

The Concept of Single Use Piston Break Safety Syringe

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Abstract. A syringe is a simple piston pump consisting of a plunger that fits tightly in a tube. The plunger can be pulled and pushed along inside a cylindrical tube (the barrel), allowing the syringe to take in and expel a liquid or gas through an orifice at the open end of the tube. The open end of the syringe may be fitted with a hypodermic needle, a nozzle, or tubing to help direct the flow into and out of the barrel. Syringes are often used to administer injections, apply compounds such as glue or lubricant, and measure liquids. The reuse and abuse of syringe has led to cross-infection of diseases; thus, the need of single use safety syringe arises. Single use safety syringe is able to prevent the abuse of syringe. Many inventions have been produced; the most common are through-push retract breakable safety syringe, rotary plunger retractable safety syringe and release-ring breakable safety syringe. A new type of single use safety syringe *Piston Break Safety Syringe* is discussed in this paper. Common safety syringes available in market consist of three major components as described earlier. Beside its simplicity, the low cost to produce also the main factor why this type is very popular. The new *Piston Break Safety Syringe* has similar design with this widely used safety syringe; hence, it makes it easier to be adapted by the users due to its similarity, since no extra training to use it is required. The cost should be equivalently low due to the similarity in size, design and number of components.

Introduction

Everybody should keep their very own needles and syringe because many serious infections are being passed on by healthcare workers, who use one needle for multiple patients. The figures are becoming alarming and the syringe manufacturers are getting worried about the future of their companies and their profits more than the ill people in most cases. Some other way was needed and eventually it arrived. Though Arthur E. Smith received eight U.S. patents for a disposable syringe from 1949-1950 [1], it was Becton, Dickinson and Company (BD) who eventually mass produced the first glass disposable syringes, called the BD Hypak, in 1954. These were produced in order for Dr. Jonas Salk's new polio vaccine could be administered to around 1 million children in the US.

In 1955, worried about the litigation that could arise from the infection caused by the use of their syringes, the top brass of Roehr Products put their heads together and came up with the world's first plastic disposable hypodermic syringe called the Monoject, which they sold for 5 cents each. For healthcare professionals, it would have flocked to buy this but that did not happen at that time. The doctors thought it was safer to reuse glass syringes after sterilizing them. A year later, in 1956, a New Zealand pharmacist, Colin Murdoch, in an effort to come up with a better way of vaccinating animals, designed and patented the plastic disposable syringe

that is widely known today. Meanwhile, Becton Dickinson had been doing extensive development trials and tests, and in 1961 introduced its first plastic disposable syringe, the BD Plastipak. Today their range of safe disposable syringes is found worldwide. Needles are thinner, shorter and sharper, often specially coated for ease of entry and exit. Injecting yourself has certainly become a lot safer and easier, even if it is not the greatest thing to have to do every day.

The need for single use safety syringe is very critical. There are many reasons why it is necessary apart from to prevent the syringe from falling into wrong hands due to misuse. The safety syringe needed here must be very similar to the currently used in the market in terms of the design, usability and cost.

Product Description

The single use safety syringe introduction into the mass market has since increased starting from year 2000. Prior to that, there are very few products introduced into the market. Most of the inventions are concentrating at “Auto Disable” or “Auto Retractable” concept where the hypodermic needle is fused together with the barrel and after the first use the needle retracts into the barrel body, thus it cannot be reused. However, these inventions are still costly, and not all hospitals are able to adapt it as the main safety syringe to be used. In Malaysia, the plastic disposable syringe is still the main safety syringe used in every hospital. This type of syringe is low in cost, easy to handle and disposable after use. This model consists of three major components; plastic plunger, rubber piston and plastic barrel as shown in Fig. 1.

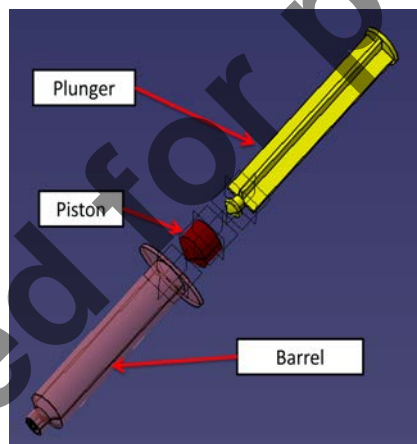


Fig. 1 Safety Syringe Components.

The standard practice in Malaysia is that after the use of the safety syringe, the needle is discarded into a special bin that breaks the needle and it cannot be reused, while the plastic syringe is thrown into another bin that is disposed through an appointed vendor who collects this scheduled waste and dispose it in a proper manner. However, this system is subjected to misuse should the syringe gets into the wrong hand.

The Invention

To overcome this problem, a disposable safety syringe used as a standard item in Malaysian hospitals must have an auto destruction feature. This feature prevents the misuse of the syringe especially when it falls into the wrong hands. To overcome this problem, we had invented a

safety syringe called the “Piston Break Safety Syringe”. The design, cost and construction of this new safety syringe can prevent the misuse of it, even if it falls into the wrong hands. Its unique feature ensures the single use ability to be preserved.

Area of Invention. This invention belongs to the medical specialization. It is an apparatus used in medical practices. Even the usage also covers up to other specializations, such as manufacturing, the major uses of this apparatus, as well as the images of this apparatus, are always related to medical purposes. This invention adapts an old principle to work. The syringe itself is an old tool that has been used as a medical device for more than a century ago. The principle to fail the piston adapts the same principle used by the original design. When the piston breaks, it causes the vacuum fails to generate, resulting in the liquid cannot be transferred into the syringe barrel.

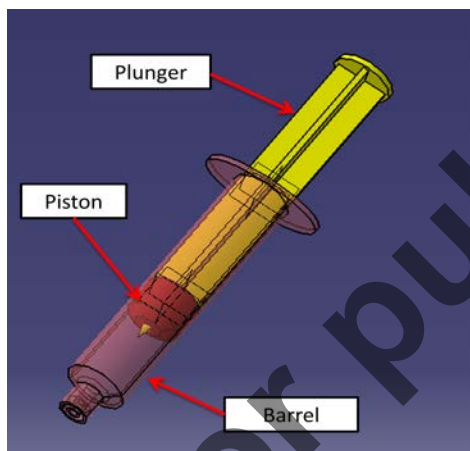


Fig. 2 “Piston Break Safety Syringe” Components

The Design

The main component of the “Piston Break Safety Syringe” is still the same as the normal disposable safety syringe. It consists of plastic plunger, rubber piston and plastic barrel as shown in Fig. 2, exactly the same as the feature in Fig. 1. The working method for this new safety syringe is also the same as its predecessor, making the adaptation to this new invention easy; thus, further training is not required.

Plunger Design. The plunger will be the main feature to determine the success of this new design. As in Fig. 3, the new plunger design on the left has extra features compared to the original design on the right. The new features include long neck, groove, flat end and needle tip:

- Long Neck: this feature ensures the piston is able to slide along the neck.
- Groove: this feature is to provide a path for air to travel through it into the lower barrel during the stroke up operation.
- Flat end: provides air/liquid seal once the piston punctures during stroke down operation
- Needle tip: to puncture the piston during stroke down operation to ensure the syringe does not function for the next refill operation.

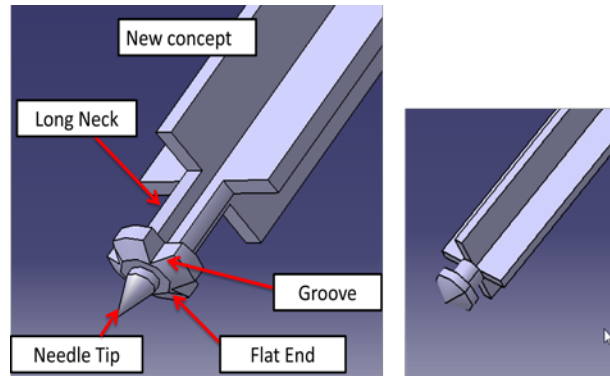


Fig. 3 Plunger features

Piston Design. For the conventional safety syringe, the piston provides the air seal and must be air tight. This will ensure the low pressure or vacuum created in the lower barrel during the stroke up operation. Failure to provide the air sealing will defeat the purpose of the syringe; it will not be able to suck the liquid into the lower barrel nor to administer the drugs into the human body. The “Piston Break Safety Syringe” as in Fig. 4 utilizes this unique capability to achieve the single use target. The piston will allow the syringe to fill the barrel with liquid during stroke up operation. This is the only stage where the syringe is capable to be filled up with the fluid. When the plunger is pressed down, the piston tears off at the bottom, but it can still administer the drugs since the sealing is provided by the flat face at the piston and at the plunger tip. However it cannot be reused. The long hole inside the piston provides sufficient space for the plunger needle tip not to puncture the piston during the initial/factory stage.

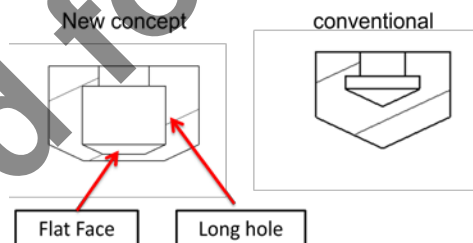


Fig. 4 Piston features

Barrel Design. In the new barrel design in Fig. 5, there is a small recess hole enough for the plunger needle tip to rest when the plunger is pressed down all the way. This ensures the drug is efficiently administered into the human body according to the required dosage. Other features remain the same as the conventional design.

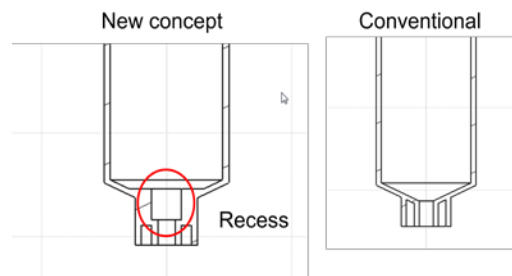


Fig. 5 New barrel design as opposed to conventional design

Assembly Method

In the factory, all assemblies are done using machines and fixtures. This prevents the piston prematurely punctured in the assembly line. Vacuum is used to bring the assembled piston and plunger to the bottom of the barrel. The syringe will be shipped in this configuration and ready to be used for only single use.

Conclusion

There is no new technology involved in this invention. It is using the old technology to the old usage. For the user, a small precaution needs to be advised before using this new safety syringe. Only single stroke down is allowed. That means if there is excess liquid inside the barrel, the operator will have only one attempt to level it into the required dosage. Failed to follow the guideline will break the syringe and it must be thrown away. The low cost design, easy to use and the true single use will make this design to become the main safety syringe in the market. Even if it falls into the wrong hand, it can only be used once, at least it will prevent the wide spread of dangerous diseases from spreading due to syringe sharing.

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