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Original Investigation

Placement of Three-Pin Head Holders in the Concorde Position

Konkorde Pozisyonunda Üçlü Çivili Başlığın Yerleştirilmesi

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ABSTRACT

AIM: To reevaluate the Concorde position with different surgical interventions to the posterior fossa and cervical pathology and to improve patient comfort in the Concorde position through obtuse angle placement of the three-pin holder while the patient is in the supine position.

MATERIAL and METHODS: Twenty-nine patients with posterior fossa pathology or cervical pathology were included in this study. All patients were operated in the Concorde position. The three-pin holder was placed with an obtuse angle while the patient was in the supine position as shown in figure 1a. The angle between the handle of the three-pin holder and the floor was measured in the supine and prone positions as shown in Figure 1A,B.

RESULTS: The average angle between the floor and the handle of the three-pin holder in the supine position and the Concorde position was 135 degrees (SD ± 5.45) and 95 degrees (SD ± 3.26) respectively (Figure 4) All the patient's body including the shoulders was within the borders of the operation table.

CONCLUSION: The placement of three-pin holders with an obtuse angle in the supine position provides three advantages: easier manipulation during neck flexion especially for cervical vertebral pathology, much less body weight loading on the three-pin holders during surgery, and less flexion of the neck to expose pathology located in the cervical or posterior fossa region.

KEYWORDS: Concorde position, Obtuse angle, Posterior cervical, Posterior fossa, Threepin holder

ÖZ

AMAÇ: Posterior fossa lezyonları ve posterior servikal patolojilere müdahale için kullanılan konkorde pozisyonu yeniden değerlendirilmiş ve üçlü çivili başlığın hasta supine pozisyonda iken geniş açı ile yerleştirilmesinin etkileri araştırılmıştır.

YÖNTEM ve GEREÇ: Posterior servikal ve posterior fossa patolojisi olan 29 hasta bu çalışmada değerlendirilmiştir. Hastalar supine pozisyonda iken üçlü çivili başlık geniş açı ile yerleştirilmiştir (Şekil 1A). Üçlü çivili başlığın kolluğu ile yer ekseni arasındaki açı hasta supine ve prone pozisyonda iken ölçülmüştür (Şekil 1A,B).

BULGULAR: Hastalar supine pozisyonda iken üçlü çivili başlık kolu ile yer ekseni arasındaki açının ortalama değeri 135 derece (SD ± 5.45) ve hastalar prone pozisyonda iken ölçülen açının ortalama değeri 95 derece (SD ± 3.26) olarak bulunmuştur (Şekil 4). Prone pozisyonda iken tüm hastaların omuzları operasyon masasının sınırları içerisinde kalmıştır.

SONUÇ: Hastalar supine pozisyonda iken üçlü çivili başlığın geniş açı ile yerleştirilmesi üç avantaj sağlamaktadır. 1- Servikal vertebral patolojisi olan hastalarda daha kolay pozisyon verme, 2- Hasta supine pozisyonda iken vücut ağırlığı üçlü çivili başlık üzerine daha az yüklenir, 3- Servikal veya posterior fossa patolojilerine ulaşmak için daha az fleksiyon verilmesi.

ANAHTAR SÖZCÜKLER: Geniş açı, Konkorde pozisyonu, Posterior servikal, Posterior fossa, Üçlü çivili başlık

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INTRODUCTION

One of the most important aims of neurosurgery is to expose the area of pathology without causing any damage to the surrounding or distant tissues. Some positions such as the sitting position, prone position and Concorde position are established in neurosurgical practice. While positioning the patients, neurosurgeons also position the neck and head using various movements such as hyperflexion or hyperextension of the neck, tilting the neck upwards or downwards and turning the head to the left or right. Each position may cause some problems including peripheral nerve injury, brachial plexus injury, venous occlusion in the neck, pressure on the eye, spinal cord injury and vertebral artery occlusion (1, 2, 3, 13, 14). There is still debate among neurosurgeons as regards positioning patients with posterior fossa or cervical pathology. Some neurosurgeons have recently preferred the Concorde position rather than the sitting position because of the common complications of the latter such as venous air embolism, hypotension, airway oedema, central cord syndrome, macroglossia, paraplegia, quadriplegia, jugular venous obstruction, spinal cord infarction, myelopathy, subdural hematoma, decreased cerebral perfusion pressure and postoperative tension pneumocephalus (1, 3, 4, 8, 13, 14, 24, 27, 28). Others prefer to use the sitting position because of some surgical advantages including better preservation of the lower cranial nerves and better visualization of the surgical area (2, 3, 17, 22, 24). Kyoshima reported using the arm-down Concorde position, but did not describe placement of the three-pin holders (11). In this study, we provided an obtuse angle between the floor and the handle of the three-pin holders in the supine position for patients undergoing surgery for posterior fossa pathology or cervical pathology. After turning the patient to the Concorde position, we put the neck in a flexion position or neutral position for adequate exposure according to the patient's pathology. We compared the angles in the supine position and in the Concorde position. In addition, we observed the body of the each patient to ensure it was adequately secured to the table and to prevent weight loading on the three-pin head holders in the Concorde position.

MATERIAL and METHODS

Twenty-nine patients (17 male and 12 female) were included in this study. The average age of the patients was 59 years. The diagnosis of each patient, types of surgery and any position-related complications are described in Table I. All patients except the five diagnosed with cervical fracture were placed with their neck fully flexed in the sitting position the day before the surgery to assess the tolerance of the spinal cord to neck flexion. The patients held this position for a minimum of five minutes, during which time they were monitored for any spinal cord compression signs and symptoms. In addition, two patients diagnosed with a cerebellopontine angle tumor were asked to turn their head toward the left or right side, according to their pathology, while the neck was in the flexion position, to determine vertebral artery supply to the brainstem. The three-pin holder was placed about 2-3 cm above the helix of the auricula and was compressed to the patient's head while he/she was on the general purpose stretcher that was parallel to the floor. The angle between the floor and the handle of the three-pin holder was arranged as an obtuse angle while the patient was in the supine position with the general purpose stretcher parallel to the floor as shown in Figure 1A. The angle between the floor axis and the line parallel to handle of the three-pin holder was measured. The patient was then put on the operation table which was again parallel to the floor in the prone position and then placed in the Concorde position and the three-pin holder secured. The angle between a line parallel to the floor and another line parallel to the handle of three-pin holder was then measured (Figure 1B). All patients were secured to the operation table and each patient's

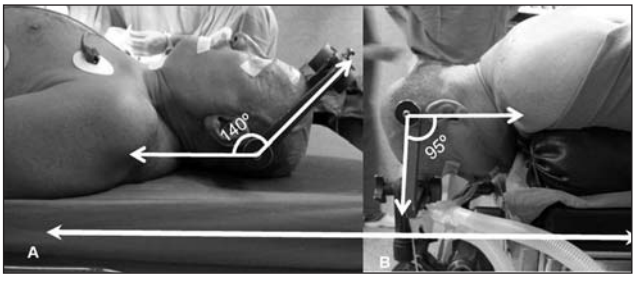

Figure 1: *The three-pin holder was placed at an obtuse angle while the patient was in the supine position on the general purpose stretcher before turning to the Concorde position. The angle between the handle of the three-pin holder and the floor was 140 degrees* ***(A)****. The patient was turned to the Concorde position and transferred to the operation table and the three-pin holder was fixed to its base unit. The angle between the handle of the three-pin holder and the floor was 95 degrees* ***(B).*** *The line at the bottom of the pictures shows the parallel position of the general purpose stretcher and operation table to the floor.*

Table I: The Diagnostic Features, Neck Position and Position-Related Complications of the Patients in this Series.

Diagnosis	Surgery	Neck position	PRC	Number of Patients
CSM	CL and LMSF	Neutral or mild flexion&	No	11
PFT	SOC and TR	Optimum flexion&	Yes#	11
CPAT	RSA and TR	Optimum flexion& and turning of the patient's head toward location of the pathology	No	2
CVF*	LMSF	Neutral or mild flexion&	No	5

CSM: Cervical spondylotic myelopathy
PFT: Posterior fossa tumor
CPAT: Cerebellopontine angle tumor
CVF: Cervical vertebra fracture
PRC: Position related complication
CL: Cervical laminectomy
LMSF: Lateral mass screw fixation
TR: Tumor resection
RSA: Retrosigmoid approach
SOC: Suboccipital craniectomy
***:** Patients with cervical vertebra fracture underwent two steps surgery. Anterior decompression and plate system were applied firstly and posterior cervical approach was performed afterwards.
&: The distance between the chin and the chest was arranged as two or three fingerbreadths in the Concorde position. In addition, each patient's chest was kept within table borders to avoid body weight loading over the three- pin holders.
#: Only one patient who was among the patients that underwent posterior fossa lesion resection had severe headache due to pneumoventriculus, but he recovered without any surgical intervention in a couple of days.

body was kept within the operation table borders. Every part of the patient's body was within the table borders except the head and neck (Figure 2A,B,C). The neck of each patient was positioned according to the pathology. For example, the neck was flexed adequately to provide exposure for the suboccipital approach. The distance between the chin and the chest was kept at three or four fingerbreadths to prevent venous obstruction and spinal cord pressure (Figure 2A). The neck was optimally positioned in patients with cervical vertebra fracture and cervical spondylosis to provide cervical vertebral alignment or to preserve cervical lordosis under X-ray scopy. If the pathology was located at the cerebellopontine angle, the patient's head was turned toward the pathology in addition to neck flexion. Once the patient was placed in the appropriate position, the arms were secured across the body, controlling the presence of the radial pulse, and the patient's shoulders were prevented from falling to circumvent compression of the brachial plexus. The table break between the body and the pelvis varied between 90

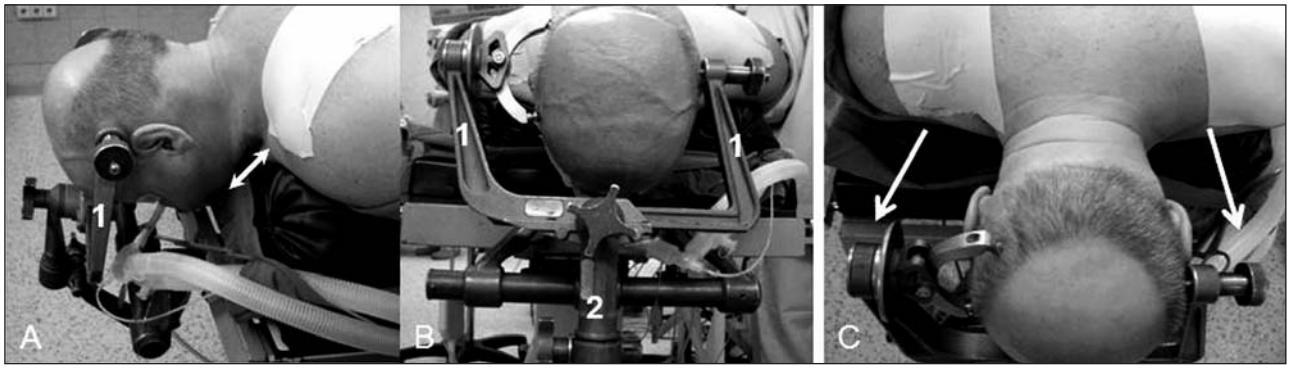

Figure 2: *The distance between the chin and chest is three fingerbreadths with the patient in the Concorde position* ***(A).*** *The patient's body and shoulders are within the borders of the operation table* ***(B, C).*** *White arrows show the borders of the operation table. 1: The handle of the three-pin holder. 2: Base unit of the three-pin holder for fixation.*

degrees to 180 degrees. After the positioning, the table break angle was arranged according to our preference (Figure 3). All patients were intraoperatively monitored regarding vital parameters including blood pressure, central venous pressure, pulse, end tidal CO2 via nasal cannula and arterial blood gases.

RESULTS

All patients were examined preoperatively except the five patients diagnosed with a cervical vertebra fracture. Four patients had spinal cord compression signs including numbness, tingling and neck pain during neck flexion. No patient experienced any head turning which was especially important for patients whose head was turned towards the pathology in the Concorde position. The average angles between the floor and the handle of the three-pin holder in the supine position and the Concorde position were 135 degrees (SD ±5.45) and 95 degrees (SD ±3.26) respectively (Figure 4). Every part of each patient's body was kept within table borders except the head and neck (Figure 3). Each patient's neck was easily positioned and the distance between the chin and the chest was at least 3 fingerbreadths after fixing the three-pin holder in the Concorde position (Figure 2A). The necks were flexed more in patients with posterior fossa pathology to obtain exposure. In addition, the neck was flexed and turned towards the pathology in patients with cerebellopontine angle tumors. The neck was in the neutral position or mildly flexed in patients with cervical spondylomyelopathy. Cervical vertebral alignment was ensured under X-ray scopy giving optimal neck position to patients with cervical vertebra fracture. There were no abnormal vital parameters during positioning or surgery in any patient in the Concorde position except one patient who developed severe headache and pneumoventricle after suboccipital craniectomy for surgical evacuation of a symptomatic arachnoid cyst. Her headache resided completely in a couple of days without any surgical attempt but the pneumoventricle resolved only partially. We did not experience position-related exposure problems during surgery in various pathological conditions in this series (Figure 3).

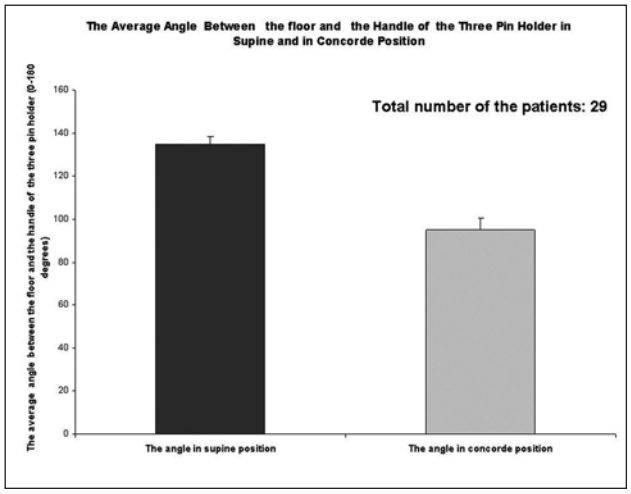

Figure 4: *Comparison of the angles between the supine position and Concorde position.*

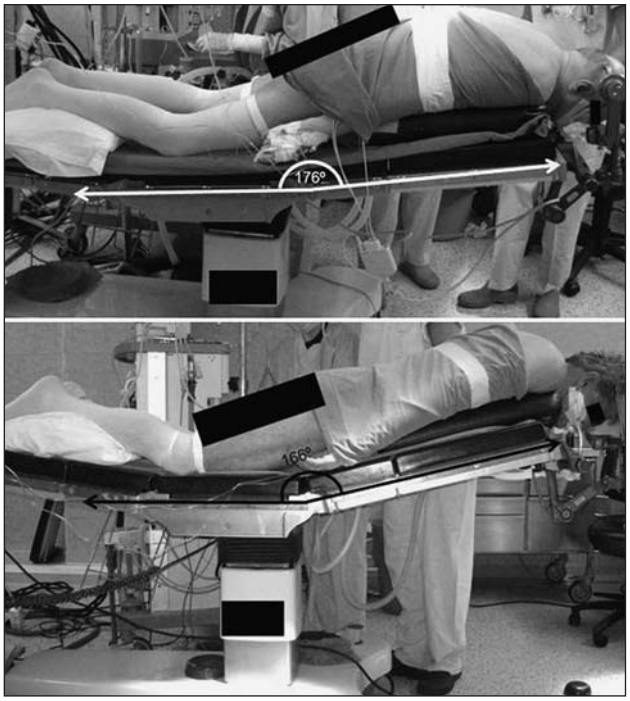

Figure 3: *The table break between the body and pelvis varied between 90 degrees and 180 degrees. After positioning of the patient in Concorde position, the table break angle was arranged depending on our preference. The arms were secured across the body, controlling the presence of the radial pulse, and the patient's shoulders were prevented from falling down to circumvent compression of the brachial plexus.*

DISCUSSION

Stendal et al reported a lower incidence of air embolism (10–17% versus 75%) in the Concorde position than the sitting position (25). Intracranial air is seen after cranial or spinal surgery in the supine, sitting, park-bench, or prone position when the dura has been opened (4, 9). Development of tension pneumocephalus is seen most frequently after the sitting position associated with posterior fossa

surgery (9, 29). Life-threatening brain herniation has been reported with tension pneumocephalus at an incidence of 3% in one large study (24). Venous air embolism has been described in association with a variety of surgical procedures and positions, including the sitting position, prone position, lateral position and supine position, but it has mostly been encountered in the sitting position during neurosurgical procedures where it is one of the most feared complications (2, 5, 7, 19, 23, 25, 26). Various complications such as infection, skull fracture, epidural hematoma and subdural hematoma regardless of the position of the patient have been described in association with the pins of the three-pin holders in neurosurgical procedures (21, 26). Establishing the Concorde position is much easier and quicker than the sitting position. In addition, complicated instrumentation is not necessary for the Concorde position. However, the Concorde position is still not commonly used among neurosurgeons, despite the lower complication risk (22). It is important to emphasize that the Concorde position is not free of risk and complications such as quadriplegia, pneumocephalus and venous air embolism have been reported by various authors (2, 10, 20, 22). The sitting position can result in many devastating complications including venous air embolism, hypotension, postoperative tension pneumocephalus, airway oedema, central cord syndrome, macroglossia, paraplegia, quadriplegia, jugular venous obstruction, spinal cord infarction, myelopathy, subdural hematoma, decreased cerebral perfusion pressure, postoperative tension pneumocephalus and tension pneumoventricle (13, 14, 15, 16, 18, 19, 25, 28, 30, 31, 32). Severe tension pneumocephalus may lead to life- threatening brain herniation with an incidence of 3% in the sitting position (24). In contrast, Duke and Young have reported that sitting position-related morbidity is not significantly different than of other positions and the sitting position can be used in selected cases (6, 31). This has been supported by other authors (7, 12, 17). There is still debate on the complications of the sitting position. We found positioning the patients and management of complications more difficult in the sitting position than in the Concorde position. The Concorde position presented some difficulty when turning the patient from the supine position to the prone position, but this can be conveniently performed with teamwork. Kyoshima reported using the arm-down Concorde position to expose the posterior fossa in the muscular or broad shouldered, short-necked or obese patient, but did not mention the placement of the three-pin holder in this position (11). In this study, we placed the three-pin holders with an obtuse angle in our presented technique while the patient was in the supine position (Figure 1A,B). The average angle was 135 degrees in the supine position, and 95 degrees after turning the patient to the Concorde position. The placement of the three-pin holders with an obtuse angle provided an advantage of about 40 degrees on average, before the neck flexion (Figure 1A,B). We believe that the 40 degrees angle difference will provide better positioning to the neck and less body weight loading on the three-pin holder and neck, and better preservation of cervical lordosis with less flexion of the neck for access to the pathology. We did not monitor somatosensory evoked potentials to prevent spinal cord compromise during surgery, but examined all patients except the five diagnosed with cervical vertebra fracture the day before surgery. No patients experienced any spinal cord compromise or vertebral artery obstruction symptoms and signs except the four patients who had been diagnosed with cervical spondylomyelopathy. A neutral neck position or moderate neck flexion was obtained in patients who had spinal cord compromise symptoms. We did not experience any exposure or manipulation problems while extracting the lesions from the posterior fossa or cerebellopontine angle and performing cervical laminectomy or inserting lateral mass screws from cervical 1 to cervical 7. Cervical lordosis was well preserved in our patients who underwent lateral mass screw fixation due to cervical spondylosis or cervical vertebra fracture. However, larger series are necessary to confirm this finding. Lack of monitoring of the somatosensory evoked potentials and the limited number of the patients are the weaknesses of this study. The noticeable results of this study were the ability to keep the patient's body within the borders of the table and less body weight loading on the three-pin holder with the patient in the Concorde position. Before the introduction of this technique, we experienced difficulty while positioning the patient in the Concorde position. We were unable to obtain satisfactory flexion of the neck without pulling the patient's body out of the table borders. The patients were pulled and their shoulders exceeded the operation table borders with the body weight partly loading on the three-pin holders that caused insecure

placement regarding three-pin holders pinsites. Positioning and manipulation of the patient's neck was much more satisfactory after the introduction of this technique. In addition, this technique may provide further advantages in patients with cervical fracture and cervical spondylomyelopathy due to minimal loading on the three-pin holders and neck. The difference of about 40 degrees between the supine position and Concorde position may also require less flexion for exposure to the pathology, and therefore less spinal cord compromise. Monitorization of intraoperative somatosensory evoked potentials is necessary during positioning and surgery to prove this hypothesis.

CONCLUSION

We believe that the placement of the three pin-holder at an obtuse angle in the supine position provides the following advantages: easier manipulation during neck flexion, much less body weight loading on the three-pin holder during surgery and less flexion of the neck to expose pathology located in the cervical or posterior fossa region.

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