MEAN SCORE OF CERVICAL PEDICLE ANGLE TO MIDLINE AND INFERIOR END PLATE IN ADULT USING MULTI SLICED COMPUTED TOMOGRAPHY

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ABSTRAK

*Cervical pedicle screw memberikan beberapa keuntungan pada fiksasi cervical posterior, yaitu kuatnya tahanan dan kontrol yang lebih baik pada bidang coronal, sagital, dan rotasional karena adanya three column fixation. Namun, pemasangan cervical pedicle screw dapat menimbulkan komplikasi neurologis dan vascular. Penelitian deskriptif dengan sampel 30 orang ini bertujuan untuk menghitung sudut rata-rata cervical pedicle terhadap garis tengah dan end plate inferior pada orang dewasa normal yang asimtomatis menggunakan MSCT di laboratorium MSCT Radiologi Graha Amerta RSU Dr. Soetomo Surabaya bulan Februari 2010- Juni 2010. Dari 19 laki-laki dan 11 perempuan, didapatkan besar sudut cervical pedicle terhadap garis tengah pada laki- laki mulai 43,11^o hingga 45,84^o pada sisi kanan, 43,32^o hingga 45,94^o pada sisi kiri, dan 43,11^o sampai 45,94^o untuk keseluruhan. Pada perempuan, nilai rata-rata sebesar 44,66^o hingga 48,54^o pada sisi kanan, 45,03o hingga 48,56o pada sisi kiri, dan 45,03o sampai 48,56o secara keseluruhan. Sudut cervical pedicle terhadap end plate inferior pada laki-laki sebesar 12,47o hingga 15o pada sisi kanan, 11,36o hingga 14,10o pada sisi kiri, dan sebesar 11,3o sampai 15o secara keseluruhan. Sedangkan pada perempuan sebesar 11,48o hingga 15,03o pada sisi kanan, 11,28o hingga 15,17o pada sisi kiri dan 11,28o sampai 15,17o secara keseluruhan. Diameter cervical pedicle pada laki-laki mulai 4,85 mm (SD ± 0,62) hingga 6,17 mm (SD ± 0,67), pada perempuan mulai 4,08 mm (SD ± 0,75) hingga 5,69 mm (SD ± 0,69). Tampak perbedaan besar sudut cervical pedicle terhadap garis tengah dan inferior end plate antara laki-laki dan perempuan.**(FMI 2014;50:58-62)***

Kata kunci: *Sudut cervical pedicle terhadap garis tengah, Sudut cervical pedicle therhadap garis end plate inferior, MSCT, orang dewasa normal asimtomatik*

ABSTRACT

*Cervical pedicle screw provides multiple benefits to the posterior cervical fixation, that is the strength of load and better control on the field of coronal, sagittal, and rotational because of the three-column fixation. However, cervical pedicle screw installation can cause neurological and vascular complications. This Descriptive study with a sample of 30 people was aimed to calculate the mean score of cervical pedicle angle toward the midline and the end plate inferior in normal asymptomatic adults using MSCT at laboratory Radiology MSCT Graha Amerta Dr. Soetomo Hospital Surabaya in February-June 2010. Among 19 men and 11 women, obtained mean score of cervical pedicle angle to the midline of men is 43.11° to 45.84° on the right side, 43.32° to 45.94° on the left side, and 43.11° to 45.94° overall. In women, the value is 44.66° to 48.54° on the right side, 45.03° to 48.56° on the left side, and 45.03° to 48.56° overall. Mean score of cervical pedicle angle to the end plate inferior on men is 12.47° to 15° on the right side, 11.36° to 14.10° on the left side, and 11.3° to 15° overall. While women at 11.48° to 15.03° on the right side, 11.28° to 15.17° on the left side and 11.28° to 15.17° overall. Cervical pedicle diameter in men ranging from 4.85 mm (SD ± 0.62) to 6.17 mm (SD ± 0. 67), in women 4,08 mm (SD ± 0.75) to 5.69 mm (SD ± 0.69). There are differences in cervical pedicl e angle to the midline and end plate inferior between men and women. **(FMI 2014;50:58-62)***

Keywords: *Normal asymptomatic adults, cervical Pedicle angle to midline, cervical Pedicle angle to end plate inferior, MSCT*

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INTRODUCTION

Cervical Pedical Screw provides multiple benefits to posterior cervical fixation and a better control to coronal, sagital, and rotational section because of three column fixation (Abumi et al 1994). The function of cervical as a head cantilever and protector of blood vessels and nerve, causes the importance of fixation in pathologic cases, mainly cervical trauma. Cervical fixation which is usually done to neoplasm, trauma, degenerative growth and development cases has been proved more practical, more safe, and more effective (Abumi et al 2000). Since the cervical fixation procedure was invented in 1891 by Berthold Earnest Hadra, MD, technique variations have been developed. The development involves Abumi and colleagues

introduced the pedicle screw fixation technique to cervical in 1994. Nowadays, medical screw fixation technique is still believed as the best fixation technique to manage cervical abnormality, while safety improvement is needed. An anatomycal study has reached 87,5% success rate of screw fixation technique (Ludwig et al 2000). However, the anatomycal variations of size and cervical pedicle angle can harm neovascular structure and restrict setting up pedicle screw in cervical.

Accuracy of getting into the cervical pedicle depends on direct x-ray and CT scan guideline. Both of them has been proved improving accuracy of setting up cervical pedicle screw. Moreover, a research has shown CT scan usage to determine entry point in setting up neurovascular lateral mass screw and decrease trauma risk (Ludwig et al 2000). The angle of setting up screw to pedicle is 30-550 in fixation operation with fluoroscopy. In a population, the mean score of cervical pedicle angle can help physician to improve safety when setting up the screw to cervical pedicle. This paper objects to calculate cervical pedicle angle to median line and end plate inferior. The results is expected to be a guideline for physician to measure the angle in setting up pedicle screw.

MATERIALS AND METHODS

This research was a descriptive study using the primary data in Radiology Department Graha Amerta Dr. Soetomo Hospital in Surabaya, Indonesia. The study sample is both men and women that were examined by means Multi Slice Computed Tomography (MSCT) in cervical area at February until June 2010. In this study, we use MSCT 64 Slices GE in axial and oblique sagital slices under control musculosceletal consultant radiologists. We can measure angle of pedicle to median line after making the vertebra midline in axial section of right and left long axis pedicle. Angle of pedicle to end plate inferior was measured subsequent to make parallel line to end plate inferior in oblique sagital projection to the line through the pedicle. The collected data was documented, analyzed and shown as percentages, tables, and graphs.

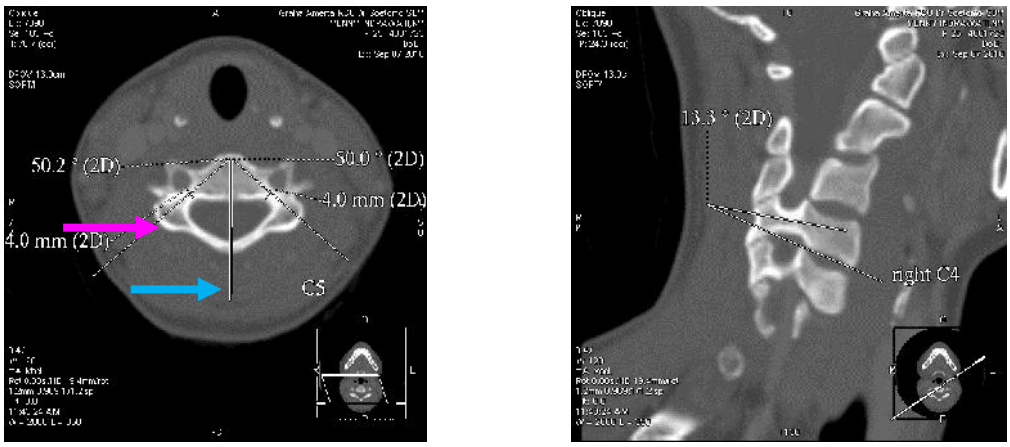

Figure 1. X-ray taking and angle measurement at MSCT workstation
→ = long axis pedicle line
→ = corpus vertebral line (midline axial)

RESULTS

Table 1 shows the mean age of patients in this study was 51.30 years old, the youngest patient was 25 years old, and the oldest 72 years old. Male patients had a mean age of 53.63 (the youngest 32 years old and the oldest 72 years), whereas female patients had a mean age of 47.27 years (youngest 25 and the oldest 68 years). Majority group consist of 16 patients at the age of 41-60 years old. Table 2 shows Estimated mean pedicle angle to the midline in male. With level of confidence 95% (α = 5%), obtained range of the mean estimate of pedicle angle to the center line of men ranging from 43.11^o to 45.84^o on the right side and 43.32^o to 45.94^o on the left side. Estimated mean pedicle angle to the midline in women with level of confidence 95% (α = 5%), obtained range of the mean estimate of pedicle angle to the center line of women ranging from 44.66^o to 48.54^o on the right side and 45.03^o to 48.56^o on the left side. Based on the data, it did not seem

significant differences between right and left pedicle angle. With level of confidence 95% (α = 5%), shows range of the mean estimate of pedicle cervical of men ranging from 6.12^o to 4.86^o on the right side and 6.17^o to 4.85^o on the left side (Table 4). Range of the mean estimate of pedicle cervical of women ranging from 5.69^o to 4.08^o on the right side and 5.67^o to 4.16^o on the left side (Table 5).

Table 1. Sample Distribution by Age

Age groups	Gender				Total	
	Men		Women			
≤ 40 years	3	15.8%	3	27.3%	6	20.0%
41-60 years	10	52.6%	6	54.5%	16	53.3%
> 60 years	6	31.6%	2	18.2%	8	26.7%
Total	19	100.0%	11	100.0%	30	100.0%

Table 2. Estimated mean pedicle angle to the midline (men)

Vertebra	n	Right			Left		
		$\bar{x}$(^{o})	Level of confidence 95%		$\bar{x}$(^{o})	Level of confidence 95%	
			Lower	Upper		Lower	Upper
C3	19	44.55	43.29	45.80	44.33	43.11	45.54
C4	19	45.15	43.73	46.56	44.93	43.44	46.42
C5	19	45.84	44.48	47.20	45.94	44.62	47.26
C6	19	44.05	42.77	45.34	43.90	42.55	45.25
C7	19	43.11	41.98	44.23	43.32	42.22	44.41

Table 3. Estimated mean pedicle angle to midline (women)

Vertebra	n	Right			Left		
		$\bar{x}$(^{o})	Level of confidence 95%		$\bar{x}$(^{o})	Level of confidence 95%	
			Lower	Upper		Lower	Upper
C3	11	46.11	44.41	47.80	46.15	44.59	47.70
C4	11	48.54	47.23	49.84	48.56	47.27	49.84
C5	11	47.75	46.15	49.34	47.73	46.19	49.26
C6	11	46.70	44.74	48.66	46.72	44.74	48.69
C7	11	44.66	42.58	46.75	45.03	43.30	46.76

Table 4. Estimated mean diameter pedicle cervical (men) in population

Vertebra	n	Right			Left		
		$\bar{x}$(mm)	Level of confidence 95%		$\bar{x}$(mm)	Level of confidence 95%	
			Lower	Upper		Lower	Upper
C3	19	4.86	4.56	5.52	4.85	4.55	5.15
C4	19	4.88	4.64	5.12	4.94	4.70	5.18
C5	19	5.24	4.97	5.51	5.22	4.95	5.49
C6	19	5.68	5.33	6.04	5.60	5.18	6.02
C7	19	6.12	5.81	6.44	6.17	5.85	6.50

Table 5. Estimated mean diameter pedicle cervical (women) in population

Vertebra	n	Right			Left		
		$\bar{x}$(mm)	Level of Confidence 95%		$\bar{x}$(mm)	Level of Confidence 95%	
			Lower	Upper		Lower	Upper
C3	11	4.08	3.58	4.59	4.16	3.66	4.67
C4	11	4.34	3.87	4.81	4.36	3.87	4.84
C5	11	4.50	3.95	5.05	4.51	3.96	5.04
C6	11	4.93	4.43	5.23	5.02	4.52	5.52
C7	11	5.69	5.23	6.15	5.67	5.21	6.14

Table 6. Estimated mean pedicle angle to end plate inferior (men)

Vertebra	N	Right			Left		
		$\bar{x}(^o)$	Level of confidence 95%		$\bar{x}(^o)$	Level of confidence 95%	
			Lower	Upper		Lower	Upper
C3	19	15.00	14.19	15.80	14.88	14.10	15.66
C4	19	14.01	12.90	15.12	13.91	12.82	15.00
C5	19	13.72	12.98	14.45	13.20	12.47	13.93
C6	19	12.87	12.00	13.73	12.29	11.65	12.93
C7	19	12.47	11.63	13.31	12.10	11.36	12.84

Table 7. Estimated mean pedicle angle to end plate inferior (women)

Vertebra	n	Right			Left		
		$\bar{x}(^o)$	Level of confidence 95%		$\bar{x}(^o)$	Level of confidence 95%	
			Lower	Upper		Lower	Upper
C3	11	15.03	13.73	16.32	15.17	14.20	16.15
C4	11	13.56	12.63	14.50	13.58	12.37	14.80
C5	11	12.62	11.70	13.53	12.61	11.97	13.25
C6	11	11.59	10.74	12.44	11.92	11.29	12.55
C7	11	11.48	10.72	12.25	11.28	10.55	12.02

With level of confidence 95% (α = 5) shows range of the mean estimate of pedicle angle to end plate inferior line of men ranging from 12.47^o to 15^o on the right side and 12.10^o to 14.88^o on the left side (Table 6). With level of confidence 95% (α = 5%), shows range of the mean estimate of pedicle angle to end plate inferior line of women ranging from 11,48^o to 15.03^o on the right side and 11,28^o to 15,17^o on the left side. Getting to the inferior, angle gets smaller (Table 7).

DISCUSSION

Fixation cervical operation with pedicle screw has been done frequently as a superior method in biomechanics and stabilization of the cervical (Abumi et al 1994). The diameter and the angle of the pedicle plays an important role in the security element transpendicular screw fixation. However, when diameter of pedicle is less than 4,5 mm, fixation is not reco mmended, as critical breach has observed in 12-18% research using cadaver (Ludwig et al 2000). The function of cervical pedicle angle in pedicle screw installation is to avoid misplacement of a screw that can introduce risk of injury to the neurovascular structures, as Marcus Richter et al (2005) has done a research that guiding screw insertion with CT scan can reduce risk of injury to neurovascular structure.

Ludwig et al (2000) in a study of placement pedicle screws in the human cadaveric cervical spine mentioned that transverse pedicle angle varies between 36.75° to 44°. From statistical tests above, it was obtained some differences that pedicle angle to the midline is greater in women than in men, whereas the pedicle angle to inferior end plate is greater in men than in women. Research by Yusof et al (2007) on a large range in the side of the pedicle diameter matches the inner diameter ranging from 1.94 mm to 2.8 mm in men and 1.52 mm to 2.31 mm in women. In this study also shows the range of the estimated diameter (outer) pedicle in men and women with the largest diameter obtained on VC 7. There is a significant difference in the diameter of the cervical pedicle which men tend to be larger than women.

CONCLUSION

Mean scores pedicle angle to the midline of men ranging from 43.11° to 45.84° on the right side and 43.32° to 45.94° on the left side, while in women ranging from 44.66° to 48.54° on the right side and 45,03^o to 48,56^o on the left side, there was no significant difference between the left and right pedicle angle, but there are significant differences pedicle angle between men and women. Mean scores pedicle angle to the end plate inferior on men ranging from 12.47° to 15° on the right side and 11.36° to 14.10° on the left side, whilst in women by up to 11.48° to 15.03° on the right side and 11.28° to 15, 17° on the left side. Pedicle diameter in men ranging from 4.85 mm (SD ± 0.62) to 6.17 mm (SD ± 0.67), in women ranging from 4.08 mm (SD ± 0.75) to 5.69 mm (SD ± 0.69). There are differences in the size of both the pedicle angle (toward the midline and end plate the inferior) and the diameter of the pedicle in men and women. The results of the research in this study can be used as a guide in assessing pedicle angle and diameter of VC 3- VC 7. This study can be continued with a larger population so that it can be widely generalized. This study can be used as a

reference for other research in the field of musculo-sceletal.

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