Clinical and experimental wound closure using a skin stretching device

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Primary Skin Closure of a Large Groin Defect after Inguinal Lymphadenectomy for Penile Cancer using a Skin Stretching Device

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INTRODUCTION

Closing a large skin defect after inguinal node dissection in penile cancer can be difficult. A technique using a skin stretching system is introduced, which allows skin to stretch beyond its inherent extensibility.

CASE HISTORY

A 44-year old man was treated initially with partial penile amputation elsewhere for stage T2N0M0-pT2G2 squamous cell carcinoma. Examination 4 months later revealed a cytologically proved inguinal metastasis on the left side and the patient was referred to us. At physical examination there were no signs of local recurrence at the penile stump. In the left inguinal region an 8 x 10 cm. inguinal mass with fixation to the skin was noted. Staging by computerized tomography did not reveal any abnormalities except for the mass in the inguinal region. The patient was scheduled for a left ilioinguinal node dissection. A 8 x 15 cm. skin area encompassing the fixed skin area over the inguinal mass was marked for removal (fig. 1). This area was removed en bloc with a left ilioinguinal node dissection.

Figure 1.
Delineation of skin incision around large left nodal mass.
After transposing the sartorius muscle over the femoral vessels and after closing the abdominal fascia, a 10 x 20 cm. skin defect remained (fig. 2). Simple primary closure of the defect was impossible. After applying a force of 1 kg., a 47 mm. defect still remained.

**METHOD**

With the use of the skin stretching system primary closure was possible. Two straight needles were placed through the dermis opposite each other along the wound margins (fig. 3, A). The skin stretching system was then anchored in place behind the 2 needles (fig. 3, B). After appropriate tension was applied the device was locked. By turning the tension screw of the device approximation of the skin edges occurred (fig. 3, C). As the skin stretched, tension reduced because of stress relaxation. This procedure was repeated until the wound margins were approximated and the wound could be sutured. The device was then removed. Undermining was avoided and the total period of stretching was close to 30 minutes.

Histopathological examination revealed a 6 cm. tumor in the inguinal region.
Figure 3.

A. After transposition of sartorius muscle 2 needles are placed in dermis parallel to each other in wound edges.

B. Skin stretching device is anchored in place behind 2 needles. By turning tension screw of device gradual approximation of skin edges occurs.

C. Appearance after primary closure of skin edges without tension.
The mass consisted of necrosis and viable tumor cells with extra-capsular growth. No nodal invasion was found in the iliac specimen. Wound healing was by first intention. Because of limited margins of resection adjuvant radiotherapy was given. No subsequent wound healing problems developed (fig. 4).

![Primary wound healing 6 months after surgery and adjuvant radiotherapy.](image)

**DISCUSSION**

Removal of large inguinal masses with fixation to the skin sometimes leads to a skin defect that cannot be closed primarily. There are various solutions for this problem. Myocutaneous flaps (tensor fascia lata flap or rectus abdominis flap) or so-called free flaps revascularized by microvascular anastomoses can be used. These techniques are time consuming, technically demanding and often necessitate closure of the donor side with a skin graft. The skin stretching system is designed to harness the viscoelastic properties of the skin using incremental traction. These biomechanical properties of skin, known as mechanical creep and stress relaxation, allow skin to stretch beyond its inherent extensibility. The stretch causes parallel alignment of the collagen fibers, which have a convoluted unorganized pattern in the relaxed state, and displacement of tissue fluid and mucopolysaccharide ground
substance.\textsuperscript{3,4} By stretching and relaxing the skin in a controlled fashion during 3 to 4 cycles a large defect can be closed primarily. This technique, called cycle loading, seems to be the optimal method.\textsuperscript{4,5} The maximum wound width in the groin that can be closed primarily using this technique is approximately 10 to 12 cm.

The results so far of closing large defects using the skin stretching system are satisfactory. In the recent literature 66 cases have been described in which a large skin defect was closed using this device. Only 11 patients had temporary complications such as superficial infection, wound dehiscence and slight necrosis of the skin edges.\textsuperscript{2,6,8} The operation can be performed without undermining, and so vascular impairment is avoided.\textsuperscript{9,10} In our case the immediate and long term viability of skin was not impaired. Also adjuvant radiotherapy did not cause any problems in wound healing.

The advantage of the skin stretching system includes the elimination of a donor defect and its associated morbidity. The stretched skin is an ideal match in color and hair bearing properties, and the cutaneous innervation is preserved. The skin stretching system is contraindicated for poor skin conditions, such as atrophic or irradiated skin, or when active infection is present. We conclude that the simplicity of closing a large skin defect by primarily closing the skin edges using a skin stretching system makes this technique a useful addition to well-known strategies for closing large wounds.
REFERENCES