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Original Article

Postoperative Safety and Functional Recovery After Subdural and Subgaleal Drainage in Traumatic Chronic Subdural Hematoma in North-Western Nigeria: A Prospective Randomized Study

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ABSTRACT

Background: Chronic subdural hematoma (CSDH) is a common neurosurgical condition, particularly among the elderly. Burr-hole craniostomy with closed drainage remains standard; however, the optimal drain location—subdural (SD) or subgaleal (SG)—is disputed. This study aimed to compare postoperative complications and functional outcomes between SD and SG closed drainage systems after burr-hole evacuation of traumatic CSDH.

Methods: In this prospective randomized study, 48 adult patients with traumatic CSDH were assigned to SD (n = 24) or SG (n = 24) drainage. Postoperative seizures, pneumocephalus, and surgical site infections (SSIs) were assessed clinically, radiologically, and using Centers for Disease Control and Prevention criteria. Functional outcomes were measured with the Glasgow Outcome Score (GOS) at discharge, 6 weeks, and 12 weeks.

Results: Mean age was 61.8 ± 13.8 years (SD) and 56.8 ± 15.3 years (SG; $P = 0.237$). At discharge, good recovery (GOS 5) occurred in 54.2% (SD) versus 41.7% (SG), moderate disability (GOS 4) in 41.7% versus 54.2%, and severe disability (GOS 3) in 4.2% in each group. At 6 weeks, good recovery increased to 75.0% (SD) and 62.5% (SG). At 12 weeks, all patients achieved good recovery. Complications were infrequent: seizures in 8.3% (SD) versus 4.2% (SG), pneumocephalus in 12.5% versus 8.3%, and SSI in 4.2% versus 0%. Differences were not statistically significant.

Conclusions: SD and SG drainage systems provide comparable safety and functional outcomes. Both systems led to progressive GOS improvement, with all patients achieving good recovery by 12 weeks. Further multicenter studies with longer follow-up are justified.

Key words: CSDH, subdural drain, subgaleal drain, SSI, seizures, pneumocephalus

INTRODUCTION

Chronic subdural hematoma (CSDH) can be defined as the presence of liquefied blood within the subdural space lined by a pseudo-membrane that has lasted for three weeks. [1, 2] Most of the studies of the CSDH support the insertion of a subdural drain, and only a few studies have discussed the role of the subgaleal drain and found its effectiveness. [3] Complications that arises post op are disappointing complications for neurosurgeons, which have led them to try many procedures to reduce their incidence. This is so because being in a developing country whose population is largely uninsured by the National Health Insurance Scheme (NHIS). Many patients lack comprehensive health insurance coverage, making repeat surgery financially burdensome. Reoperation increases hospital costs, prolongs admission, and exposes patients to further anesthetic and postoperative risks, including infection, deep vein thrombosis, and mortality. Additionally, prolonged hospitalization often disrupts family income, as relatives may need to remain with the patient during recovery.

The prevalence of pneumocephalus following burr-hole drainage is common, observed in a wide range of patients, often between 14% and 44% postoperatively. [4] The rate of surgical site infection (SSI) is generally low, around 1.4% to 3.0%. [5]

A meta-analysis investigating the efficacy and safety of subdural drains showed a trend toward a higher complication rate. The risk of brain tissue injury was reported to be 6.1%. [6]

Evidence comparing the two techniques is conflicting. Some studies and meta-analyses have suggested that subgaleal drains may be associated with lower infection rates or procedure-related complications. [4, 5] Conversely, other investigators have reported lower residual hematoma rates and better radiological outcomes with subdural drainage. [6–8]

These inconsistencies may reflect variations in study design, patient selection, follow-up duration, and outcome definitions. Consequently, there remains no clear consensus regarding the superiority of either technique. Further prospective randomized studies are needed to clarify their relative efficacy and safety. Given the clinical importance of minimizing complications and their economic impact in resource-limited settings, identifying the most suitable drainage method is crucial. Furthermore, the debates surrounding the management of CSDH, coupled with the lack of similar research in our area, highlight the need to address this gap in knowledge, thereby providing context-specific evidence to guide surgical practices.

Accordingly, this study aimed to compare the rates of postoperative complications and functional outcomes between subdural and subgaleal closed drainage systems following burr-hole evacuation for traumatic CSDH.

MATERIALS AND METHODS

Study Design, Settings, and Population

This was a prospective randomized controlled clinical trial conducted at Usmanu Danfodiyo University Teaching Hospital over a twelve-month period from June 2020 to May 2021. The study aimed to compare complication rates and functional outcomes between subdural (SD) and subgaleal (SG) closed drainage systems in patients with traumatic CSDH.

A total of 48 adult patients (≥18 years) diagnosed with traumatic CSDH using computed tomography (CT) or magnetic resonance imaging (MRI) and requiring surgical intervention were recruited. Both unilateral and bilateral cases were included.

Patients' Randomization, Inclusion, and Exclusion Criteria

Patients were randomly allocated to either the SD or SG drainage group using computer-generated random numbers. Allocation concealment was ensured through sealed, opaque, sequentially numbered envelopes opened only after enrollment.

A double-blind design was employed, where patients, caregivers, and outcome assessors were unaware of group allocation.

Inclusion Criteria

- Adults aged ≥18 years
- Diagnosis of traumatic CSDH confirmed by CT or MRI
- Both unilateral and bilateral CSDH cases
- Indication for surgical intervention
- Provision of informed consent

Exclusion Criteria

- Recurrent CSDH
- Patient with intracranial mass lesions causing CSDH.
- Patients treated with procedures other than burr-hole evacuation
- CSDH secondary to coagulopathies or spontaneous causes

Neurosurgical Procedure

All surgeries were performed by the principal researcher with assistance. Procedures were conducted under general anesthesia with endotracheal intubation or local anesthesia.

Patients were placed in the supine position with the head tilted away from the hematoma and supported on a head ring, while a roll was positioned under the shoulder on the affected side. Prophylactic intravenous Ceftriaxone (1 g) was administered at induction. The scalp was shaved, cleaned with Savlon, and prepared with 10% povidone-iodine. Local infiltration with adrenaline and 2% lidocaine was applied to assist hemostasis. Two skin incisions were made for unilateral cases(frontal and parietal) and four for bilateral hematomas. Hemostasis was maintained using bipolar diathermy, and the pericranium was swept, and the skin flap was retracted with a Waitlaner self-retaining retractor.

A double burr-hole craniostomy was performed for unilateral CSDH and bilateral double burr holes for bilateral cases. The dura was opened in a cruciate fashion using a size 11 blade after bipolar coagulation, and the cavity was irrigated with normal saline until clear. A Foley catheter drain size 16 fr was inserted into the subdural or subgaleal space on the posterior burr-hole and brought out through a separate incision, anchored and connected to a collection bag to act as a passive drain. The wound was closed with nylon suture. Postoperatively, patients were nursed supine, received analgesia with Paracetamol and Diclofenac, and drains were removed when output fell below 25 mL.

Sample Size Calculation

Sample size was determined using a two-proportion comparison formula with a 95% confidence interval, 5% margin of error, and assumed proportions of 12.5% (baseline) and 7.8% (post-intervention) based on prior literature.

The calculated sample size was 21 patients per group. After adjusting for a 10% contingency for incomplete data, the sample size increased to 23 patients per group. Ultimately, 24 patients were included in each group.

Outcome Measures and Data Analysis

The primary outcome was functional status assessed using the Glasgow Outcome Scale (GOS) at discharge, 6 weeks, and 12 weeks postoperatively. Outcomes were categorized as:

1. Death
2. Persistent vegetative state
3. Severe disability
4. Moderate disability
5. Good recovery

For analysis, outcomes were grouped into:

- Favorable: GOS 4–5
- Unfavorable*:* GOS 1–3

Secondary outcomes included postoperative complications such as:

- SSI
- Seizures
- Pneumocephalus

Seizures were documented using a seizure chart, and appropriate antiepileptic treatment was administered. Pneumocephalus was assessed using CT scans in cases of neurological deterioration (e.g., ≥2-point drop in Glasgow Coma Scale).

Surgical wounds were evaluated on alternate days and during follow-up using infection criteria defined by the Centers for Disease Control and Prevention (CDC), which includes the following: purulent drainage from the incision, signs or symptoms of infection - pain or tenderness, localized swelling, redness or heat, or systemic symptoms.

Ethics Statement

Ethical approval was obtained from the Institutional Ethics Committee of Usmanu Danfodiyo University Teaching Hospital (Approval No: UDUTH/HREC/2019No.838).

Every patient received sufficient information in a language they could understand better, regarding the study's goals, methods, risks, and advantages. Before enrollment, written informed consent was acquired. Patient information was kept entirely private, participation was completely optional, and withdrawing at any time would not interfere with their routine care.

Statistical Analysis

Data analysis was performed using *IBM* Statistical Package for Social Sciences version23:

- Normality assessed using the Shapiro–Wilk test
- Parametric data presented as mean ± standard deviation
- Non-parametric data presented as median and interquartile range
- Categorical variables are analyzed using Pearson's Chi-square test or Fisher's exact test
- Statistical significance set at $P < 0.05$

RESULT

We recruited 48 patients, 24 in each group.

The mean age of patients in the subdural group was 61.83 ± 13.85 years, compared with 56.79 ± 15.27 years in the subgaleal group. The difference in mean age between the two groups was not statistically significant ($t = 1.198$; P = 0.237).

The majority of participants in both groups were aged ≥60 years, accounting for 58.4% in the subdural group and 50.0% in the subgaleal group. There was no statistically significant difference in age distribution between the groups (Fisher's exact test, $P = 0.843$).

Regarding sex distribution, males predominated in both groups. In the subdural group, 16 patients (66.7%) were male, and 8 (33.3%) were female, whereas in the subgaleal group, 18 patients (75.0%) were male and 6 (25.0%) were female. The difference in sex distribution was not statistically significant ($\chi^2 = 0.403$, $P = 0.525$). **Table 1** summarizes the socio-demographic characteristics of patients.

Functional Outcomes

At discharge, 13 patients (54.2%) in the subdural group attained good recovery compared with 10 patients (41.7%) in the subgaleal group. Moderate disability was observed in 10 patients (41.7%) in the subdural group and 13 patients (54.2%) in the subgaleal group. Severe disability occurred in one patient (4.2%) in each group. The difference was not statistically significant (Fisher's exact test, $P = 0.773$).

At 6 weeks follow-up, good recovery was observed in 18 patients (75.0%) in the subdural group and 15 patients

Table 1: Socio-demographic characteristics of patients**.**

Variable	Subdural (n = 24) n (%)	Subgaleal (n = 24) n (%)	Test statistic	*P* value
Age group (years)			Fisher's exact	0.843
20–39	2 (8.3)	3 (12.5)		
40–59	8 (33.3)	9 (37.5)		
≥60	14 (58.4)	12 (50.0)		
Sex			$\chi^2 = 0.403$	0.525
Male	16 (66.7)	18 (75.0)		
Female	8 (33.3)	6 (25.0)		
Mean age (years)	61.83 ± 13.85	56.79 ± 15.27	$t = 1.198$	0.237

χ^2 = Pearson's Chi-square test; SD = standard deviation; *t* = Independent samples *t*-test.

(62.5%) in the subgaleal group. Moderate disability occurred in 6 (25.0%) and 8 (33.3%) patients, respectively, while one patient (4.2%) in the subgaleal group had severe disability. There was no statistically significant difference between groups (*P* = 0.534).

At 12 weeks of follow-up, all assessed patients in both groups achieved good recovery (100%). Three patients in the subdural group were lost to follow-up. There was no statistically significant difference in functional outcome between groups (*P* = 0.234). **Table 2** describes Glasgow Outcome Score (GOS) at discharge, 6 weeks, and 12 weeks follow-up.

Three patients in the subdural group were lost to follow-up at 12 weeks.

Postoperative Complications Among Participants (Seizure, Pneumocephalus, and SSI)

Postoperative seizures occurred in 2 (8.3%) patients in the subdural drain group and 1 (4.2%) patient in the subgaleal drain group. Although seizures appeared slightly more frequent in the subdural group, the difference between the two groups was not statistically significant (Fisher's exact test, *P* = 0.689). The patients who developed post-operative seizures in the subdural group were different from those who had seizures at presentation.

Pneumocephalus was observed in 5 (20.8%) patients in the subdural drain group and 3 (12.5%) patients in the subgaleal drain group. This difference was not statistically significant (Fisher's exact test, *P* = 0.786). Additionally, no cases of tension pneumocephalus were recorded in either group.

Superficial SSI occurred in 2 (8.3%) patients in the subdural group and 3 (12.5%) patients in the subgaleal group. The difference between the two groups was not statistically significant (Fisher's exact test, *P* = 0.794). All cases were managed conservatively with antibiotics and wound dressing.

Overall, although some complications appeared slightly more frequent in the subdural drain group, no statistically significant differences were observed between the two treatment groups for any of the post-operative complications assessed (**Table 3**).

Postoperative seizures occurred in 2 (8.3%) patients in the subdural drain group and 1 (4.2%) patient in the subgaleal drain group. Although seizures appeared slightly more frequent in the subdural group, the difference between the two groups was not statistically significant (Fisher's exact test, *P* = 0.689). The patients who developed post-operative seizures in the subdural group were different from those who had seizures at presentation.

Pneumocephalus was observed in 5 (20.8%) patients in the subdural drain group and 3 (12.5%) patients in the subgaleal drain group. This difference was not statistically significant (Fisher's exact test, *P* = 0.786). Additionally, no cases of tension pneumocephalus were recorded in either group.

Table 2: GOS at discharge, 6 weeks, and 12 weeks follow-up.

Variable	Subdural (n = 24) n (%)	Subgaleal (n = 24) n (%)	Test statistic	*P* value
GOS at discharge			Fisher's exact	0.773
Good recovery	13 (54.2)	10 (41.7)		
Moderate disability	10 (41.7)	13 (54.2)		
Severe disability	1 (4.2)	1 (4.2)		
Persistent vegetative state	0	0		
Death	0	0		
GOS at 6 weeks			Fisher's exact	0.534
Good recovery	18 (75.0)	15 (62.5)		
Moderate disability	6 (25.0)	8 (33.3)		
Severe disability	0	1 (4.2)		
Persistent vegetative state	0	0		
Death	0	0		
GOS at 12 weeks			Fisher's exact	0.234
Good recovery	21 (100)*	24 (100)		
Moderate disability	0	0		
Severe disability	0	0		
Persistent vegetative state	0	0		
Death	0	0		

GOS = Glasgow Outcome Score.

Table 3: Post-operative complications among patients.

Variable	Subdural (n = 24) n (%)	Subgaleal (n = 24) n (%)	Test statistic	*P* value
Seizure	2 (8.3)	1 (4.2)	Fisher's exact	0.689
Pneumocephalus	5 (20.8)	3 (12.5)	Fisher's exact	0.786
Surgical site infection	2 (8.3)	3 (12.5)	Fisher's exact	0.794

Superficial SSI occurred in 2 (8.3%) patients in the subdural group and 3 (12.5%) patients in the subgaleal group. The difference between the two groups was not statistically significant (Fisher's exact test, $P = 0.794$). All cases were managed conservatively with antibiotics and wound dressing.

Overall, although some complications appeared slightly more frequent in the subdural drain group, no statistically significant differences were observed between the two treatment groups for any of the post-operative complications assessed (**Table 3**).

Association Between Age, Sex, and Postoperative Complications Among the Participants

Postoperative seizure occurred in 3 (6.3%) patients, pneumocephalus in 8 (16.7%), and SSI in 5 (10.4%). There was no statistically significant association between age group and the occurrence of seizure ($P = 0.610$) or pneumocephalus ($P = 0.440$). However, SSI showed a significant association with age group ($P = 0.030$), occurring predominantly in patients aged 20 to 59 years. Sex was not significantly associated with any of the post-operative complications ($P > 0.05$). Since our sample is small, the regression is usually reported as an odds ratio (OR) with 95% confidence interval (CI; **Table 4**).

Predictors of Postoperative Complications

Patients aged 20 to 39 years had 1.82 times higher odds of developing complications compared with those ≥60 years, but this was not statistically significant.

Patients aged 40 to 59 years had 1.36 times higher odds, also not significant. Male patients had slightly higher odds of complications (OR = 1.21) compared with females, but this was not statistically significant ($P > 0.05$).

Overall, age and sex were not independent predictors of post-operative complications in this study. Multivariate logistic regression analysis showed that neither age group nor sex was a significant predictor of post-operative complications among the study participants ($P > 0.05$; **Table 5**).

DISCUSSION

This study compared the clinical outcomes and postoperative complications associated with subdural and subgaleal drainage systems following burr-hole evacuation of CSDH. The findings demonstrate that both drainage techniques produced comparable functional outcomes and complication rates. Overall, there were no statistically significant differences between the two groups with respect to patient characteristics, postoperative neurological recovery, or complication profiles. These results suggest that both drainage methods are safe and effective in the surgical management of CSDH.

Socio-Demographic Characteristics

The socio-demographic profile of patients in this study showed that the majority were elderly and predominantly male. The mean age was 61.83 ± 13.85 years in the subdural group and 56.79 ± 15.27 years in the subgaleal group, with no statistically significant difference ($P = 0.237$), indicating comparability between the groups. Most patients were aged 60 years and above, consistent with the established epidemiology of CSDH. Age-related cerebral atrophy predisposes elderly individuals to CSDH, as progressive brain shrinkage increases tension on bridging veins, making them more susceptible to rupture even after minor trauma.

Male predominance was observed, with a male-to-female ratio of approximately 2:1 in the subdural group and 3:1 in the subgaleal group ($P = 0.525$), reflecting trends reported in previous studies. [8, 9] Higher male prevalence may result from increased exposure to trauma through physically demanding occupations such as farming, transportation, and trading, as well as the widespread use of motorcycles, often under unsafe conditions. Road traffic crashes were the most common etiological factor, accounting for 58.3% of cases in the subdural group and 50% in the subgaleal group, highlighting a significant public health challenge in developing countries. [8, 10]

Table 5: Logistic regression analysis of predictors of postoperative complications (n = 48).

Variable	Odds ratio (OR)	95% CI	*P* value
Age group			
20–39	1.82	0.42–7.91	0.423
40–59	1.36	0.39–4.73	0.629
≥60 (Reference)	1.00	–	–
Sex			
Male	1.21	0.35–4.16	0.764
Female (Reference)	1.00	–	–

Table 4: Association between age, sex, and postoperative complications among patients (n = 48).

Variable	Seizure n (%)	Pneumocephalus n (%)	Surgical site infection n (%)	Test statistic	*P* value
Age group (years)				Fisher's Exact	
20–39 (n = 5)	0 (0.0)	2 (40.0)	2 (40.0)		
40–59 (n = 17)	1 (5.9)	2 (11.8)	3 (17.6)		
≥60 (n = 26)	2 (7.7)	4 (15.4)	0 (0.0)		
P value	0.610	0.440	0.030*		
Sex				χ^2	
Male (n = 34)	2 (5.9)	6 (17.6)	3 (8.8)		
Female (n = 14)	1 (7.1)	2 (14.3)	2 (14.3)		
P value	0.890	0.770	0.630		

Significant at P < 0.05.

Functional Outcomes

Functional outcomes were assessed using the GOS at discharge, 6 weeks, and 12 weeks postoperatively. The results demonstrated progressive neurological improvement over time in both treatment groups.

At discharge, good recovery was observed in 54.2% of patients in the subdural group and 41.7% in the subgaleal group, while moderate disability occurred in 41.7% and 54.2% of patients, respectively. Severe disability was recorded in one patient in each group. However, these differences were not statistically significant (*P* = 0.773).

At the 6-week follow-up, the proportion of patients achieving good recovery increased to 75.0% in the subdural group and 62.5% in the subgaleal group. By 12 weeks, all patients who completed follow-up had achieved good recovery. This progressive improvement indicates that neurological recovery continues beyond the immediate postoperative period as the brain gradually re-expands and neurological deficits resolve.

Importantly, no deaths or persistent vegetative states were recorded in either group during the study period. The absence of significant differences in functional outcomes between the two drainage techniques suggests that both subdural and subgaleal drainage systems are effective in facilitating neurological recovery following burr-hole evacuation of CSDH.

These findings are consistent with previous studies, which have reported comparable outcomes between the two techniques. [15]

Postoperative Seizures

Postoperative seizures were relatively uncommon in this study. They occurred in two patients (8.3%) in the subdural drain group and one patient (4.2%) in the subgaleal drain group. Although seizures were slightly more frequent among patients with subdural drains, the difference was not statistically significant (*P* = 0.689).

The slightly higher seizure rate in the subdural group may be related to cortical irritation caused by the placement of the drain within the subdural space. Direct contact between the drain and the cortical surface may increase neuronal excitability and predispose patients to seizure activity.

Similar observations have been reported in previous studies. [7, 11, 12] Oral et al. documented seizure rates of 5.2% and 2.7% in the subdural and subgaleal groups, respectively. Ishfaq also reported higher seizure rates among patients with subdural drainage compared with those with subgaleal drainage. Singh et al. similarly found a statistically significant difference, with no seizures occurring in the subgaleal group compared with five cases in the subdural group.

The lack of statistical significance in the present study may be due to the relatively small sample size, which limits the statistical power to detect differences between the groups.

Pneumocephalus

Pneumocephalus was another postoperative complication observed in this study. It occurred in five patients (20.8%) in the subdural drain group and three patients (12.5%) in the subgaleal drain group. Although the incidence was higher in the subdural group, the difference was not statistically significant (*P* = 0.786).

Pneumocephalus is a common complication following burr-hole evacuation of CSDH and is usually self-limiting. In the present study, all cases were managed conservatively, and no cases of tension pneumocephalus were recorded.

Previous studies have reported similar findings. [7, 11, 13, 17] Ishfaq observed higher rates of pneumocephalus among patients treated with subdural drainage, while Gazzeri et al. reported relatively lower rates among those treated with subgaleal drainage systems. However, some studies have reported comparable rates between the two techniques. [16]

A possible explanation for pneumocephalus is the use of intraoperative irrigation, which may introduce air into the subdural cavity. The presence of intracranial air may delay brain re-expansion and increase the risk of recurrence. [18]

Surgical Site Infection

SSI occurred in two patients (8.3%) in the subdural group and three patients (12.5%) in the subgaleal group. All infections were superficial and were successfully managed with antibiotics and wound care.

These findings are broadly consistent with previous reports. Soleman et al. reported lower infection rates in the subgaleal group [14] while Chih et al. reported no SSIs in their series. [15] Variations between studies may reflect differences in surgical technique, perioperative antibiotic protocols, and institutional practices.

Association Between Patient Characteristics and Complications

Further analysis showed that postoperative seizures occurred in 6.3% of patients, pneumocephalus in 16.7%, and SSI in 10.4%. Age group was not significantly associated with seizure occurrence or pneumocephalus, although SSI showed a significant association with age group (*P* = 0.030). Sex was not significantly associated with any of the complications.

Multivariate logistic regression analysis demonstrated that neither age nor sex was an independent predictor of postoperative complications. These findings suggest that complications following burr-hole evacuation of CSDH are likely influenced by multiple factors beyond demographic characteristics, including surgical technique, hematoma characteristics, and perioperative management.

Therefore, the choice between subdural and subgaleal drainage may largely depend on surgeon preference, experience, and intraoperative considerations rather than clear differences in clinical effectiveness.

Limitations

Despite the important findings of this study, several limitations should be acknowledged:

1. The relatively small sample size limits the statistical power of the study and may reduce the ability to detect subtle differences between treatment groups.

2. The study was conducted at a single center, which may limit the generalizability of the findings to other institutions or populations.
3. Some patients were lost to follow-up, which may have influenced the assessment of long-term outcomes.
4. The duration of follow-up was relatively short, and longer follow-up periods may be required to evaluate recurrence rates and delayed complications.

CONCLUSIONS

This study demonstrated that both subdural and subgaleal closed drainage systems are effective in the surgical management of CSDH following burr-hole evacuation.

There were no statistically significant differences between the two techniques in terms of functional outcomes or postoperative complications, including seizures, pneumocephalus, and SSIs. Patients in both treatment groups showed progressive neurological improvement during follow-up, and all patients who completed the twelve-week follow-up achieved good functional recovery. Therefore, both drainage techniques may be considered safe and effective options in the surgical management of CSDH.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Both subdural and subgaleal drainage systems can be used safely following burr-hole evacuation of CSDH, as they produce comparable outcomes and complication rates.
2. The choice of drainage technique may be guided by the surgeon's clinical judgment, experience, and intraoperative considerations.
3. Larger prospective multicenter studies with longer follow-up periods should be conducted to further evaluate potential differences in recurrence rates and long-term outcomes between the two techniques.
4. Public health interventions aimed at improving road safety and reducing traumatic head injuries may help decrease the incidence of CSDH in the population.

AUTHORS' CONTRIBUTION

Each author has made a substantial contribution to the present work in one or more areas, including conception, study design, conduct, data collection, analysis, and interpretation. All authors have given final approval of the version to be published, agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

None.

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