Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 12, pp.62488-62492, December, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

PONTICULUS POSTICUS – IS IT A RARE ANOMALY?

[1]Roshan P. Verghese, [2]Anjali, P., *[,3]Manasa D. Hosamane, [4]Jesin Y. Das, [5]Chetan, R. and [6]Satheesha Reddy, B. H.

[1]Department of Oral Medicine and Radiology, Private Practice, Banagalore, Karnataka, India
[2]Department of Oral Pathology and Microbiology, Private Practice, Kochi, Kerala, India
[3]Department of Periodontics, Subbaiah Institute of Dental Sciences, Shivamogga, Karnataka, India
[4]Department of Oral Medicine and Radiology, Subbaiah Institute of Dental Sciences, Shivamogga, Karnataka, India
[5,6]Department of Oral Medicine and Radiology, AECS Maaruti College of Dental Sciences and Research Center, Bangalore, Karnataka, India

ARTICLE INFO

Article History:
Received 14th September, 2017
Received in revised form
16th October, 2017
Accepted 20th November, 2017
Published online 27th December, 2017

Key words:
Ponticulus Posticus,
Cephalogram,
Cervical vertebra.

ABSTRACT

Objectives: Radiologists play an important role in evaluation of anatomical landmarks and anomalies associated with the same. In the atlas vertebra one such anomaly seen is the Ponticulus Posticus, which is a bony arch enclosing the foramen through which the vertebral artery passes. Some suggest that this anomaly has a protecting effect on the artery from external injury and few suggest that they cause compression of the artery leading to headache and migraine. Objective of this study was to assess the prevalence of Ponticulus Posticus with age and sex distribution and morphological variations among the South Indian population between age groups 15-55 years using Digital cephalometry.

Methods: The study was conducted in the Department of Oral medicine and radiology, A.E.C.S Maaruti College of Dental Sciences And Research Centre Bangalore. A total of 400 patients in the age group of 15-55years were recruited for the study. Digital lateral cephalograms were taken and examined for the presence of Ponticulus Posticus and further evaluated and recorded for partial or complete forms.

Results: Among 400 subjects the study showed a significant prevalence of 34.8%. Females (62.3%) and age group of 15-25 years (46%) showed a higher prevalence of Ponticulus Posticus. 23.8% showed presence of partial ossification and 11% showed complete ossification.

Conclusion: Hence we conclude that Ponticulus Posticus is not such a rare anomaly. Lateral cephalogram must be considered as one of the basic screening tools for detection of these kind of anomalies of spine and radiologists should pay attention to the same.

Citation: Roshan P. Verghese, Anjali, P., Manasa D. Hosamane *et al.* 2017. "Ponticulus posticus – Is it a rare anomaly?", *International Journal of Current Research*, 9, (12), 62488-62492.

INTRODUCTION

The evaluation of anatomic landmarks is an important task of the radiologist because significant changes in these structures may be an index to underlying disease processes. The 1st cervical vertebra also known as atlas vertebra, shows a groove formed by the vertebral artery. The artery ascends in the foramen in the transverse process of the vertebra, then follows a posterior and mesial course, crossing the vertebral arch in the groove and entering the foramen magnum. At times an anomalous ossification center occurs in the ligament, and bridges the sulcus. This bony arch-the Ponticulus Posticus encloses the foramen arcuale or posterior atlantoid foramen, and through this the suboccipital nerve and vertebral artery pass as they course over the upper surface of the first vertebra (Agrawal *et al*., 2012). Ponticulus Posticus means "little posterior bridge" in Latin. It is defined as an abnormal small bony bridge which is formed between the posterior portion of the superior articular process and the posterolateral portion of the superior margin of the posterior arch of the atlas (Schilling *et al*., 2010). This bony bridge has been called by different names such as sagittale foramen, atlantal posterior foramen, arcuate foramen, a variant of Kimmerle 's anomaly, upper retro- articular foramen, canalis vertebralis, retro articular canal and retro-articular vertebral artery ring and retrocondilar vertebral artery ring. However, its most accepted name is "Ponticulus Posticus" (Yong Jae Cho, 2009). The presentation

***Corresponding author:* Manasa D. Hosamane,**
Department of Periodontics, Subbaiah Institute of Dental Sciences, Shivamogga, Karnataka, India.

of these bony arches may be bilateral or unilateral with complete or incomplete tunnels, having a varied prevalence rate, in terms of region. Its clinical significance lies in the fact that either the vertebral artery ring on the posterior arch is being protected from kinking these projections or is it being compressed, causing symptoms like headaches, migraine or dizziness (Schilling *et al*., 2010). Its prevalence has been reported to be between 5.14-37.83% in the western population (Taitz and Nathan, 1986). Taitz (Taitz and Nathan, 1986) had mentioned about the presence of partial posterior bridging of atlas in 25.9% and of its complete bridging in 7.9% of the population. This condition had not been a matter of concern for spine surgeons until its surgical significance in the insertion of screws into the lateral mass of the atlas was recently reported. Some spine surgeons have recently reported that it could cause a severe complication such as a vertebral artery injury during insertion of C1 lateral mass screws. At times, the sulcus is bridged by an anomalous ossification and a posterior ponticulus; a lateral ponticulus is occasionally formed. It forms the arcuate foramen that contains the vertebral artery and the suboccipital nerve. It can be a possible cause of posterior circulation ischaemia and cervicogenic headache (Schilling *et al*., 2010; Yong Jae Cho, 2009).

The potential clinical significance of Ponticulus Posticus is that a majority of patients with this finding are symptomatic. Some studies have determined that patients with Ponticulus Posticus have no greater chance of experiencing adverse effects from cervical adjustments which are related to the presence of a Ponticulus Posticus. However, symptoms that may be associated with Ponticulus Posticus include migraine, vertigo, diplopia, shoulder pain and neck pain which may be caused by the compression of vertebral artery as it passes from the foramen transversum of the first cervical vertebra to the foramen magnum of skull (Koutsouraki *et al*., 2010). In clinical practice lateral cephalogram is the most commonly used diagnostic radiograph and it can be used for significant cervical spine pathology studies. Considering the grave complications that can arise from overlooking this anomaly in cervical spine surgery and other cervical spine interventions and the ease with which it can be avoided, if identified correctly, it can emphasize identification of the Ponticulus Posticus on routine lateral cephalograms.

Radiographically Miki *et al.* (1979) have classified Ponticulus Posticus into three types;

1. Full type - It forms a complete ring.
2. Incomplete type - Some portions of the bony ring are defective.
3. Calcified type - There is a linear or amorphous calcification.

The present study was conducted to evaluate the prevalence of Ponticulus Posticus in South Indian population using Digital lateral Cephalogram and also to assess the morphologic variations in the same.

MATERIALS AND METHODS

The present study was a cross sectional study. 400 Subjects (200 males & 200 females) between the age group of 15-55 years who visited the Department of Oral Medicine and Radiology, AECS Maaruti College of Dental Sciences and Research Centre, between 15 February 2015 and 15 February 2016 for dental examination, who were willing to provide consent were included in the study. Subjects with congenital anomalies, syndromes of the craniofacial region and any history of trauma to the cervical spine region were excluded. Images with poor resolution and Partial images which failed to reveal the posterior arch of atlas due to overlapping of mastoid process or occiput were excluded. The study subjects were grouped into 4 categories based on their age as shown in Table 1. All the subjects in the study were explained about the procedure and a written consent was obtained. The Lateral cephalogram were made using Panoramic Radiograph machine CS8000C equipped with standard positioning device. (Exposure parameters were 70kv, 10ma & exposure time of 0.5sec) The lateral Cephalogram was taken with teeth in occlusion in the standardized head position described by Siebaek-Nielsen and Solow. The images were viewed on a flat screen viewsonic (TFT-LCD MONITOR) with a resolution of 2906 x 2304 pixels in JPEG format with a 24bit grayscale. The lateral cephalogram of each patient was scrutinized for the presence or absence of Ponticulus Posticus and further evaluated and recorded for partial or complete forms (Fig 1 and 2).

Stastical analysis

Data was entered into Microsoft® Excel & was analyzed using Predictive analysis Software version 18.0 (PASW Statistics). Data were summarized as Percentage, Mean & Standard Deviation (SD). Chi-square test was done to test the significance between the variables. For the entire test, a p-value of 0.05 or less was considered as statistically significant.

RESULTS

Lateral cephalograms of 400 subjects were examined for the presence and absence of Ponticulus Posticus and they were further evaluated & recorded for the presence of partial or complete forms. Among 400 subjects, 139 subjects (34.8%) were positive for presence of Ponticulus Posticus and 261 subjects (65.2%) were negative (Table 2). Chi square test was applied to indentify if the difference in prevalence of Ponticulus Posticus between each age group is statistically significant. A p value of 0.00 was obtained in age group 15-25 years (46%), which suggest a statistically significant higher prevalence of Ponticulus Posticus in this age group as compared to others. Among 200 male and 200 female subjects, 51 males and 88 females showed presence of Ponticulus Posticus respectively as depicted in Table 3. Chi square test showed that presence of Ponticulus Posticus in females (63.3%) is significantly higher when compared to males (36.7%) with a p value of 0.00. Out of 400 subjects 23.8% showed presence of partial ossification and 11% showed complete ossification (Table 4).

Chi square test shows that complete ossification of Ponticulus Posticus in age group 26-35 years (54.5%) is significantly higher when compared to other age groups with a p value of 0.00. Among 200 male subjects 33 (40.9%) showed partial and 18 (34.7%) showed complete ossification of Ponticulus Posticus. Among 200 female subjects 62 (65.3%) showed partial and 26 (59.1%) showed complete ossification of Ponticulus Posticus (Table 5). Chi square test showed that partial ossification of Ponticulus Posticus in females (65.3%) is significantly higher when compared to males (34.7%) with a p value 0.00.

Table 1. Age wise distribution of study subjects

Categories	Age Group (In Years)	Male	Female
1	15-25	50	50
2	25-35	50	50
3	35-45	50	50
4	45-55	50	50

Table 2. Age wise distribution of presence or absence Ponticulus Posticus

		Ponticulus Posticus	
		Present	Absent
Age group	15-25 years	64 (46%)	36 (13.8%)
	26-35 years	50 (36%)	50 (19.2%)
	36-45 years	25 (18%)	75 (28.7%)
	46-55 years	0 (0%)	100 (38.3%)
Total		139 (34.8%)	261 (65.2%)

Table 3. Gender based distribution of presence or absence of Ponticulus Posticus

		Ponticulus Posticus	
		Present	Absent
Sex	Male	51 (36.7%)	149 (57.1%)
	Female	88 (63.3%)	112 (42.9%)
Total		139 (34.8%)	261 (65.2%)

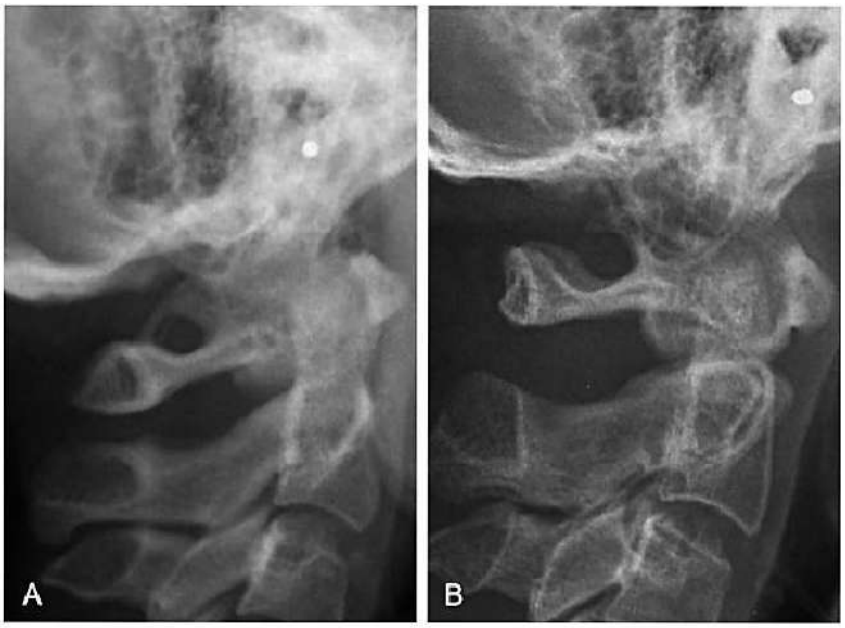
Table 4. Age wise distribution of subjects based on ossification of Ponticulus Posticus

		Ponticulus Posticus ossification		
		Nil	Complete	Partial
Age group	15-25 years	36 (13.8%)	20 (45.5%)	44 (46.3%)
	26-35 years	50 (19.2%)	24 (54.5%)	26 (27.4%)
	36-45 years	75 (28.7%)	0 (0.0%)	25 (26.3%)
	46-55 years	100 (38.3 %)	0 (0.0%)	0 (0.0%)
Total		261 (65.2%)	44 (11%)	95 (23.8%)

Table 5. Gender wise distribution of subjects based on ossification of Ponticulus Posticus

		Ponticulus Posticus ossification		
		Nil	Complete	Partial
Sex	Male	149 (57.1%)	18 (40.9%)	33 (34.7%)
	Female	112 (42.9%)	26 (59.1%)	62 (65.3%)
Total		261 (65.2%)	44 (11%)	95 (23.8%)

Figure 1. Ponticulus Posticus on atlas vertebrae



A Complete form; B Partial form

Figure 2. Complete and Partial forms of Ponticulus Posticus

DISCUSSION

Normal human anatomy varies among individuals and can simulate diseases. Proper diagnosis of this incidental, rare normal variants is important to avoid patient mismanagement and requires familiarity with the anatomy and pathology of these structures. Ponticulus Posticus is such a clinical finding that can be detected on a lateral radiograph. It may present either as a partial or complete radiopaque bridge arching along the oblique portion of the atlanto-occipital membrane from the posterior aspect of the superior lateral mass to the posterior arch of atlas. The vertebral artery passes through the groove in its path from the transverse foramen into the foramen magnum, accompanied by the suboccipital nerve (Hong *et al*., 2008). It is speculated to be congenital or as a result of degeneration. Some authors suggest that these undergo demineralisation over time (Paraskvas *et al*., 2005). The potential clinical significance of Ponticulus Posticus is controversial because the majority of patients with this finding are asymptomatic (Kuhta *et al*., 2010). Various studies have been done to evaluate the importance of this anomaly. The external pressure it causes on vertebral artery as it passes through the foramen transversarium of the first cervical vertebra is considered to be the root cause of the problems associated due to the presence of this anomaly. Significant association has been observed in patients with this anomaly and migraine without aura (Wight *et al*., 1999; Baeesa *et al*., 2012). Chronic tension type headache, vertigo, shoulder pain, arm pain and onset of acute hearing loss are seen to be other related symptoms (Patel *et al*., 2012). Some studies also suggest that the presence of this anomaly might have a protective effect on the vertebral artery against manual pressure (Afsharpour *et al*., 2016). Meta analysis of Ponticulus Posticus in the Indian population has shown a prevalence of 16.7% (Krishnan *et al*., 2015). In our study done, predominantly on South Indian population shows a slightly higher prevalence of Ponticulus Posticus with 34.8%. However, the results of our study was very similar to the study conducted by Sekerci *et al*. (Sekerci *et al*., 2015) which showed a prevalence of 36.8%. Though, slightly higher prevalence was seen in the study conducted by Kuhta *et al.* (2010) which showed a prevalence of 45.9%.

The present study showed a higher prevalence of Ponticulus Posticus in female subjects (63.3%) when compared to male subjects (36.7%) and the difference is statistically significant. This was in accordance with the study conducted by Baba *et al* (Baba *et al*., 2015) which showed a prevalence of 52% in females. However, study conducted by Sharma *et al.* (2010) and Sekerci *et al.* (2015) showed a male predominance. Study conducted by Kendrick and Biggs (1963) showed that there was no apparent sex differences in the occurrence of this anomaly. The study by Manjula *et al.* (2013) showed that there is a higher prevalence in young males and elderly females. In the present study, out of 100 subjects in each group, presence of Ponticulus Posticus was seen as follows; in age group between 15-25 years it was 64, in 26-35years it was 50, in 36-45years it was 25 and in age group of 46-55years there were no cases positive for the presence of Ponticulus Posticus. Hence it was seen that in the age group of 15-25 years the prevalence was more and it was statistically significant. Our study was not in accordance with the study done by Bayrakdar *et al.* (2014) which concluded that the prevalence of Ponticulus Posticus increased with age; and highest prevalence was seen in subjects between 49-81 years of age. Also a study done on normal skulls by John and Robert (Pyo and Lowman, 1958) showed a prevalence of 12-13% in a population principally beyond the age of 40 years. Radiographically Ponticulus Posticus was seen to be of three types according to Miki *et al.* (1979) which included a partial type, a complete type and a calcified type. The present study evaluated the presence of partial or complete forms of ponticulus posticus. The study showed that among the males (200 subjects) 33 showed partial type ossification and 18 showed complete type of ossification which was 40.9% and 34.7% respectively. Among the females (200 subjects) 62 showed partial type ossification and 26 showed complete type of ossification which was 65.3% and 59.1% respectively. Overall partial ossification was seen in 23.8% of subjects and complete ossification was seen in 11% of subjects which was in accordance with the study conducted by Chitroda *et al.* (2013) and Baba *et al.* (2015) which also showed that partial ossification was more prevalent than complete ossification. In the present study, chi square test showed a statistically significant difference between males and females showing partial type of ossification. It was seen that females showed a higher prevalence of 65.3% when compared to males who showed a prevalence of 34.7%. This was in accordance with the study conducted by Gibelli *et al.* (2015) and Baba *et al.* (2015) which also showed a higher prevalence of partial type of ossification in females.

In the present study among different age groups partial ossification of Ponticulus Posticus in different age groups were as follows; 15-25years, 26-35years, 36-45years showed 46.3%, 27.4%, 26.3% respectively. Partial ossification was not seen in subjects between the age group of 46-55years. Our study was in accordance with the study done by Baba *et al.* (2015) which also showed a higher prevalence of partial form of Ponticulus Posticus ossification among subjects aged 19-48 years. Complete ossification was seen in 45.5% and 54.5% in the age groups of 15-25 years, 26-35 years respectively. Complete ossification was absent in subjects between the age group of 36-45 years and 46-55 years. Chi square test was significant for the presence of complete ossification of Ponticulus Posticus being higher in the subjects in the age group between 26-36 years. The present study was in accordance with the study done by Chitroda *et al* (2013) and Baba *et al.* (2015) which also showed a higher prevalence of complete ossification of Ponticulus Posticus in a mean age group of 28 years which was a younger age group. In study conducted by Paraskevas *et al.* (2005) incomplete Canal for the vertebral artery (CVA) appeared to be more characteristic in the age group of 5-44 years, while in an older age group the incomplete CVA was less characteristic. When compared with the present study complete and partial (incomplete) ossification was seen more in the younger age group.

Conclusion

The presence of Ponticulus Posticus in the age group 15-25 yrs (46%) was higher when compared to other age groups. Its presence was higher in female subjects with a prevalence of 63.3% and the common type of ossification seen in females was partial type with a prevalence of 65.3%. Complete type of ossification was more commonly seen in the age group between 26-35 years which showed a prevalence of 54.5%. The present study revealed that Ponticulus Posticus was not a very uncommon anomaly and it should be documented in the patient's health record. If Ponticulus Posticus is suspected or confirmed on radiographs like a lateral cephalogram, three-dimensional CT scanning should be considered. Therefore

lateral cephalograms must be considered as one of the baseline screening tool for detecting spinal anomalies and if and when such anomalies are detected, it should be noted in the patients health record and specialist treatment/consultation sought when significant complaints are present. Since "the eye sees what the mind knows", clinicians and radiologists have to "see" the cervical spine and be equipped to identify any departures from normal anatomy.

Acknowledgement

The authors would like to thank all the participants of the study and Dr. Mahesh P. (Statistician) for helping with the statistical management of data.

Source(s) of support: There are no sources of funding.

Conflicting Interest: The authors report no conflict of interest.

Ethical committee approval: Approval taken

REFERENCES

Afsharpour S, Hoiriis K T, Fox R B and Demons S. 2016. An anatomical study of arcuate foramen and its clinical implications: A case report. *Chiropractic & Manual Therapies*, 24(4):1-7.

Agrawal R, Ananthi S K, Agrawal S and Usha K. 2012. Posterior arch of atlas with abnormal foramina in south Indians. *J. Anat. Soc*., 61(1):30-32.

Baba IA, Shah AF, Yousuf A, Md. Adhnan MF, Manzoor H and Safdar Z. 2015. Prevalence of ponticulus posticus in Kashmiri population. A*nnals of Dental Speciality*, 3(1):6-8.

Baeesa S, Bokhari R F, Bajunaid K M and Al-Sayyad M J. 2012. Prevalence of the foramen arcuale of the atlas in a Saudi population. *Neurosciences*, 17(4):345-351.

Bayrakdar I S, Miloglu O, Altun O, Gumussoy I, Durna D and Yilmaz A B. 2014. Cone beam computed tomography imaging of ponticulus posticus: prevalence, characteristics and a review of literature. *Oral Surg Oral Med Oral Pathol Oral Radiol*., 118:210-219.

Chitroda P K, Katti G, Baba I A, Najmudin M, Ghali S R and Kalmath B. *et al.* 2013. Ponticulus posticus on the posterior arch of atlas, prevalence analysis in symptomatic and asymptomatic patients of Gulbarga population. *Journal of Clinical and Diagnostic Research*, 7(12):3044-3047.

Gibelli D, Cappella A, Cerutti E, Spagnoli L, Dolci C and Sforza C. 2015. Prevalence of ponticulus posticus in a northern Italian orthodontic population: a lateral cephalometric study. *Surg Radiol Anat*., 15:1554-1557.

Hong J T, Lee S W, Son B C, Sung J H, Yang S H and Kim I S. 2008. Analysis of anatomical variations of bone and vascular structures around the posterior atlantal arch using three-dimensional computed tomography angiography. *J Neurosurg spine*, 8(3):230-236.

Kendrick G S and Biggs N L. 1963. Incidence of the ponticulus posticus of the first cervical vertebra between ages six to seventeen. *Anat. Rec*., 145: 449-454.

Koutsouraki E, Avdelidi E, Michmizos D, Kapsali S E, Costa V. and Baloyannis S. 2010. Kimmerle's anomaly as a possible causative factor of chronic tension-type headaches and neurosensory hearing loss: Case report and literature review. *International Journal of Neuroscience*, 120:236–239.

Krishnan P, Kartikueyan R, Patel S M and Das S. 2015. Ponticulus posticus: An anatomical curiosity with clinical implications. *Neurology India*, 63(5):805-806.

Kuhta P, Hart J, Orndorff L G, Reizer B M and Rush P. 2010. The prevalence of ponticulus posticus: retrospective analysis of radiographs from a chiropractic health centre. *Journal of Chiropractic Medicine*, 9:162-165.

Manjula S, Chuha P, Ali S, Mongia M, Verma P and Ahmad, 2013. A prevalence of ponticulus posticus of atlas: a radiological and cadaveric study in hilly regions of Uttarakhand. *National Journal of Medical and Dental Research*, (3):28-33.

Miki T, Oka M, Urishidani H, Hirofuji E, Tanaka S and Iwamoto S. 1979. Ponticulus posticus : its significance. *Acta medica kinki univ*., 4(2):427-430.

Paraskvas G, Papaziogas B, Tsonidis C and Kapetanos G. 2005. Gross morphology of the bridges over the vertebral artery groove on the atlas. *Surg Radiol Anat*., 27:129–136.

Patel Z, Zalawadia A and Pensi C A. 2012. Study of arcuate foramen in atlas vertebrae in Gujarat region. *NJIRM*, 3(2):73-75.

Pyo J and Lowman R M. 1958. The "ponticulus posticus" of the first cervical vertebral. Conn., 72:850-854.

Schilling J. and Schilling Suazo G I. 2010. Ponticulus posticus on the posterior arch of atlas, prevalence analysis in asymptomatic patients. *Int. J. Morphol*., 28(1):317-322.

Sekerci A E, Soylu E, Arikan M P, Ozcan G, Amuk M and Kocoglu F. 2015. Prevalence and morphologic characteristics of ponticulus posticus: analysis using cone beam computed tomography. *Journal of Chiropractic Medicine*, 14:153-161.

Sharma V, Chaudhary D and Mitra R. 2010. Prevalence of ponticulus posticus in Indian orthodontic patients. *Dentomaxillofacial Radiology*, 39:277–283.

Taitz C and Nathan H. 1986. Some observations on the posterior and lateral bridge of the atlas. *Acta Anat*., 127:212-217.

Wight S, Osborne N and Breen A C. 1999. Incidence of ponticulus posterior of the atlas in migraine and cervicogenic headache. *Journal of Manipulative and Physiological Therapeutics*, 22(1):15- 20.

Yong Jae Cho, 2009. Radiological analysis of ponticulus posticus in Koreans. *Yonsei Med J*., 50(1):45–49.

****