



## Use of synthetic ligament in reconstruction after massive bone tumour removal

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With advances in medical imaging over the past decades and with a multidisciplinary approach in bone tumour management, limb sparing procedures are more often feasible but come with new challenges. One of these is to deal with the remaining soft tissues, especially muscles, or bony parts and to restore continuity and a correct function.

Synthetic ligaments have been used safely for several decades in various ligament reconstruction procedures with good results. We present a technique in which a synthetic ligament is used to augment or replace a joint capsule around a megaprosthesis. The joint is thus stabilized, and the remaining bony parts and muscles are attached to the synthetic material to restore continuity and allow better function of the spared limb.

**Keywords :** bone tumour ; surgery ; synthetic ligament.

### INTRODUCTION

In massive bone tumour resection, bone and also parts or even all of a joint capsule and portions of the surrounding muscles are removed. To stabilize joints and restore muscle continuity is a major challenge.

The technical tip of using a synthetic ligament to replace or reinforce the joint capsule and then attach the remaining bony or muscle parts to it is a useful tool to help the surgeon in this task.

### Surgical technique

After major bone, joint and soft tissue resection for tumour surgery, one is left with the difficult problem of the reconstruction of the salvaged limb (Fig. 1).

The removed joint and bones have to be replaced and stabilized. Continuity of the different muscles and tendons is also necessary to obtain an adequate function of the limb.

An off-the-shelf revision prosthesis or a custom made megaprosthesis will replace the removed joint and bone.

To stabilize the joint, the capsule and other soft tissues left will be replaced or augmented with the use of a synthetic material. This material should have a good biological tolerance, a possibility for fibroblastic ingrowth, a mechanical resistance to fatigue and resistance to elongation.

Synthetic ligaments have been used for more than a decade in the reconstruction of ligaments around the knee and have these properties (4,5,6).

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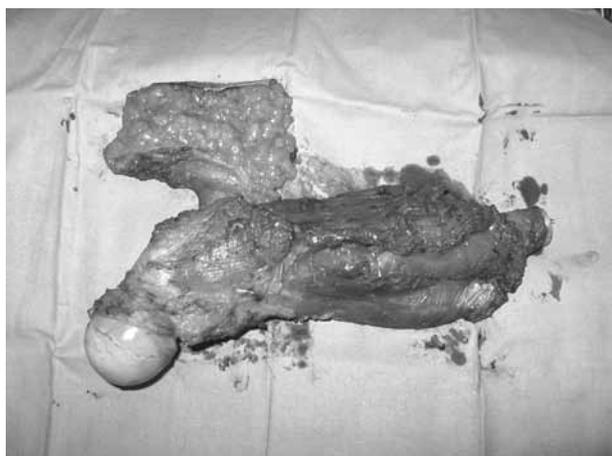
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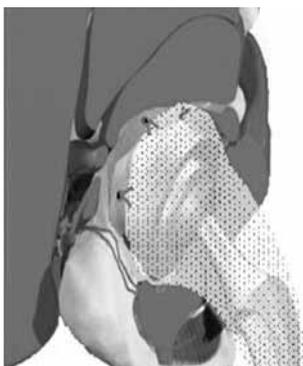
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**Fig. 1.** — Removed massive tumour of the proximal femur and surrounding muscle and soft tissue.



**Fig. 2.** — Attachment of the synthetic ligament to the acetabulum.

The “tumour band”, inspired from those more classical synthetic ligaments, is a 6 × 40 cm tube, although it is also available as a band (LARS ligament, Surgical Implants and Devices, Arc-sur-Tille, France). It can be cut to the desired length but was used with its full length in the situations described here.

The material is non-resorbable and is made of 90 knitted polyester fibers. The elongation rate is less than 7% after 1 million cycles of traction and the minimum rupture level is 4000 Newtons.

These artificial ligaments have a good biological tolerance with fibroblastic ingrowth.

The cup of the hip prosthesis is first implanted. Then, prior to the insertion of the mega prosthesis



**Fig. 3.** — Prosthesis ready for implantation



**Fig. 4.** — Prosthesis slipped in to the synthetic “tube” and greater trochanter attachment.

stem, the ligament is sewn to the rim of the acetabulum with non resorbable sutures (Fig. 2).

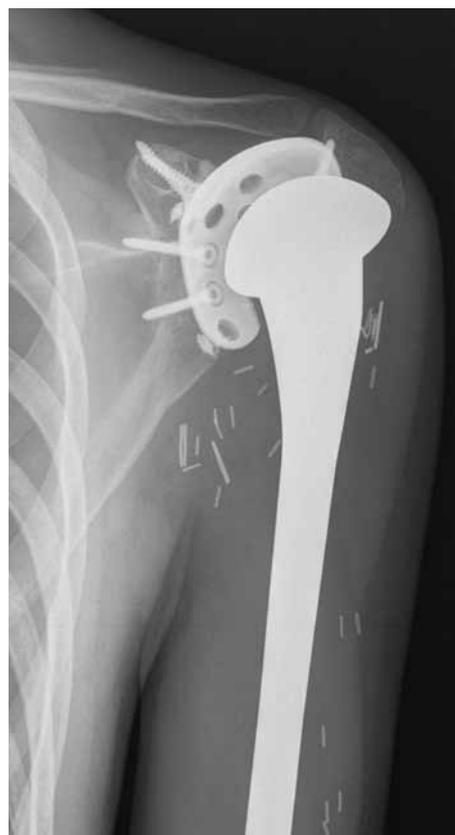
Once the “tube” is in place, the stem and the prosthesis are slipped into it (Fig. 3 & 4). Next the greater trochanter, then other remaining muscles are attached onto it. The rest of the closure and post-operative handling is unremarkable.

Radiographs confirm the situation later on (Fig. 5). This surgery was performed three years ago (October 2008) and the patient has an adequate function and has presented no episode of dislocation.

This procedure has been used in quite the same manner for the stabilization of the shoulder after



**Fig. 5.** — Postoperative radiograph



**Fig. 6.** — Radiograph showing reconstruction after massive resection for a tumour of the proximal humerus.

tumour resection of the humerus (Fig. 6). This latter patient was operated on two and a half years ago. The shoulder remained stable and suffered no dislocation. The patient had to undergo a revision for a distal loosening secondary to a trauma. This occurred a year and a half after the initial surgery and, interestingly, it was very difficult to distinguish the synthetic ligament from the normal surrounding tissues. The synthetic ligament underwent fibroblastic ingrowth as predicted.

The synthetic ligament can also be used, with success, in revision hip arthroplasty, especially for instability and recurrent dislocation.

## DISCUSSION

Synthetic ligaments have been used for several decades in the reconstruction of various ligaments,

especially around the knee, with overall good results.

These artificial structures are well tolerated by the human body and thus are used in wider indications.

There is scarce information available in literature about the use of synthetic ligaments in the reconstruction or reinforcement of a joint capsule and restoration of muscle and other soft tissue continuity.

Reinforcement of the hip joint capsule in posterior or total hip dislocation using this type of synthetic ligament has been described by Barbosa *et al* in 2004 (1) ; their 4 patients did not present any further posterior dislocation after an average follow-up of 28 months.

Holroyd and Fern in 2008 (3) also used this type of ligament to augment and reconstruct damaged

muscles during revision arthroplasty of the hip. They used it to replace part of the “missing” muscular structure.

Dominkus *et al* in 2005 (2) also used a synthetic ligament as part of the reconstruction of the extensor mechanism of the knee after wide tumour resection. They also mentioned the possibility of using it in major hip surgery, complex shoulder reconstruction or other type of massive bone and soft tissues removal.

We used the synthetic ligament-band-tumour tube to replace the hip capsule to stabilize the joint after massive bone tumour removal. We also re-attached the healthy bony portion of the greater trochanter and its muscles to the band to allow muscle and soft tissue continuity. We found it a very useful tool in this challenging situation.

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