

## DIGITAL TOURNIQUET SAFETY

The risks associated with digital tourniquets include damage to the underlying neurovascular structures due to excessive tourniquet pressure and digital necrosis due to a forgotten digital tourniquet. The T-Ring was specifically designed to minimize if not eliminate the risks that have been associated with all other digital tourniquet techniques.

## OTHER METHODS AND THEIR RISKS

- **Penrose Drain** – has been shown in several studies to apply the highest pressure of all the digital tourniquet methods- pressures that often easily exceed what is considered to be safe. This is particularly true when it is wrapped down the digit and clamped in place, resulting in recommendations to not use this technique (9-11,25-28). Another technique involves sliding a Penrose drain over the end of a digit and rolling it down, creating a constricting band at the digits base. This method has also been advised against, due to the tourniquet's low profile and increased risk of being forgotten on the digit (7,21).
- **Rolled Glove Finger** – the use of this device **has been strongly advised against**, due to its low profile and risk of being left on a digit, resulting in digital ischemia and necrosis. Several articles advise against the continued use of this method (3,6,21). There are numerous other case reports involving the rolled glove finger being left on a digit, with additional warnings advising against its use. (4,19,22,23)
- **Rolled Glove Finger with a Clamp** – this method has been proposed to prevent the rolled glove from being forgotten on the digit; however, this method has also been warned against due to the increase in pressure that may be applied to the digit. (14-16 )
- **Rolled Glove using the entire Sterile Glove** - the entire glove is put on so that the operator will not forget to take it off. This technique has been advised against because of the risk of further injury in the case of a complex wound, and the difficulty associated with its application. (18)
- **Commercially Available Silicon Rings** – these rings have been shown in studies to apply pressure that is greater than what is generally considered to be safe (8,10). They also have been reported to be difficult to apply and also have the risk of being left in place on the digit. (6,17)
- **Pneumatic Tourniquet** - the inflated cuff is placed proximally on the extremity and prevents blood flow to a large area of tissue not involved in the operation. They have an increased risk of complications, including blood clot, tissue injury and infection (24). Venous congestion occurs if the limb is not exsanguinated prior to cuff inflation. The most uncomfortable of all methods.
- **Summary**-all of the commonly used digital tourniquet devices have had recommendations that advise against their use. We have continued to use them, despite these recommendations, because there has not been a better alternative -until now. The T-Ring was developed as a result of the risks and deficiencies associates with the traditional techniques, and is the safest digital tourniquet available today.

## **SAFETY ADVANTAGES OF THE T-RING:**

- **Safe Pressure Every Time** – the T-Ring is the only tourniquet that automatically adjusts to the size of the digit, resulting in a safe, reliable pressure every time. This eliminates the risk of excessive pressure that has been associated with all other digital tourniquet methods and avoids unnecessary injury to the underlying digital vessels and nerves.
- **Free From Operator Error** – the T-Ring only comes in one size for adults, so the incorrect size cannot be used. Its design also makes it impossible to over tighten.
- **High Visibility** – the T-Ring's size and bright colors make it extremely unlikely if not impossible to forget on a digit, avoiding the catastrophic complication of digital ischemia and necrosis.
- **Safest Device Available** – the T-Ring is, in all aspects and without comparison, the safest digital tourniquet available for use today.

## **UTILITY AND EASE OF USE**

The commonly used digital tourniquet methods include the Penrose Drain, the rolled glove finger, and a commercially available silicon ring. When using these methods the operator has to decide which size to use, and how tightly they need to wrap, roll, twist or clamp. The rolled glove finger and silicon ring both are tightly adhered to the digit and must be rolled over the injured area, which in some cases may be difficult or cause further injury. This is especially true if the injury involves a significant flap, mangled or hanging tissue. While the Penrose Drain remains a commonly used method, it does not exsanguinate the digit unless it is first wrapped from the tip of the digit to the digit's base. Not only is this relatively cumbersome, studies have shown that this technique may frequently apply excessive pressure and has led to recommendations that this method not be used.

## **ADVANTAGES OF THE T-RING:**

- **One Size Fits All**
- **Instantly Exsanguinates** - as it is slid onto digit
- **Provides Immediate Hemostasis** – stops bleeding instantly!
- **Broad Application** - may be used on injuries involving significant flaps or deformities
- **Fastest and Easiest of All Methods to Use**

## LITERATURE - KEY POINTS

The literature contains numerous studies, case reports and review articles regarding the use of the various digital tourniquets. Key points from the literature include:

- Use the least amount of pressure necessary to achieve hemostasis- the risk of damage to the digital vessels and nerves increases with increasing pressure ( 1,2,29-32)
- Most tourniquet related injuries are due to excessive pressure (20, 29,30)
- In upper extremity surgery, the maximum safe pressure that pneumatic cuffs are inflated to has been set at 300mm Hg (20)
- Pressures in excess to what is considered to be safe have been demonstrated by each of the following methods ( 8-11 ):
  - Penrose Drain
  - Rolled Rubber Glove Finger
  - Commercial Silicon Ring
- Even when following recommendations on how to apply these methods safely, it is difficult to produce a reliably safe pressure (8-11).
- Further highlighting the above difficulties, there currently is no method to monitor the pressure to alert the user when excessive pressure is being applied (1, 12,13).
- Despite numerous warnings in the literature, tourniquets continue to be forgotten on digits leading to digital necrosis and amputations (3-7, 19,21-23 )
- **The T-Ring is the ONLY method that has ever been shown to reliably apply a safe and effective pressure to the digit, regardless of the size of the digit or how the tourniquet is applied.** It also has been shown to apply less pressure than any other method. This is a remarkable advancement in digital tourniquet safety, and will eliminate the excessive pressures that have been associated with all previously used methods and prevent unnecessary injury to the underlying neurovascular structures.

## **LITERATURE WARNINGS**

None of the traditional digital tourniquets are reliably safe, and there are numerous warnings in the literature regarding the use of these devices.

### **Methods That May Apply Excessive Pressure:**

- Penrose Drain\* (9-11,25-28)
- Rolled Glove Finger (8,10,11); risk further increases when using a clamp (14,15,16)
- Commercially Available Silicon Band ( 8,10)

\*studies show the Penrose drain most commonly applies the greatest pressure, frequently exceeding what is generally considered to be safe

### **Methods That Are Low Profile and More Prone to being Left on a Digit:**

- Rolled Glove Finger (3\*, 4,5,6\*,19,21\*,22,23)
- Silicon Band (6\*,17,19 )
- Penrose Drain (7,21)

\*article advises against continued use of this method

### **Methods that may be Difficult to Apply**

- Silicon Band (17 )
- Rolled Glove Technique Using the Entire Glove ( 18 )

**Summary-** all of the commonly used digital tourniquet devices have had recommendations that advise against their use. We have continued to use them, despite these recommendations, because there has not been a better alternative - until now. The T-Ring was developed as a result of the risks associated with these traditional methods, and is the safest digital tourniquet available today.

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