

## Evaluation of ventriculoperitoneal shunt malfunction regarding ventricular catheter placement

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### Abstract

**Background:** Shunting procedures specifically ventriculoperitoneal shunts are the main line of treatment for management of hydrocephalus despite available new techniques and systems of shunting. Associated complications should be recognized and managed properly, but the most recognized complications are shunt obstruction which its prevalence through surgical approach is discussed here. Two approaches (frontal and parietal) are used to insert ventriculoperitoneal shunt. In this study we retrospectively examined patterns of shunt failure in patients with symptoms of shunt malfunction. Factors analyzed included site of failure, time from shunt placement or last revision of failure, age of patient at time of failure, infection and primary etiology of hydrocephalus. Two approaches were compared to determine which one is more associated with shunt failure.

**Methods:** 250 patients with symptoms of shunt malfunction over 4 years period were retrospectively examined, in 126 cases who were shunted through frontal approach, 48 cases and in 124 patients whose shunts were inserted through parietal approach 64 cases of malfunction observed. All data was analyzed with SPSS software and with T-test, and then the failure rate for frontal versus parietal approach was compared.

**Results:** Significant difference in malfunction rate between these two approaches regardless of underlying cause of ventriculoperitoneal shunt failure was observed, with the less failure rates through frontal approach.

**Conclusion:** Although proximal obstruction is the most common cause of ventriculoperitoneal shunt failure and frontal approach demonstrated less failure rate, but as it is known placing the catheter tip away from the choroids plexus is the most important factor avoiding obstruction.

**Keywords:** hydrocephalus, ventriculoperitoneal shunt complication, CSF shunt devices.

### Introduction

The ventriculoperitoneal shunt (vps) is the CSF shunting device usually used to treat hydrocephalus. All shunting systems regularly malfunction despite the best efforts of physicians and biomedical engineers [1]. Mechanical complications and infection are the most

common problems account for shunt failure [2] although these malfunctions caused by material, construction, and technical errors during shunt placement or revision and mechanical failure [1]. Malfunction of ventricular catheter is made by choroids plexus, ventricular ependyma or debris [3,4].

Although the patients age, sex and underlying

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condition in some studies do not influence the shunt complication rate, age and the etiology of the hydrocephalus remains to be the most important complicating factors. For example infants make up the large majority of patients who undergo first insertion of a CSF shunt device [2]. It should be mentioned that the longevity of shunt was very variable and shunt obstruction could happen at any time, hence, we did not include it in our study.

Many improvements in ventricular fluid diversion devices have occurred in recent years, but maintaining adequate shunt function continues to be a challenge.

**Methods**

A retrospective study was performed on 250 patients who had undergone ventriculoperitoneal shunt at our institution within the past four years. Each patient had a complete chart review consisting of age, sex, primary etiology of shunting, surgical approach of shunting and the kind of shunt which was used.

In patients, who needed shunt removal or revision, shunt malfunction data was recorded and analyzed with SPSS software.

Quantitative data was stated with mean ± SD and statistical analysis performed with an unmatched paired T-test to compare rate of failure for frontal versus parietal placement. Multiple group comparison was performed by the Kruskal Wallis H T-test and statistical significance was set less than 0.05.

**Results**

250 Patients were included in this study who had been operated for ventriculoperitoneal shunt since 4 years ago. Average age was 27,24 ± 24.26 year (2 weeks up to 82 years old). In 124 cases parietal approach and in 126 frontal approach were performed.

All of the 250 patients were divided based on cause of shunting and device company and the surgical approach which was made, therefore, 98 of the total patients were shunted be-

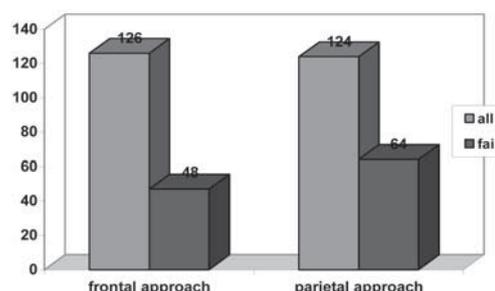


Fig. 1. Failure rate of two approaches for all the patient groups.

cause of tumor, 31 because of bleeding, 45 due to myelomeningocele, 30 of them due to aqueduct stenosis, 19 because of NPH and 27 were shunted due to other causes. All surgeries were supervised by one university professors and 116 of them was made by Fuji company and 90 by Pudenz company. In 126 frontal approach, 48 malfunction and obstruction with shunt revision were seen. In parietal approach group, 64 cases of malfunction were found. Comparing these data with non-parametric method demonstrated a dominant difference between two approaches was detected. (U Test, P= 0.022).

Failure rate was compared between two approaches and no significant difference between them in different senile groups, was observed.

155 cases were male and 97 were female with no significant difference with each other

Table 1. The frequency of etiology for ventriculoperitoneal shunt insertion in 250 cases.

Etiology	Patients
Primary tumor	98
Hemorrhage	31
Myelomeningocele	45
Aqueduct stenosis	30
NPH	19
Infection	12
Arachnoid cyst	10
Arnold chiari	4
Pseudomeningocele	1

Table 2. The Shunt information and multiple group comparison which failed to demonstrate a significant difference between shunts made by various companies. (p= 0.133)

	<i>Fuji</i>	<i>Pudenz</i>	<i>Phonix</i>	<i>Medtronic</i>	<i>Codman</i>	<i>Total</i>
Functional	60	62	6	2	5	135
Failed	56	37	13	6	3	115
Total	116	99	19	3	8	250

(p&gt;0.05).

### Discussion

Proximal shunt obstruction is the main cause of majority of shunt malfunctions [5]. It is well known that the ideal placement of the proximal catheter tip is in the frontal horn away from the choroid plexus [6,7].

There are two surgical approaches (frontal or parietal) for proximal catheter placement. In frontal route the catheter is inserted among the coronal suture at the papillary line and in parietal approach, which is called posterior, it is inserted in the parietal region.

The decision for choosing an appropriate approach is neurosurgeon - dependent, based on training, cosmetics and other patient specific variables [7], This study analyzed failure rates for two different surgical approaches used to insert proximal catheters for ventriculoperitoneal shunt in adult and pediatrics. It is apparent that a right frontal approach is the shortest route and decrease the amount of brain parenchyma through which the catheter passes and easier in placing the proximal catheter. The definitive answer to the question about ventricular catheter placement would come from a randomized clinical trial [8].

Although the primary factor determining proximal catheter malfunction is not the surgical approach, stated in some studies [7]. This study strongly supports frontal insertion of shunts because of their longer function and also conflicts with many studies which have stated no difference between these two routes. But it should be emphasized that despite this difference in our study between frontal and parietal approaches, the proximity of the catheter tip to

choroids plexus is the most important variable in ventriculoperitoneal shunt malfunction.

### Conclusion

Ventricular catheter shunt malfunction is the most common problem after insertion of a ventriculoperitoneal shunt [7]. This study on the surgical approaches for ventriculoperitoneal shunt insertion demonstrated that malfunction rate via frontal approach was less than parietal approach. Nonetheless, it is known that final catheter tip position in relation to the choroids plexus considered to be the most important factor in prevention of proximal catheter malfunction.

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