Original article

Introduction to “tension loop internal fixation” of simple fractures and “Faisal’s double noose loops”

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ABSTRACT

In this paper, is described a new method of internal fixation for smaller bone fractures without comminution and with interdigitating ends, especially clavicle and forearm bones. Fixation and compression are achieved by a new technique called “the double noose loop”.

This fixation can be **Temporary** to allow placement of a plate easily. Or it can also be used as a **Definitive fixation** along with a splint.

Faisal’s double noose loop is a suture passed through bone and over fracture, with noose knots at both ends that are linked to form a loop around fracture. The loop can be tightened to decrease the circumference/diameter of the loop by a big amount, thus allowing compression.

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1. Introduction

1.1. Faisal’s double noose loop

Faisal’s double noose loop (Fig. 1a) is a suture with noose knots at both ends that are linked to form a loop. The loop can be tightened to decrease the circumference/diameter of the loop by a big amount, thus allowing compression. Other variation, a single noose loop, a crossed loop (Fig. 1b), unicortical loop (Fig. 1c) or a stainless steel wire loop (Fig. 1d) can also be used. Henceforward the two ends of the suture will be referred to as first and second end.

1.2. Procedure

Step 1: Tie a noose at first end of the suture (Fig. 2a).

Step 2: Tie a simple knot at second end of suture, but don’t tighten it (Fig. 2b).

Step 3: Bring the second end of suture (n) through the first noose (m) (Fig. 2c).

Step 4: Loop “n” through “m” and pass it again through second knot (o) to form the second noose (Fig. 2d).

Step 5: Pull both the free ends to tighten the loop (Fig. 2e).

1.3. Loop internal fixation

In this paper, is described a new method of internal fixation for fractures without comminution and with interdigitating ends, especially clavicle, fibula and forearm bones. Fixation and compression are achieved by the double noose loop described earlier.

This fixation can be **Temporary**. For example in forearm fractures, when reduction is achieved, next step is placing a plate over the fractured bone and clamping it to the reduced bone. But this is often very difficult and placing the plate on the bone and clamping it is messy and often displaces the fracture. This problem is especially faced by younger surgeons. Here an absorbable or non-absorbable suture can be used to Loop the fracture and it provides sufficient strength to allow comfortable placing of plate. The suture can be removed after plate fixation or even if it is not removed it can be left in.

This fixation can also be **Definitive**. Especially in children who require open reduction and internal fixation, loop can be used to fix the fracture. Or in clavicular fractures, where there is no need of rigid fixation but there is need of low profile fixation.¹ Or in lateral malleolus fractures where plates and screws are a common source of tendon irritation.² Compression can be achieved at the fracture site. There is less periosteal stripping and less periosteum is lost under the lesser area of a loop as compared to a plate and this promotes bone healing. This method is better than cerclage whenever applicable, because there is longitudinal periosteal obstruction, as compared to circumferential obstruction of a cerclage. Less length of bone is required for fixation, hence less

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Fig. 1. Different tension loops.

Fig. 2. Faisal's double noose loop.

Fig. 3. Procedure for loop fixation.

dissection and soft tissue stripping; and this is especially helpful when there is a risk of involvement of physis in the plate, screws or K-wires. There is also no need of a second surgery for removal of hardware. However there is a need for external splinting after surgery till the fracture heals. These methods can be used to stabilise vertical splits of bone and butterfly fragments also.

1.4. Prerequisites

Simple fractures.

No/Minimal comminution.

Interdigitating ends (interdigitating ends give some stability to translation and rotation when compression is applied).

2. Method

In this demonstration we will use an animal bone. We apply a bending force to produce a transverse fracture, with nice interdigitating ends. We use a 5 number ethibond suture to tension loop the fracture.

Step 1: Align the bone (Fig. 3a).

Step 2: Drill parallel holes in both fragments using a K-wire (Fig. 3a).

Step 3: Tie a noose on first end of the suture (Fig. 3b).

Step 4: Pass the suture through the holes (Figs. 3 c and 1 a).

Step 5: Reduce the fracture and pull the second end of suture till the noose lies near its hole (Fig. 3d).

Step 6: Make a simple knot on the second end of suture (Figs. 3 d and 1 b).

Step 7: Pass the second end of the suture through the first noose (Figs. 3 e and 1 c).

Step 8: Pass the second end of the suture through the Second knot (Figs. 3 f and 1 d).

Step 9: With a needle through the second knot, pull the knot right up to its hole (Fig. 4a).

Step 10: Tighten the knot to form the second loop (Fig. 4b).

Step 11. Pull the suture ends in their own direction to tighten the loop and cause compression at the fracture site (Fig. 4c).

Step 12: Pull the suture ends in opposite direction (Fig. 4d) to lock the nooses. Tie a few square knots for more stability (Fig. 4e).

Step 13: Another loop is put in a plane perpendicular to the first one but a bit farther from the first loop. More loops can be put but at different distances from the fracture and in different planes (Fig. 4f).

3. Discussion

There are various methods of fixation of fractures, like plating, lag screws, nailing, etc. All have their benefits and their complications, all have their uses and all have their unique limitations. To this vast variety of options available to a surgeon, I present an addition, with its own benefits and complications, its unique uses and limitations; which will make this technique preferable and better in some fracture and situations, and will provide the surgeon an additional option in addition to the many options that he already has.

3.1. Problems with current methods of internal fixation

Plates are a wonderful device, perfect for many situations, but they have some problems. Plates require massive dissection, and hence more chances of complications. It is often a struggle to hold the fracture in a reduced position with clamps and negotiate the plate through the clamps without displacing the reduction. Plates need a good amount of bone for fixation, and when the fractures are near the epiphysis, there may not be adequate space for fixation. Plates cause irritation in places like clavicle and lateral malleolus.^{1,2} Plates cause load bearing and hence bone weakness.³ Plates as well as the screws used with them are a source of stress on the bone and can cause new fractures of their own.⁴ Plates are rigid and do not allow dynamic compression.

Nails on the other hand need lesser dissection but the reduction is not as perfect. Nails are not considered that good in clavicle, fibular, forearm and some other fractures. The entry point may be a source of irritation⁵ and weakness in some patients.⁶ Nails are also limited when the fracture is too near the epiphysis.

So, here is provided a new method which may overcome some of these problems in some situations and may improve the outcome of certain fractures.

Fig. 4. Procedure for loop fixation.

3.2. Benefits of tension looping

- Less dissection and periosteal stripping are needed as compared to a 6 or even 8 hole plate, hence better bone healing and lesser complications occur and ofcourse there is a smaller and more cosmetic scar.
- Less manipulation is needed, and reduction can be achieved and maintained more easily.
- Smaller and lesser number of holes needed than those needed for 3.5 or even 4.5 mm screws, hence there is less strain on bone and there are less chances of periimplant or iatrogenic fractures.
- The holes are in different planes, so there are lesser chances of longitudinal/split fractures as compared to the uniplanar screws of a plate.
- It is a cost effective fixation.
- Easy availability and producibility.
- Current devices are load sharing or load bearing. This method is load transmitting, and hence doesnt cause bone weakness/osteoporosis and promotes healing.
- This method allows static compression while permitting dynamic compression as well.
- This method provides stability to translation, distraction, rotation and it also prevents bending in the plane of the loop. To prevent bending in the plane perpendicular to the loop, a second loop can be used perpendicular to the first loop.
- There is less hardware irritation, and a low profile fixation.
- There is no need for hardware removal.
- This method can avoid physis in children by either using a smaller metaphyseal area for fixation or by simply bypassing the physis and using epiphysis instead for fixation.
- It can be used to fix longitudinal splits without the need to accommodate lag screws in the subsequent plate placement.
- This method can be useful in extremely osteoporotic bones where cortical screws cant get purchase of bone.

3.3. Problems of tension looping

- This method is a little difficult and complicated to master.
- The threads needed should have a high tensile strength and low elasticity, while most of the threads available have a low tensile strength and high elasticity.
- Fixation is not as secure as conventional methods of fracture fixation and a splint is needed during the healing process and there is a delay in starting ROM.
- It cannot be used in comminuted fractures.
- It needs circumferential exposure of the bone segments to be fixed.

3.4. Practical tips

- Use atleast 2 suture loops for adequate stability.
- Crossed and unicortical tension loops are probably more stable than simple tension loop. However they are difficult as well.
- Single wire loop may provide adequate stability.
- If only one loop can be put, Put it across the narrow diameter of the bone, or in case of both bones fracture, put it in the plane perpendicular to the plane of the two bones.

Conflict of interest

The author has none to declare.

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