

Study on the angle of needling Yamen (GV 15) in atlanto-axial dislocation patients

寰枢椎脱位患者哑门穴针刺角度的研究

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Abstract

Objective: To compare the risk angle and safety angle of needling Yamen (GV 15) between the atlanto-axial dislocation (AAD) patients and healthy subjects.

Methods: A total of 177 AAD patients diagnosed and treated at the Center of Upper Cervical Vertebra of Beijing China-Japan Friendship Hospital between January 2010 and January 2018 were included in the AAD group. Another 207 healthy subjects were included in the normal group. There were totally 191 males and 193 females. The MRI scan was performed for the cervical vertebrae to measure the risk angle and safety angle of acupuncture at Yamen (GV 15) on the sagittal image.

Results: In the AAD group, the risk angle was $(13.14 \pm 3.99)^\circ$ and the relative safety angle was $(10.31 \pm 3.23)^\circ$ for the perpendicular needling, while the oblique needling risk angle was $(9.09 \pm 3.09)^\circ$ for the male; the risk angle was $(12.12 \pm 2.74)^\circ$ and the relative safety angle was $(10.56 \pm 2.09)^\circ$ for the perpendicular needling, while the oblique needling risk angle was $(9.70 \pm 2.95)^\circ$ for the female. In the normal group, the risk angle was $(7.89 \pm 1.59)^\circ$ and the relative safety angle was $(10.21 \pm 3.55)^\circ$ for the perpendicular needling, while the oblique needling risk angle was $(16.07 \pm 1.77)^\circ$ for the male; the risk angle was $(6.93 \pm 1.45)^\circ$ and the relative safety angle was $(10.70 \pm 2.94)^\circ$ for the perpendicular needling, while the oblique needling risk angle was $(14.89 \pm 2.18)^\circ$ for the female. The perpendicular needling risk angles for the males and females in the AAD group were larger than those in the normal group, and the differences were statistically significant (both $P < 0.01$); for the inner-group comparison, there was no significant difference in the perpendicular needling risk angle between the male and the female in the AAD group ($P > 0.05$); however, the perpendicular needling risk angle for the male was larger than the female, and the difference was statistically significant in the normal group ($P < 0.01$). There were no significant differences in the relative safety angle for both the male and the female between the AAD group and the normal group (both $P > 0.05$). For the inner-group comparison, there was no significant difference in the relative safety angle between the male and the female ($P > 0.05$). The oblique needling risk angles for both the males and females were smaller in the AAD group than those in the normal group, and the differences were statistically significant (both $P < 0.01$); the oblique needling risk angle for the male was not significantly different from that for the female in the AAD group ($P > 0.05$); in the normal group, the oblique needling risk angle for the male was larger than that for the female, and the difference was statistically significant ($P < 0.01$).

Conclusion: Under the AAD condition, the risk angle and safety angle of acupuncture at Yamen (GV 15) change significantly, perpendicular needling should be better if performed slightly lower than the horizontal direction, and the oblique needling should be safer across the occipital foramen toward the occipital bone.

Keywords: Acupuncture Therapy; Point, Yamen (GV 15); Atlanto-axial Joint; Joint Dislocations; Research on Acupoints; Needling Direction; Safety

【摘要】目的: 比较寰枢椎脱位(AAD)患者与正常人哑门穴针刺的危险角度和安全角度。**方法:** 选取2010年1月至2018年1月在北京中日友好医院上颈椎中心诊断并治疗的177例AAD患者为AAD组,另选取207例正常人为正常组,其中男性191例,女性193例。对其行颈椎MRI平扫,在矢状位像上测量哑门穴针刺的危险角度和安全角度。**结果:** 在AAD组中,男性直刺危险角度 $(13.14 \pm 3.99)^\circ$,相对安全角度 $(10.31 \pm 3.23)^\circ$,斜刺危险角度 $(9.09 \pm 3.09)^\circ$;女性直刺

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危险角度(12.12 ± 2.74)°, 相对安全角度(10.56 ± 2.09)°, 斜刺危险角度(9.70 ± 2.95)°。正常组中, 男性直刺危险角度(7.89 ± 1.59)°, 相对安全角度(10.21 ± 3.55)°, 斜刺危险角度(16.07 ± 1.77)°; 女性直刺危险角度(6.93 ± 1.45)°, 相对安全角度(10.70 ± 2.94)°, 斜刺危险角度(14.89 ± 2.18)°。AAD组男性和女性的直刺危险角度均大于正常组, 且差异有统计学意义(均 $P < 0.01$); 两组组内比较, AAD组中男性直刺危险角度与女性无统计学差异($P > 0.05$), 但正常组中男性大于女性, 且差异有统计学意义($P < 0.01$)。AAD组男性和女性的相对安全角度与正常组均无统计学差异(均 $P > 0.05$); 两组相对安全角度的组内比较, 男性与女性均无统计学差异(均 $P > 0.05$)。AAD组男性和女性的斜刺危险角度均小于正常组, 且差异均有统计学意义(均 $P < 0.01$); AAD组中, 男性的斜刺危险角度与女性无统计学差异($P > 0.05$); 正常组中, 男性的斜刺危险角度大于女性, 且差异有统计学意义($P < 0.01$)。**结论:** AAD状态下, 哑门穴针刺危险角度和安全角度发生了明显的改变, 针刺时直刺以水平方向略偏下为宜, 斜刺应越过枕骨大孔向枕骨方向针刺最为安全。

【关键词】 针刺疗法; 穴, 哑门; 寰枢关节; 关节脱位; 穴位研究; 针刺方向; 安全性

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Yamen (GV 15) is located in the depression above the spinous process of C_2 , on the posterior midline and 0.5 cun above the middle of the posterior hair margin. It is the crossing acupoint of the Governor Vessel and Yang Link Vessel, and the commonly used acupoint for stiff neck and headache, aphasia, aphonia and abnormal consciousness^[1]. Yamen (GV 15) is deeply adjacent to the medulla of the life center and superiorly adjacent to the occipital foramen. Clinically, too deep needling or upward oblique needling may be risky. However, shallow acupuncture is difficult to achieve the desired therapeutic effect. Atlanto-axial dislocation (AAD) is the loss of the normal matching and stability of the articular surfaces between the atlas and the axis caused by various factors, leading to a series of dysfunctional diseases^[2].

Yamen (GV 15) is often used as a major or adjunct acupoint for AAD. AAD has a change in the anatomy of the atlanto-axial joint, therefore, the conventional acupuncture angle is no longer applicable when acupuncture is performed on AAD patients. How to prevent damage to the spinal cord during clinical acupuncture has become an urgent issue^[3]. The study on the risk angle and safety angle of acupuncture is of great significance for the safety of the patients^[4]. We measured the risk angle and safety angle of Yamen (GV 15) using plain MRI scan of the cervical spine in the AAD group and the normal group. After statistical analysis, the corresponding conclusions were obtained for clinical reference.

1 Clinical Materials

1.1 Diagnostic criteria

Diagnostic criteria for atlanto-axial dislocation: clinical manifestations and imaging examinations are consistent with atlanto-axial dislocation or instability; imaging diagnosis, atlas-dens interval (ADI) > 5 mm or space available for the cord (SAC) ≤ 13 mm, or the presence of significant atlanto-axial joint instability^[2].

1.2 Inclusion criteria

After measuring the body weight and height of each age group, the moderate type (Roche index: 1.29-1.49) was selected according to the Roche index [Roche index = $100 \times \text{Body weight (g)} \div \text{Height (cm)}$]³ in the *Diagnostic Dictionary*^[5]; patients in the AAD group must meet the above diagnostic criteria; AAD and other diseases that cause spinal anatomical abnormalities must be excluded from the normal group.

1.3 Statistical methods

All data were analyzed using SPSS 20.0 software. Measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$), independent sample *t*-test was used for comparison between groups. Paired sample *t*-test was used for comparison within the group. The count data were analyzed by Chi-square test. The difference was statistically significant at $P < 0.05$.

1.4 General information

A total of 177 AAD patients diagnosed and treated at the Center of Upper Cervical Vertebra, China-Japan Friendship Hospital between January 2010 and January 2018 were included in the AAD group, including 96 males and 81 females; the age was 18-83 years old. The 207 healthy subjects with AAD excluded and normal anatomy were included in the normal group, with 95 males and 112 females; the age was 21-82 years old. The differences between the two groups in clinical data were statistically insignificant (both $P > 0.05$), (Table 1).

Table 1. Comparison of general data between the two groups

Group	n	Gender (case)		Average age ($\bar{X} \pm s$, year)
		Male	Female	
AAD	177	96	81	51.8 \pm 15.0
Normal	207	95	112	51.3 \pm 15.7
Statistical value			2.66 ¹⁾	0.34 ²⁾
P-value			0.10	0.71

Note: 1) χ^2 value; 2) *t*-value

2 Observation Methods

2.1 Acupoint positioning

Yamen (GV 15) was located according to the *Nomenclature and Location of Acupuncture Points* (GB/T 12346-2006)^[1]: in the upper depression of the second cervical spinous process and on the posterior midline.

2.2 MRI scanning method

The plain cervical spine scan was performed in the AAD group and the normal group by GE1.5T MRI, Department of Radiology, China-Japan Friendship Hospital.

2.3 Image measurement method

All images were obtained from the MRI median sagittal T1W image. At Yamen (GV 15), the localization and measurement were performed according to clinical operating habits and practical feasibility. As shown in Figure 1 and Figure 2, posterior neck surface O of Yamen (GV 15) was the apex, which was crossed at point A with the upper line for the horizontal relative spinous process of axis and the dura mate of spinal cord, crossed at point B with the lower line for the posterior arch of the atlas and the dura mate of spinal cord, crossed at point C with the upper line for the posterior arch of the atlas and the dura mate of spinal cord, crossed at point D with occipital macroporous trailing edge connection and the dura mate of spinal cord. $\angle AOB$ was the risk angle for the perpendicular needling at Yamen (GV 15) acupoint. $\angle BOC$ was the relative safety angle for the perpendicular needling and the oblique needling at Yamen (GV 15) acupoint. $\angle COD$ was the risk angle of the oblique needling at Yamen (GV 15). Below the OA line (downward oblique needling) and above the OD line (upward oblique needling to avoid the foramen magnum) was an absolute safety angle.



Figure 1. Schematic diagram of image measurement in the AAD group



Figure 2. Schematic diagram of image measurement in the normal group

3 Observation Results

3.1 Risk angles of perpendicular needling

There was no significant difference in the risk angle of perpendicular needling between the male and the female in the AAD group ($P>0.05$). However, in the normal group, the risk angle of perpendicular needling for the male was larger than the female, and the difference was statistically significant ($P<0.01$). The risk angles of perpendicular needling in the AAD group for both male and female were larger than those in the normal group, and the differences were statistically significant (both $P<0.01$), (Table 2).

Table 2. Comparing the risk angles of perpendicular needling in the two groups ($\bar{x} \pm s, ^\circ$)

Group	n	Male	Female	t-value	P-value
AAD	177	13.14±3.99	12.12±2.74	2.00	0.05
Normal	207	7.89±1.59	6.93±1.45	4.54	0.00
t-value		-11.95	-15.55		
P-value		0.00	0.00		

3.2 Relative safety angle

There were no significant differences in the relative safety angles between the male and the female in both ADD group and normal group (both $P>0.05$). In between-group comparisons of both the female and the male, there were no significant differences in the relative safety angles (both $P>0.05$), (Table 3).

3.3 Risk angles of oblique needling

In inner-group comparisons, there was no significant difference in the risk angle of oblique needling between the male and the female in the AAD group ($P>0.05$); the risk angle of oblique needling for the male was larger than that for the female in the normal group, and the

difference was statistically significant ($P<0.01$). The risk angles of the oblique needling for the male and the female in the AAD group were smaller than those in the normal group, and the differences were statistically significant ($P<0.01$), (Table 4).

Table 3. Comparison of relative safety angles between the two groups ($\bar{x} \pm s, ^\circ$)

Group	n	Male	Female	t-value	P-value
AAD	177	10.31±3.23	10.56±2.09	-0.62	0.54
Normal	207	10.21±3.55	10.70±2.94	-1.09	0.28
t-value		-0.20	0.37		
P-value		0.84	0.71		

Table 4. Comparing the risk angles of the two groups ($\bar{x} \pm s, ^\circ$)

Group	n	Male	Female	t-value	P-value
AAD	177	9.09±3.09	9.70±2.95	-1.35	0.18
Normal	207	16.07±1.77	14.89±2.18	4.29	0.00
t-value		19.20	13.40		
P-value		0.00	0.00		

4 Discussion

Yamen (GV 15) is first recorded in *Su Wen · Qi Xue Lun* (Chapter of Qi and Acupoints Theory, Essential Questions), and has been discussed by doctors of all ages. It is an effective acupoint for meridian symptoms and signs, aphasia, aphonia, and abnormal consciousness. In *Su Wen · Ci Jin Lun* (Chapter of Needling Contraindications Theory, Essential Questions), there is a saying that 'acupuncture at the door of brain will cause death when entering the brain'. Medulla oblongata may be injured through the atlanto-axial intervertebral space. Oblique needling can damage the arachnoid and cerebellum through the large hole of the foramen magnum. Therefore, the doctor is required to 'know if the disease is inside or outside by judging the depth' when acupuncture is performed. Meanwhile, during needling operation, it is necessary to carefully determine the appropriate depth and angle of the needling according to different conditions to ensure a safe acupuncture^[6]. Studies have shown that the incidence of minor adverse events is 14/10 000, and the incidence of serious adverse events is between 0.05/10 000 and 0.55/10 000 caused by acupuncture^[7]. When the depth is too deep or the angle is not correct in acupuncture, it may cause serious complications, such as brain stem or spinal cord injury, subarachnoid hemorrhage^[8], and even death. For the safety study of needling Yamen (GV 15), modern physicians quantified the safe acupuncture range of Yamen (GV 15) according to the anatomical and imaging quantitative studies. Zhao CX, *et al*^[9] studied the acupuncture angle of

Yamen (GV 15) under the normal anatomy by MRI, and their results were basically consistent with this study. With the progression of medical imaging, this study further measured the images of the posterior arch of the atlas for the safety and risk angle of acupuncture, to improve the concept of 'relative safety angle'.

Modern medical research has found that there is a correlation between the depth of acupuncture and somatotype^[10]. Zhou DY divides the somatotype into an asthenic type, a moderate type, and a pyknic type. The safety depth of acupuncture was obtained by CT measurement. Tang J, *et al*^[5] contrasted the safe depth of acupuncture among different somatotypes and different age groups. They clearly confirmed that there was no correlation between safety depth and age, and there was a positive correlation with the Roche index. However, there is no research on the relationship between the somatotype and acupuncture angle. This study mainly measured the effect of AAD on the acupuncture angle. AAD is a rare disease; therefore, other somatotypes have not been studied, but only the patients with moderate somatotype were analyzed. The effect of somatotype on the acupuncture angle is needed to be improved.

AAD is the loss of the normal matching and stability of the articular surface between the atlas and the axis caused by various factors, including trauma, congenital malformation, degeneration and other factors, and may lead to a series of pathological states such as joint dysfunction, spinal cord injury, and nerve compression. The main clinical manifestations are neck occipital pain, limited neck activity, limb weakness; which may be accompanied by symptoms of vertebral artery insufficiency such as dizziness, tinnitus, etc.; severe cases can lead to paralysis, and even death^[2]. Yamen (GV 15) can achieve a certain effect in improving the dysfunction caused by AAD (such as the neck and occipital pain, and limited motion of the neck)^[11]. Abnormal anatomy of atlanto-axial joint causes changes in the structure of Yamen (GV 15). But the anatomy of the acupoint is not the key, and the core is the healthy qi and its changes. Acupuncture should be changed with the onset of the disease^[12-13]. Therefore, it is particularly important to determine the safety angle and risk angle of acupuncture at Yamen (GV 15). Following the standard acupuncture angle is an important method to prevent adverse events of acupuncture^[14]. Therefore, we performed the MRI examination and analyzed using statistical methods for the moderate body type patients between the AAD group and the normal group, which are summarized as follows.

First, the risk angle of perpendicular needling Yamen (GV 15) for the male and female patients with AAD was larger than that in the healthy subjects, but there was no significant difference between the male and female

with AAD. The risk angle of perpendicular needling in healthy subjects was larger for the male than for the female. The possible reason is that AAD is often characterized by anterior dislocation^[15]. There is very little posterior dislocation of the atlas beyond the fascia dentata^[16]. Therefore, the sagittal angle between the atlas and axis is significantly larger than that in patients with normal anatomy, and the risk angle of perpendicular needling is larger than that of the healthy subjects. AAD is mostly caused by trauma and congenital malformation. Congenital malformations are often accompanied by skeletal muscle dysplasia, and muscle atrophy also occurs in the later stages of trauma. Therefore, there is no significant difference between the male and female AAD patients in the risk angle of perpendicular needling.

Second, no significant difference in the relative safety angle between the perpendicular needling and the oblique needling was observed regardless of whether the anatomical structure was dislocated. The reason may be that the posterior arch of the atlas is only 5.52 mm^[17], and it is not enough to produce a significant effect on its angle; it may also be because the MRI median sagittal position measure was used in this study, and there was an error in the full display and measurement of bone compared to the three dimensional (3D) CT reconstruction.

Third, the risk angle of oblique needling Yamen (GV 15) was smaller for the male and female AAD patients than that for the healthy subjects; there was no significant difference in the risk angle of oblique needling between the male and female patients with AAD; the risk angle of perpendicular needling were larger for the male patients than for the female patients with normal anatomy. The reason may be that AAD patients often have atlas and occipital deformities, atlas and occipital fusion or limited atlas and occipital activities. Therefore, the risk angle was smaller than the healthy subjects, and it was less likely to hurt the foramen magnum. The remaining reasons are the same as above.

We performed imaging measure and introduced the concept of 'relative safety angle'. However, because the risk angles of the perpendicular needling and the oblique needling were partially overlapped, it was difficult to represent the entirety by mean and standard deviation. Therefore, it was not recommended to use a 'relative safety angle' for acupuncture. The depth of the needle should be controlled within its safe range for acupuncture treatment of AAD patients with normal anatomy. We will elaborate this in another article. Since shallow needling at Yamen (GV 15) is hard to obtain needling sensation, the needling angle must be strictly controlled during deep needling.

In summary, significant changes have taken place in the risk and safety angles of acupuncture at Yamen

(GV 15) under in AAD. Perpendicular needling is preferable when performed slightly below the horizontal direction (perpendicular to the skin) to prevent the damage to the spinal cord after penetration into the spinal canal; the oblique needling should be performed towards the occipital bone beyond the occipital foramen, i.e., the safest angle with OA in Figure 1 and Figure 2, in male was $>(32.54\pm 6.56)^\circ$, and in female was $>(32.39\pm 4.99)^\circ$. It can avoid damage to the arachnoid and cerebellum in acupuncture at the occipital foramen. However, when performing acupuncture, it is not possible to mechanically rely on the scope of acupuncture for treatment. The patient's age, gender, body type, etc., must be comprehensively considered. In addition, factors such as the patient's posture, needle type and needle retention time should also be considered^[18-20].

Conflict of Interest

The authors declared that there was no potential conflict of interest in this article.

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Statement of Informed Consent

Informed consent was obtained from all individual participants.

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