ОРИГИНАЛЬНЫЕ СТАТЬИ

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MORPHOMETRIC ANALYSIS OF TYPICAL SUBAXIAL CERVICAL SPINE PEDICLE IN AXIAL PLANE AS A PREOPERATIVE EVALUATION FOR PEDICLE SCREW INSERTION USING CT SCAN

Background. *Any abnormalities in subaxial typical cervical vertebrae could cause functional disorder and/or instability. Instrumentation can be applied to overcome the instability, such as pedicle screw insertion. Pedicle screw insertion in typical subaxial cervical spine is technically demanding due to its pedicle dimension. This study is designed to measure the anatomical morphometric of typical subaxial cervical pedicle in Hasan Sadikin hospital as a preoperative evaluation to avoid the complication in that procedure.*

Materials and methods. *This study is a cross sectional study in patient who needs a CT scan examination in Neurosurgery Department Hasan Sadikin Hospital, and the image will be reconstructed using OsiriX software. Right and left pedicle length, pedicle width, projection line in pedicle screw insertion, interbifid line and pedicle transverse angle were measured in each level of C3 to C6.*

Results. *There were 31 patients' CT scan that included in the study, in which 19 were male and 12 were female with mean age was 39,12 years ± 9,73. The highest mean of pedicle length and pedicle width was in C6, with 5,31 mm and 5,41 mm respectively. The highest number of projection line in pedicle screw insertion in axial plane was in C6, 32,43 mm. Pedicle transverse angle in mediolateral angle for pedicle screw insertion showed variations range from 42,7° to 43,9° with the widest angle was in C4. Bivariate analysis showed that each segment of cervical vertebrae and gender determine the pedicle dimensions and pedicle screw insertion with p value < 0,05.*

Conclusion. *The pedicle dimension in typical subaxial cervical spine in our centre has a different measurement in each segment of subaxial typical cervical vertebrae and between male and female, so the knowledge of anatomical variations is needed for the operation technique and instrument size to avoid neurovascular injury in typical subaxial cervical pedicle screw operation.*

Keywords: *morphometric, cervical, subaxial, pedicle, pedicle screw*

Introduction

The main indication for posterior approach in subaxial cervical spine instrumentation is instability. The techniques in posterior approach vary from the simple wiring technique to the bony fusion with screw insertion. Lateral mass screw and pedicle screw have been used extensively in subaxial cervical spine with their own advantages and limitations. Cervical pedicle screw insertion provides optimal stability in biomechanic aspects, but due to the small subaxial cervical pedicle dimension, the insertion becomes more challenging and difficult and associated with potential risk of neurovascular injury. [1, 2, 3] Nakashima (2012) reported complications due to cervical pedicle screw insertions such as screw malposition, vertebral artery injury, nerve root injury, and mechanical failure. [4] Another study was performed by Yukawa (2009) reported 28 screw malposition from 153 screw in subaxial cervical pedicle screw insertions. [5] Those complications can be reduced by using computer-guided navigation system during surgery, but our centre has not been equipped with those technologies, so a preoperative plan and determination of the pedicle angles are mandatory for cervical pedicle screw placement. [3]

Materials and methods

This study is a prospective, cross-sectional, single-center study conducted in patients over 18 years of age, who filled the indication for cervical CT scan imaging with no history of trauma, cervical spine congenital anomaly, malignancy, previous cervical spine surgery and in pregnancy. There were 31 patients, in whom a cervical CT scans were performed and filled those criterias, were asked for their consent to be included in the study. Patient selection was obtained from the outpatient clinic of Neurosurgery Department, and the CT scan imaging was performed in Radiology Department, Padjadjaran University, Hasan Sadikin Hospital, Bandung. This study was reviewed and approved for its ethical clearance by the Health Research Ethics Commitee, Faculty of Medicine Padjadjaran University.

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Cervical CT scans were performed constantly by one operator to avoid the technical mistake during imaging with 0.5 mm slice thickness. The axial plane reconstructions were obtained using OsiriX® software for each level typical subaxial cervical pedicles, i.e. C3, C4, C5 and C6 and all the paired parameters were measured on the right and left side. The cervical pedicle parameters we measured in axial plane were following :

- *Pedicle length (PL),* distance between the anterior surface of the superior articular facet and the posterior limit of the body.
- *Pedicle width (PW),* distance between the medial and lateral borders of the pedicle.
- Interbifid line (IBL), distance at the midline of the most anterior surface vertebral body to the midline of the most posterior surface bifid spinous process.
- Projection line of pedicle screw (PPS), distance from the outer part of the lateral mass to the midline of the most anterior surface vertebral body through the middle part of pedicle.
- Pedicle transverse angle (PTA), angle between the projection line of pedicle screw (PPS) and interbifid line (IBL).

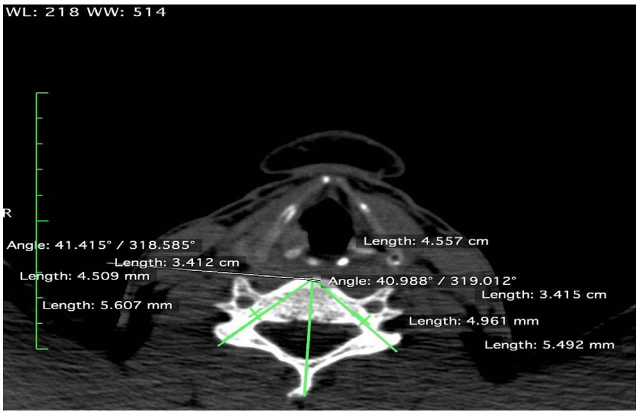

Figure 1 – Anatomical parameters measurements on axial plane using OsiriX® software

All the measurements have been calculated and tabulated for their mean, standard deviation, and range of variations. Statistical analysis comparing two groups in evaluating the right and left side or gender variations were using unpaired t-test on normal distribution data and Mann Whitney test for non-normal distribution data. Meanwhile, in comparison of more than two groups, ANOVA test was used on normal distribution data and Kruskall Wallis test for non-normal distribution data. The level significance was chosen at p ≤ 0,05. All the statistical analysis was done using SPSS ver. 21.0.

Results

There were 31 persons included in this study, 19 were male (61,3%) and 12 were female (38,7%) with mean age is 39.1290 with standard deviation 9,73907. We measured the parameters in each segment of subaxial typical cervical vertebrae and the pedicle length from C3 until C6 in milimeters were 5.046677, 5.071935, 5.232435, 5.314065, respectively. Those values are larger from rostral to caudal and statistically significant with p value =0.0070 (p value <0.05). The same result was showed in pedicle width measurements from C3 to C6 were 4.619048, 4.668419, 4.978435, 5.418823, respectively and statistically significant with p value = 0.0001 (p value < 0.05). Interbifid lines in C3 to C6 were 30.39, 39.426129, 42.032581, 48.505806, respectively and statistically significant with p value = 0.0001 (p value < 0.05). Projection lines of pedicle screw in C3 to C6 were 30.39, 30.761713, 32.175161, 32.433226, respectively, and statistically significant with p value = 0.0001 (p value < 0.05). The pedicle transverse angle showed the different tendency which the largest was in C3 and the narrowest was in C6, but not statistically significant with p value = 0.2980 (p value > 0.05). Those measurements are listed in Table 1.

We measured all the variables in each level of subaxial typical cervical vertebrae and we compared in each sides, right and left. This measurement is important for size determination and the technique in both sides. In C3 level, there was no statistically significance differences for pedicle length, pedicle width, projection line of pedicle screw, and pedicle transverse angle with p value > 0.05. The measurements are listed in table 2. In C4 level, there was no statistically significance differences for pedicle length, pedicle width, projection line of pedicle screw, and pedicle transverse angle with p value > 0.05. The measurements are listed in table 3. In C5 level, there was no statistically significance differences for pedicle length, pedicle width, projection line of pedicle screw, and pedicle transverse angle with p value > 0.05. The measurements are listed in table 4. In C6 level, there was no statistically significance differences for pedicle length, pedicle width, projection line of pedicle screw, and pedicle transverse angle with p value > 0.05. The measurements are listed in table 5.

We made a comparison in pedicle dimensions (pedicle length and width) from sex groups in each side, right and left, and we found that pedicle dimensions in male are larger than in female. This trend was not only the same in right side and left side, but also showed the significancy with p value < 0.05. The mean pedicle length in male group was 5.3395 mm on the right side and 5.3343 mm on the left side. The mean pedicle width in male group was 5.1159 mm on the right side and 5.1245 mm on the left side. Female group showed the smaller size, in which the mean pedicle length was 4.8833 mm on the right side and 4.9219 mm on the left side. The mean pedicle width was 4.6288 mm on the right side and 4.5834 mm on the left side. The results are listed in table 6.

Table 1

Morphometric data results of subaxial typical cervical vertebrae in each segment

Variables	C3		C4		C5		C6		P-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Pedicle width	4.619048	±0.6023345	4.668419	±0.5090357	4.978435	±0.4479440	5.418823	±0.7021513	0.0001**
Projection line of pedicle screw	30.390000	±1.4447735	30.761613	±1.7136350	32.175161	±2.2774992	32.433226	±2.2681116	0.0001**
Interbifid line	30.390000	±2.4189568	39.426129	±2.7456920	42.032581	±3.0105979	48.505806	±4.0554390	0.0001**
Pedicle transverse angle	42.727790	±3.2459851	43.960258	±3.4864375	43.292258	±4.0237947	43.170548	±3.6552725	0.2980
Pedicle length	5.046677	±0.5220500	5.071935	±0.4831692	5.242435	±0.4187067	5.314065	±0.5715760	0.0070**

Note :We used ANOVA test to measure the p value in numerical data if it is within normal distribution and Kruskall Wallis test if it is not normal distribution. We used Chi-Square and alternatively Kolmogorov-Smirnof to measure p value in categorical data. Significancy is achieved for p value < 0.05.

** statistically significant

Table 2

Morphometric data results in C3 vertebrae with comparison in right and left side

Variables	Mean	Range		SD	P-value
		Minimum	Maximum		
PEDICLE WIDTH (mm)					**0.516**
Right	4.669258	3.2560	5.9910	±0.5.9910	
Left	4.568839	3.3130	5.8330	±0.5778253	
PROJECTION LINE OF PEDICLE SCREW (mm)					**0.495**
Right	30.440968	27.1100	33.0500	±1.4084799	
Left	30.339032	26.9700	35.4200	±1.5017109	
PEDICLE TRANSVERSE ANGLE (degree)					**0.342**
Right	43.194387	32.1000	49.3030	±3.2667840	
Left	42.261194	33.1160	46.5340	±3.2097095	
PEDICLE LENGTH (mm)					**0.871**
Right	5.035806	3.8430	6.1100	±0.5002250	
Left	5.057548	3.8650	6.1850	±0.5510786	

Note: We used paired-t-test to determine the p-value in numerical data if it is in normal distribution and Mann-Whitney test if it is not in normal distribution. Significancy is achieved if p-value < 0.05.

Table 3

Morphometric data results in C4 vertebrae with comparison in right and left side

Variables	Mean	Range		SD	P-value
		Minimum	Maximum		
PEDICLE WIDTH (mm)					**0.883**
Right	4.658806	3.3650	5.6130	±0.5113278	
Left	4.678032	3.7320	5.8950	±0.5149997	
PROJECTION LINE OF PEDICLE SCREW (mm)					**0.142**
Right	30.440968	27.1100	33.0500	1.4084799	
Left	31.082258	26.9300	36.0900	1.9428531	
PEDICLE TRANSVERSE ANGLE (degree)					**0.359**
Right	44.370000	36.7500	50.6180	3.5276026	
Left	43.550516	35.5730	49.9930	3.4532185	
PEDICLE LENGTH (mm)					**0.825**
Right	5.085677	4.0580	5.9190	±0.4919221	
Left	5.058194	4.0140	5.8180	±0.4819846	

Note: We used paired-t-test to determine the p-value in numerical data if it is in normal distribution and Mann-Whitney test if it is not in normal distribution. Significancy is achieved if p-value < 0.05.

Table 4

Morphometric data results in C5 vertebrae with comparison in right and left side

Variables	Mean	Range		SD	P-value
		Minimum	Maximum		
PEDICLE WIDTH (mm)					**0.816**
Right	4.965000	4.0770	5.8450	±0.4390981	
Left	4.991871	4.2040	5.9290	±.4634824	
PROJECTION LINE OF PEDICLE SCREW (mm)					**0.560**
Right	32.345484	26.4300	36.8300	2.4165166	
Left	32.004839	26.6100	35.5900	2.1557827	
PEDICLE TRANSVERSE ANGLE (degree)					**0.405**
Right	43.722226	34.6600	53.4400	4.4553314	
Left	42.862290	34.9600	47.9010	3.5622322	
PEDICLE LENGTH (mm)					**0.821**
Right	5.230258	4.2010	6.0170	±0.4282519	
Left	5.254613	4.4680	6.1570	±0.4156542	

Note: We used paired-t-test to determine the p-value in numerical data if it is in normal distribution and Mann-Whitney test if it is not in normal distribution. Significancy is achieved if p-value < 0.05.

Table 5

Morphometric data results in C6 vertebrae with comparison in right and left side

Variables	Mean	Range		SD	P-value
		Minimum	Maximum		
PEDICLE WIDTH (mm)					**0.977**
Right	5.416226	4.3890	7.5230	±0.7108253	
Left	5.421419	4.3020	7.6980	±0.7051102	
PROJECTION LINE OF PEDICLE SCREW (mm)					**0.609**
Right	32.582258	27.3400	37.1600	2.2068042	
Left	32.284194	26.7600	38.0100	2.3546235	
PEDICLE TRANSVERSE ANGLE (mm)					**0.462**
Right	43.515290	35.5080	54.6850	4.0489812	
Left	42.825806	35.9130	49.8980	3.2446164	
PEDICLE LENGTH (mm)					**0.847**
Right	5.299903	4.0000	6.5100	±0.5778506	
Left	5.328226	4.0610	6.5400	±0.5744235	

Note: We used paired-t-test to determine the p-value in numerical data if it is in normal distribution and Mann-Whitney test if it is not in normal distribution. Significancy is achieved if p-value < 0.05.

Table 6

Morphometric data results in pedicle dimension on right and left side with comparison in male and female groups

Variable	Sex Groups	Mean	SD	P-value
RIGHT PEDICLE LENGTH	Male	5.3395	±0.30693	**0.001****
	Female	4.8833	±0.40677	
RIGHT PEDICLE WIDTH	Male	5.1159	±0.38833	**0.001****
	Female	4.6288	±0.26577	
LEFT PEDICLE LENGTH	Male	5.3343	±0.34124	**0.004****
	Female	4.9219	±0.36143	
LEFT PEDICLE WIDTH	Male	5.1245	±0.39329	**0.0001****
	Female	4.5834	±0.26643	

Note: We used paired-t-test to determine the p-value in numerical data if it is in normal distribution and Mann-Whitney test if it is not in normal distribution. Significancy is achieved if p-value < 0.05.

DISCUSSION

The cervical pedicle screw insertion provides the more superior biomechanical stability compared to lateral mass screw fixation and wiring techniques but remains a demanding technique due to the small pedicle in subaxial cervical spine and the potential risks of iatrogenic damage to the neuerovascular structures.[1, 2, 3, 6, 7] The knowledge of the anatomy of cervical pedicles and its morphometric variations can reduce the risks and helpful for the pedicle screw entry, trajectory, and screw size.[8,9] Morphometric measurements based on CT scans are more efficient in determining pedicle dimensions than manual calliper measurements, because CT scan could avoid the possible deviations by post-mortem changes such as dehydration and altered tonus of the soft tissue. [8] Fluoroscopic imaging intraoperatively may assess the screw precision in sagittal view but not that much for evaluating screw trajectory and angle in axial plane. The combination of sagittal view assessment intraoperatively by fluoroscopic with the axial view measurements preoperatively by imaging will provide the higher succeed rate in non-computer guided or freehand technique of cervical pedicle screw insertion. [10, 11]

Pedicle dimensions were measured in two dimentional images from CT scan in this study with pedicle lengths were 5,04 mm, 5,07 mm, 5,24 mm, and 5,3 mm from C3 to C6, respectively. The pedicle widths were 4,6 mm, 4,6, mm, 4,9 mm, 5,4 mm from C3 to C6, respectively. Those results are similar with the literatures and previous studies, which are the pedicles dimension increase from rostral to caudal, due to the overall anatomical size of cervical spine is larger from rostral to caudal. [3, 7, 8, 9, 10, 11, 12, 13, 14, 15] We listed the previous morphometric measurements with our findings. The pedicle dimensions in our population (Indonesian) tends to be smaller in size than the population from Northeastern Mexico, China, And Mexican population. [8, 9, 12] We describe our findings and the previous studies in table 7 and table 8 for pedicle dimensions morphometric data.

Table 7

Previous studies and this study in pedicle length morphometric measurements

Studies (year)	Pedicle Length (Mean ± SD)							
	C3		C4		C5		C6	
	Right	Left	Right	Left	Right	Left	Right	Left
Bazaldua (2011)	5,27 ± 1,39		5,25 ± 0,81		4,71 ± 1,24		3,80 ± 1,00	
Banerjee (2012)	5,03±0,83	4,51±1,02	5,01±0,91	4,62±0,92	5,37±0,91	4,91±1	5,54±0,92	5,04±0,96
This study (2015)	5,03±0,5	5,05±0,5	5,08±4,05	5,05±4,01	5,23±0,42	5,25±0,41	5,29±0,57	5,32±0,57

Table 8

Previous studies and this study in pedicle length morphometric measurements

Studies (year)	Pedicle Width (Mean ± SD)							
	C3		C4		C5		C6	
	Right	Left	Right	Left	Right	Left	Right	Left
Bazaldua (2011)	5,14 ± 2,22		6,07 ± 1,08		5,77± 0,98		6,53 ± 1,17	
Banerjee (2012)	4,71 ±0,81	4,89 ±0,88	4,76 ±0,83	4,87 ±0,78	4,98 ±0,78	5,09 ±0,72	5,34 ±0,82	5,42 ±0,82
Chen (2013)	6,14±0,84	6,02±0,74	6,19±0,82	6,08±0,69	6,60±0,83	6,43±0,88	6,99±0,71	6,91±0,76
This study (2015)	4,66 ±0,5	4,56 ±0,57	4,65 ±0,51	4,67±0,51	4,96±0,43	4,99±0,46	5,41±0,71	5,42±0,70

The projection line of pedicle screw insertion in typical subaxial cervical spine in this study tend to be larger from rostral to caudal both on the right and left side, due to the increasing of cervical spine size from rostral to caudal. This projection line plays important role in screw length selection to obtain the optimal fixation without excessive penetrates the anterior part of vertebral body. The difference length of this line on the right and left side did not statistically significant in our study. In general, the safety range of screw length which is used in typical subaxial cervical pedicle is 20 mm – 22 mm to minimize the vertebral body penetration. [8] Biomechanic study shows screw length selection should be two-third from the length of screw insertion distance on the axial plane. [17] Based on that measurements, we found that the safe screw length for our patients is 20,26 mm – 21,62 mm which is on the safe margin based on the literature.

Pedicle transverse angle is useful to determine the trajectory of screw insertion on axial view. We found the largest transverse angle on C4 (43,9°) and the smallest on C3 (42,7°). The angle did not show the same pattern like the pedicle dimension that was larger from rostral to caudal. Previous studies showed variations about this angle. Chen (2013) said that the narrowest axial angle was in C7, 32,36° and the largest was in C3, 47,79°. Some studies said the tendency of this angle is decreased from the C3 to C7, with the consistent value from the C3 to C5, but the noticeable differences are in C6 and C7, possibly due to pedicle cohesion. [8] Those results are not similar with our findings, that the largest angle was in C4 and the value was not consistent. The exact determination of the entry point and angle of direction for the pedicle screw instrumentation has not been assigned. Anatomical landmark has been used widely to define the entry point and screw trajectory. Albumi (1999) said the screw entry point should be slightly lateral from the centre of articular mass and just about the inferior articularis process of the upper level from the level which is aimed to be instrumented. [18] Tomasino et al. found the entry point of vertebral artery was generally at transverse foramen C6 and the lateral pedicle angle was narrow at this level. [6] Chanplakorn (2014) performed cervical CT scan evaluation and revealed that no significance variety in pedicle screw angle insertion in axial plane, though the pedicle dimensions are statistically significant. [7] The great variety of pedicle transverse angle should be considered carefully due to the operation technique that might put the neurovascular structures in the highly risk of injury. The success rate of cervical pedicle screw will be achieved if the angle in axial plane and sagittal plane can be combined. Preoperative evaluation using two dimensions imaging in measurements of mediolateral angle in axial plane is a mandatory if the instrumentation will be performed with no computer-based technique. [5, 10, 11] Based on the previous studies and our findings, it is suggested that this angle in axial plane for pedicle screw insertion should be adressed individually using the imaging studies.

The morphometric data of subaxial typical cervical vertebrae in this study showed no significant differences in this study on the right and left sides in each segments. Our findings are similar with the previous studies, so there is no spesific differences in operation technique on the right or left sides when applying pedicle screw instrumentation in typical subaxial cervical vertebrae. [7, 8, 13, 17, 19]

We compared the parameters both in males in females group and the result is similar with the previous studies which is males' pedicles are found to be larger than females' pedicles. The differences in pedicle dimensions for both sex groups are statistically significant, in which male groups are larger than female groups. Those findings are similar with the previous studies. [7, 9, 12, 13, 19] Those results are important in instrument size selection for our patients, in which the mean pedicle length is 5,3 mm and the mean pedicle width is 5,1 mm for the male group both on the right and left side. The pedicle dimensions in female group tend to be smaller with the mean pedicle length is 4,8 mm on the right side and 4,9 mm on the left side, the mean pedicle width is 4,6 mm both on the right and left side. Those pedicle dimension, especially pedicle width size is very important to determine screw diameter. Some literatures suggest the safe range of screw diameter to avoid the pedicle breakage is between 3,5 mm to 4,5 mm. [11, 17] Chen suggested the risk of pedicle wall perforation will increase if the pedicle width less than 4,5 mm. Biomechanic test showed the minimal pedicle width size for the suitable rigid fixation is 3,5 mm.[8]

Our study limitation is we did not evaluate the sagittal and coronal plane, so that the data analysis will be practically useful for the operation technique accuracy and the data will reflects the better analysis in multiplanar sections.

Conclusion

The morphometric analysis of pedicle dimensions in typical subaxial cervical vertebrae are larger from rostral to caudal but the angles of pedicle screw insertion in mediolateral or axial plane are adressed individually. The morphometric data is useful to determine the screw size selection and to increase the accuracy of operation technique especially in the centre which the computer-based intraoperative imaging has not been used.

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ТҮЙІНДЕМЕ

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ОМЫРТҚАНЫҢ МОЙЫН БӨЛІГІНІҢ СУБАКСИАЛДЫ ТРАНСПЕДИКУЛЯРЛЫ ФИКСАЦИЯСЫН ОПЕРАЦИЯ АЛДЫ ЖОСПАРЛАУ ҮРДІСІНДЕ АКСИАЛДЫ ПРОЕКЦИЯДАҒЫ ОМЫРТҚА ТАРМАҚТАРЫНЫҢ КОМПЬЮТЕРЛІК ТОМОГРАФИЯСЫНЫҢ МОРФОМЕТРЛІК ТАЛДАУЫ

Кіріспе. Омыртқаның мойын бөлігінің субаксиалды түрлі патологиялары сегменттің тұрақсыздығы және/немесе функционалды бұзылыстарының туындауына әкелуі мүмкін. Тұрақсыздықты еңсеру үшін омыртқаның артқы фиксациясы, соның ішінде транспедикулярлық фиксация қолданылуы мүмкін. Омыртқаның мойын бөлігінің субаксиалды түрінің транспедикулярлық фиксациясы тармақтардың мөлшерлерінің әртүрлілігіне байланысты техникалық күрделі болып табылады. Аталған зерттеудің мақсаты аталған процедурамен байланысты асқынуларды болдырмау үшін операция алдындағы субаксиалды омыртқаның мойын бөлігінің омыртқа тармақтарының стандартты анатомиялық морфометрлік сипаттамаларын шығару болып табылады.

Материалдар мен әдістер. Аталған зерттеу Hasan Sadikin ауруханасының нейрохирургиялық бөлімшесіндегі КТ бақылауына мұқтаж пациенттің кросс-секциялық зерттеуін ұсынады. КТ суреті OsiriX бағдарламалық қамтамасыз ету көмегімен қайта құрылатын болады. Тармақтың оң жақ және сол жақ ұзындығы, оның ені, транспедикулярлық винтке енгізудегі проекция сызығы, ішкі жарықшақтану сызығы және тармақтың көлденең кесіндісі С3-тен С6-ға дейінгі барлық деңгейлерде өлшенді.

Нәтижелері. 31 пациенттің КТ сканерлері зерттеуге енгізілді, олардың орташа жасы 39,12 ± 9,73 жыл. Олардың арасында 19 ер адам және 12 әйел адам. С6-да сәйкес тармақтың орташа ұзындығы және ені 5,31 мм және 5,41 мм құрады. Транспедикулярлық винттің осьтік кесік жалпақтығына енгізудегі проекция сызықтарының көптік саны С6, 32,43 мм болды. Транспедикулярлық винт үшін медиалатералдық бұрыштағы тармақтың көлденең бұрышы 42,7° ден 43,9° дейін С4 кең бұрышын диапазонындағы өзгерістерді көрсетті. Екі өлшемді талдау омыртқаның мойын бөлігінің әрбір сегменті және жынысына қарай тармақтың мөлшерін және транспедикулярлық винттің $p < 0,05$ мағынасына қарай қосылатындығын анықтайтындығын көрсетті.

Қорытындысы. Омыртқаның әдеттегі субосьтік мойын бөлігіндегі тармағының мөлшері біздің орталығымызда әртүрлі мөлшерде, әйел мен еркектің арасындағы омыртқаның әдеттегі субосьтік мойын бөлігіндегі әрбір сегментте мөлшері әртүрлі, сол себепті анатомиялық айырмашылықтарды білу транспедикулярлық винтпен омыртқаның әдеттегі субосьтік мойын бөлігіне операция жасау кезінде нерв-тамырлы зақымданулар болмас үшін операция техникасын және аспап мөлшерін таңдау үшін қажет.

Негізгі сөздер: Морфометрлік, омыртқаның мойын бөлігі, субосьтік, тармақ, транспедикулярлық винт.

РЕЗЮМЕ

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МОРФОМЕТРИЧЕСКИЙ АНАЛИЗ КОМПЬЮТЕРНОЙ ТОМОГРАФИИ НОЖЕК ПОЗВОНКОВ, В АКСИАЛЬНОЙ ПРОЕКЦИИ, В ПРОЦЕССЕ ПРЕДОПЕРАЦИОННОГО ПЛАНИРОВАНИЯ ТРАНСПЕДИКУЛЯРНОЙ ФИКСАЦИИ СУБАКСИАЛЬНОГО ШЕЙНОГО ОТДЕЛА ПОЗВОНОЧНИКА

Введение. Различные патологии субаксиального шейного отдела позвоночника могут вызвать функциональные нарушения и/или нестабильность сегмента. Для преодоления нестабильности может быть использована задняя фиксация позвоночника, в частности транспедикулярная фиксация. Транспедикулярная фиксация в субаксиальном шейном отделе позвоночника является технически сложной из-за размеров ножки. Целью данного исследования является, выявление стандартных анатомических морфометрических характеристик ножек позвонков в субаксиальном шейном отделе позвоночника в предоперационном обследовании, для избежания осложнений связанных с данной процедурой.

Материалы и методы. Данное исследование представляет собой кросс-секционное исследование пациента, который нуждается в обследовании КТ в отделении нейрохирургии больницы Hasan Sadikin. Изображение КТ будет реконструировано при помощи программного обеспечения OsiriX. Длина правой и левой ножки, ее ширина, линия проекции во внедрении транспедикулярного винта, линия внутреннего расщепления и поперечный разрез ножки измерялись на всех уровнях от С3 до С6.

Результаты. Сканы КТ 31 пациента, были включены в исследование, средний возраст которых составил 39,12 ± 9,73 лет. Среди них было 19 мужчин и 12 женщин. Соответственно в С6 средняя длинна и ширина ножки составила 5,31 мм и 5,41 мм. Наибольшее число линий проекции во внедрении транспедикулярного винта в плоскость осевого сечения была в С6, 32,43 мм. Поперечный угол ножки в медиолатеральном углу для транспедикулярного винта показали изменения в диапазоне от 42,7° до 43,9° с широким углом в С4. Двумерный анализ показал, что каждый сегмент шейных отделов позвонков и половая принадлежность определяют размер ножки и вставки транпедикулярного винта со значением $p < 0,05$.

Выводы. Размер ножки в типичном субосевом шейном отделе позвоночника в нашем центре имеет разные размеры в каждом сегменте субосевого типичного шейного отдела позвонков между мужчиной и женщиной, так что знание анатомических различий необходимо для выбора техники операции и размера инструмента, чтобы избежать нервно-сосудистых повреждений во время операции на типичный субосевой шейный отдел позвоночника с транспедикулярным винтом.

Ключевые слова: Морфометрический, шейный отдел позвоночника, субосевой, ножка, транспедикулярный винт.