tuvo como objetivo investigar la morfología anatómica de los nervios subescapular y axilar originados en el fascículo posterior del plexo braquial y evaluar su posible relevancia clínica en el tratamiento del dolor de hombro en bailarines. Se disecaron diez hombros de cadáveres para identificar los patrones de ramificación de los nervios subescapular y axilar, seguidos de una intervención de ejercicios de 8 semanas con ocho bailarinas que presentaban molestias leves en el hombro. Los resultados revelaron cuatro tipos principales de patrones de ramificación del fascículo posterior. La evaluación posterior a la intervención demostró una marcada disminución del dolor de hombro, lo que sugiere que el fortalecimiento de los músculos inervados por las ramas del fascículo posterior puede contribuir a la reducción del dolor y a una mayor estabilidad del hombro. Estos hallazgos indican que la comprensión anatómica de la distribución nerviosa puede orientar las estrategias de rehabilitación basadas en el ejercicio para las disfunciones del hombro en bailarines.

**PALABRAS CLAVE: Nervio subescapular; Nervio axilar; Dolor de hombro; Plexo braquial; Disección cadavérica.**

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