ORIGINAL ARTICLE

# Computed Tomography based Morphometric Analysis of Dorsal Vertebral Pedicle in South Indian Population

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## Abstract

**Background:** The pedicle of the thoracic vertebrae (dorsal pedicle) is a cylindrical anatomical structure that bridges between the vertebral body and posterior elements. Hence, pedicle screw fixation allows stable-3-column fixation of the spine which is biomechanically superior to other methods of spinal fixation. The dorsal pedicle has a complex anatomy and its morphological characteristics vary between different ethnic populations. Hence, the present study was planned to assess the morphological characteristics of dorsal pedicle in our local population.

**Materials and methods:** A retrospective analysis of 648 dorsal vertebrae of 54 patients (40 males and 14 females), who were all over 20 years of age was performed and compared with previously reported studies using established methods.

**Results:** Dorsal pedicle morphometric parameters showed significant variations between gender and different ethnic population despite having a similar general pattern. Smaller pedicle width, axis length, and medial angulation of transverse pedicle angle were unique to the South Indian population in this study cohort. Females had smaller pedicle sizes when compared to males in this study.

**Conclusion:** The morphological differences suggest caution needs to be taken for transpedicular fixation in the Indian population with western surgical instruments, especially in the mid-thoracic region and particularly in South Indian females who have significantly smaller and shorter pedicles.

**Keywords:** Anatomy, Morphometry, Screw instrumentation, Spinal surgery, Thoracic pedicle.

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## Introduction

Dorsal pedicle has a complex anatomy and morphological characteristics which varies with different ethnic population. Transpedicular screw fixation of dorsal spine is most widely practiced because of its stable construct and various biomechanical advantages, however, there is a potential risk of injuring the adjacent neurovascular structure with malposition of screws.[1,2] Understanding pedicle morphometric variations help to decrease the risk of surgical complications. There are multiple studies on the morphometry of dorsal vertebrae using various methods such as plain radiography, computed tomography (CT) scan, direct cadaveric dissections, and dry vertebra to predict safe instrumentation in their population.[3] Very few studies are carried out in the Indian population, to quantify thoracic pedicle morphometric data on a computed tomography scan, which is a noninvasive gold-standard method for preoperative planning.[4]

## Materials and Methods

This study is an analysis of 648 dorsal vertebrae of 54 patients (40 males and 14 females) who were above 20 years of age and underwent CT Dorsal spine for medical ailments without any spinal pathology at the Institute of Orthopedics and Traumatology, Coimbatore Medical College Hospital. The CT scanner used was Toshiba Alexion 16 slice scanner. The study was conducted during 2019–2020 after Ethical Committee clearance.

Measurements are acquired in reformatted CT images for right and left side pedicles using bone window in the transverse section for pedicle width (PW), transverse pedicle angle (TPA), and pedicle axis length (PAL). Measurement of various morphometric parameters are acquired using Vitrea Dicom workstation with standard computer grid. The measured data are recorded in an excel spreadsheet and statistical analysis was done.

Parameters measured are:

### Pedicle Width (PW)

It is the distance between the medial and lateral margin of pedicle at the narrowest point measured perpendicular to the long axis of the pedicle (Fig. 1A).

### Pedicle Axis Length (PAL)

It is the distance measured along the line drawn from the posterior aspect of the laminar cortex to the anterior cortex of the vertebral

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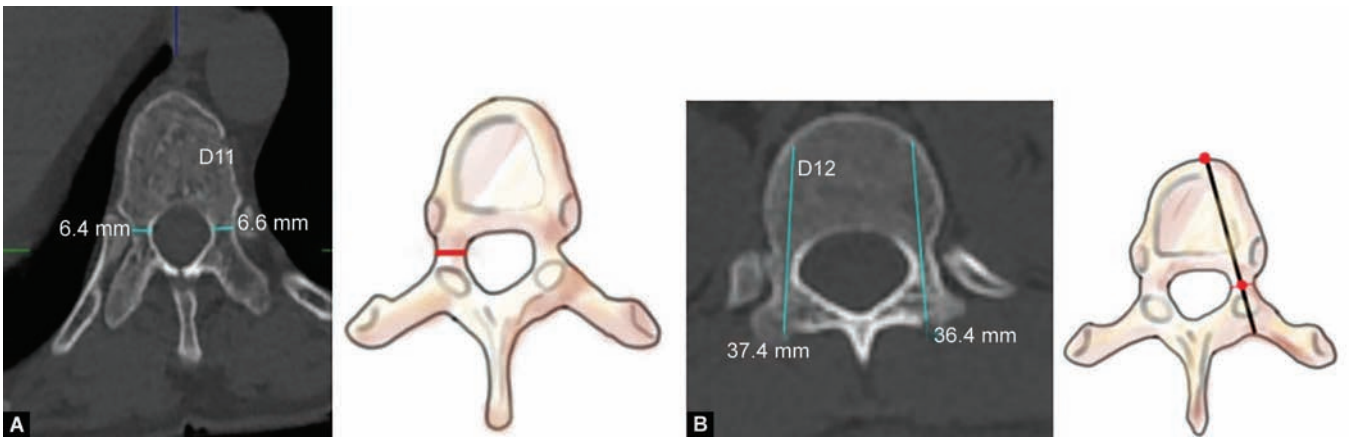


**Figs 1A and B:** (A) Pedicle width; (B) Pedicle axis length

body in the midline longitudinal pedicle axis as described by Olsewski et al.[5] (Fig. 1B).

### Transverse Pedicle Angle (TPA)

It is the angle measured between a line passing through the midline pedicle axis and a line to the vertebral midline in the transverse plane as described by Berry et al.[6] (Fig. 2).

## Results

### Pedicle Width (PW)

Minimum pedicle width was observed at D4 level (3.91 mm in males and 3.23 mm in females) and maximum pedicle width was observed at both the ends of dorsal vertebrae [D1 (7.04 mm in males and 6.57 in females) and D12 (6.6 mm in males and 6 mm in females)]. There is no significant statistical difference between the right and left sides of the most vertebral levels, but significant statistical difference between males and females ($p < 0.05$) (Table 1). Females have smaller pedicle width when compared to males.

### Pedicle Axis Length (PAL)

Pedicle axis length showed a gradual increasing pattern from D1–9 followed by decreasing pattern from D10–12. There is no significant statistical difference between the right and left sides of most of the vertebral level, but significant statistical difference between males and females ($p < 0.05$) (Table 1). Females have smaller pedicle axis lengths when compared to males.

### Transverse Pedicle Angle (TPA)

Transverse pedicle angle showed a decreasing trend from D1–12 with maximum medial angulation seen at D1 (31.3*) and a minimum angulation at D12 (4.3*). No significant statistical difference between males and females ($p < 0.05$) (Table 2).

## Discussion

Pedicle is a cylindrical anatomical structure that makes strong bridges between the vertebral body and posterior elements. Pedicle consists of the inner core of cancellous bone covered by an outer shell of cortical bone. Pedicle screw fixation allows stable 3-column fixation of the spine and it is biomechanically superior to other methods of spinal fixation.

The current study was done to obtain the complete knowledge of the thoracic pedicle morphology in the South Indian population and the result from the current study were compared with the

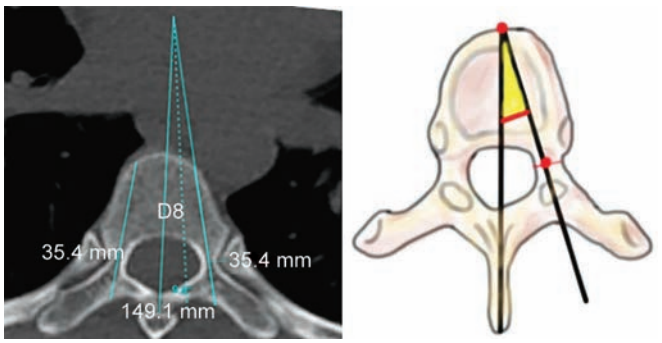


**Fig. 2:** Transverse pedicle angle

previously published literature from other various parts of India, China, Singapore, Africa, and USA.[4–18] The previous Indian studies of morphometry in pedicle by Datir and Mitra et al. was based on 18 cadaveric specimens from western India (Nagpur), Chadha et al. did on 31 patients, Acharya et al. did on 50 patients using computed tomography from central India (Delhi). These two studies studied only lower thoracic pedicles.[8,9] Verma et al. did on 20 dry vertebras in central India.[10] Kaur et al. did on 50 patients with computed tomography and Singh et al. did on 100 cadavers in northern India (Haryana).[4,7] BS Pai et al. did on 15 patients with computed tomography in South India (Bengaluru).[11] Ashwini et al. did on 30 patients using computed tomography in the Dakshina Kannada population (Mangaluru).[12] Gangadhara et al. did on 20 cadaveric specimens in South India (Andhra).[13] Soh et al. did on 400 patients using magnetic resonance Imaging (MRI) in the Asian population (Singapore).[15] Hou S et al. did on the lower thoracic vertebra in 40 cadavers in the Chinese population.[16] Zindrick et al. did on cadaveric specimen in America.[18]

Cadaveric dry vertebral measurements are from the outer cortical measurement of the pedicle in computed tomographic measurement is inner cancellous bone of pedicle hence there may be slight difference of measurement value. In our study 54 patients, 648 dorsal vertebrae morphometry are analyzed using computed tomography with a male to female ratio of 2.8:1 in the South Indian population.

### Pedicle Width (PW)

The pedicle width determines the maximum screw size it can accommodate without breach of cortex. The pedicle width gradually decreased from D1–4 and then started increasing from D5–12 in our study. A similar trend was also reported in Kaur et al., BS Pai et al., Gangadhara et al., Soh et al., and Muteti EN

**Table 1:** Pedicle width and pedicle axis length measurement of the right and left side of vertebra in male, female and combined

| | *Pedicle width measurement* | | | | | | *Pedicle axis length measurement* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Total (n = 54)* | | *Male (n = 40)* | | *Female (n = 14)* | | *Total (n = 54)* | | *Male (n = 40)* | | *Female (n = 14)* | |
| *Vertebra* | *Right (mm) Mean (SD)* | *Left (mm) Mean (SD)* | *Right (mm) Mean (SD)* | *Right (mm) Mean (SD)* | *Left (mm) Mean (SD)* | *Right (mm) Mean (SD)* | *Left (mm) Mean (SD)* | *Right (mm) Mean (SD)* | *Left (mm) Mean (SD)* | *Left (mm) Mean (SD)* | *Right (mm) Mean (SD)* | *Left (mm) Mean (SD)* |
| D 1 | 6.89 ± 0.39 | 6.56 ± 0.46 | 7.04 ± 0.31 | 29.3 ± 3.2 | 29.0 ± 3.1 | 30.5 ± 2.5 | 30.2 ± 2.4 | 25.9 ± 2.6 | 25.6 ± 2.4 | 6.98 ± 0.40 | 6.57 ± 0.43 | 6.52 ± 0.48 |
| D 2 | 5.40 ± 0.73 | 5.35 ± 0.55 | 5.43 ± 0.81 | 31.6 ± 3.9 | 31.2 ± 3.6 | 32.8 ± 3.5 | 32.3 ± 3.2 | 28.3 ± 2.8 | 28.0 ± 2.7 | 5.43 ± 0.58 | 5.17 ± 0.35 | 5.01 ± 0.33 |
| D 3 | 4.29 ± 0.60 | 4.24 ± 0.63 | 4.30 ± 0.65 | 32.7 ± 3.8 | 32.5 ± 3.8 | 34.0 ± 3.4 | 33.9 ± 3.4 | 28.8 ± 2.1 | 28.7 ± 2.0 | 4.36 ± 0.65 | 4.02 ± 0.31 | 3.84 ± 0.35 |
| D 4 | 3.82 ± 0.61 | 3.73 ± 0.65 | 3.92 ± 0.64 | 33.3 ± 4.2 | 33.0 ± 4.0 | 34.8 ± 3.8 | 34.4 ± 3.6 | 29.0 ± 1.9 | 29.1 ± 2.0 | 3.91 ± 0.67 | 3.42 ± 0.25 | 3.23 ± 0.16 |
| D 5 | 3.96 ± 0.65 | 3.93 ± 0.54 | 4.13 ± 0.58 | 35.6 ± 3.9 | 35.3 ± 3.8 | 37.0 ± 3.4 | 36.7 ± 3.2 | 31.5 ± 2.0 | 31.2 ± 2.0 | 4.12 ± 0.52 | 3.55 ± 0.16 | 3.43 ± 0.22 |
| D 6 | 4.24 ± 0.51 | 4.23 ± 0.51 | 4.31 ± 0.53 | 36.7 ± 4.7 | 36.4 ± 4.6 | 38.4 ± 3.9 | 38.1 ± 3.9 | 31.6 ± 2.6 | 31.4 ± 2.4 | 4.36 ± 0.49 | 3.89 ± 0.19 | 3.87 ± 0.39 |
| D 7 | 4.55 ± 0.59 | 4.51 ± 0.60 | 4.68 ± 0.62 | 38.2 ± 4 | 38.1 ± 3.4 | 39.8 ± 3.3 | 39.6 ± 3.3 | 33.8 ± 1.4 | 33.8 ± 1.5 | 4.68 ± 0.60 | 4.12 ± 0.22 | 4.02 ± 0.24 |
| D 8 | 4.75 ± 0.54 | 4.72 ± 0.57 | 4.91 ± 0.52 | 39.4 ± 3.8 | 39.2 ± 3.6 | 41.0 ± 2.9 | 40.7 ± 2.8 | 34.9 ± 1.9 | 34.9 ± 2.0 | 4.87 ± 0.55 | 4.31 ± 0.31 | 4.24 ± 0.26 |
| D 9 | 5.02 ± 0.51 | 5.04 ± 0.50 | 5.12 ± 0.51 | 39.8 ± 3.6 | 39.7 ± 3.6 | 41.3 ± 2.7 | 41.1 ± 2.8 | 35.4 ± 1.9 | 35.5 ± 2.1 | 5.21 ± 0.47 | 4.62 ± 0.24 | 4.53 ± 0.19 |
| D 10 | 5.44 ± 0.58 | 5.47 ± 0.65 | 5.59 ± 0.60 | 39.5 ± 4.1 | 39.2 ± 4 | 41.3 ± 2.8 | 41.0 ± 2.7 | 34.4 ± 3.0 | 34.1 ± 2.9 | 5.61 ± 0.69 | 5.03 ± 0.24 | 5.01 ± 0.19 |
| D 11 | 6.04 ± 0.57 | 6.09 ± 0.65 | 6.11 ± 0.50 | 38.7 ± 3.8 | 38.2 ± 3.8 | 40.2 ± 3 | 39.8 ± 3 | 34.4 ± 2.1 | 33.8 ± 2.1 | 6.21 ± 0.509 | 5.62 ± 0.56 | 5.56 ± 0.52 |
| D 12 | 6.43 ± 0.56 | 6.52 ± 0.61 | 6.62 ± 0.44 | 36.6 ± 5.4 | 36.9 ± 3.5 | 37.7 ± 6.1 | 38.3 ± 2.9 | 33.3 ± 2.1 | 33.0 ± 1.8 | 6.69 ± 0.53 | 5.93 ± 0.61 | 6.02 ± 0.57 |

**Table 2:** Transverse pedicle angle measurement of the right and left side of vertebra in male, female and combined

| | *Total (n = 54)* | | *Male (n = 40)* | | *Female (n = 14)* | |
|---|---|---|---|---|---|---|
| *Vertebra* | *Right (Degree) Mean (SD)* | *Left (Degree) Mean (SD)* | *Right (Degree) Mean (SD)* | *Left (Degree) Mean (SD)* | *Right (Degree) Mean (SD)* | *Left (Degree) Mean (SD)* |
| D 1 | 31.3 ± 4.0 | 29.2 ± 5.1 | 31.1 ± 3.7 | 29.3 ± 5.2 | 32.0 ± 5.0 | 31.5 ± 4.2 |
| D 2 | 20.9 ± 3.4 | 21.0 ± 3.7 | 20.9 ± 3.3 | 21.3 ± 3.6 | 20.7 ± 3.8 | 20.0 ± 3.8 |
| D 3 | 13.8 ± 3.1 | 13.8 ± 2.9 | 13.7 ± 2.7 | 13.9 ± 2.5 | 14.1 ± 4.1 | 13.5 ± 3.8 |
| D 4 | 11.7 ± 2.6 | 11.4 ± 2.6 | 11.8 ± 2.7 | 11.5 ± 2.6 | 11.4 ± 2.6 | 11.2 ± 2.5 |
| D 5 | 10.1 ± 2.3 | 9.9 ± 2.1 | 10.2 ± 2.2 | 10.0 ± 2.0 | 10.0 ± 2.7 | 9.51 ± 2.4 |
| D 6 | 9.4 ± 2.1 | 9.2 ± 2 | 9.4 ± 2.1 | 9.3 ± 2.1 | 9.3 ± 2.2 | 9.1 ± 1.8 |
| D 7 | 8.8 ± 2.0 | 8.7 ± 2.1 | 8.8 ± 2.0 | 8.7 ± 2.1 | 8.7 ± 2.3 | 8.7 ± 2.1 |
| D 8 | 8.4 ± 2.1 | 8.1 ± 1.9 | 8.4 ± 2.0 | 8.0 ± 1.9 | 8.3 ± 2.4 | 8.2 ± 2.1 |
| D 9 | 7.8 ± 2.1 | 7.3 ± 2.1 | 7.7 ± 1.9 | 7.2 ± 2.0 | 7.9 ± 2.7 | 7.6 ± 2.5 |
| D 10 | 6.0 ± 1.6 | 5.7 ± 1.5 | 6.1 ± 1.5 | 5.7 ± 1.4 | 5.6 ± 1.8 | 5.7 ± 1.6 |
| D 11 | 5.1 ± 1.5 | 5.0 ± 1.5 | 5.3 ± 1.6 | 5.1 ± 1.6 | 4.6 ± 1.1 | 4.5 ± 1.1 |
| D 12 | 4.3 ± 1.4 | 4.3 ± 1.4 | 4.3 ± 1.3 | 4.3 ± 1.3 | 4.5 ± 1.6 | 4.4 ± 1.7 |

et al.[4,11,13,15] However, pedicle width is decreased from D1–5 was observed in Singh et al., Datir et al., Ashwini et al., and Zindrick et al.[7,8,12,18] This pattern of change in the pedicle width size may be due to transition from a more mobile upper dorsal vertebra to a relatively fixed mid-dorsal region, and again, to a mobile lower dorsal vertebra putting differential stress on vertebral pedicles and facet joints.

Overall dorsal pedicle width in our study is smaller when compared to other studies like Kaur et al., Singh et al., Datir et al., BS Pai et al., Muteti EN et al., and Zindrick et al.[4,7,8,11,18] In our study, dorsal pedicle width show near similar measurement in most of the dorsal pedicle except lower dorsal pedicle (D9–12) in the study of Gangadhara et al. of South India (Andhra) and Soh et al. study on Singapore population was smaller dorsal pedicle width when compared to others and the current study.[13,15]

Pedicle screw diameter is selected with 80% of pedicle width measurement to avoid pedicle breach. It is safe to use 0.5 mm less screw diameter to the corresponding pedicle width.[19]

Based on our study 5 mm pedicle screw can be safely used in D1, D2, and D10–12 levels. A 4 mm pedicle screw is safely used in D6–9 levels. A 3.5 mm pedicle screw is ideal for mid-dorsal vertebra D3–5 levels (Table 3 and Fig. 3).

## Pedicle Axis Length (PAL)

Pedicle axis length is the maximum safe length of screw that can be inserted during transpedicular screw fixation without injuring adjacent neurovascular structures at the anterior aspect of the vertebral body.

**Table 3:** Comparison of dorsal pedicle width in mm with other studies

| | *Our study (Coimbatore)* | *Kaur et al. (Haryana)* | *Aswini et al. (Mangaluru)* | *Singh et al. (Haryana)* | *Gangader et al. (Andhra)* | *Soh et al. (Singapore)* | *E.N.Muteti et al. (Kenya)* | *Zindrick et al. (USA)* |
|---|---|---|---|---|---|---|---|---|
| *Vertebra* | *CT* | *CT* | *CT* | *Cadaver* | *Cadaver* | *MRI* | *CT* | *CT* |
| D 1 | 6.89 | 9.27 | 7.636 | 7.72 | 6.98 | 5.6 | 7.8 | 7.9 |
| D 2 | 5.4 | 7.5 | 5.707 | 6.22 | 5.62 | 4.2 | 6.2 | 7 |
| D 3 | 4.29 | 6 | 5.167 | 5.03 | 4.43 | 3.2 | 5.2 | 5.6 |
| D 4 | 3.82 | 4.5 | 4.601 | 4.53 | 3.9 | 2.9 | 4.5 | 4.7 |
| D 5 | 3.96 | 5 | 4.572 | 4.22 | 3.93 | 3.1 | 4.6 | 4.5 |
| D 6 | 4.24 | 5.5 | 4.532 | 4.58 | 4.28 | 3.3 | 4.9 | 5.2 |
| D 7 | 4.55 | 6 | 4.885 | 4.82 | 4.77 | 3.5 | 5.2 | 5.3 |
| D 8 | 4.75 | 6.32 | 4.803 | 4.82 | 4.95 | 3.6 | 5.5 | 5.9 |
| D 9 | 5.02 | 6.28 | 5.671 | 5.33 | 5.59 | 3.9 | 5.9 | 6.1 |
| D 10 | 5.44 | 6.54 | 7.398 | 6.1 | 6.66 | 4.5 | 6.7 | 6.3 |
| D 11 | 6.04 | 7.84 | 8.471 | 7.36 | 7.55 | 5.5 | 8 | 7.8 |
| D 12 | 6.43 | 8.31 | 7.639 | 7.94 | 7.88 | 5.6 | 8.4 | 7.1 |

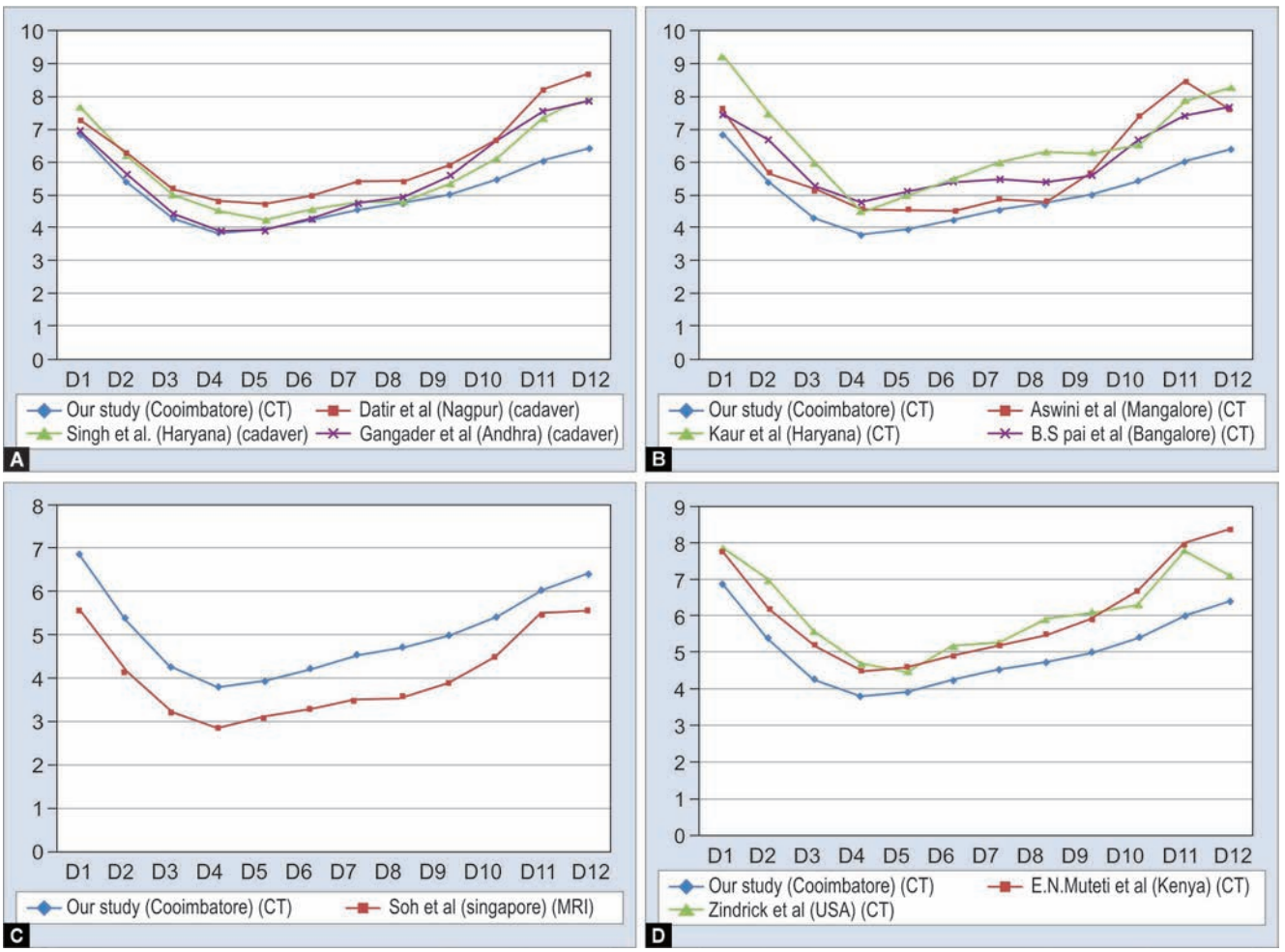


**Fig. 3:** Comparison of our dorsal pedicle width in mm with other studies

In our study, the pedicle axis length was shortest at D1 (29.3 mm) and gradually increased downward and maximum at the lower dorsal vertebra. A similar trend was observed in other Indian morphological studies except for Datir et al. study in which D3 vertebra has the least pedicle axis length (28.8 mm).[4,7–9,11,12] However, our study measurements are smaller than those of the African and American populations.[18] Based on our study, the safest screw length is 25 mm at D1, 30 mm in D2–6 and D12, and 35 mm at D7–11 (Table 4 and Fig. 4).

**Table 4:** Comparison of pedicle axial length in mm with other studies

| | *Our study (Coimbatore)* | *Kaur et al. (Haryana)* | *Aswini et al. (Mangaluru)* | *Singh et al. (Haryana)* | *Gangader et al. (Andhra)* | *Soh et al. (Singapore)* | *EN Muteti et al. (Kenya)* | *Zindrick et al. (USA)* |
|---|---|---|---|---|---|---|---|---|
| *Vertebra* | *CT* | *CT* | *CT* | *Cadaver* | Cadaver | *MRI* | *CT* | *CT* |
| D 1 | 29.3 | 30.3 | 25.01 | 24.6 | 31.88 | 34 | 37.5 | 36.9 |
| D 2 | 31.6 | 32.3 | 27.8 | 25.08 | 34.33 | 36 | 36.2 | 35.7 |
| D 3 | 32.7 | 33.21 | 28.73 | 26.27 | 36.15 | 37 | 36.4 | 37.7 |
| D 4 | 33.3 | 36.5 | 29.68 | 27.47 | 37.96 | 38.6 | 38.1 | 38.5 |
| D 5 | 35.6 | 37.83 | 29.9 | 29.06 | 39.26 | 40.4 | 39.5 | 41.9 |
| D 6 | 36.7 | 39.84 | 32.05 | 30.53 | 41.04 | 42.1 | 40.4 | 42.1 |
| D 7 | 38.2 | 40.07 | 33.5 | 32.11 | 43.41 | 43.5 | 41.7 | 44.6 |
| D 8 | 39.4 | 40.64 | 35.28 | 33.71 | 43.74 | 44.8 | 42.9 | 45.4 |
| D 9 | 39.8 | 39.54 | 35.83 | 34.26 | 44.48 | 45.4 | 43.7 | 45.2 |
| D 10 | 39.5 | 40.11 | 36.09 | 34.35 | 43.87 | 44.9 | 43.3 | 44 |
| D 11 | 38.7 | 36.21 | 36.6 | 35.6 | 43.83 | 45.1 | 41.4 | 41.8 |
| D 12 | 36.6 | 34.24 | 37.43 | 29.65 | 44.57 | 47 | 41.4 | 38.6 |

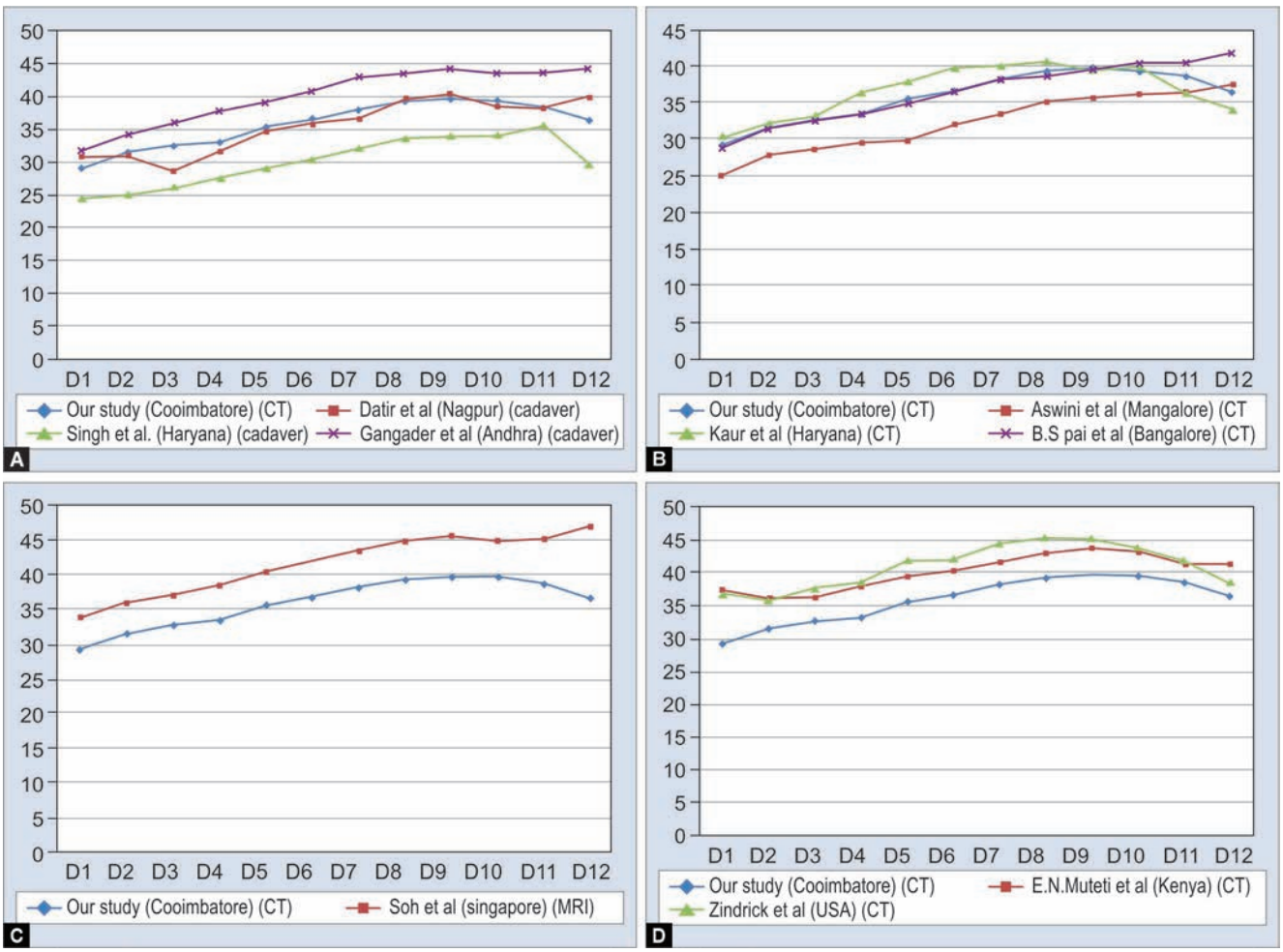


**Fig. 4:** Comparison of our dorsal pedicle axis length in mm with other studies

**Table 5:** Comparison of transverse pedicle angle in degree with other studies

| | *Our study (Coimbatore)* | *Kaur et al. (Haryana)* | *Aswini et al. (Mangaluru)* | *Singh et al. (Haryana)* | *Soh et al. (Singapore)* | *EN Muteti et al. (Kenya)* | *Zindrick et al. (USA)* |
|---|---|---|---|---|---|---|---|
| *Vertebra* | *CT* | *CT* | *CT* | *Cadaver* | *MRI* | *CT* | *CT* |
| D 1 | 31.3 | 35.4 | 29.65 | 31.8 | 34 | 41.6 | 26.6 |
| D 2 | 20.9 | 26.21 | 23.56 | 25.8 | 25.9 | 26.4 | 19.1 |
| D 3 | 13.8 | 20.01 | 18.58 | 20.79 | 20.1 | 16.6 | 14.6 |
| D 4 | 11.7 | 19.06 | 16.51 | 8.12 | 17.4 | 13.9 | 12.6 |
| D 5 | 10.1 | 16 | 15.6 | 15.5 | 16.4 | 12.4 | 9.4 |
| D 6 | 9.4 | 14.38 | 14.52 | 13.06 | 15.5 | 10.7 | 9.6 |
| D 7 | 8.8 | 11.82 | 14.62 | 12.25 | 14.5 | 9.3 | 8.7 |
| D 8 | 8.4 | 12.29 | 13.64 | 11.22 | 13.6 | 8.6 | 8.1 |
| D 9 | 7.8 | 11.21 | 11.65 | 10.09 | 13 | 8.9 | 7.6 |
| D 10 | 6 | 8.7 | 10.02 | 8.78 | 11.9 | 8.1 | 4.6 |
| D 11 | 5.1 | -2.3 | 8.87 | -1.4 | 11.1 | 5.3 | 1.2 |
| D 12 | 4.3 | -9.8 | 8.58 | -10.01 | 9.4 | 2.6 | -4.2 |

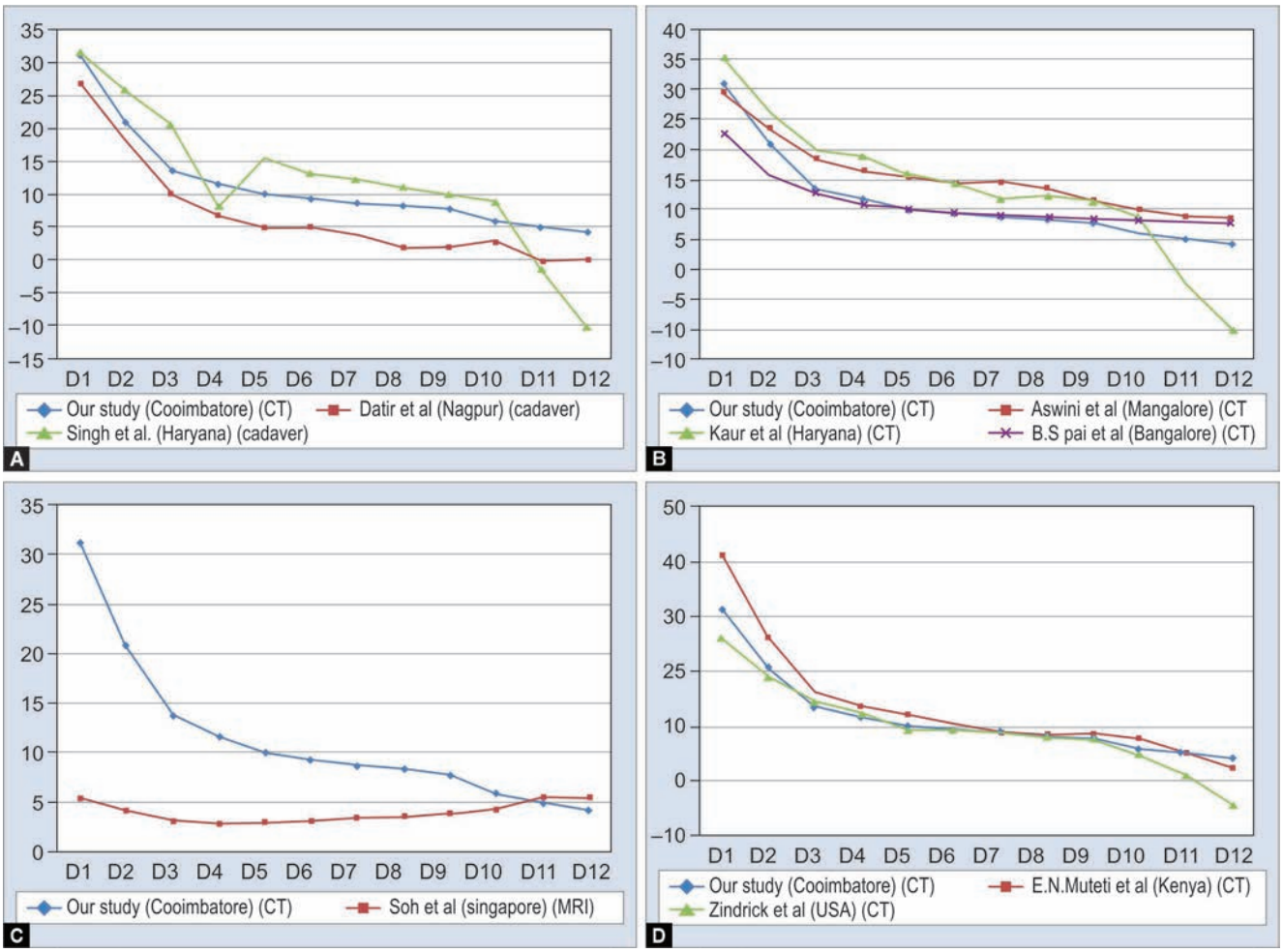


**Fig. 5:** Comparison of dorsal transverse pedicle angle in degree with other studies

## Transverse Pedicle Angle (TPA)

The transverse pedicle angle (TPA) is to identify the trajectory path of the screw for safe insertion direction in transpedicular fixation. In the present study, the transverse pedicle angle (TPA) is gradually decreasing from D1–12. There is more medial angulation in the upper dorsal pedicle when compared to the lower dorsal pedicle. Indian studies conducted by Datir et al., BS Pai et al., and Aswini et al. along with Soh et al. in Singapore and Muteti EN et al. in Kenya showed transverse pedicle angle (TPA) decreasing trends similar to our study.[8,11,12,15] Kaur et al. and Singh et al. in the Indian

population and Zindrick et al. reported anterolateral angulation at lower thoracic pedicles which were not observed in our study.[4,7,18] (Table 5 and Fig. 5).

## Conclusion

Dorsal pedicle morphometric parameters show significant variations in different studies both in the Indian and western populations. There is significant variation in morphometric parameters between males and females in the South Indian population. Females have smaller pedicle sizes when compared to males. Morphological differences suggest caution needs to be taken for transpedicular fixation in the Indian population with western instruments, especially in the mid-thoracic region, particularly in South Indian females who have significantly smaller and shorter pedicles. South Indians have a small pedicle size in the mid-dorsal vertebra and a very small pedicle axis length in our study. The screw size of 3.5 mm at the mid-dorsal level and the screw length of 25 mm at the upper dorsal vertebra and 30–35 mm at the lower dorsal vertebra seem to be safe. A preoperative CT dorsal spine scan is an important investigation for preoperative evaluation in patients planned for thoracic pedicle screw instrumentation.

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