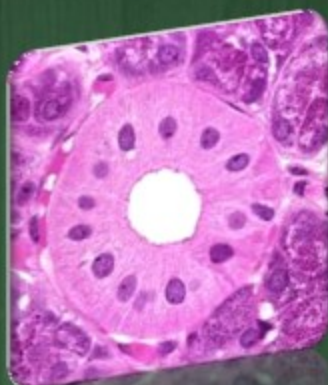
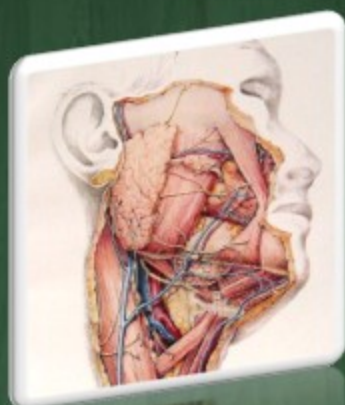


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Original Article

STUDY ON VARIATIONS OF BICEPS BRACHII MUSCLE AND ITS CLINICAL SIGNIFICANCE IN UTTAR PRADESH POPULATION

Muktyaz Hussein¹, Mukesh Bansal¹, Ved Prakash²

1. Department of Anatomy, Government Medical College, Budaun, India
2. Department of Anatomy, M.P.T. Medical College, Siddharth Nagar, India

ABSTRACT

Introduction: The variations and abnormalities of the upper limb muscles have become significant because of new imaging techniques, such as computed tomography and magnetic resonance imaging. The biceps brachii muscle is one of the muscles of the anterior compartment of the arm and it is one of the most variable muscles in the human body in terms of number and morphology. The biceps brachii muscle has two heads, long and short head.

Materials and Methods: The present study comprised of 26 adult cadavers (52 upper limbs) (40 male, 12 female) from Uttar Pradesh population during routine abdominal dissection conducted for medical undergraduates at the department of Anatomy. Both the arms of the cadavers were dissected carefully observed and biceps brachii muscle variations were photographed and recorded.

Results: A three headed biceps brachii muscle was found unilaterally only in male cadavers, belonging to the right side. The incidence of present of third of head biceps brachii muscles were observed in 03 cadavers (11.5%).

Conclusions: Knowledge of such variations is very important for surgeons who do operating procedure in the arm region.

Keywords: Biceps brachii, Third head

INTRODUCTION

The biceps brachii muscle is a dual headed muscle of the flexor compartment of the upper arm. It originates proximally with a long head from the supraglenoid

tubercle and a short head from the coracoid process of scapula. Distally, these heads join to form a common tendon, which gets inserted to the posterior aspect of the radial tuberosity

Address for Correspondence:

Dr. Muktyaz Hussein, Associate Professor, Department of Anatomy, Government Medical College, Budaun, India
Email: muktyazmukky@gmail.com Mob: 9161431601

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and some aponeurotic fibres form bicipital aponeurosis which merge with the deep fascia of forearm and mainly contribute to flexion and supination of the forearm [1]. The description of the origin of these bellies (short and long) is consistent with the description in standard texts, and variations have been seen in the mode of insertion of the said muscle. In this study the Biceps brachii have been classified based on extra bellies of insertion [2].

The medial brachial origin of the surplus head of the biceps brachii muscle may contribute to pronation of forearm irrespective of shoulder joint position. In addition to elbow flexion independent of shoulder joint, the third head of biceps brachii may enhance the strength of elbow flexion [3]. The third head of biceps brachii might cause compression of neurovascular structures in upper limb [4]. It is well known that a third head may extend from upper medial part of the brachialis to the bicipital aponeurosis and medial side of tendon in ten percent of cases [5].

MATERIALS AND METHODS

In the present study, observations were made on the cadavers while they were used for routine dissection classes for medical undergraduate students over a period of six years comprising of 26 adult formalin fixed cadavers (52 upper limbs) (40 male, 12 female) from Uttar Pradesh population in the department of Anatomy, Govt. Medical College Budaun and Govt. Medical College

Ambedkar Nagar. The embalmed cadaveric dissections were performed according to Cunningham's manual of practical Anatomy [6] carefully. The Biceps brachii muscle and its surrounding structures were studied for the presence of variations in Biceps brachii muscle heads. This was an observational study with no usage of experimental instruments. The appropriate measurements were taken by calipers and measuring tape, the Biceps brachii muscle was photographed and the findings were appropriately documented.

RESULTS

In the present study, out of 26 adult cadavers (52 Upper limbs) of both sexes (16 males and 10 females) showed the presence of variations of Biceps brachii muscle in the right arm. The incidence of presence of third of head biceps brachii muscle was observed in three cadavers 11.5% showed in Table 1. On further observation in the study on arm dissection in the right side, the cadaver had three head of Biceps brachii muscle (Fig. 1).

Most of the fibers of the additional third head of Biceps brachii (length- 7.2 cm and width- 2.1cm) originated from Pectoralis major muscle tendon. The third head of Biceps brachii joined with muscle belly and inserted to the posterior aspect of the radial tuberosity and some fibers were merged with the deep fascia of forearm. The additional third head was innervated by the Musculocutaneous nerve after piercing Coracobrachialis, like the

Table 1. Incidence of presence of third head of biceps brachii in Uttar Pradesh Population.

Cadavers Studied 26 (52 Arms)	Normalhead of biceps brachiin (%)	Presence of third head of biceps brachii in right side(%).	Presence of third head of biceps brachii in left side (%).
	23 (88.5%)	3 (11.5%)	0

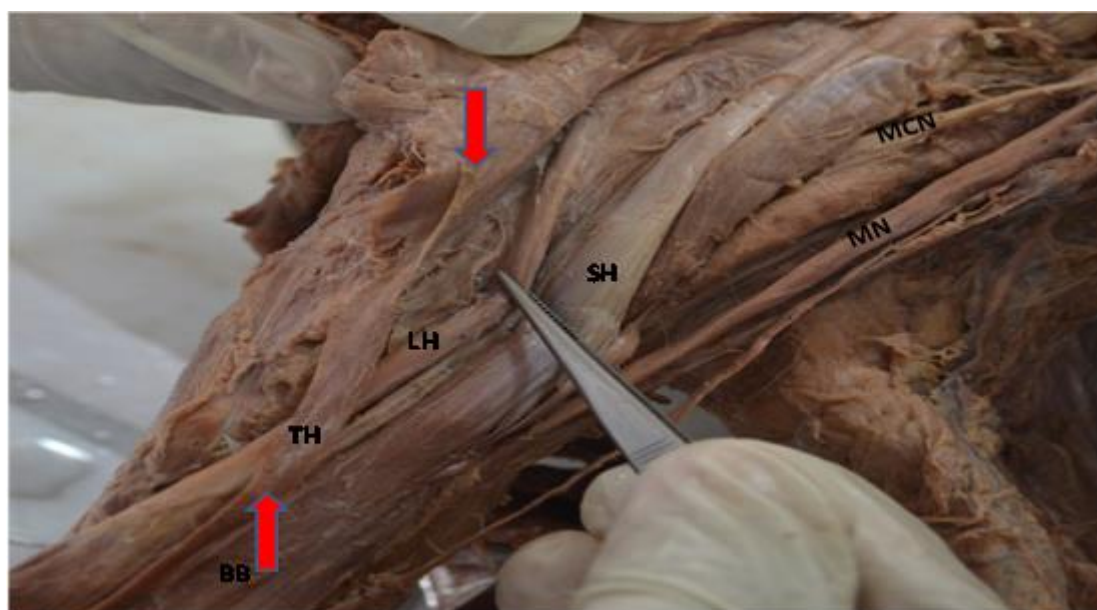


Fig. 1. Third head of the right Biceps brachii originating from Pectoralis major and joining the belly of Biceps. (Lh – Long head; SH – Short head; TH – Third head; MN – Median nerve; MCN – Musculocutaneous nerve)

innervations of long and short heads and continued as the lateral cutaneous nerve of the forearm passing in the middle of Brachialis and Biceps brachii (Fig. 2,3).

In the present study we found vascular supply of third head of Biceps brachii were from the Brachial artery and we identified third of head Biceps brachii muscle in three cadavers (11.5%) on the right side only and a third head on left side was not observed in any of the 26 cadavers.

DISCUSSION

The variations of the Biceps brachii muscle are commonly known, but the occurrence of a third head of Biceps brachii is rare. In the current study it was found that the variations of Biceps brachii heads were present only on the right side and incidence of unilateral three headed Biceps brachii were present in three cadavers (11.5%). The incidence of the presence of variations in Biceps brachii muscle heads and comparison with other authors have been shown in Table 2.

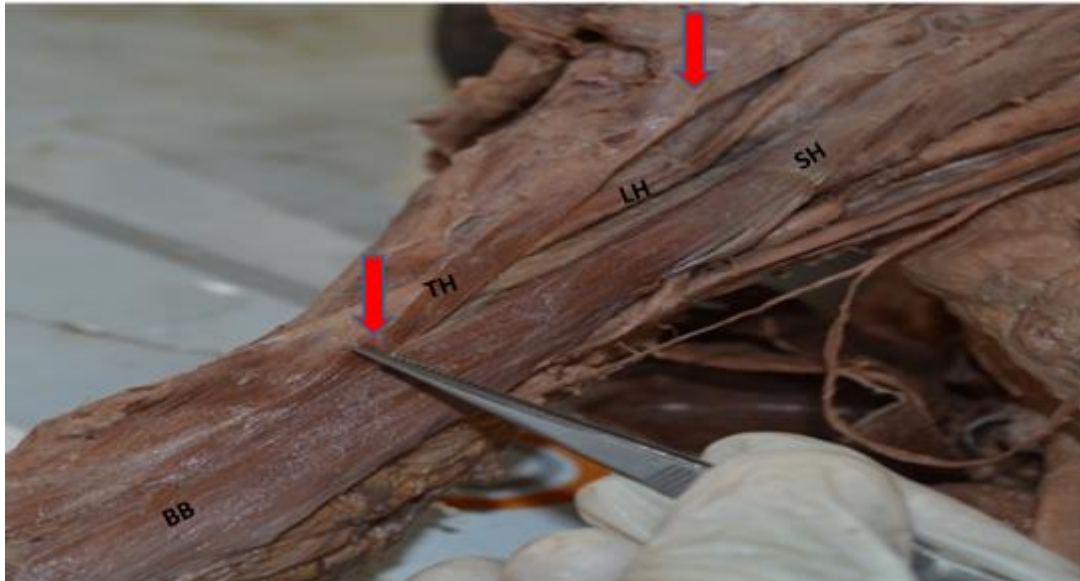


Fig. 2. Third head of the right Biceps brachii originating from Pectoralis major and joining the belly of Biceps with insertion on the posterior part of Radial tuberosity. (Lh – Long head; SH – Short head; TH – Third head; BB – Biceps brachii)

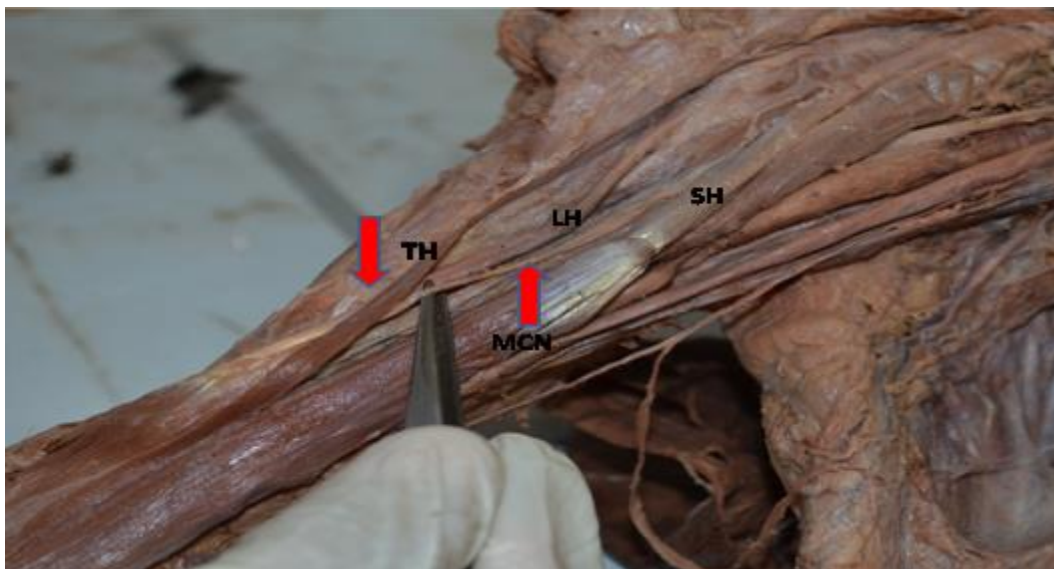


Fig. 3. Third head of the right Biceps brachii originating from Pectoralis major and supplied by the Musculocutaneous nerve. (Lh – Long head; SH – Short head; TH – Third head; MCN – Musculocutaneous nerve)

Table 2. Incidence of presence of variations in Biceps brachii muscle heads and comparison with various other authors.

S.No.	Authors	Presence of third heads of biceps brachii muscle in percent%
1	Present current study	11.5%.
2	Avadhani R and Chakravarthi KK [7]	16.66%
3	Ambali Manoj P et al., [8]	11.53%
4	Cheema P and Singla R [9]	2.3%
5	Kervancioglu P and Orhan M [10]	8.33%
6	Kumar H et al., [11]	3.3%
7	Lokanadham S and Subhadra Devi V [12]	5%
8	Bharambe VK et al., [13]	13.3%
9	Jolly Agarwal, Krishna Gopal [14]	6.5%

The musculature of the arm differentiates from the limb bud mesenchyme of lateral plate mesoderm during the process of development. By distinctive growth and apoptosis, under higher molecular regulation, the somites lead to muscle formation. Due to unevenness in the expression of Hox genes and process the variations of the muscle arise usually, therefore resulting in absence, presence or abnormal orientation of the muscle or its part [15]. Presence of extra heads may be injured by surgeons during surgeries on shoulder joint or arthroscopy of the joint, which may cause injury to neurovascular structures of the upper limb [16].

The extra heads may cause bone displacement after fracture. Sometimes, musculotendinous slips from muscle may be inserted at more than one place, and then it

may result in independent function of each part of the muscle [17]. In such cases the knowledge of the innervation of accessory head as well as the compression of vasculature becomes essential to the surgeons [18]. The Biceps brachii is a powerful flexor of the elbow and supinator of the forearm. Many researchers have stated that the presence of accessory heads of Biceps brachii muscle may increase its power of flexion and supination of the forearm [11]. The action of Biceps brachii at three joints makes it suitable for pitching. Repetitive overhead throwing produces a significant mechanical stress on the shoulder and elbow joint.

The Biceps brachii muscle can give rise to pain not only in the shoulder region in softball pitching but also towards the medial aspect of the arm due to origin of its

accessory head. Thus, the knowledge of these variations also helps orthopaedicians and physiotherapists who are dealing with sports medicine [19]. Asvat et al. identified that the third head of Biceps brachii originated from the humeral shaft either inferior to, and in common with, the insertion area for the Coracobrachialis or in common with the Brachialis muscle.

They also observed a dual origin in which the medial fibres originated from the short head of Biceps and the lateral fibres from the Deltoid fascia[20]. Sweiter and Carmichael emphasized that the incidence of the third head of the Biceps is more on the right side [3]. Similarly in our study we found third head of Biceps brachii on the right side. Several authors reported gender and racial differences in the presence of third head of Biceps as Chinese 8%, European White 10%, African Black 12% and Japanese 18% [21].

CONCLUSION

The Biceps brachii muscle will be useful as a component of flap surgery. Variations of Biceps brachii may confuse a surgeon who operates on the arm, and which may lead to injuries. The presence of transmitting branch between Musculocutaneous and Median nerve may be at risk of intermuscular compression which may result in various neural symptoms like tingling and weakness of movements. The awareness of the morphological variations of Biceps muscle

brings good pre-operative evaluation, safe surgical intervention within the arm and stronger postoperative results.

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Original Article

TO DETERMINE THE ORIGIN OF POSTERIOR INTERVENTRICULAR ARTERY IN CADAVERIC HEARTS

Aditya Pratap Singh¹, Areeba Nasar¹, Sarita Devi¹, Nandish L. Purli¹, C. Mohanty¹

1. Department of Anatomy, United Institute of Medical Sciences, Prayagraj, India

ABSTRACT

Introduction: The coronary circulation is a vital part of the cardiovascular system that supplies blood to the heart. The posterior interventricular artery (PIV) is a crucial branch of coronary circulation, and its origin has been a topic of debate among anatomists. Determining the origin of the PIV is important for managing coronary artery disease and assessing prognosis, especially in cases of coronary dominance. The aim of this study was to determine the origin of the posterior interventricular artery in a sample of preserved heart specimens and cadaver hearts.

Materials and Methods: This was a cross-sectional study that included 50 preserved heart specimens and cadaver hearts randomly selected from Anatomy department of United Institute of Medical Sciences, Prayagraj. The hearts were dissected to trace the course of the posterior interventricular artery from its origin to its termination, and any variations in origin and termination were noted. The coronary dominance was determined based on the origin of the PIV.

Results: Out of the 50 specimens studied, the posterior interventricular artery originated from the right coronary artery (RCA) in 90% of the hearts, from the left circumflex artery (LCX) in 8% of the hearts, and from both the RCA and LCX in 2% of the hearts. Thus, the study found a higher proportion of right-dominant hearts compared to left-dominant hearts.

Conclusions: This study provides important insights into the origin of the posterior interventricular artery in a sample of preserved heart specimens and cadaver hearts. The findings suggest that right dominance is more common than left dominance in the study population. The knowledge of normal and variant anatomy of coronary circulation can be beneficial for treating heart diseases and achieving better outcomes.

Keywords: Coronary circulation, Posterior interventricular artery, Coronary dominance

Address for Correspondence:

Dr. Nandish L. Purli, Senior Resident, Department of Anatomy, United Institute of Medical Sciences, Prayagraj, India
Email: nanpurli@gmail.com

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INTRODUCTION

The cardiovascular system is a complex network of arteries, veins, and capillaries that are responsible for delivering oxygen and nutrients to all the tissues in the body. The heart is the central organ of the cardiovascular system, and it requires a constant supply of oxygen and nutrients to function properly [1]. The word 'Coronary' has its roots in the Latin word "Corona," which translates to "Crown." The heart receives its blood supply from two main arteries known as the Right Coronary Artery (RCA) and Left Coronary Artery (LCA). The anatomy of the coronary arteries is known for its considerable diversity in terms of origin, path, end point, and branching pattern.

Additionally, there are significant regional variations in the anatomy of these arteries that are not extensively covered in standard reference texts [2,3]. Coronary circulation is the network of blood vessels that supply the heart with blood, and it includes the left and right coronary arteries, as well as the posterior interventricular artery. The origin of the posterior interventricular artery has been a topic of debate among anatomists for many years. The knowledge of normal and variant anatomy and anomalies of coronary arterial circulation becomes essential for treating heart diseases to get better outcomes.

Dominance becomes a major part in assessing prognosis of coronary artery disease [4]. Compared to right and mixed

types of dominance, left dominance is fatal. Conducting a study on the coronary arteries specific to a region can be beneficial for cardiac surgeons and radiologists to effectively manage coronary heart disease. A majority (72%) of people have a right dominant pattern, while a small percentage (12%) has a left dominant pattern, where the PIV artery is a branch of the circumflex artery [5].

The aim of this study was to determine the origin of the posterior interventricular artery in a sample of preserved heart specimens and cadaver hearts.

MATERIALS AND METHODS

Over a period of two years, a sample of 50 preserved heart specimens and cadaver hearts used for dissection teaching were randomly selected from the Department of Anatomy, United Institute of Medical Sciences, Prayagraj. To determine the origin of the posterior interventricular artery, we performed a dissection of the heart and coronary circulation in a sample of cadavers. We carefully traced the course of the posterior interventricular artery from its origin to its termination, and we recorded our findings.

Study design: This study is a cross-sectional study

Sample size calculation: To calculate the sample size for the given scenario, the following formula was used:

$$n = (Z^2 * p * q) / d^2$$

Where:

- Z is the Z-value for the desired confidence level. For a 95% confidence level, Z = 1.96.
- p is the expected proportion of the population with the characteristic of interest. In this case, p = 0.72 (proportion of right-dominant hearts).
- q is 1 minus the expected proportion of the population with the characteristic of interest. In this case, q = 0.28 (proportion of non-right-dominant hearts).
- d is the margin of error, which is expressed as a proportion. We do not have a specific margin of error given, so we will assume a margin of error of 0.05 (5%).

Substituting these values into the formula, we get:

$$n = (1.96^2 * 0.72 * 0.28) / 0.05^2$$

$$n \approx 51.6$$

Rounding up to the nearest whole number, the sample size required was 50. Therefore, at least 50 preserved heart specimens and cadaver hearts used for dissection teaching had to be studied to achieve a power of 80% and confidence level of 95%, assuming that the proportions of right-dominant and non-right-dominant hearts were similar to those found in the initial sample (72% and 28%, respectively).

The dissection process involved several steps. Firstly, the hearts were obtained from cadavers by cutting through the ribs and

sternum and ligating and cutting the great vessels. The parietal pericardium was then incised to remove the heart from the pericardial cavity. All the hearts were washed to remove blood clots and preserved in a formalin solution. Each heart was tagged with a unique numerical identifier.

The coronary arteries and their branches were dissected in all the hearts, and fat removed from the coronary sulcus. The right coronary artery and its branches were dissected on the posterior surface of the heart, tracing it from its origin until it turned on the posterior surface. The left coronary arteries and their branches were identified, and the posterior interventricular artery passing along the posterior interventricular groove was located, and its origin and course were noted, along with any variations in origin and termination.

Based on the origin of the posterior interventricular artery (from the RCA, LCA, or both), coronary dominance was determined. The data was tabulated and subjected to statistical analysis.

The inclusion criteria for this study involved formalin-fixed heart specimens with intact coronary arteries, regardless of age, sex, or race. Heart specimens that were lacerated, injured, or had damaged coronary arteries, as well as those that had undergone any surgeries on the coronary arteries or were maldeveloped, were excluded from the study.

Ethical clearance was obtained from the institutional ethical review board for this study.

RESULTS

In this study, 50 cadaveric heart specimens were examined to determine the number, origin, and level of termination of the posterior interventricular artery. The coronary dominance was determined based on the origin of the posterior interventricular artery, and the findings were recorded and tabulated for analysis. The data indicates that among the 50 patients observed, there were 27 male hearts and 23 female hearts.

Out of the total specimens observed, the origin of the posterior interventricular artery was found to be from the left coronary artery (LCA) in 4 specimens (Fig. 1), which accounted for 8.0% of the total. In 45 specimens, the posterior interventricular artery originated from the right coronary artery (RCA) (Fig. 2), representing 90.0% of the total. In only 1 specimen (2.0%), the posterior interventricular artery originated from both the LCA and RCA. (Table 1)

DISCUSSION

The heart contracts approximately 100,000 times in a single day. The development of coronary arteries that supply the heart starts during the third week of embryonic development through a process involving vasculogenesis, angiogenesis, arteriogenesis, and remodeling [6-8]. The complexity of this developmental process often leads to variations and anomalies in the coronary arteries. These anomalies can have important clinical implications, especially in cases of anomalous origin of these arteries.

The pattern of coronary dominance plays a crucial role in various clinical conditions. Left dominance, in comparison with right and mixed types of dominance, has been found to be associated with an increased risk of certain clinical manifestations [9-11]. Due to the complexity of this development, variations and anomalies are common. Anomalous origin of coronary arteries can have significant clinical implications. The dominance pattern of the heart plays a crucial role in various clinical conditions and can affect outcomes

S.No.	Origin of posterior interventricular artery	Specimen	%
1.	LCA	4	8.0
2.	RCA	45	90.0
3.	Both	1	2.0

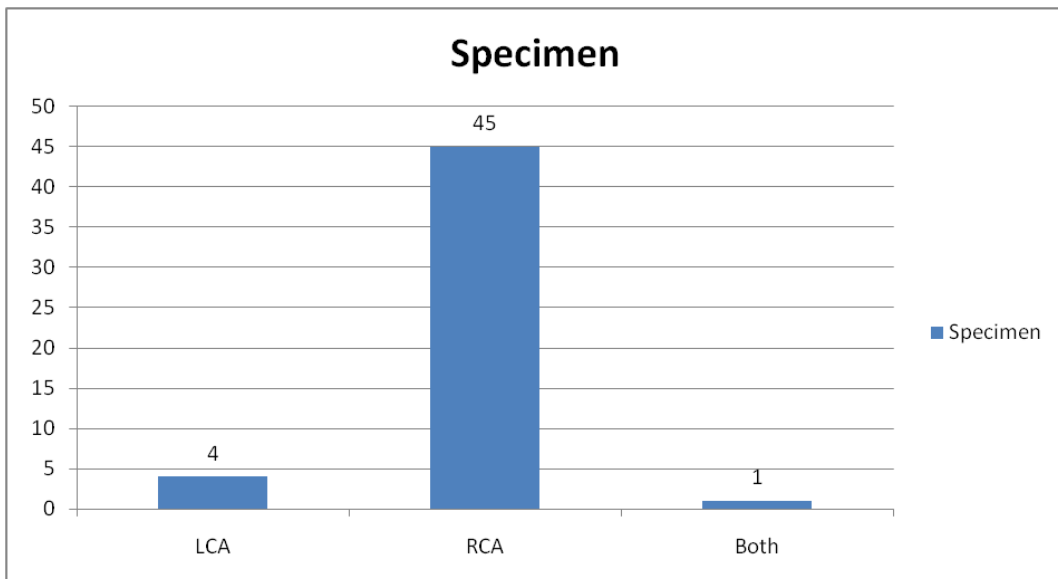
Table 1. Origin of posterior interventricular artery



Fig. 1. Posterior Interventricular artery branch of Right coronary artery



Fig. 2 – Posterior Interventricular artery branch of Left coronary artery



Graph 2. Origin of posterior interventricular artery

such as the extent of damage to the left ventricular myocardium following an inferior wall infarct.

Left dominant hearts are associated with increased mortality, as they supply even more of the area of the left ventricle than right dominant hearts [12]. Anomalies in the coronary arteries can also lead to sudden death, especially in young athletes. Therefore, a comprehensive understanding of the normal and variant anatomy of the coronary arteries is essential for clinicians treating heart diseases.

In this study, 50 specimens were analyzed, and right coronary dominance was observed in 90.0% of cases, while left coronary dominance was found in 8.0%, and co-dominance in 2.0%. These findings are consistent with earlier studies [13-16]. The modes of termination of the right coronary artery and the circumflex artery were described with the help of five points: at the right border, between the right border and the crux, at the crux, between the crux and the left border and at the left border.

The origin of the posterior interventricular artery was taken as the basis of dominance. Coronary artery dominance has an important clinical significance. On comparison right dominance was statistically insignificant ($z = 0.91$, $p = 0.36$), left dominance was statistically insignificant ($z = 0.46$, $p = 0.64$), and balanced pattern was also statistically

insignificant. The results of the study were compared with other authors and variations were noted.

In a study conducted by Murphy et al [17], it was observed that patients with left dominance have a relatively shorter left main coronary artery compared to those with right dominance. The prevalence of a dominant left coronary arterial system in aortic stenosis suggests that this may be due to developmental factors. Additionally, patients with left dominance are at a higher risk of perioperative myocardial infarction if they have associated obstructive coronary artery disease.

CONCLUSION

Coronary artery disease is a leading cause of mortality, and both sedentary and high-stress lifestyles increase the risk of developing it. Coronary dominance is a critical factor since inferior wall myocardial infarctions are prevalent and the outcome depends on the extent of damage to the left ventricular myocardium. When treating blockages, knowledge of the normal and variant anatomy of coronary arteries is essential for successful revascularization. The posterior interventricular artery is particularly important in determining coronary dominance, and awareness of variations is crucial in procedures such as imaging with conventional catheters. In conclusion, the posterior interventricular artery is an important branch of the coronary circulation that

supplies the posterior part of the interventricular septum and the adjacent portion of the ventricular wall. The findings from our dissection study provide valuable insights into the origin and anatomy of the posterior interventricular artery, which is an important branch of the coronary circulation. This knowledge has important clinical implications for the management of coronary artery disease and may be useful in procedures such as revascularization and imaging.

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Original Article

THE GREATER TROCHANTER METHOD: A NOVEL APPROACH TO LOCALIZING SACRAL HIATUS FOR CAUDAL EPIDURAL BLOCK

Sheetal Kotgirwar¹, Rekha Lalwani¹, Sunita Athawale¹

1. Department of Anatomy, All India Institute of Medical Sciences, Bhopal, India

ABSTRACT

Introduction: Localization of sacral hiatus is a prerequisite for caudal epidural block. The present study verified the 'equilateral triangle' method for localization of sacral hiatus on cadavers and also introduced a new 'greater trochanter' method for the same.

Materials and Methods: Localization of the sacral hiatus by the two methods) Equilateral triangle & ii) Greater trochanter was verified and compared on 25 adult cadavers by three observers independently.

Results: The variability of localization was greater in case of equilateral triangle method as compared to greater trochanter method. It was thus observed that greater trochanter method was more superior in localization of sacral hiatus and was also less variable in its deviation from the sacral hiatus. The measure of deviation from the hiatus, where it could not be located correctly, was also less in greater trochanter method as compared to equilateral triangle method.

Conclusions: The greater trochanter method may be used for localization of sacral hiatus independently or in conjugation with other methods. This method is easy to perform as no measurements are required and can be effectively used in adults and obese individuals as well.

Keywords: Epidural Anaesthesia, Greater trochanter, Sacral cornu, Surface landmarks

Address for Correspondence:

Dr. Sunita Athawale, Associate Professor, Department of Anatomy, All India Institute of Medical Sciences, Bhopal, India
Email: sunita.anatomy@aiimsbhopal.edu.in Mob: 8878895453

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INTRODUCTION

Caudal epidural anaesthesia is a very popular technique for giving regional anaesthesia in children. Though considered challenging to perform in adults; the technique is still used for managing wide variety of conditions, especially chronic pain in adults [1- 3].

The caudal approach of epidural space is through the sacral hiatus. The sacral hiatus is a triangular aperture at the caudal end of the dorsal aspect of sacrum and is bordered by two sacral cornua [4,5]. Anatomical variations in sacral hiatus and changes caused by aging have been often attributed to difficult or failed caudal epidural block [1-3,6].

Localization of sacral hiatus is also a challenging task, especially in adults. However, very few studies have reflected on this aspect [1-3]. Primarily two ways to localize sacral hiatus have been described in literature: the 'sacral cornu' and the 'Equilateral Triangle (ET)' method[4-7]. Inconsistency in localization of sacral hiatus along with the other variations in the region have led to use of fluoroscopy and ultrasound guidance for caudal epidural block [1-3,6].

The present study was conducted to explore the utility of a new method the 'Greater Trochanter'(GT)method in localizing the sacral hiatus and compare it with the method in popular use, the 'Equilateral Triangle' (ET) method.

MATERIALS AND METHODS

Twenty-five adult human cadavers (19 male, 6 female) available in the department of Anatomy of a tertiary care teaching institute in Bhopal were studied after ethical approval had been granted for the study by the IHEC. Cadavers showing any apparent deformity or diseases affecting the normal anatomy of sacral region, pelvis and upper thigh were excluded from the study. The position of sacral hiatus was localized and marked with a needle by the ET and GT methods by three independent observers.

Method 1 - Equilateral Triangle method:[7,11]

The cadaver was kept in prone position. The two posterior superior iliac spines (PSIS) were marked (right and left as points 1 and 2 respectively). A horizontal line was drawn in between these points. This line formed the base of an ET. The length of this line was measured (R). Another vertical line was drawn in the mid sagittal plane. To construct the ET, straight lines of length R were drawn from point number 1 and 2 so that they intersect the vertical line denoting the apex of the ET (point 3) and the location of sacral hiatus.

Method 2 - Newly devised Greater Trochanter method

The cadaver was kept in prone position. The lower limbs were kept in adducted position. The GTs on both sides were palpated as the most lateral prominence on the lateral aspect

of the gluteal region, a hands breadth below the midpoint of iliac crest (point 1 & 2)[4,8]. A horizontal line was drawn between the highest points (apex)of the two GTs. Another vertical line was drawn in the mid sagittal plane. A pin was inserted on the point where these two lines intersect (point 3), to localize the sacral hiatus.

By using the above methods, position of sacral hiatus was localized for methods 1 &2,respectively. Pins of different colors were inserted at positions localized by the two methods (Fig. 1). Each method was performed thrice in a cadaver by three different observers.

After localizing the sacral hiatus, skin over the region around the pin was reflected, connective tissue was cleaned and position of tip of pin was noted with respect to the sacral canal. Owing to high variability of length of sacral hiatus, it was defined as a horizontal strip of 1 cm width with its lower margin lying at the level of tip of sacral cornua. In case if

pin was not within the sacral hiatus, its nearest distance from the sacral hiatus was measured. Localization of sacral hiatus and measurement of deviation from sacral hiatus was compared by the two methods.

RESULTS

The variability of localization was greater in case of ET method as compared to GT method. It was thus observed that GT method was more superior in localization of the sacral hiatus and was also less variable in its deviation from the sacral hiatus. Table 1 Shows the localization of sacral hiatus by the ET and GT methods respectively by three investigators independently.

It was observed that the localization was almost twice often as in case of GT method. Table 2 shows the measurement of deviation from the hiatus. It was observed that localization deviated mostly inferiorly rather than superior to the actual position of the sacral hiatus.

Parameters	Localization of sacral hiatus by equilateral triangle method	Localization of sacral hiatus by greater trochanter method
On spot	20/75	34/75
Below	53/75	33/75
Above	2/75	8/75

Table 1. Localization of sacral hiatus (N=75 Implied attempts of localization by the three observers)

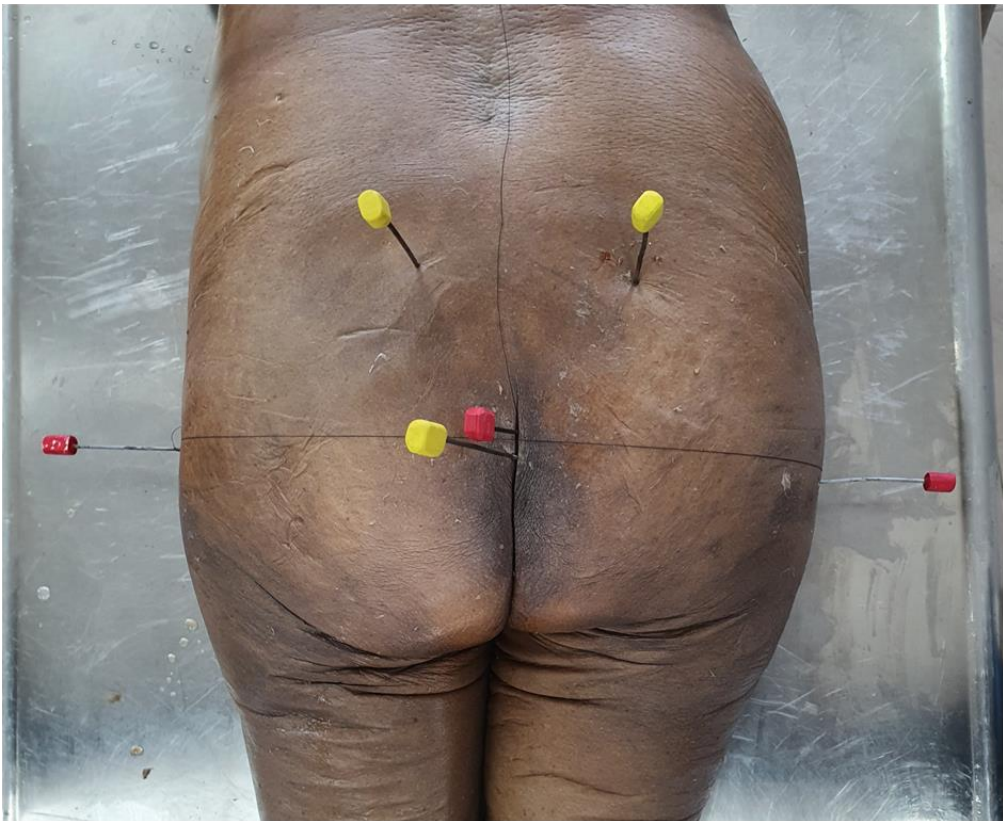


Fig. 1. Showing surface localization of sacral hiatus performed by Equilateral Triangle method (yellow pins) and Greater Trochanter method (red pins)

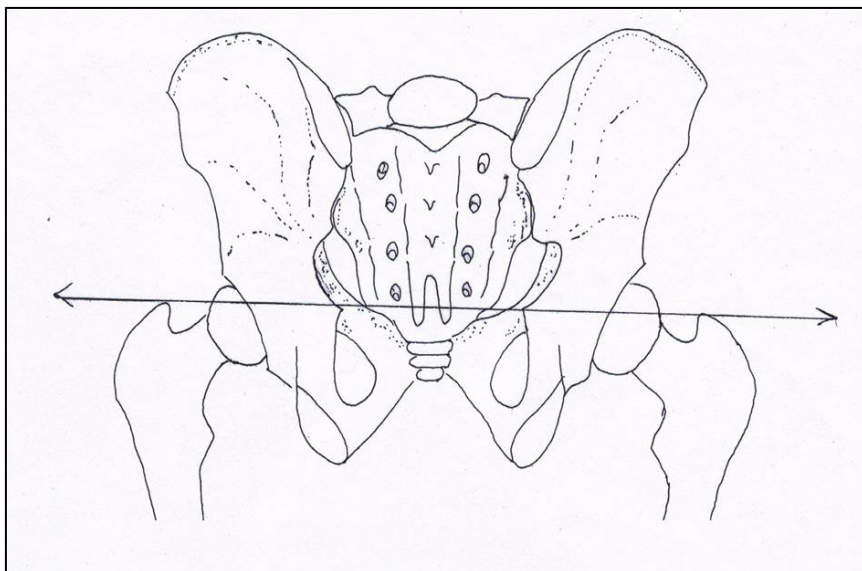


Fig. 2. Showing line diagram of dorsal aspect of pelvis and hip region depicting the localization of sacral hiatus by Greater Trochanter method

Parameters	Localization of sacral hiatus by equilateral triangle method	Localization of sacral hiatus by greater trochanter method
Below	Mean- 0.6 St. deviation- 0.84	Mean- 1.92 St. deviation- 0.96
Above	Mean- 1.75 St. deviation 1.06	Mean 0.94 St. deviation – 0.54

Table 2. Measure of deviation of localization of sacral hiatus

DISCUSSION

The present study was done on 25 adult cadavers. The study verified the equilateral triangle method for localization of sacral hiatus on cadavers and, also introduced a new 'Greater Trochanter' method for the same. Authors found that the greater trochanter method may be used for localization of sacral hiatus independently or in conjugation with other methods to localize the sacral hiatus. Standring and team have described the localization of sacral hiatus by sacral cornua method [4]. This method recommends palpation of sacral cornua in upper end of narrowed natal cleft.

However, palpation of sacral cornua has been described to be difficult by Sekiguchi and team. Aggarwal et al [9-10] and Sekiguchi et al reported that the sacral cornua were bilaterally palpable in only 19% and unilaterally palpable in 25 % cases and bilaterally impalpable in 54 % adults [9]. Aggarwal et al reported cornua to be palpable in 61 % in adult cadavers and implied that sacral cornua cannot be relied upon for localizing sacral hiatus. Difficulty in palpation of sacral cornua has rendered this method unpopular [10].

Another method to localize the sacral hiatus was described by Martin [11] and verified by Senoglu et al [9]. They performed these studies on dry sacra and not on cadavers or in living. They presumed posterior superior iliac spine (PSIS) to be readily palpable landmarks in the living. They located PSIS, a part of the hipbone, on the 'superolateral sacral crest' of sacrum which may not be considered a dependable landmark and is not well described in anatomical texts.

In a cadaveric study, Aggarwal et al located the apex of sacral hiatus and then constructed a triangle between the two PSIS and found that in 51 % equilateral triangle could not be formed. This may be because of variable length of sacral hiatus thus shifting its apex up and down. It also indicates the sacral hiatus method does not localize sacral hiatus correctly [12].

The present study compared the localization of sacral hiatus by ET > methods and found that GT method could localize sacral hiatus correctly almost twice as frequently as by ET method. Even in cases of deviation from the sacral hiatus, the measurement of deviation by GT method was less than that of ET method.

The GT method has other advantages over the ET method as follows:

1. Easy to palpate – Greater trochanter is an anatomically an ‘easy to palpate’ landmark, even in adults and obese individuals. Its localization has been described in anatomical texts as ‘breadth of subject’s hand below the midpoint of iliac crest’[4]. In cases of difficulty in palpation, slight abduction of the lower limb makes the palpation easy [8]. While PSIS is localized by presence of a dimple [4] at the level of second sacral vertebra; such a dimple is very often not seen except in small children and very lean individuals.

In a systematic review on reliability of palpation of PSIS, Cooperstein and co-workers observed that most studies reported low reliability in localization of PSIS even in experienced individuals and even after training. Moreover, limited movement occurring at the sacroiliac joint does not help clinician in locating PSIS [13].

2. Easier to perform – No complex measurements are needed to localize the hiatus as a single horizontal line (Fig. 2) and needs to be drawn as against constructing an equilateral triangle.

In recent times, the difficulty in localization of sacral hiatus has led to use of fluoroscopy and ultrasound [1-3,6]. While fluoroscopy is not advisable due to radiation exposure; use of ultrasound has its own limitations like

availability of machine and expert human resource especially in settings which are not very well equipped.

The GT method can be used independently for blind procedures and in conjunction with other method to increase efficacy of localization of sacral hiatus. The ultrasound may be sometimes deceptive if the sacral hiatus is very long; there are chances that the dural sac may be punctured. The greater trochanter method consistently localizes sacral hiatus or an area about 2cm below or 1 cm above it. This may act as a reference point for the level of sacral hiatus and hence caution the anaesthetists against proceeding higher (even if the canal is open) and accidentally puncture the dural sac.

Limitation - The study has been carried out on cadaveric specimen and needs confirmation in living individuals using some imaging modality.

CONCLUSION

A new method the ‘Greater Trochanter’ method for localization of sacral hiatus has been devised. This method is approximately twice as effective as compared to equilateral triangle method in localizing the sacral hiatus correctly. This is also easier to perform and more practicable even in adults and obese individuals.

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Original Article

THE MAGIC OF LEARNING BY DOING IN ANATOMY

Shweta Singh¹, Abeer Zubair Khan¹, Sushobhana¹,
Pratibha Dwivedi¹, Dewanshi Mishra¹

1. Department of Anatomy, Hind Institute of Medical Sciences, Safedabad, Barabanki, India

ABSTRACT

Introduction: There are various teaching and learning methods like lectures, demonstration, practicals etc. employed for teaching MBBS students. As the famous quote by Benjamin Franklin goes- "Tell me and I forget. Teach me and I remember. Involve me and I learn" we wanted to determine the effectiveness of students' involvement in Teaching Learning Method (TLM).

Materials and Methods: Two cohorts of 1st year MBBS students, 2020-21 Batch and 2022-23 Batch were taught the same topic by the same teacher but by different methods. The Batch of 2020-21 were taught the topic of General Anatomy of Nervous System by lecture alone while batch 2022-23 were taught the same topic by the same teacher with the help of lecture as well as activity based small group learning. The question framed on the topic was asked in the Part Completion Test of both the Batches. The answers were then marked by three different evaluators based on clarity in the understanding of the topic and the diagram drawn by the students of both the batches. The p-values of the marks obtained were compared for both the batches based on the marks allotted by all the three evaluators.

Results: The p-value obtained by independent T Test was significant in case of all the three evaluators thus proving that activity-based teaching in Anatomy when added to lecture-based teaching has a greater understanding among students as compared to lecture-based teaching alone.

Conclusions: As the new curriculum lays emphasis on student centric approach and application-based teaching for achieving a higher level of learning based on the Millers pyramid, the activity based TLM could be of great help in attaining the desired result.

Keywords: Small group teaching, Student activity, Student involvement

Address for Correspondence:

Dr. Shweta Singh, Professor & Head, Department of Anatomy, Hind Institute of Medical Sciences, Safedabad, Barabanki, India
Email: drshwetaghy@gmail.com Mob: 8874849882

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INTRODUCTION

Various methods of teaching learning methods are employed for teaching the students of MBBS 1st Year in the subject of Anatomy. These methods include lectures, small group teaching, tutorials, demonstrations and dissection. Adult learning requires a different approach as it is detailed, application based and requires reasoning and logical thinking in contrast to the childhood learning which is more rote based.

The subject of Anatomy is not only vast but also volatile with an array of newer terminologies which might be difficult for the new learners of Anatomy. The concepts of Anatomy also require immense power of imagination which might not be evident or evident in the dissection or in the histological study. Such concepts may be a problem area for students.

This study was conducted to determine if employing an activity-based method of teaching and learning along with lecture was more helpful in improving the concepts and understanding among students as compared to the lecture-based teaching alone.

As the famous quote by Benjamin Franklin goes- "Tell me and I forget. Teach me and I remember. Involve me and I learn" we wanted to determine the impact and effectiveness of Activity based Teaching and Learning method in the learning outcomes of students.

MATERIALS AND METHODS

The present study was conducted in the department of Anatomy of HIMS, Safedabad, Barabanki. The study was a Retrospective Cohort Study which compared the outcomes in two batches of 1st professional MBBS students for whom both the exposure i.e. method of TLM employed as well as outcome i.e. scores obtained in the question asked in the Part Completion Test had already occurred.

The study Cohorts consisted of the fresh group of 100 MBBS students admitted in the course in the year 2020-21 and year 2022-23. Both the cohorts were taught the topic of General Anatomy of Nervous System by the same teacher. The method of instruction for the batch of 2020-21 was lecture alone while for the Batch of 2022-23, the lecture on this topic was also followed by an activity- based teaching learning method.

The students of batch 2022-23 were divided into 10 small groups and each group was given a thermocol sheet (30x20 cm), an A4 size paper, few thumb pins and colored woolen threads. The students were instructed by a facilitator to draw a spinal segment and via thumb pins to mark the cell body and woolen threads to mark the axon, mark the situation and course of the axons on the spinal segment as shown in Fig. 1. This activity helped the students to understand clearly the situation of various neuronal

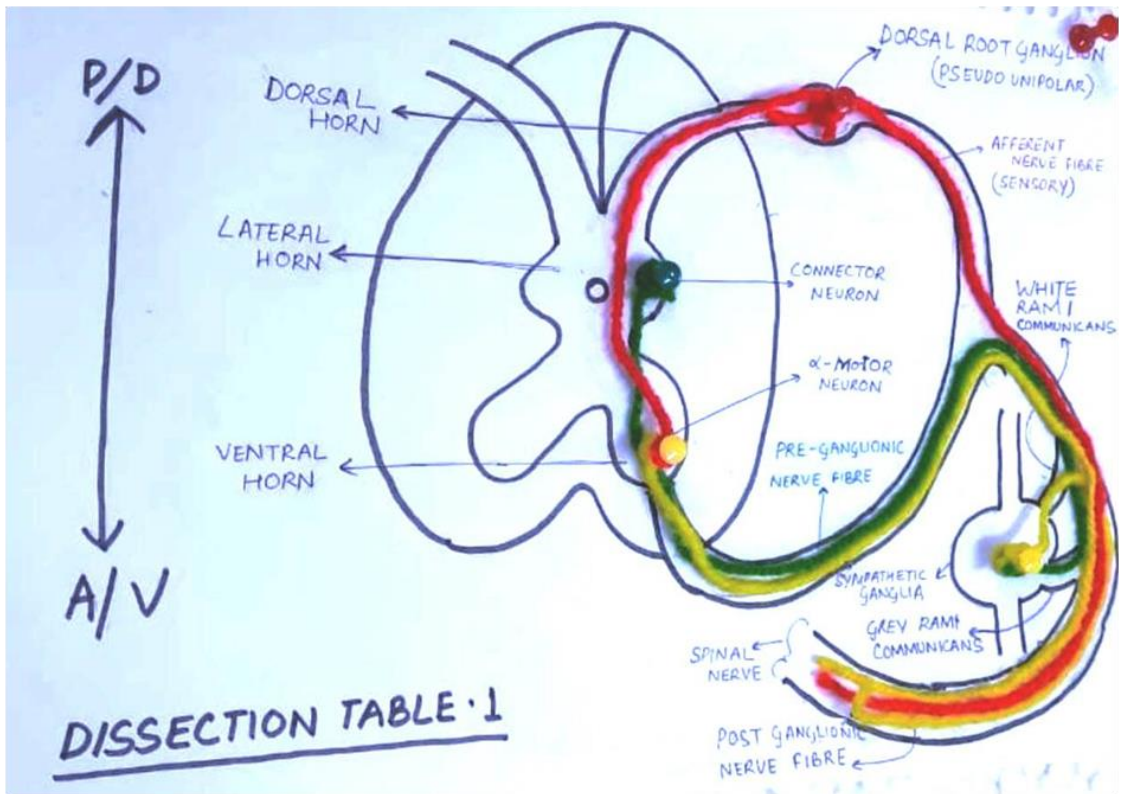


Fig. 1. Activity-based depiction of a spinal segment with its various parts.

bodies, the course of their axons and how they unite and branch to form a typical spinal nerve.

The method of instruction was followed by a Part Completion Test for both the batches of students on a scheduled date. The answer booklets were collected, marked and stored for records which are generally done for three years. For the purpose of study, the answer booklets of General Anatomy were retrieved from the store. The question on the typical spinal nerve was reevaluated by three different evaluators for decreasing bias.

The marks were awarded out of 10 based on the understanding of the concept evident from the diagram drawn by the students and the

explanation written by them. Out of the batch of 100 students, the students who didn't appear for the test were excluded from the study. The marks awarded by all the three evaluators were entered on the same sheet by delineating areas on the sheet [1]. The p-value was calculated by independent T test on the excel sheet by entering the required data by all the three evaluators separately and analyzed.

RESULTS

The mean marks obtained by group 2020-21 were -2.37, 3.19 and 3.33 by the three evaluators respectively, while the mean marks obtained for Batch 2022-23 was 2.88, 3.95 and 3.99 respectively. P-value obtained from the data was calculated separately for all

Evaluators	Cohort-1 Mean for batch 2021-22 (n= 99)(df=98)	Standard deviation for Batch - 2021-22	Cohort-2 Mean for batch 2022-23 (n=100)(df=99)	Standard deviation for Batch -2022-23	P Value
Evaluator-1	2.37	1.82	2.88	2.48	0.05
Evaluator-2	3.19	2.47	3.95	2.92	0.02
Evaluator-3	3.33	2.15	3.99	2.68	0.03
Null hypothesis(H_0 - there is no improvement in learning outcomes by using activity-based teaching along with lecture compared to lecture-based teaching alone as TLM (Teaching learning method)					
Alternative hypothesis H_A - the learning outcomes improve by using activity-based teaching along with lecture as compared to lecture-based teaching alone.					

Table 1. the mean, standard deviation (SD), null hypothesis and alternative hypothesis, calculated p value for each evaluator and mean p value.

the three evaluators and the values obtained were 0.05, 0.02 and 0.03 respectively. The mean of these p-values was 0.03 and hence the result was statistically significant. Table 1 shows the mean, standard deviation (SD), null hypothesis and alternative hypothesis, calculated p value for each evaluator and mean p value. As the P Value obtained was statistically significant (≤ 0.05), the null hypothesis could be rejected, and alternative hypothesis could be accepted [2].

DISCUSSION

The above results show a significant improvement in the mean marks obtained by the students when the method of TLM was activity based small group discussion along with lecture as compared to lecture alone. When the students are involved in the process of teaching and learning it helps in better internalization of concepts and better retention by the students. This was also evident from the diagrams drawn by the

students as these students drew clearer diagrams with correct knowledge of the situation of different structures (Fig1).

Incorporating activity in the TLM is a powerful tool in internalizing the concepts by the students [3]. The results of this study showed that a majority of students scores increased in the lecture followed by activity-based teaching group as compared to the lecture-based group only and also aligned with the study by Answer F [4].

According to Domin (2007) [5] by constructivism, teachers cannot transfer their knowledge to the students. For meaningful learning to take place, learners require to experience an event. Hull (1999)[6] noted rightly that “The majority of students in our schools are unable to make connections between what they are learning and how that knowledge will be used”. ABL is helpful to contextualize the students learning. In an

These activities, if carried out in an effective manner, develop skills like Team-working, Communication, Design and Leadership [8,10,11,12].

There is research evidence which shows that students will retain limited knowledge if they are involved passively in teaching- learning process McKeachie (1998) [8]. The same is indicated in the 'Dale's cone of experience' developed by Dale (1969) [9]. During the 1960s, Edgar Dale theorized that learners retain more information by what they “do” as opposed to what is “heard”, “read” or “observed”. His research led to the development of the Cone of Experience. Today, this “learning by doing” has become known as “experiential learning” or “action learning”.

CONCLUSION

The study of Anatomy requires vivid imagination hence cadaveric dissection helps in the understanding of these concepts. However certain concepts like connection of nerve fibers may not be evident either in gross or histological examination. Such concepts can be made comprehensible to the students by the means of such hands-on activities, and it has better learning outcome as well. Students actively participate in such activities and consider them as a fun learning experience.

CONCLUSION

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Original Article

STUDY OF ANGIOGRAPHIC ANATOMY AND PREVALENCE OF THIRD CORONARY ARTERY AMONG NORTHERN INDIAN POPULATION

**Priti Sinha¹, Sanjeev Saxena², Antima Gupta¹, Satyam Khare³,
Shilpi Jain³, Yashi Saxena⁴**

1. Department of Anatomy, LLRM Medical College, Meerut, India
2. Cardiologist, Metro Heart Institute, Meerut, India
3. Department of Anatomy, Subharti Medical College, Meerut, India
4. MBBS student, Maulana Azad Medical College, New Delhi, India

ABSTRACT

Introduction: Anatomy of the coronary circulation has been of interest to physicians ever since it emerged that mammalian hearts have their own blood supply. Frequent presence of two right coronary artery roots & separate origin of conal branch of right coronary artery or Third Coronary Artery (TCA) is not generally well appreciated, even though it has been evident to anatomists and cardiac surgeons for centuries. Detail knowledge of coronary anatomy & anomalies is necessary to prevent misinterpretation & disastrous complications during increasing coronary intervention & cardiac surgery. The present study describes the angiographic anatomy and prevalence of third coronary artery (TCA) in northern Indian population.

Materials and Methods: 2470 consecutive coronary angiogram of northern Indian population were evaluated to study the anatomy and prevalence of TCA. Patients with congenital heart diseases were excluded. The incidence, position, course of the third coronary artery will be discussed in the present study.

Results: Of the total coronary angiograms evaluated, the mean age was 51.3 (30-76) years. TCA was present in 840 cases (34%). In 74 cases (3%) we found 2 TCA. In most of the cases TCA bifurcated & supply the pulmonary infundibulum & anterior wall of the left ventricle. In 126 cases (5.1%) TCA also reached inferior border of heart supplying the apex.

Conclusions: The frequent presence of TCA in northern Indian population is noted. The area of perfusion of TCA was extensive than usual. Well-developed collateral circulation through TCA may allow diagnostic and therapeutic interventions in patients with coronary artery disease.

Keywords: Coronary Circulation; Third Coronary Artery; Conal Artery; Coronary Angiography; Pulmonary Infundibulum.

Address for Correspondence:

Dr. Priti Sinha, Professor & Head, Department of Anatomy, LLRM Medical College, Meerut, India
Email: drpritianatomy@yahoo.com Mob: 9837017328

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INTRODUCTION

The human heart in most cases vascularized by two coronary arteries, the right and the left coronary artery. Supernumerary or added coronary arteries are also present sometimes. Supernumerary coronary artery, which arises independently from the right aortic sinus (sinus Valsvae) and passes through sub-epicardial adipose tissue of pulmonary conus and anterior side of the right ventricle, is called third coronary artery.

The third coronary artery (TCA) is a direct branch from the right aortic sinus (RAS) without any observable common trunk with the right coronary artery (RCA). It supplies the infundibulum (conus) of the Right Ventricle (RV), which is usually supply by the conal branches of the Right Coronary Artery and the left anterior descending (LAD) artery [1,2].

The studies done in past suggest ethnic variability regarding the prevalence of TCA [1-4]. The Third coronary artery may supply variable parts of the anterior wall of the RV and the Inter-ventricular septum but the details of vascularization area & its distributions is relatively unexplored [5-7]. This study was undertaken with the purpose of estimating the incidence, position, and course of the third coronary artery in northern Indian population.

MATERIALS AND METHODS

The study was carried out in the Department of Anatomy, Subharti Medical College, Meerut, UP in collaboration with Metro Heart Institute Meerut UP. 2470 Coronary Angiograms of adult patients having age range between 40-70 years referred to the Cardiac catheterization Lab from Jan. 2015 to Dec 2016 for coronary angiography were evaluated.

Patients with diagnosed anomalous coronary arteries and congenital heart disease were excluded from the study. Approval from the ethics committee of Hospital was obtained. Angiographic films of the patients were analyzed for the origin of right, left and third coronary arteries, ostium, the branches of the TCA were traced distally to confirm the course, branching and termination.

RESULTS

Total 2470 coronary angiograms were evaluated out of which 69% (N=1707) were of male and 31% (N=767) were females. The mean age was 51.3 (30-76) years. Out of the 2470 coronary angiogram evaluated third coronary artery (TCA) was present in 840 cases (34%) (figure-1,2). Incidence in males was 650 out of 1707 cases (38.07%) and in females TCA was present in 190 out of 767 cases (24.77%).

Majority of the third coronary artery, i.e. 645 (76.7%) had an independent course without obvious anastomosis. Rest of the cases, 195 (23.3%) had a short course and had anastomosis with right coronary artery. In 74 cases (3%) we found two Third coronary arteries. Multiple orifices were noted in 5 cases. In most of the cases TCA bifurcated & supply the pulmonary infundibulum & anterior wall of the left ventricle (Fig-3). In 126 cases (5.1%) TCA also reached inferior border of heart supplying the apex of the heart.

DISCUSSION

Angiographic study of coronary artery anatomy has been done by many authors in past in relation to their variations and anomalies. Prevalence of third coronary artery has also been studied with the help of coronary angiograms, but very few studies have been done in our country specially in northern Indian population. Supernumerary coronary artery arises mostly from the right aortic sinus. According to Almira et al., out of 25 hearts examined, 8 of them (32%) had conal artery and 1 heart (4%) had four coronary arteries [8].

In a Kenyan study by Olabu et al., it is observed that out of 148 hearts, third coronary artery was seen in 35.1% [9]. Study by Gouda Hareesh et al., discussed the importance of geographical differences and in establishment of partial identity if ante-mortem record is maintained [10].

Studies from other countries regarding the incidence of the third coronary artery are mentioned in Table 1 [3,4,7,11-13]. In our study, the incidence was 34.00%, which is higher (~9%) than the values given by Kalpana [13]. It is remarkable that although the incidence of third coronary artery in our study is close to most of the other studies, much lower values have also been reported. These findings suggest ethnic variability and appear to support the proposal by Garg et al [14] that there are geographical differences in coronary artery variations, which may have a genetic basis.

Two orifices within the Right aortic sinus had also been reported in one study [15]. The separate orifices for the TCA and the RCA had been explained by insufficient unification of these two vessels, during their growth towards the ascending aorta [16,17]. H Iselimoviae [18] points out that even three coronary arteries may arise independently from the right aortic sinus what was confirmed by this study too.

The available literature uses different terms for identifying this artery: conal artery, preinfundibular or supernumerary right coronary artery [18-20]. Previous literature describes cases with anastomosis of the coronary artery with the front interventricular branch, diagonal, circumflex one, as well as with the branches of the right coronary artery [21-24].

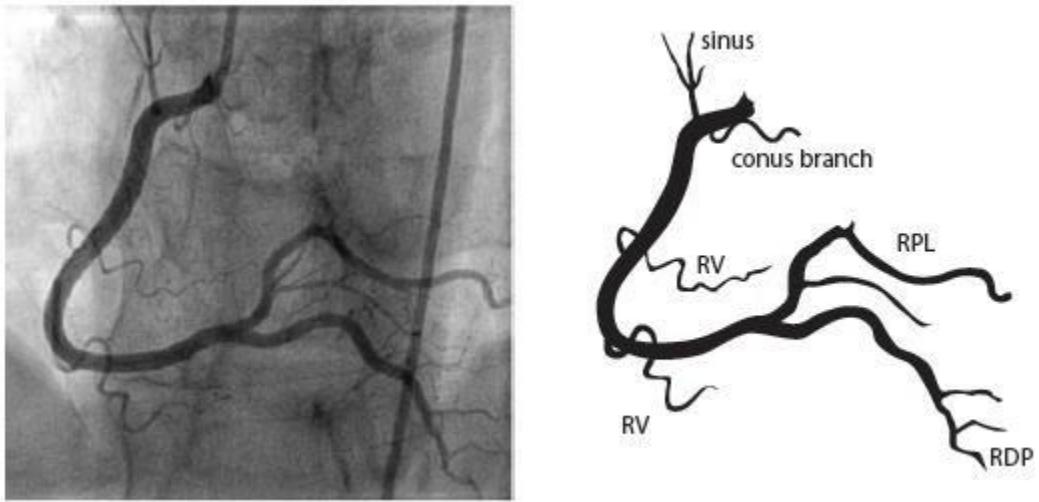


Fig. 1. Angiographic view of RCA and conal branch.



Fig. 2. Separate ostium for conal branch of RCA (TCA).

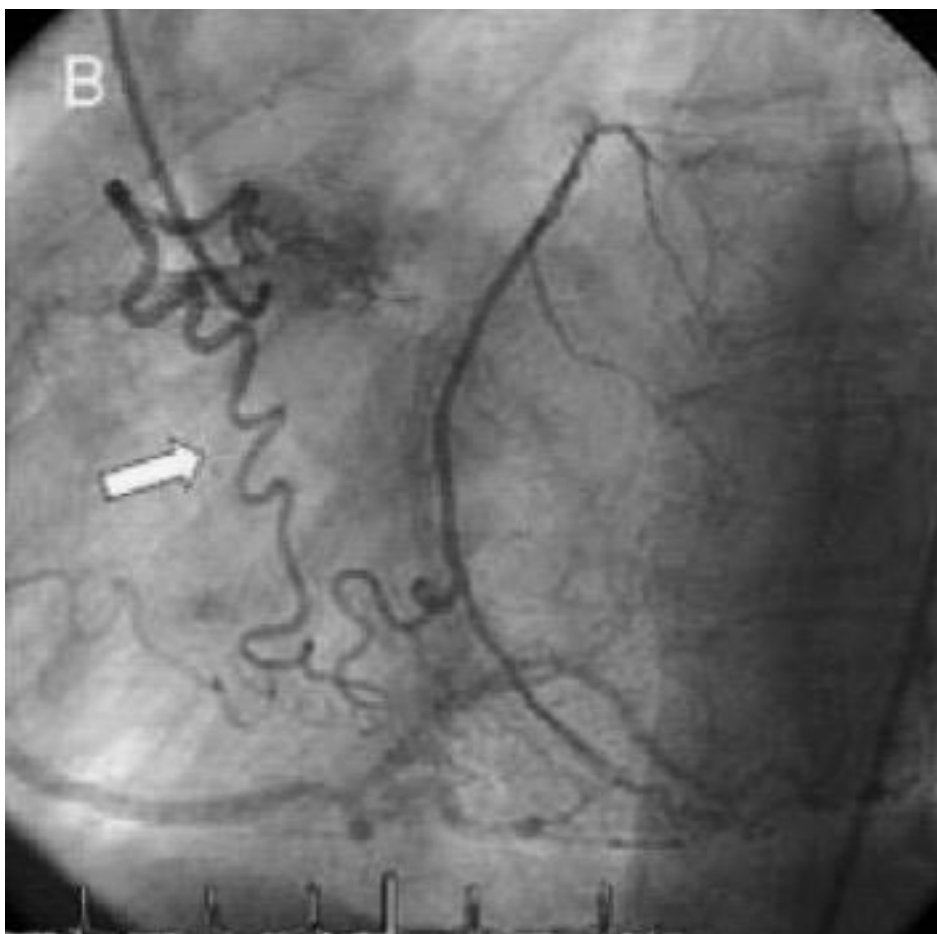


Fig. 3. TCA anastomosis with Left anterior descending (LAD) artery.

Author	Population	Incidence
Miyazaki et al ³	Japanese	36.8%
Ivan et al ⁴	Bulgarian	34.8%
V. Ludinghausen et al ⁷	German	7.1%
Kurjia et al ¹¹	Iraqi	8%
Kalpana ¹²	Indian	24%
Turner et al ¹³	English	15.8%
Present study	Indian	34.00%

Table 1. Incidence of Third coronary artery.

CONCLUSION

The most Common variation from normal coronary artery anatomy is presence of supernumerary Third Coronary Artery that arises independently from the right aortic sinus. The present study highlights that the incidence of third coronary artery in northern Indian population is 34.00%, which is relatively higher as compared to previous studies done even in India.

The relative higher prevalence of TCA in this Large volume northern Indian study highlights the importance of TCA for interventional cardiologist and cardiac surgeons during cardiac procedures. Further studies, which include presence, distribution, and anastomosis of third coronary artery, in Indian population should be done to assess the applied and clinical importance of third coronary artery.

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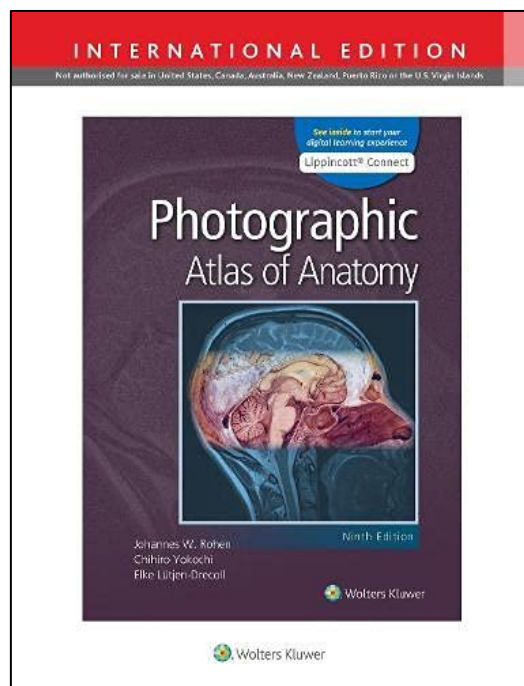
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Book Review

illuminating Anatomy: A Comprehensive Review of "Photographic Atlas of Anatomy, 9th Edition"

Deepika Poonia¹

1. Department of Anatomy, University College of Medical Sciences, Delhi, India



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Address for Correspondence:

Dr. Deepika Poonia, Assistant Professor, Department of Anatomy, University College of Medical Sciences, Delhi, India
Email: dr.deepikapoonia@gmail.com Mob: 8285048497

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INTRODUCTION

"Photographic Atlas of Anatomy" has been a staple in medical education for generations, guiding students through the intricacies of human anatomy. The 9th edition continues this tradition, offering a comprehensive visual tour of the human body. This in-depth review assesses the book's educational value, chapter by chapter, evaluating the quality of both text and images.

REVIEW

The "Photographic Atlas of Anatomy" by Johannes W. Rohen, in its 9th edition, is an indispensable resource for students and professionals studying human anatomy. This comprehensive atlas offers a unique learning experience by presenting high-quality photographs of actual human cadavers, providing an unparalleled level of detail and realism. The ninth edition incorporates advanced imaging technologies, such as MRI and CT scans, ensuring a contemporary and accurate portrayal of the human body's intricacies.

Organized systematically, the atlas covers various body regions, including muscles, bones, nerves, and organs. Each section features meticulously labeled photographs accompanied by concise and informative annotations. This visual approach enhances the understanding of anatomical structures, aiding readers in grasping complex concepts effectively.

One of the key strengths of this atlas lies in its clinical relevance. The book includes clinical notes and imaging studies, connecting anatomical knowledge to real-world medical applications. This integration enhances the practical utility of the information presented, making it particularly valuable for medical students, healthcare professionals, and educators.

By combining detailed visuals, up-to-date medical imaging, and clinical insights, the 9th edition of the "Photographic Atlas of Anatomy" offers a comprehensive and user-friendly learning experience. It not only serves as an essential reference for anatomy students but also provides a valuable resource for healthcare practitioners seeking a deeper understanding of the human body's structures and their clinical significance.

CHAPTER-WISE ANALYSIS

Chapter 1: Introduction to Human Anatomy

The introductory chapter provides an excellent overview of anatomical terminology and basic concepts. The text is clear and concise, setting the stage for the ensuing chapters. The anatomical illustrations are visually engaging and effectively introduce the main anatomical regions. A strong start to the atlas.

Chapter 2: Thorax

The thorax chapter offers a detailed exploration of chest anatomy. The textual descriptions are comprehensive, providing a

solid foundation for understanding. The images of thoracic structures, including the heart, lungs, and major vessels, are of exceptional quality, offering clear and detailed views. This chapter excels in clarity and detail.

Chapter 3: Abdomen

The abdominal chapter provides an in-depth look at the abdominal cavity's structures. The text is informative and well-structured, with clear explanations of organ relationships. The photographic images of abdominal organs, such as the liver, pancreas, and intestines, are meticulously captured, enhancing the reader's understanding. An exemplary chapter for abdominal anatomy.

Chapter 4: Pelvis and Perineum

The pelvis and perineum chapter offers comprehensive coverage of this intricate region. The text elucidates complex structures effectively, making challenging concepts accessible. The photographic images are clear and detailed, providing valuable insights into the male and female pelvis and perineum. A standout chapter for its precision.

Chapter 5: Back and Spinal Cord

The back and spinal cord chapter effectively delves into the anatomy of the vertebral column and spinal cord. The text provides clear explanations of spinal structures. The photographic images of spinal cord dissections and vertebral column segments are informative and instructive. A valuable

resource for understanding the back and spinal cord anatomy.

Chapter 6: Upper Limb

The upper limb chapter offers detailed coverage of arm and hand anatomy. The textual content is well-organized and comprehensive. The photographic images of upper limb dissections and structures are exemplary, providing valuable guidance for students. This chapter stands out for its clarity and detail.

Chapter 7: Lower Limb

The lower limb chapter maintains the book's high standards. The text offers clear explanations of lower limb anatomy and function. The photographic images of lower limb dissections and structures are top-notch, providing essential guidance for students. An indispensable resource for mastering lower limb anatomy.

Chapter 8: Head and Neck

The head and neck chapter impresses with its depth of coverage. The text elucidates complex structures effectively, enhancing understanding. The photographic images of head and neck dissections are exceptional, detailing intricate anatomical relationships. A vital resource for a region of paramount clinical relevance.

Chapter 9: Neuroanatomy

In the neuroanatomy chapter, the book excels in simplifying complex neural structures. The

text offers clear explanations of brain and nervous system anatomy. The photographic images of brain dissections and neuroanatomical structures are exemplary, providing a roadmap for understanding neuroanatomy. A crucial chapter for medical students.

Chapter 10: Special Senses

The chapter covering special senses showcases the book's versatility. It effectively covers the eye, ear, and other sensory organs. The photographic images in this section maintain the book's high standards, providing clarity and detail. An indispensable resource for exploring sensory anatomy.

Chapter 11: Histology

The histology chapter offers an insightful journey into cellular anatomy. The text effectively explains tissue types and cellular structures. The photographic images of histological sections are well-captured, offering clear representations of cellular components. A valuable resource for understanding histology.

Chapter 12: Surface Anatomy and Radiology

The surface anatomy and radiology chapter offers practical insights into clinical anatomy. The text provides a solid foundation for understanding surface landmarks and radiological imaging. The photographic images effectively complement the content, aiding in the identification of surface

structures. A useful chapter for clinical applications.

CONCLUSION

The 9th edition of the "Photographic Atlas of Anatomy" stands as a testament to its enduring value in medical education. Chapter by chapter, the book offers a meticulous blend of clear textual explanations and exemplary photographic images, ensuring that students can explore human anatomy with confidence. Its role as a visual companion in anatomical education remains unparalleled.