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Inguinal tensile strength and pain level after Shouldice repair

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Abstract Background: Tension of the abdominal wall in the inguinal region induced by Shouldice repair of an inguinal hernia is said to be responsible for elevated postoperative pain levels. Patients and methods: In 20 patients we recorded the inguinal tensile strength during closure of the hernial gap using a wound retractor equipped with strain gauges. Postoperative pain levels were scaled using a visual analogous score, and correlated with the tensile strength of the inguinal abdominal wall together with peak flow and forced expiratory volume in 1 s (FEV1) 8, 24, and 48 h after the time of operation. Results: Shouldice repair caused an average increase in inguinal tensile strength of 2.9 ± 0.58 N (mean ± SEM). The pain level expressed by active patients was twice the value obtained from resting patients (41.55 ± 6.3% vs 20.81 ± 7.1% 8 h after operation), but decreased slightly later on. Peak flow during forced expiration was depressed to about 80% of the control values, whereas the 1-s volume during forced expiration decreased only to 95% of the control value. We excluded any correlation between the recorded individual inguinal tensile strength or the changes in distance between the lateral edge of the rectus sheath and the base of the inguinal ligament and the postoperative pain level. Conclusion: We failed to see any evidence for the hypothesis that higher inguinal tensile strength induced by Shouldice repair leads to an elevated level of postoperative pain. If there is any effect, it may be masked by other factors with a stronger influence.

Keywords Inguinal hernia · Shouldice repair · Tensile strength · Pain

Introduction

Many reports deal with the favourable outcome of patients after mesh repair of their inguinal hernia [1, 8, 14, 29]. This policy, however, includes the permanent implantation of a prosthetic mesh into the inguinal region, which in the primary situation is not without controversy among inguinal hernia repair specialists [3, 11, 16, 24, 27]. Especially in young patients with a long life expectancy, this implantation of foreign material has to be viewed critically, as it induces chronic inflammatory changes, which may lead to malignancy in rare cases [13, 17].

One of the major advantages of the tension-free principle, however, is a low postoperative pain level in comparison with Shouldice repair [15, 29]. This is said to be due to the lack of tension which is induced in the abdominal wall of the inguinal region by adapting the inguinal ligament and the lateral edge of the rectus sheath during the transversal fascia plasty in Shouldice repair. This advantage is reported for all kinds of patients independent of their personal constitution and body condition. Intraoperative findings, however, indicate that some patients present strong anatomical landmarks, and others show a floppy condition of their abdominal wall. Therefore, the amount of tensile strength induced by Shouldice plasty should be strongly related to the individual constitution of the patient. Furthermore, the size of the hernial gap should also have an effect on the tensile strength in the inguinal region after closure of the defect. Following the hypothesis of obtaining better results by the omission of postoperative abdominal wall tension, the intraoperative quantification of the tensile forces induced by the
Shouldice repair should correspond to the postoperative pain level.

**Materials and methods**

**Patients**

After providing informed consent, 20 consecutive patients with a mean age of 52 years underwent intraoperative evaluation of their tensile strength in the inguinal region during original Shouldice repair of a unilateral primary inguinal hernia. All operations were carried out under local anaesthesia. Intraoperatively, the ilioinguinal nerve and the genital branch of the genitofemoral nerve were sought and preserved. Following a standardized protocol we used 5 mg diazepam for anxiolysis exclusively [20]. No other medication with relaxing side effects was given. Active cooperation of the patient was possible at all times.

**Instrument**

The instrument was designed based on a wound retractor. The tips of the branches contained two and three spikes, respectively, for secure fixation at fascial structures. These spikes at a distance of 1.5 cm were placed alternately such that closure of the instrument resulted in complete approximation of the fixed fascial lines. The branches of the instrument incorporated strain gauge force transducers (CEA-XX-250UW-350; Measurements Group Messtechnik, Lochham, München, Germany), protected by component cement (Fig. 1). Any force acting on the fascial level led to a bending of the force transducers, which induced an electric current. After amplification these electrical changes were recorded on a personal computer. A potentiometric distance sensor (Type 8711; Burster Präzisionsmesstechnik, Gernsbach, Germany) continuously recorded the position of the branches.

**Data collection**

After division of the transversal fascia the base of the inguinal ligament and the lateral edge of the rectus sheath were prepared. Then the branches of the instrument were fixed to the structures mentioned. Closure of the wound retractor approximated the lateral edge of the rectus sheath to the basis of the inguinal ligament thereby closing the hernial gap. This manoeuvre simulated Shouldice repair. A continuous increase in the tensile strength was recorded simultaneously with decreasing distance between the branches of the wound retractor (Fig. 2). A remaining distance of 3 mm was left following the conditions during Shouldice repair.

Data were collected at a frequency of 10 Hz from channel bridge amplifiers (type 301; Hugo Sachs Elektronik, March-Hugstetten, Germany) using a high-speed analogue and digital I/O board (DAS 1202, MetraByte Corporation, Taunton, Mass.), and stored in a personal computer.

**Pain analysis**

Pain analysis was carried out using the 100-mm visual analogue scale score described by Huskisson [12]. The patient was asked to mark his current pain level between the two end points “no pain” and “worst imaginable pain”. From the back of the instrument the investigator read the corresponding percentage pain level. This instrument has been found to be appropriate for measuring acute pain intensity [4] and has been successfully tested against different pain assessment tools [9]. The pain level was evaluated 8, 24, and 48 h postoperatively, and was recorded at rest and during normal activities such as coughing and walking. The pain-related ventilatory parameters peak flow and forced expiratory volume in 1 s (FEV1) were also determined as objective factors [10] using a mobile analyser (Spirotron; Dräger, Lübeck, Germany). After giving detailed instructions to the patient and following a minimum rest of 30 min, we chose the best of three tests. The spirometric value achieved before operation was regarded 100%, and the postoperative decrease in the ventilatory function recorded as a percentage of the preoperative function. The relationships between the individual tensile strength and the postoperative pain level or the change in the ventilatory parameters were also analysed. For this purpose the patients were classified according to their amount of inguinal tensile strength: low (0–1.4 N, \( n = 7 \)), moderate (1.5–3.9 N, \( n = 7 \)), and high (4–10 N, \( n = 6 \)). Finally, the degree of correlation between the change in distance between the lateral edge of the rectus sheath and the base of the inguinal ligament and the postoperative pain level was determined. Therefore, the patients had to be classified according to the amount of change in distance: small (0–0.5 cm, \( n = 9 \)), moderate (0.51–1.1 cm, \( n = 6 \)), and large (>1.1 cm, \( n = 5 \)).

Statistical analysis was carried out using the two-tailed unpaired t-test. Statistical significance of differences was assumed for \( P \)-values less than 0.05. All data are presented as mean±SEM.

![Fig. 1](image1.png) Branches of the wound retractor designed for recording the tensile strength induced by Shouldice repair

![Fig. 2](image2.png) Direction of the tensile forces acting on the branches of the wound retractor during closure of the hernial gap