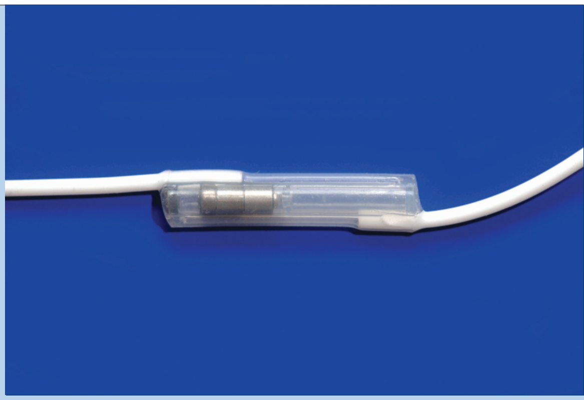
CHHABRA 'Z' FLOW

HYDROCEPHALUS SHUNT SYSTEM

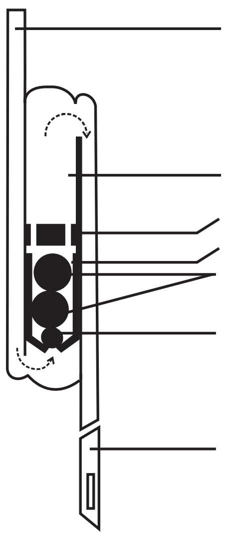


i INTRODUCTION

Z' Flow shunt is the result of a new and scientific approach to hydrocephalus shunting. It controls pressure precisely in all the postures of the body. The valve of a 'Z' flow shunt adjusts it's resistance to the flow of CSF according to a change in the posture of the body. The horizontal posture demands least resistance to the flow of CSF, whereas the vertical posture needs a valve with a much higher resistance. A 'Z' Flow shunt fully meets both these demands.

a ADVANTAGES

1) A 'Z' Flow shunt is based on a scientific understanding of the whole system so IT CONTROLS PRESSURE PRECISELY IN ALL POSTURES OF THE BODY.
2) It is simple in design and most effective in function.
3) The regulating valve, made of metal, is more durable and reliable.
4) It has an accurate and stable regulating mechanism because the weight of balls will never change.
5) It has a wide passage throughout the system, so the flow of the fluid is unaffected even by large amounts of proteins in CSF.

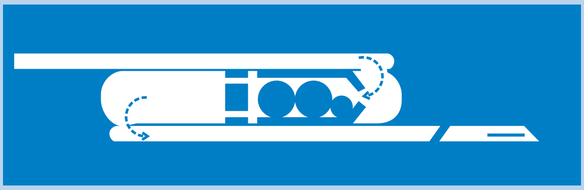


d DESCRIPTION

The main body of a 'Z' Flow shunt is made of high quality silicone elastomer. It has three channels. One side-channel is connected with the ventricular catheter and the second side-channel is connected with the distal catheter. The central channel houses the main regulating valve. A stainless steel housing is located in the lower part of the central channel. It has a valve seat at the lower end and the upper end is open. There are multiple balls in the housing. One ball is small and made of saphire, the other balls are larger and made of stainless steel. A silicone disc with multiple holes covers the open end of the housing. The space above the valve assembly, is for flushing and is named flushing chamber. The end with a black plug is the lower end and it is to be connected with the distal catheter.

f FUNCTION

The cerebrospinal fluid flows, in the main shunt body, in the form of 'Z'. The fluid goes down and then enters the middle channel. Here it moves upwards, through the valve housing, to reach the flushing chamber. Finally it passes through the third channel in a downward direction.



A 'Z' Flow shunt in horizontal posture

IN HORIZONTAL POSTURE as the balls are away from the valve seat, the passage of the fluid through the valve is unobstructed. It is the resistance of the whole system, including the tubing attached, which affects the flow of the fluid. For a flow of 20 ml per hour, a pressure of 3 to 5 cm of water is required.

IN VERTICAL POSTURE the balls settle on the valve seat and obstruct the flow of the fluid. The fluid will flow only when the pressure of the fluid is higher than the force exerted by the balls. (Refer to fig. 1)

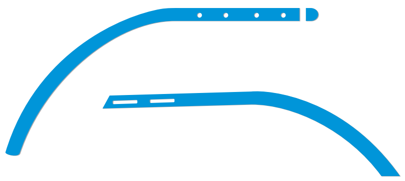
s SPECIFICATIONS

MAIN VALVE BODY

It is available in three types-two-ball system, three-ball system and four-ball system. We have dispensed with the conventional categories of low-pressure, medium-pressure and high-pressure shunts that are in vogue because basically the very idea of such categories is erroneous.

UNI CATHETER

It is a one meter long tube. One of its ends is ventricular catheter and the other is distal catheter. It can be used for both ventriculo-atrial and ventriculo-peritoneal shunting. The length of the ventricular catheter and the distal catheter can be



ventricular catheter from the distal catheter. The ventricular end is closed with a black tantalum impregnated silicone tip. It has 32-40 holes in four rows. The Distal catheter is of a no-pressure type. It has multiple slits, which act as one way valves. The tubing of catheters is radio-opaque and kink resistant..

CONNECTERS

Two connecters are supplied with each pack. The connecters are made of plastic. The design of the connecters is such that even if the catheters are not tied, they will not easily come out.

p PRESSURE/FLOW CHARACTERISTICS

The pressure/flow characteristics of a 'Z' Flow shunt, are different in different postures. In horizontal posture, these are identical in all three types of 'Z' Flow shunts. In vertical posture, however. each of the three types of shunts has different characteristics. The four-ball system has the highest resistance in vertical posture whereas the two-ball system has the lowest resistance among three types of 'Z' Flow shunts. These characteristics are given in the chart below.

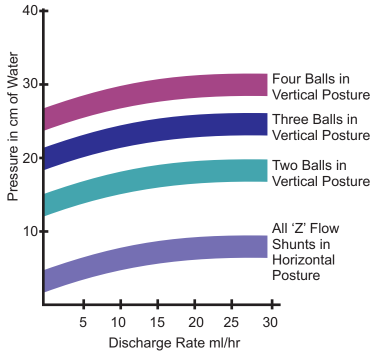


Fig. In vitro pressure/flow Characteristics of 'Z' Flow shunts

h HOW SUPPLIED

Complete shunt system is supplied in one pack. All the components are also available separately.

The pack contains one uni-catheter, one main valve body, two connecters and two suture collars. It is sterilized by ETO.

q QUICK GUIDE FOR SELECTION

The distance is to be measured (in cm) between vertex and the second intercostal space in case of ventriculoatrial shunting and between vertex and the sixth intercostal space in case of ventriculo-peritoneal shunting.

Distance in cm between vertex and 2nd or 6th intercostal space	Type of system according to no. of large balls in the housing	Code No.
(a) for infants and children upto two years	Two-ball system	SH101
(b) upto 38 cm	Two-ball system	Sh101
(c) 39 to 47 cm	Three-ball system	SH102
(d) 48 cm onwards	Four-ball system	Sh103

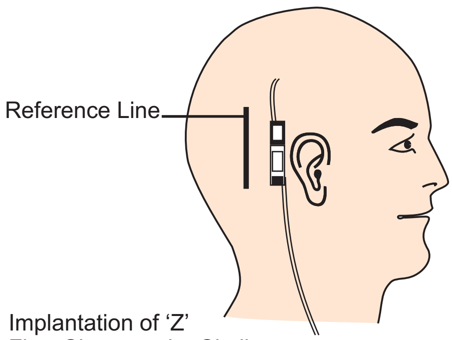
It is, however, advisable to use a system with one ball less in the following conditions than otherwise recommended:

1) Raised central venous pressure
2) Ascitis
3) Low pressure type of hydrocephalus.

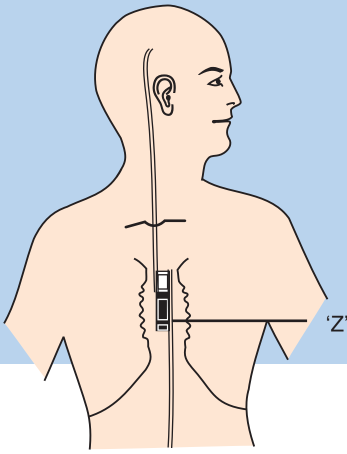
i IMPLANTATION

A 'Z' Flow shunt, which is implanted like any other shunt, particularly requires that the main valve-body must be parallel to the vertical axis of the body when the patient is in an erect posture. It can be implanted either on the skull or on the sternum.

When the skull is selected for implantation, the patient, before the operation, may be asked to sit or stand erect and look straight and then a line parallel to the vertical axis of the body should be marked on the skull to serve as a reference, to ensure that the implantation is parallel.



Implantation of 'Z' Flow Shunt on the Skull



Implantation of 'Z'
Flow Shunt on the Sternum

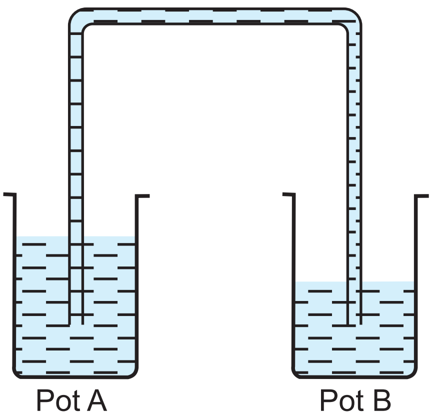
But the sternum, being structurally vertical, does not need any such marking for reference. It is. therefore, a preferable site for a 'Z' Flow shunt, except in ventriculo-atrial shunting. This site is particularly advantageous in case of babies because the chances of skin erosion are comparatively less here. The presumption that the sternum is not the right place for shunt is not valid. Implantation here in no way affects the efficient functioning of the shunt.

The Flushing of the distal catheter can be done by pressing the flushing chamber. If resistance is felt. it indicates a distal block. The non-filling of the flushing chamber indicates a proximal block, as in any other shunt.

Note: For Indications, Contraindications, Method of use, Warnings, Precautions & Complications please refer to Instruction for use supplied with the shunt.

d DISCUSSION

The 'Z' Flow shunt system claims to have broken a new ground in the approach to hydrocephalus shunting. This change is not merely in shunt design but also in the concept of how the cranial cavity, rt. atrium and.



peritoneal cavity develop a new relationship and create a new system after the shunt is implanted and consequently what new demands are made on the shunt system. This brief discussion is intended to explain this new approach as also to dispel the doubts related to hydrocephalus shunting.

In order to put the idea across in all its simplicity let us illustrate the function of a hydrocephalus shunt with the help of two pots, filled with fluid and interconnected with a tube. The level of the fluid is higher in pot A and the fluid is flowing from pot A to pot B. The following observations here are relevant to the functioning of a shunt.

1) The ultimate level in pot A depends entirely on the level of the fluid in pot B.
2) The level in pot A cannot fall below the level in pot B.

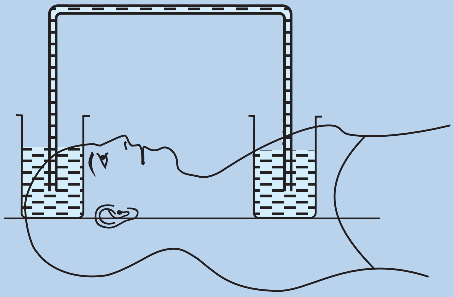
Human body has measurable normal pressures in different parts of the body. For our present purpose these are given below:

Part of the body	Pressure in horizontal posture	Pressure in vertical posture
Cranial cavity level (lateral Ventricles)	5 to 15 cm of water at the level of the foramen of Monro	-3 to -15 cm of water at the of the foramen of Monro
Right atrium	5 to 1 0 cm of water at the level of the mid-axillary line	-0 to -3 cm of water at the level of the second intercostal space
Peritoneal cavity	5 to 1 0 cm of water at the level of the mid-axillary line	-0 cm of water at the level of the sixth intercostal space
Pelvic floor the,	----	40 cm of water at the level of pelvic floor

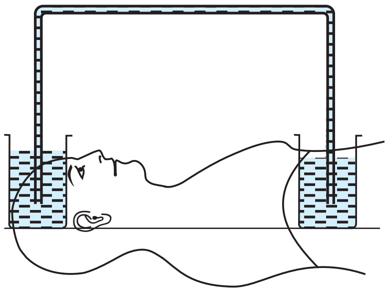
Note: Refer to Bibliography at No.1, 3 & 5

Net pressure gradients between ventricle & right atrium and ventricle & peritoneal cavity in horizontal and vertical posture, in adults, are given below:

Body posture	Pressure gradient between ventricle & rt. atrium	Pressure gradient between ventricle & peritoneal cavity
Horizontal posture	3 to 5 cm of water	3 to 5 cm of water
Vertical posture	1 5 to 20 cm of water	25 to 32 cm of water

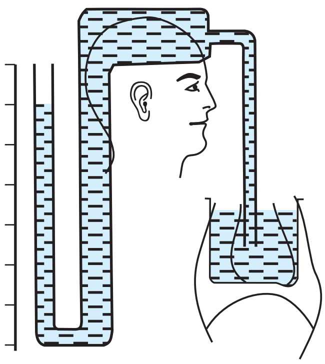


Demonstration of the function of a
ventriculo-atrial shunt in horizontal position

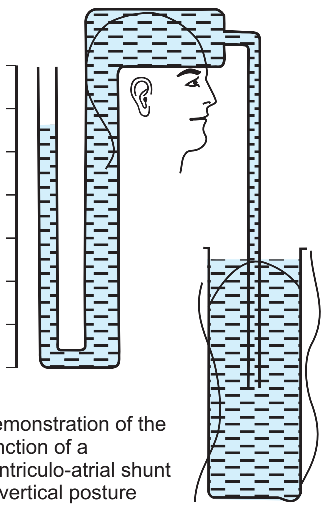


Demonstration of the function of a
ventriculo-atrial shunt in horizontal position.

In the above illustrations the cranial cavity, right atrium and peritoneal cavity are substituted for pots and a line is drawn at the level of the foramen of Monro and the mid-axillary line. The levels shown here in the horizontal posture are normal levels present in the three spaces.



Demonstration of the function of a
ventriculo-atrial shunt in vertical posture



Demonstration of the
function of a
ventriculo-atrial shunt
in vertical posture

The levels shown here in vertical posture are normal levels present in' the three spaces.

An analysis of this pot analogy leads to the following inferences:

1) The ultimate level in cranial cavity depends entirely on the level in right atrium or peritoneal cavity.

2) The level in cranial cavity cannot fall below the level in right atrium or peritoneal cavity.

This brings us to two broad conclusions, both relevant to hydrocephalus shunting:

THAT IN HORIZONTAL POSTURE. THE PRESSURE (LEVEL) IN CRANIAL CAVITY CANNOT FALL TO AN ABNORMALLY LOW PRESSURE EVEN IF A PLAIN TUBE IS USED AS A SHUNT.

THAT IN VERTICAL POSTURE, THE PRESSURE (LEVEL) IN CRANIAL CAVITY CAN FALL TO DANGEROUSLY LOW LEVELS AFTER SHUNTING.

Thus the modus operandi of a good shunt should be :

(a) to offer minimum resistance to the flow of CSF from cranial cavity to right atrium or peritoneal cavity in horizontal posture, and

(b) to produce sufficient resistance so as to check the fall of the pressure (level) in the cranial cavity below - 3 to - 15 cm of water, in vertical posture,

THE INHERENT LIMITATIONS OF A CONVENTIONAL SHUNT

It is time to re-examine the conventional shunts in the light of above facts. The need for a shunt originally arose because of the need to regulate pressure of CSF in cranial cavity; and in designing a shunt the only factor taken into account was the pressure in the cranial cavity and the cranial cavity alone,

However, it was not realized that the moment a shunt was implanted, an entirely new system came into existence because the pressure in the cranial cavity then ceased to exist in isolation and became inter-joined with the pressure in right atrium or peritoneal cavity. This wrong approach has been persisting ever Since.

A conventional shunt is designed to allow an optimum flow (20 ml/hr) at a pressure gradient of 7 to 10 cm of water and this property is suitable neither for the horizontal nor for the vertical posture.

The pressure gradient available in horizontal posture between cranial cavity and rt. atrium or between cranial cavity and peritoneal cavity, is only 3 to 5 cm of water. So the conventional shunt cannot be expected to function efficient lowing to the lack of suitable pressure gradient.

In sharp contrast to the above, the pressure gradient available in vertical position, between cranial cavity and right atrium is 15 to 20 cm of water and between cranial cavity and peritoneal cavity it is 25 to 32 cm of water. Both these pressure gradients are much higher.

higher than those required for optimum functioning of a conventional shunt. It will thus result in an overflow of CSF and an abnormal low pressure, in cranial cavity.

Excessively low intracranial pressure is hazardous and can result in low pressure headache, postural irritability, secondary craniosynostosis, subdural haematoma and conversion of communicating to non-communicating hydrocephalus (ref. no. 6)

Low intracranial pressure occurs only in vertical posture and it is in this posture that human body remains for more than 65% of the time, Even babies remain in this posture for long periods. A 'Z' Flow shunt alone has the capability of preventing a low intracranial pressure in vertical posture. So its use is Free from the above problems.

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