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Clinical Article

A new simple therapeutic method for chronic subdural hematoma without irrigation and drainage

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Summary

Background. We developed a new simple therapeutic method for the treatment of chronic subdural hematoma (CSDH) without irrigation and drainage. This method is characterized by replacement of the hematoma with oxygen.

Methods. Seventy patients (seventy-eight sides) with CSDH were treated with this method from May 1994 to October 2002. For the complete replacement of the hematoma with oxygen, subdural tapping site was changed from the thickest area of the hematoma to the parietal tuber. Irrigation and drainage were not used in all patients.

Results. Neurological recovery after the treatment was satisfactory in all 70 patients. An average amount of replaced hematoma was 96.1 ml, ranging from 5 to 280 ml. An initial hematoma pressure ranged from 0 to 200 mm H_2O (average: 92.1 mm H_2O). During the follow up periods, clinical recurrence was noted in 7 patients (10%) and 7 sides (9.0%).

Conclusion. The replacement of the hematoma with oxygen via percutaneous subdural tapping without irrigation and drainage is useful and less invasive method for the treatment of CSDH.

Keywords: Chronic subdural hematoma; subdural tapping; oxygen.

Introduction

Until recently, the most popular procedure for the treatment of chronic subdural hematoma (CSDH) in adults has been burr hole craniostomy with irrigation using saline and closed-system drainage. Recently, usefulness of twist drill craniostomy instead of burr hole craniostomy was described in several reports in the literature [7, 10], and the necessity of irrigation using saline or closed-system drainage was discussed [2, 4].

As mentioned above, there are a variety of treatments of CSDH [9], however this no irrigation and no drainage method for CSDH with a twist drill is the treatment of choice for CSDH. This report is about Aoki's method, which uses a closed system drainage [1].

In this study, we review the results of this simple procedure and discuss the theoretical basis.

Patients and methods

Over a 9-year period between 1994 and 2002, 91 patients with CSDH underwent surgical treatment at the Department of Neurosurgery, Tokyo Metropolitan Ohkubo Hospital. This study consists of 70 patients (78 sides) who were treated with a new therapeutic method which consists of replacement of the hematoma with oxygen via percutaneous subdural tapping without irrigation and closed system drainage. The diagnosis was made on CT scanning or MRI, and the hematoma content was confirmed at the time of percutaneous subdural tapping. No strict selection of patients for this procedure was adopted. We treated any type of CSDH by this simple procedure as the method of choice.

We clarified and assessed these patients by physical and neurological examination.

We used the neurological grading system of Markwalder et al, which is as follows (Table 1):

Grade 0: patient neurologically normal
Grade 1: patient alert and oriented; mild symptoms, such as headache; absent or mild symptoms or neurological deficit, such as reflex asymmetry.
Grade 2: patient drowsy or disoriented with variable neurological deficit, such as hemiparesis.
Grade 3: patient stuporous but responding appropriately to noxious stimuli; severe focal sign, such as hemiplegia.
Grade 4: patient comatose with absent motor response to painful stimuli; decerebrate or decorticate posturing.

We referred to Nakaguchi and his colleague classifying CSDH into four types by the hematoma density (homogenous, laminar, separated,

Table 1.

Characters	No. of patients (%)
Sex	
– Male	56 (80)
– Female	14 (20)
Sides	
– Right	30 (43)
– Left	32 (46)
– Both	8 (11)
Age	72.8 ± 12.0 ys
– Male	71.8 ± 12.8 ys
– Female	76.5 ± 7.1 ys
Removed hematoma volume	96.1 ± 57 ml
Initial pressure	92.1 ± 63.3 mm H_2O
Recurrent cases	7 (10)
Recurrent sides	7 (9.0)
Characters of recurrent cases	
– Age	74.4 ± 16.2 ys
– Male	7 (100)
– Female	0 (0)
– Recurrence	3 (43)
Neurological grading	
– Grade 0	6 (8.5)
– Grade 1	25 (36)
– Grade 2	38 (54)
– Grade 3	1 (1.4)
– Grade 4	0 (0)

Data are expressed as mean ± standard deviation.
Neurological grading: Markwalder's classification as followed.

trabecular type) and three types by the hematoma position (cranial base, convexity, interhemispheric type) (Table 4). Fifty-six of the patients were male, and 14 were female. Their ages ranged from 52 to 92 years, with an average of 72.8 years. The hematoma was located on the right side in 30 patients, on the left in 32, and on both sides in 8. All patients were followed up for more than 6 months, so any recurrence occurred in this period. The unique technical details of this procedure are as follows.

Percutaneous subdural tapping is performed under local anesthesia at the patient's bedside without sedatives. The patient is placed in the lateral position and the skull was perforated at the parietal eminence using a depth check drill with a Hudson brace (Codman & shurtleff, inc.).

Perforating point is always at the parietal eminence except for unusually localized hematoma. The parietal eminence is not only an easy landmark, but also a suitable position for the complete hematoma evacuation with the head rotation technique as mentioned below. After perforation of the skull, a needle device consisting of outer and inner parts is placed, and the outer needle is left in site (19-gauge, Muraishi Iryoki, Tokyo) (Fig. 1).

After measuring the pressure of the hematoma cavity with an extension tube, 10 ml of oxygen in a syringe is slowly injected into the hematoma cavity, and an equal volume of the hematoma is aspirated with the syringe. The oxygen supplied from the bedside supply device is easy to obtain and has no negative influence on the brain. The patient's head is rotated step by step to the supine position according to the volume of residual hematoma.

This procedure is repeated until no more hematoma can be obtained. To keep the pressure in the hematoma cavity equal to atmospheric pressure, the amount of oxygen injected and that of the hematoma aspirated is controlled during the procedure. Finally the patient is returned to the lateral position, the needle is removed and a simple gauze dressing is placed without closed system drainage.

As soon as this procedure is finished, the patient is allowed to get up (Fig. 1). This retrospective study chose no strict selection of patients for this procedure. These unique data were analysed by Student's non-paired t-test and Spearman's correlation by rank.

Results

Table 1 shows the patient's characteristics in the present series within the neurological classification according to Markwalder's grading system [4]. The CT scan findings according to Nakaguchi's classification were examined as recurrence factor in Table 4.

Neurological recovery after the treatment was satisfactory in all 70 patients. All patients recovered within 24 hours, so the patient who has no special features left our hospital the day after the operation. Hospitalization was 5.8 days on average, ranging from 2 to 19 days. 52% of these patients' were discharged within three days. The last three years, most patients were treated during two days of hospitalization, that is one of the shortest period in Japan. The amount of the evacuated hematoma was 96.1 ml on average, ranging from 5 to 280 ml. The pressure of the hematoma cavity was 92.1 mm H_2O on average, ranging from 0 to 200 mm H_2O. These parameters are compared with each other and discussed in the next section (Tables 2, 3).

During the follow-up period, clinical recurrence was noted in 7 patients (10%) and seven sides (9.0%) on the 8 from 44 days after surgery. All these 7 patients were male, and their ages ranged from 54 to 92 years, with an average of 74.4 years (Table 1). They were treated by the same procedure. Four patients had no further recurrence, and three patients were "repeated" twice until clinical cure was obtained.

Discussion

Safety is very important for surgery. Some neurosurgeons seem to fear not only that subdural tapping may injure the cortex or bridging veins but also that oxygen may cause brain similar compression with hematoma.

However, there is only minimal danger if this procedure is used to treat CSDH, as is seen in this series. Indeed, we have reported a complicated case in which the needle tapping induced an acute epidural hematoma [12], but we have not experienced any other complications. As this surgery is a blind procedure, careful manipulation and close observation of the patients' condition is required when it is done. Because this complication might reasonably be expected to occur when the blind tip of the drill-needle reaches the dura mater without penetrating the outer membrane of the hematoma

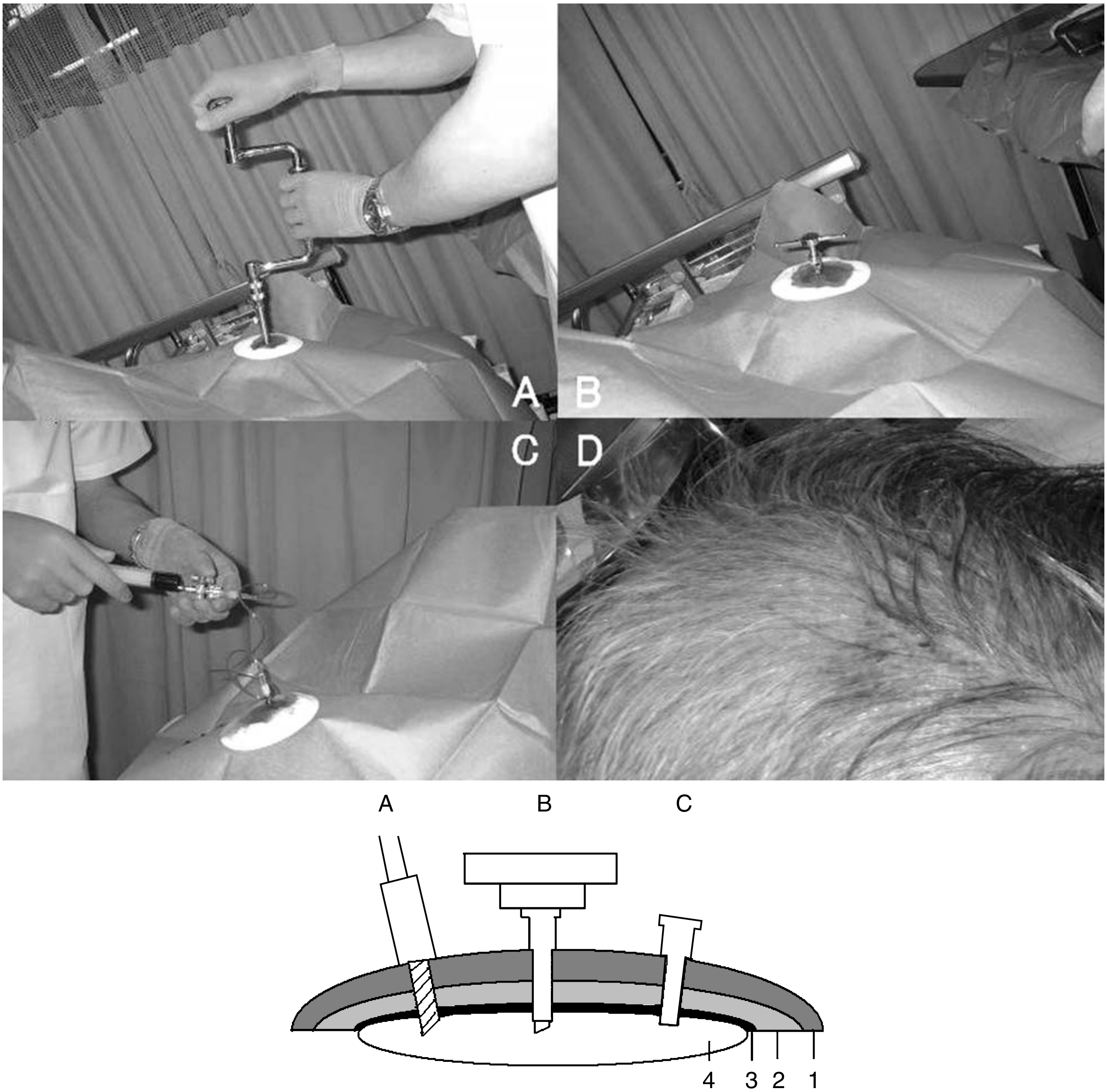

Fig. 1. Technical details. Over view: Close-up. (A) Perforation by hand drill. (B) Percutaneous subdural tapping needle was inserted. (C) After measuring pressure by an extension tube, replacing the hematoma with oxygen gradually. (D) After surgery. Minimal wound remained. *1* Skin, *2* skull, *3* dura, *4* hematoma cavity

Table 2. *Significant differences of initial pressure of hematoma cavity ($p < 0.05$)*

≦70 ys	80.6 ± 9.0 mm H_2O
≧69 ys	113.0 ± 12.9 mm H_2O

Student's non-paired t-test.
Data are expressed as mean ± standard deviation.

Table 3. *Related parameters*

Initial pressure and Removed hematoma volume	$p < 0.01$ (S)
Initial pressure and Paresis or Gait disturbance	$p < 0.05$ (T)
Initial Pressure:	
Paresis or Gait disturbance+	109.6 ± 59.1 mm H_2O
Paresis or Gait disturbance−	65.2 ± 61.8 mm H_2O
Initial pressure and Headache	$p < 0.01$ (T)
Initial Pressure: Headache+	118.7 ± 57.4 mm H_2O
Headache−	79.1 ± 57.4 mm H_2O

T Student's non-paired t-test, *S* Spearman's correlation by rank.
Data are expressed as mean ± standard deviation.

cavity [12], we have devised a depth check drill which contributed to prevent this adverse event. Since the needle was changed to a depth check drill which made perforation of the skull easier and has an adjusted

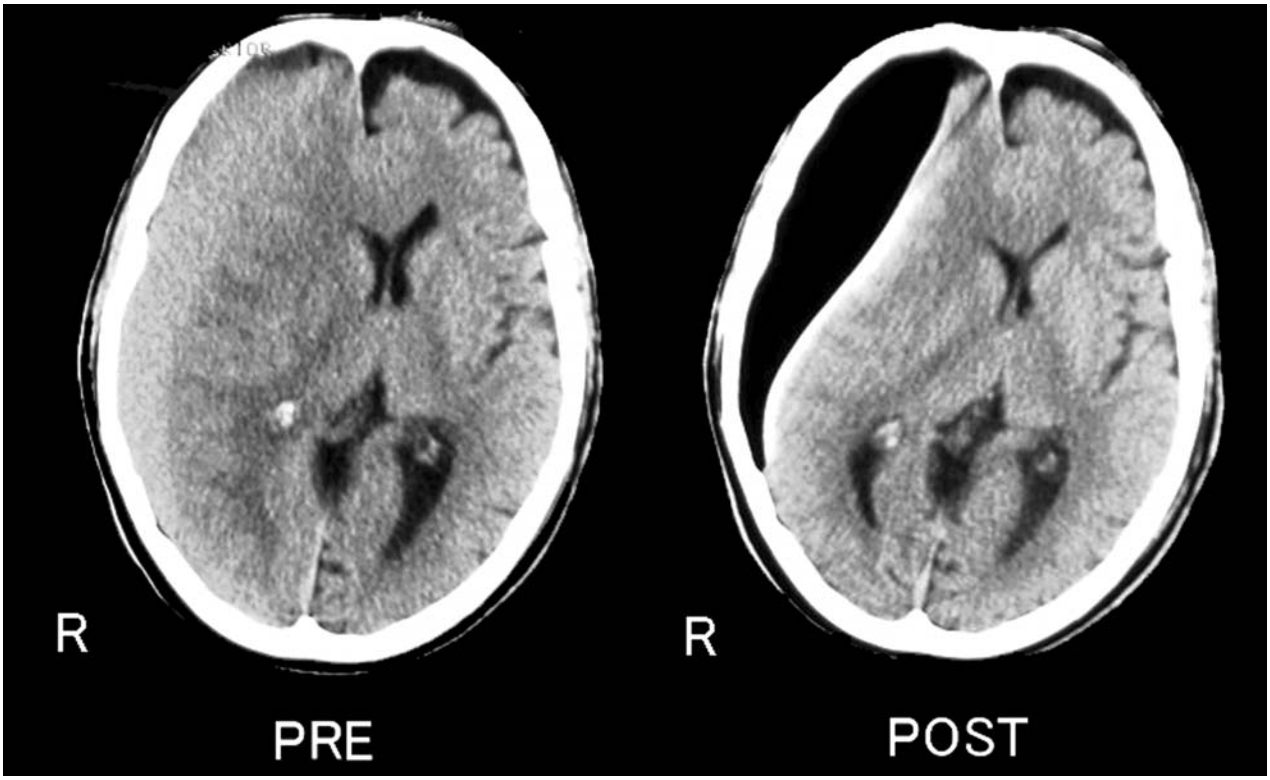

Fig. 2. Typical CT scans of this type of surgery. The CSDH almost changed to oxygen

suitable length, no complication occurred in these 70 patients. Sometimes we have treated a multilobular type of CSDH by this method. We have been asked: "Why use oxygen to fill the cavity rather than air?". After aspiration of the haematoma headache can occur because of low pressure, and the aim is to substitute for the haematoma. Oxygen does not have an adverse effect on the brain and is readily available at the bedside device, reducing the risk of infection from ward air. Almost every cases of this type of CDSH could be

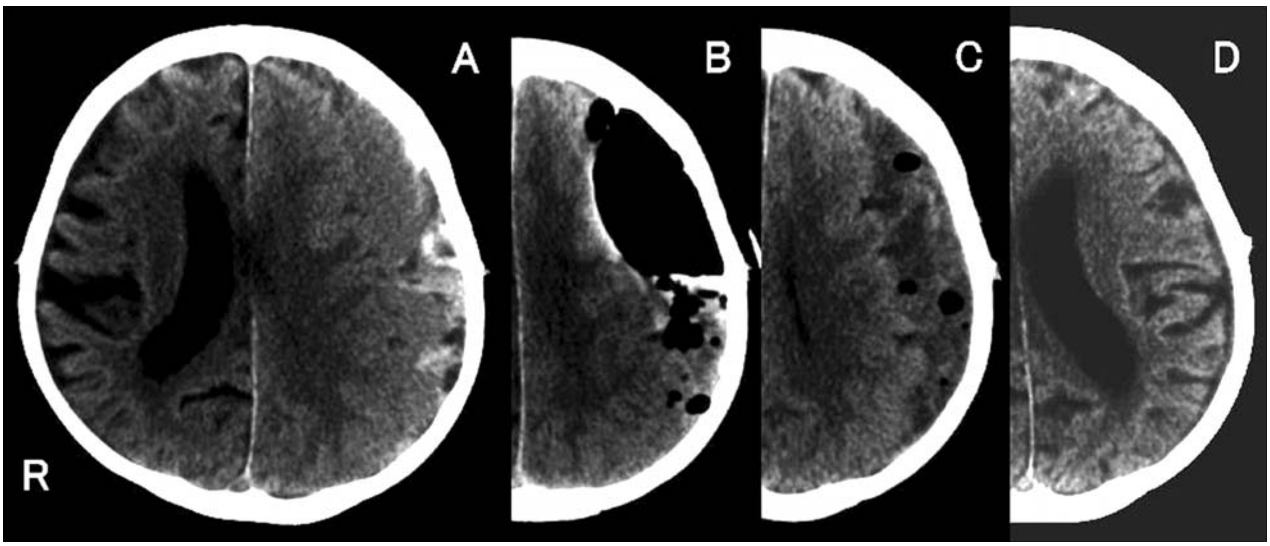

Fig. 3. Atypical progress. (A) Irregular density hematoma was revealed on the left side in the CT scan. (B) The hematoma remains considerable and existence of some cavities was also suspected. (C) Ten days after surgery. Although no neurological deficit was found, the hematoma has increased. (D) Sixty days after surgery without re-operation, no hematoma was found

treated by only one point of tapping. In typical cases, which were single cavity and removed almost all of the hematoma, we can measure the hematoma volume accurately (Fig. 2).

In some cases, however, we did not intent to evacuate hematoma completely, because residual hematoma usually disappeared during the follow up period without further treatment (Fig. 3). Indeed, the hematoma in all 7 recurrent cases was almost completely evacuated. It is unique that this procedure can measure the pressure of the hematoma cavity. The pressure was 92.1 mm H_2O on average, and was under 200 mm H_2O in 80% of patients. The reliability of this procedure was also supported by the favorable results, which showed a 10% (9.0% in sides) recurrent rate in this series. In standard burr-hole craniostomy and saline irrigation, recurrent rate is 9.8% [3]. We can measure the initial pressure and total volume of the hematoma by this method. When these parameters are compared, the unexpected result may be found. Larger hematoma volume was more likely to have higher initial pressure, however, there was no reverse relationship. Paralysis, disturbance of consciousness, headache tend to be associated with patients with a high pressure. Disturbance of consciousness was found to be caused by increased hematoma volume. Although there is no difference in the average hematoma volume between over and under the age of 70 years, initial pressures have the tendency to be high in patients under the age of 70 years (Tables 2, 3). There was no statistically significant factor in recurrence in our cases (Table 4). Recently, some reports in the literature discuss the recurrence of CSDH. Oishi and his colleague announced that the CT scans in recurrent cases showed high or isodensity lesions [6], which were identical with our series.

Table 4.

Risk factors of recurrence	Total no. of patients (%)	Recurrent cases (%)
Symptoms		
Headache	25 (35)	2 (29)
Hemiparesis or Gait disturbance	38 (42)	2 (29)
Dementia	12 (17)	1 (14)
Disturbance of consciousness	6 (9)	2 (29)
Past history		
Hypertension	21 (30)	0 (0)
Symptomatic cerebral infarction	5 (7)	0 (0)
Coagulopathy	3 (4)	0 (0)
Anticoagulant or antiplatelet	15 (21)	0 (0)
Head injury	36 (51)	2 (29)
Diabetes mellitus	4 (6)	1 (14)
History of seizure	0 (0)	0 (0)
Favorite		
Alcohol	37 (52)	3 (43)
Tobacco	28 (40)	2 (29)
Hematoma densities of CT scan		
Low	14 (18)	0 (0)
Iso	15 (19)	3 (43)
High	12 (15)	3 (43)
Niveau	6 (8)	0 (0)
Mixed	16 (20)	1 (14)
Unknown	15 (19)	
Classification of Internal Structure*		
Homogenous	32 (41)	5 (71)
Laminar	9 (12)	1 (12)
Separated	6 (8)	0 (0)
Trabecular	16 (20)	1 (14)
Unknown	15 (19)	
Type of CSDH*		
Cranial Base type	18 (23)	4 (57)
Convexity type	28 (36)	2 (29)
Interhemispheric type	20 (26)	1 (14)
Unknown	12 (15)	

* Nakaguchi's classification is followed [5].

Nakaguchi and his colleague classified CSDH into four types by the hematoma density and three types by the hematoma position [5]. In this literature, the recurrent rate associated with the separate type and basal type was high, whereas that associated with the trabecular type and the convexity type was low. In our cases, the separate type has few tendencies to cause recurrence.

Yamamoto and his colleague announced that in addition, the width of the hematoma (the thickest position on CT scan), a history of seizure and no past diabetes mellitus are closely related to the incidence of CSDH recurrence [11].

In our cases, however, there are no such tendencies to cause recurrence. Residual hematoma after treatment did not have a tendency to cause recurrence in our series. Although some authors described that the remaining air after standard surgery for CSDH significantly contributed to recurrence [8], the recurrent rate in our series did not differ from that in other treatment modalities.

The cases of recurrence in seven patients, especially in three who were operated on twice are difficult to clarify. However, there are inherent factors in the recurrent patients themselves, because the recurrent rate of the second procedure (43%) is much higher than that of the original procedure.

The treatment modality presented here has many advantages compared to burr-hole craniostomy with saline irrigation: it is a bedside technique, does not need sedatives requires only a short time of bed rest, short hospital stay, at low cost, with less pain, low risk, and no scalp suture.

Erol and his colleague compare burr hole craniostomy-irrigation technique and burr hole craniostomy-drainage technique [2]. In comparison of recurrence rate (17% vs. 14%), complications and hospitalization (average 5 vs. 6 days), he states that burr hole with irrigation alone is as reliable as the closed system drainage technique. Although their methods also attain good results, our method is more advantageous and effective in respect of a simplicity, complications and hospitalization.

Weigel and his colleague reviewed 48 publications of CSDH [10]. In his paper, he summarised that twist drill and burr hole craniostomy can be considered first tier treatment and the postoperative outcome of CSDH has not improved substantially over the past 20 years. In the results of outcome, and recurrence rate, of our method is certainly the same as other methods. On the other hand, in simplicity, mobility, and hospitalization, our method is advantageous. Because of no drainage technique, our method is easier than the Aoki's method.

From these considerations, we believe that replacement of the hematoma with oxygen via percutaneous tapping without drainage is acceptable as an alternative procedure to burr-hole craniostomy with saline irrigation. This procedure is particularly recommended for elderly patients in poor general condition.

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