Improving care for digit wounds

A single-use, one-size-fits-all device can help improve patient outcomes and also offer clinical time savings when dealing with digit procedures in theatre or cuts or lacerations in A&E. *The Clinical Services Journal* reports.

For healthcare practitioners working in both primary care and acute care settings, managing injuries to digits is a daily occurrence. It has been estimated that nearly 4% of visits to emergency department visits in the US are as a result of injury to a finger. Around 75% of these injuries will involve soft tissue injury requiring haemostasis, and a significant number will involve injury to a deep structure. Such injuries have a high rate of complications, and are a common source of litigation in the US for health care providers practicing in the acute care setting. Around 24% of all emergency department claims result from wound related complications – most commonly from failure to diagnose an injury to an underlying tendon, nerve, bone or joint capsule; or as a result of a missed foreign body in the wound.

It is vital for the clinician to perform a safe, thorough examination of the wound to enable accurate diagnosis and treatment of finger injuries. While healthcare providers have devised a variety of different approaches to evaluate and manage these injuries, experts agree that it is critical to evaluate all wounds in a bloodless field, to minimise the risk of complications. Failure to do so will lead to a higher rate of missed deep tissue injuries, missed foreign bodies and a higher rate of infection.

While traditional digital tourniquets provide the necessary haemostasis to achieve a bloodless field, there are well-documented complications associated with their use. These include neurovascular injury due to excessive pressure, and digital necrosis resulting from a forgotten tourniquet.

Clinicians will often use a Penrose drain to gain haemostasis during procedures on fingers and toes. The intended purpose of the drain tube is to remove fluid from a wound area, but it is also frequently used as a digital tourniquet. Another well-used tourniquet solution has been the use of a rolled up surgical glove.

The recommended pressure for an upper extremity tourniquet is 200 mm Hg, with the 'not to exceed pressure' of 300 mm Hg, and the level known to cause injury is 500 mm Hg. A recent study by Naim measured the pressure applied by traditional digital tourniquet methods.[1] The rolled surgical glove method applied 561 mm Hg, the commercial band tourniquet 636 mm Hg, and the elastic catheter (Penrose drain) 834 mm Hg.

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Pressures of such magnitude significantly increase the risk of iatrogenic neurovascular injury, and are completely unnecessary when being applied to a digit because digital artery pressures are significantly lower than arterial pressures in the arm. Tuncali *et al* reported on a method to estimate the arterial occlusion pressure; according to these principles the pressure necessary to prevent digital blood flow ranges from 110 mm Hg to 130 mm Hg.[2] Based on their experience with using digital tourniquets on patients in the clinical setting, Shaw *et al* reported pressures of 150 mm HG to be 'very adequate' to maintain haemostatis.[3]

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The National Patient Safety Agency (NPSA) identified 31 serious incidents between August 2005 and November 2009 relating to digital tourniquets being left in place after surgery. Of these, 18 patients needed further surgical treatment and nine resulted in partial or complete amputation. These were reported from operating theatres, emergency departments and primary care.

The NPSA reported that at least six of the incident reports related to the use of surgical gloves being used as tourniquets and this resulted in it issuing a report advising against the use of surgical gloves as tourniquets (including techniques to reduce risks by using artery clips).

The NPSA search for published research relating to complications associated with the use of finger and toe tourniquets discovered a report from De Boer and Houpt,[4] which stated that when treating a tip avulsion in a five-year old boy the tourniquet, a rubber glove, was accidently left in place. This resulted in a necrotic finger that had to be amputated. The authors explained how 'painless' ischaemia can occur because after an operation the finger will still be numb from the local anaesthesia and nerves are the first structures in the digit to become damaged by the pressure of the tourniquet.

Hass reported on necrosis of the big toe in a 20-year-old woman with an ingrowing toenail after a tourniquet was left in place after an operation.[5] The ischaemia, which lasted for two days, resulted in necrosis of the big toe.

The Medicines and Healthcare Regulatory Authority (MHRA) further points out that the use of surgical gloves as a tourniquet in any form is beyond the manufacturer's intended purpose. As with any off-label use of medical devices, it poses possible risks to the patients and the potential for litigation against the hospital or healthcare professional.

Reviewing tourniquet complications

It was while reviewing malpractice cases resulting from digital tourniquet complications that Dr William Green, a staff physician at Hoag Hospital in Newport Beach, California in the US, first identified a widespread problem with the existing digital tourniquet techniques. This led to him to look for a better solution.

Dr Green explains: "In our department alone, three malpractice cases occurred in a 10 month span due to complications related to the management of finger injuries. The first was a serious finger infection that resulted from a missed wound foreign body. Another patient developed a digital nerve paresthesia after a Penrose drain was used for a nailbed repair. The Penrose was only on the patient for 20 minutes, but four months later the patient had still not recovered sensation to the digit. The third case resulted in a patient having a finger amputated after developing necrosis from a forgotten tourniquet. A surgical glove had been used, but it was inadvertently forgotten and bandaged over. The necrosed finger was discovered two days later when the bandage was removed from the finger."

Dr Green looked into the issues in

Improved wound care for digits

The use of the T-Ring can provide a good solution for treatment of uncomplicated finger lacerations which measure less than 2 cm (>80% of finger lacerations). The ability of the T-Ring to immediately stop bleeding enables the clinician to perform a better examination, reducing the risk of missing a deep tissue injury or foreign body. It also enables treatment options other than suturing to be considered. For example, the application of topical skin adhesives (TSA) and steri-strips, both of which are only considered an option if bleeding is completely controlled and the wound is dry.

Quinn *et al*[1] found that non-suturing of hand lacerations less than 2 cm in length produced similar cosmetic and functional outcomes to suturing and was 14 times faster to treat and less painful for the patient. The wound does not need to be anaesthetised and no follow up visits are required by the patient.

For those concerned about wound dehiscence when using a TSA on a digit, the results of Saxena's study show that, when using a topical skin adhesive on the hands, feet and over joints of paediatric patients, only two of 32 lacerations (mean length of 2.4 cm) dehisced, and both of these closed uneventfully.[2] Further, he concluded that even if all patients with wound dehiscence due to topical skin adhesive failure returned for a check up, this would result in a 6% return rate, *versus* nearly 100% re-visit rates for patients whose wounds were closed with sutures.

References

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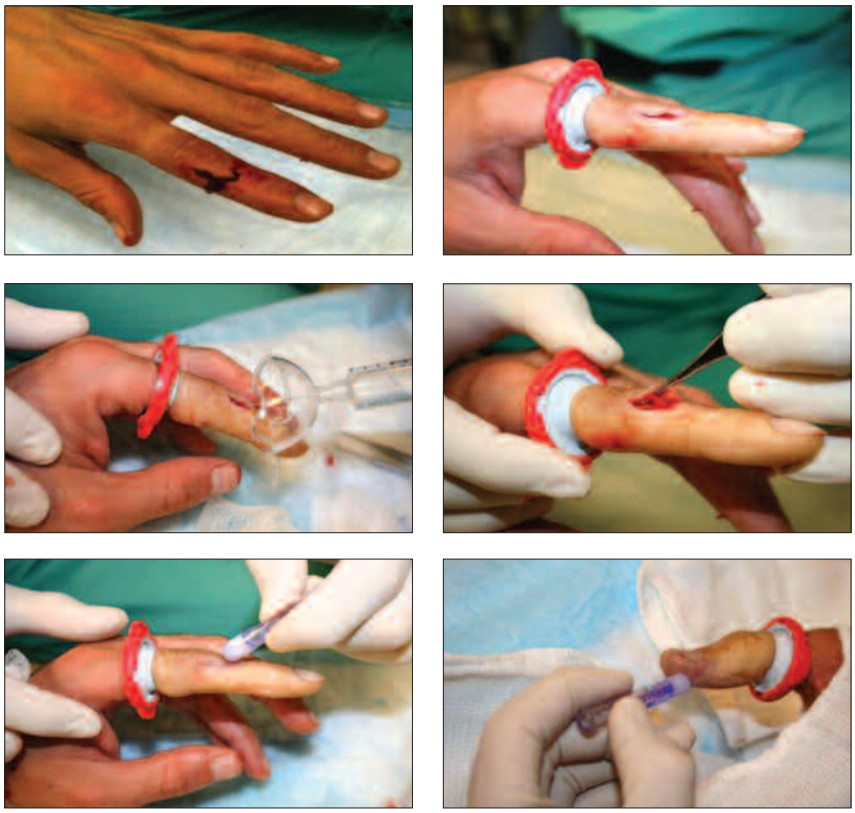
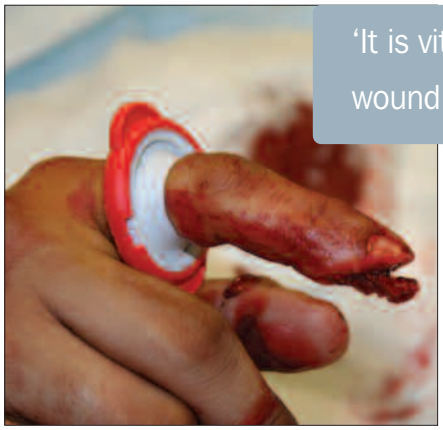


T-Ring provides immediate control of bleeding on all digit sizes, improving wound exploration and allowing topical laceration closure techniques in wounds less than 2 cm – frequently eliminating the need for suturing.



T-Ring can instantly stop the flow of blood to the digit, providing immediate haemostasis and better wound visualisation without the application of excessive pressure.

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more depth. "I was amazed by the number of articles over the past 50 years that discuss the complications related to the use of digital tourniquet methods. There were numerous articles advising that Penrose drains, surgical gloves and commercial silicon bands should not be used. The literature was clear on two things – the bloodless field provided by tourniquets is critical to minimise missed injuries and foreign bodies; however, traditional tourniquet methods should not be used owing to the significant complications associated with their use."

Overcoming the issues

Dr Green decided it was time to design a better solution, one that could provide the benefits of tourniquet use without the risks associated with existing tourniquets. He realised that the biggest challenge was to create a solution that always applied a safe and effective pressure, regardless of the size of the digit or method of applicaton. "Naim's study showed us that elastic catheters, rolled surgical gloves and commercial silicon bands all apply highly excessive pressures, even when applied correctly. Digital nerves are most commonly injured, but vascular injuries are also well documented. Unlike ischaemic injuries, pressure related injuries can occur quickly. Significant nerve palsies and ischaemia resulting from vascular thrombosis are documented to occur in as little as 15 minutes," he said.

"The challenge with digits is that they are the only place on the body that tourniquets are placed without being able to monitor or control the pressure being applied. They are also totally dependent on the individual provider's technique. Are they selecting the correct size glove or commercial band? How tightly do they wrap, roll, twist or clamp an elastic catheter or Penrose drain?"

Having reviewed the available literature and consulted experts to identify the features required of an 'ideal' digital tourniquet, Dr Green developed the "T-Ring". The T-Ring is the world's first one-size-fits-all tourniquet for digits, and was brought to market by US-based company Precision Medical Devices, LLC to offer a safer and more effective option to the traditionally used digital tourniquet methods. It is believed to be the only digital tourniquet available that is able to automatically adjust to the size of the digit, resulting in a safer, more reliable pressure being applied to the digit. The single-use T-Ring can instantly stop the flow of blood to the digit as soon as it is applied, providing immediate haemostasis and better wound visualisation without the application of excessive pressure.

"It is impossible to apply excessive pressure when using the T-Ring. The T-Ring becomes wider when placed on larger digits, resulting in a safe and effective pressure on all sizes, regardless of who puts it on or how it is applied," said Dr Green. It is designed to spread a potentially greater pressure over a larger surface, ultimately resulting in safe, uniform pressures with each application.

Consistent pressure

This was evidenced in a study by Lahham,[6] that found the T-Ring applied a consistent pressure of between 150 mm Hg and 165 mm Hg on all digits sizes, noting that only between 90 mm Hg and 130 mm Hg is required to maintain haemostasis. Lahham's study also showed that the T-Ring applied the lowest pressure of all tourniquet methods on all digit sizes; consistent with recommendations to 'always use the least amount of tourniquet pressure necessary to maintain haemostasis'.

Another important consideration in the design of an 'ideal' digital tourniquet solution was to eliminate the risk of digital necrosis resulting from a forgotten tourniquet. Dr Green explains how this was achieved: "The T-Ring has an extremely high profile, extending 14 mm from the surface of the digit, compared to 2 mm for the rolled glove, and 3-4 mm for the commercial bands. The T-Ring's outer ring is bright red to make it stand out against the digit, as opposed to surgical gloves and elastic bands that are usually flesh coloured. This makes the T-Ring highly visible, meaning that it is much less likely to be accidentally left on a digit, helping to eliminate the other well-known complication of digital tourniquet use – ischaemia due to a forgotten digital tourniquet.

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T-Ring is a one-size-fits-all tourniquet for digits.

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