DESIGNING A MOTORISED NASAL ASPIRATOR

BY

PRITAM GHOSHAL

UNDER THE GUIDANCE OF

PROFESSOR SUMAN KALYAN DAS

Abstract

A simple and cost-effective design of a motorised nasal aspirator suitable for all age groups has been made using the Autodesk Maya software and a comparison made against the existing designs in the market.

1. Introduction

A nasal aspirator is a device that is used to suck mucous from the nasal passage, usually of a baby child. It is used usually when the nasal passage is so congested that it hampers the normal ability to breathe, eat or sleep. Adults blow their noses when they get stuffed up. Since babies do not have that ability, that mucous has to be removed in some way. However even in adult patients suffering from bronchitis, the nasal aspirator may be used.

2. Need For Design

There are three main designs of the nasal aspirator in the market currently. They are:

(i) The Bulb Syringe: It is also known as the bulb aspirator and is the classic snot sucking tool. Made of rubber with a large ball at one end and a narrow-tapered opening on the other, it looks like a large eye dropper. It is the most low-tech option available. Its disadvantage is that it is very rough during operation and the suction level cannot be controlled.

(ii) Oral Suction Aspirator: It consists of a tube that goes into the baby's nose and the other end goes to the caregivers mouth, who then uses

oral suction to get the mucous out. It has the advantage that the suction level can be controlled according to the needs by the caregiver. However, it has a very important disadvantage. While the mucous gets trapped by the filter preventing it from going into the mouth of the caregiver, no such provision can be made to trap the bacteria or virus. So, the caregiver can become infected too.

(iii) Electric Aspirator: These battery powered gadgets are designed for ease. Everything is done at the push of a button. There is no chance of infection and the suction can also be controlled.

3. Design Considerations

The following things have to be considered while designing the nasal aspirator:

(i) Cleanliness: If the nasal aspirator is to be used for more than once, provisions have to be made for it to be disassembled so that it can be cleaned to prevent bacteria and mould growth. Filters and tips have to be disposable

(ii) Material: The parts of the aspirator that come into direct contact with bodily fluids should be made of a material that does not harbour bacteria or facilitate its growth. Solid-surface materials satisfy the criteria but are not practical for this type of device. Silicone is the standard for flexible but sanitary medical devices.

(iii) Size of nasal tip: Size of nostril may change as the baby grows. Different child has different size of nostrils. So, the aspirator must have interchangeable tips.

(iv) Strength of suction: Level of congestion varies as does the baby's pain tolerance. A suction level that is suitable for one baby may not be suitable for another baby. So, the device must have varying suction levels.

(v) Cost: It should be cost effective

(vi) Ease of use: It should be easy to use and should not cause any discomfort to the baby.

4. Design

The following nasal aspirator has been designed using Autodesk Maya.

Fig 1: Nasal Aspirator

The device has the following components

(i) The vacuum regulator: The motor pump used will produce a vacuum significantly higher than the permissible limit for a new born. By using the slider, the amount of vacuum can be controlled over a wide range. As a result, the product is not limited to infants only. Also, this eliminates the use of any gears or vacuum breaker.

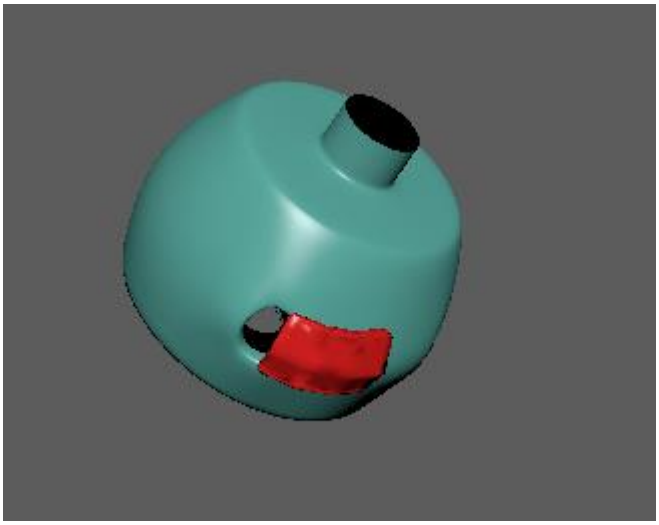

Fig 2: The vacuum regulator

(ii) Casing: It will house the motor pump and the battery. There are three switches, one for suction, one for blower, and one for turning the device off. Suction switch will be used for normal operation. Blower switch will be used for cleaning the casing after use. As a result, washing of the casing with water is not needed and any chance of short circuiting due to cleaning water is also eliminated. Also the casing need not be made waterproof.

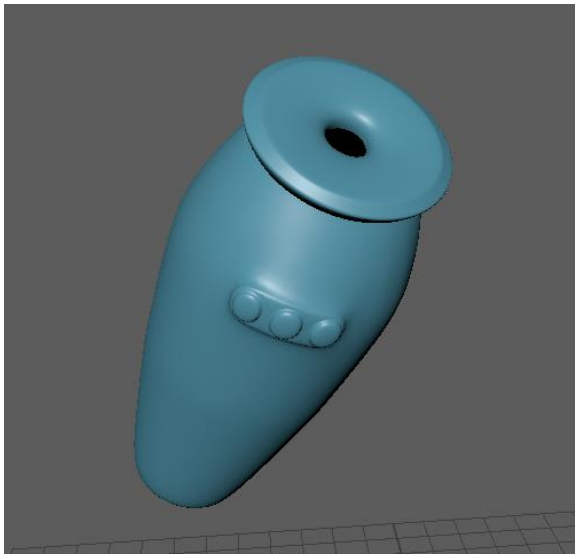

Fig 3: The casing

(iii) Storage Tank: It will be used to store the mucous. The pipe is eccentrically placed to decrease the probability of the mucous from going into the motor casing. Even if some particles do get through, it will be stopped by the filter placed just below this.

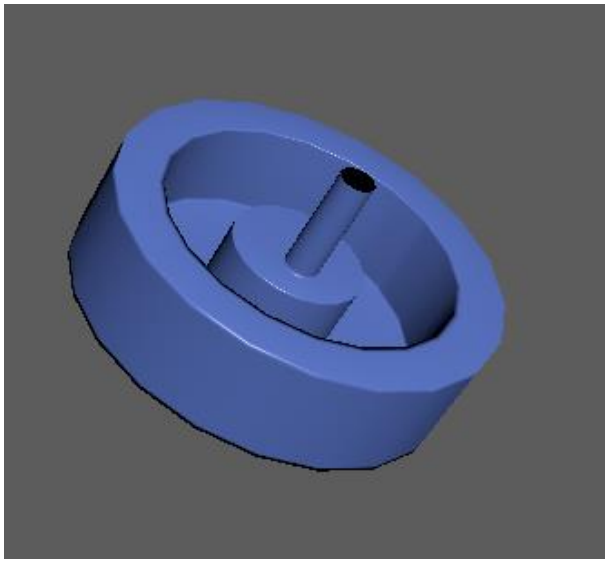

Fig 4: The storage tank

(iv) Top casing: This can be opened and washed separately. Catheters of any size can be fixed to it.

Fig 5: The top casing

(v) 6V motor pump: Motor pump with the following specifications will be used. The motor pump has the capacity of producing the required vacuum as prescribed for each age group in Figure 7.

- Pressure: 90 kPa
- Flow Rate: 2 Litre / min
- Weight: 58G
- Rated Voltage: DC6V; Current: 0.45A
- Size: Diameter: 27mm Length: 64mm

Specifications for this item

Brand Name	INVENTO
Colour	blue
Ean	8944769490752
Height	5 centimeters
Item Shape	cylindrical
Item Weight	50.0 grams
Length	5 centimeters
Manufacturer Series Number	ISC 506

Other Sellers on Amazon

₹ 460.00 Add to Cart

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Sold by: Invento Sales

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Fig 6: Specifications of motor pump

Age	Suction Pressure
Neonates	60 – 80 mmhg
Infants	80 – 100 mmhg
Children	100 – 120 mmhg
Adults	100 – 150 mmhg

Fig 7: Allowable suction pressure:

(vi) Suction catheters: Instead of suction tips, suction catheters have been used so that it does not cause any discomfort to the baby's nose and also the device may be operated at a distance so that the sound of the motor does not irritate the baby.

ETT and Suction Catheter Sizes

Age	ETT Size	Sx Catheter Size
Premature	2.5-3.5 mm	6 Fr.
Newborn	3.0	6
6 mo.	3.5	6
18 mo.	4.0	8
3 yr.	4.5	8
5 yr.	5.0	10
6 yr.	5.5	10
8 yr.	6.0	10
12 yr.	6.5	10
16 yr./Small adult female	7.0	14
Adult female	8.0	14
Adult male	9.0	14

Fig 8: Prescribed sizes of suction catheters

5. Cost Analysis

The cost per product has been calculated below.

Serial Number	Item name	Unit Price (Rs)	Number of Units	Total Price
1	Motor Pump	460	1	460
2	DPDT Switch	25	3	75
3	Duracell 1.5V battery	40	6	240
4	Catheters	25	10	250
5	Casing	1200	1	1200
6	Filter	50	10	500
7	Electrical Connections	50	1	50
			Total	**2775**

6. Advantages

The proposed design offers some advantages in comparison to the products already in the market.

(i) Eliminates the chance of short-circuiting during washing because it can be cleaned by operating in blower mode
(ii) Can be used across all age groups and for patients with bronchitis because the vacuum regulator can be adjusted to the desired pressure
(iii) Can be operated in two modes (suction and blower)
(iv) Vacuum can be regulated as per need
(v) Irritation due to noise will be eliminated
(vi) Easily portable
(vii) Silicone in catheter is BPA and phthalate free
(viii) Disposable filters promote hygiene
(ix) Prevents bacteria and mucous growth

7. Scopes For Improvement

There are two main disadvantages of the designed model. Firstly, it is a little pricey and secondly the batteries need to be replaced after some time. Rechargeable batteries may be used but that will further add to the cost. So, scopes of improvement in the design still remain.

REFERENCES

- **Amazon.in**
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