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Research Article

A MORPHOMETRIC STUDY OF PEDICLES OF LUMBAR VERTEBRAE AND ITS CLINICAL SIGNIFICANCE

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Abstract

Introduction: Various anatomical studies have been conducted in different populations to measure the dimensions of pedicles of lumbar vertebrae. A thorough knowledge of the normal diameters of the pedicles will serve as reference guide to the clinicians to make a perfect choice of size of screw for transpedicular screw fixation. **Aim:** To study the morphometric measurements of pedicles of lumbar vertebrae. **Material methods:** Various measurements of the lumbar vertebrae were done in 200 lumbar vertebrae, obtained from the Department of anatomy of Sri Muthukumaran medical college and hospital, Chennai. The vertical height and breadth of the pedicles of the lumbar vertebrae were measured on both right and left side of the typical and atypical vertebrae using digital Vernier calliper. **Results:** The pedicles' dimensions which include the mean height & width on the right and left side in typical vertebrae were 14.9 mm & 11mm and 14.7 mm & 11.1 mm while the mean height & width on the right side and left side in atypical vertebrae are 21 mm & 18 mm and 20 mm & 18.8 mm respectively. **Conclusion:** This study concludes that there is always an increase in the height and width of lumbar vertebral pedicles proceeding from L1 – L5 levels and the height and width being maximum at L5 level .This will be useful for spine surgeons while performing safe surgeries in this region.

KEY WORDS: Lumbar vertebra, Pedicle, Transpedicular screw fixation.

INTRODUCTION

The vertebral column forms the central axis and gives main support to the bones and muscles[1]. It is specially designed to support the weight of the body and transmit the entire weight to the ground. The lumbar part of the vertebral canal contains the conus medullaris and the cauda equina. The pedicles of lumbar vertebrae are small, thick curved posterior projections which arise from the upper part of the body at the junction of its lateral and dorsal surfaces[2]. Transpedicular fixation of the spine is a safe way of gaining effective vertebral stabilization in the management of different spinal ailments. If disproportionate size of the screws is used, that might result in damage to the pedicles[3]. Hence, choice of the screw for the operation is determined by the minimum diameter of the pedicle. Proper placement of pedicle screw is highly important for achieving a successful outcome in using screw fixation

device in spinal surgeries[4]. Pedicular fixation in spinal surgeries is used in cases of spine instability such as fracture and degenerative changes[5].

Thus the main objective of the present study is to report the results of the morphometric study of adult lumbar vertebral pedicles which will serve as reference guide to the choice of size of screw for Transpedicular screw fixation.

MATERIALS AND METHODS

The present study was carried out on 200 dry lumbar vertebrae collected from the department of Anatomy of Sri Muthukumaran Medical College, Chennai. The lumbar vertebrae were divided into two categories, the typical and atypical vertebrae. This is done based on the features of atypical vertebrae (L5) such as large vertebral body, distance between the inferior articular processes is equal to or more than that between the superior articular processes, the transverse process are short, thick and pyramidal in shape and its base is attached to the whole thickness of the pedicle and encroaches on the side of the body.

Various measurements of the pedicles of the lumbar vertebra were taken by using Vernier callipers and recorded. Vertical height and breadth of the pedicle was measured on both right and left side of the typical and atypical vertebrae using digital Vernier calliper. The vertical height is defined as the closest point opposite each other on the upper and lower margins of the pedicles (Fig.1)

Fig .1 : Measurement of Height of Pedicles of Lumbar Vertebrae

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The pedicle width is defined as the deepest point on the medial and lateral surfaces of each pedicle (Fig. 2).

Fig .2: Measurement of Width of Pedicles of Lumbar Vertebrae

A Statistical analysis of the data was performed and the mean and range for each side was calculated.

RESULTS

Two hundred Lumbar vertebrae were studied. The results of the height and width of pedicles of typical and atypical vertebrae are tabulated in Tables 1 & 2.

Table 1 -The height & width of Pedicles of Typical Lumbar vertebrae

TYPICAL VERTEBRAE				
Pedicle	**Side**	**Parameter**	**Mean (mm)**	**Range**
	Right	**Height**	**14.9**	**10.55-31.40**
		Width	**11**	**4.8 -32.8**
	Left	**Height**	**14.7**	**9.8-29.8**
		Width	**11.1**	**4.8-34.14**

Table 2 -The Height & Width of Pedicles of Atypical Lumbar vertebra

ATYPICAL VERTEBRAE				
Pedicle	**Side**	**Parameter**	**Mean (mm)**	**Range**
	Right	**Height**	**21**	**8.89-34.80**
		Width	**18**	**6.9-35.36**
	Left	**Height**	**20**	**11.27-33.50**
		Width	**18.8**	**6.82-36.26**

The pedicles' dimensions which include the mean height & width on the right and left side in typical vertebrae were 14.9 mm & 11mm and 14.7 mm & 11.1 mm while the mean height & width on the right side and left side in atypical vertebrae are 21 mm & 18 mm and 20 mm & 18.8 mm respectively.

It was observed in the present study that in typical and atypical lumbar vertebrae, the height of the pedicle is greater than the width. As we moved down in lumbar vertebra from L1 to L5 both the height and width of pedicle were found to be increasing and were more than the typical vertebrae.

DISCUSSION

A thorough knowledge of the racial variations in the size of the pedicles is extremely important when pedicle screws are used.

In a study done by Chandini et.al[2] in typical lumbar vertebrae the mean height of the pedicle on both right and left side were more compared to the width, but in atypical vertebrae the mean height and width were almost the same. In our study, from L1 to L5 both height and width of pedicle went on increasing and were more than the typical vertebrae.

In another study by Aruna & Rajeswari[3], the range for breadth for typical lumbar vertebrae was 4.5 – 20 mm and range for the height was 11.5 mm- 20 mm & in atypical vertebra the range for breadth was 13-22 mm and height was 10- 16 mm respectively. In our study, the range of breadth and height for typical vertebra was 4.8 mm – 34.14 mm and 9.8 mm - 31.40 mm respectively. In atypical vertebra, the range of breadth and height was 6.82 mm - 36.26 mm and 8.89 mm - 34.8 mm respectively.

Singel et al[6] found that the pedicle width of the lumbar segment increased progressively from L1 to L4 and increased abruptly at L5 level. In our present study also, the width of L5 lumbar vertebral pedicles was greater than L1- L4.

Chawla et al[7], conducted the study on 30 dry L3 lumbar vertebrae and found that the average height of the pedicle was 14.0 ±1.1 mm on right side and the average height of the pedicle on left side was 14.1 ± 1.0 mm.The mean width of the pedicle was 8.7 ± 1.4 mm on the right side and 8.7 ± 1.7 mm on the left side. In our study, the pedicle dimensions which includes the mean height and width on the right and left side in typical vertebrae are 14.9 mm &11mm and 14.7 mm & 11.1 mm respectively.

Lumbar vertebral pedicles are strong and large which enables fixing of screws through them. This is currently used for spinal fixation for various spinal problems[6]. The pedicles of lumbar vertebrae are used for placing screws through them. In this, the screw is inserted through the posterior aspect of the pedicle in to the body of the lumbar vertebra anteriorly. For this the screw required to be inserted is determined by the minimum diameter of the pedicle. Hence diameters of the pedicles are of utmost importance in pre operative planning[7].

As quoted by Defino and vendrame[8] vertebral pedicles are being used very often as a fixation site for procedures on vertebral bodies such as biopsies of vertebral bodies, vertebroplasties & kyphoplasties. The present study has found significant differences in various dimensions of lumbar vertebral pedicles at various levels (L1 – L5), that is from L1 to L5 both height and width of pedicle went on increasing and were more than the typical vertebrae. These differences have critical implication for spinal surgeons to perform safe operations in this area.

There is an increase in use of pedicle screws and so there is great emphasis of studies on the dimensions of pedicles of lumbar vertebrae in different populations[9]. If there is mismatch between the size of the screw and the pedicle, it may lead to cortex perforation of pedicle, fracture pedicle or loosening of the screw, which may result in serious implications[10]. Hence for pedicle screw fixation the height and width of pedicles play an important role in deciding the choice of the screw.

CONCLUSIONS:

This study provides anatomical knowledge of the pedicles of lumbar vertebrae in a sample population of south Indians. This study concludes that there is always an increase in the height and width of lumbar vertebral pedicles proceeding from L1 – L5 levels and the height and width being maximum at L5 level .This will be useful for spine surgeons for performing safe operations in this region.

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