

INTRACOMPARTMENTAL PRESSURE IN THE LOWER EXTREMITY AFTER ARTHROSCOPIC SURGERY

by J. JEROSCH, W. H. M. CASTRO and B. GESKE

We measured the intracompartmental pressure of 53 patients in the anterior, lateral, and dorsal compartments of the calf after arthroscopic procedures. Prior to making these measurements we established normative data in 80 healthy volunteers in a lying, sitting, and standing position. After short procedures like lavage, partial meniscectomy, removal of loose joint bodies, and shaving, we documented nearly normal pressures. We did the same in lateral release. In time consuming procedures like total synovectomy or ACL-reconstruction, especially if dorsal portals were used, we found a significant increase in intracompartmental pressure. In one patient the pressure even increased up to 55 mmHg.

Keywords : knee ; arthroscopy ; intracompartmental pressure.

Mots-clés : genou ; arthroscopie ; pression intracompartmentale.

SAMENVATTING

J. G. JEROSCH, W. H. M. CASTRO en B. GESKE. Intracompartmentele druk in de onderste extremiteiten na arthroscopische chirurgie.

Bij 53 patiënten werd de intracompartmentele druk gemeten in de anteriore, laterale en dorsale loges van het onderbeen, na arthroscopische technieken. Alvorens deze metingen uit te voeren werden de normale waarden bepaald bij 80 gezonde vrijwilligers in lig, zit en staande houding. Na korte ingrepen, zoals spoeling, gedeeltelijke meniscectomie, verwijdering van corpora libera en shaving, bleef de druk praktisch normaal. De druk werd ook gemeten na

laterale release. Na langdurige ingrepen, zoals totale synovectomie of reconstructie van de kruisbanden, en vooral na de dorsale benadering, werd er een relevante verhoging van de intracompartmentele druk gemeten. Bij één patiënt was de druk zelfs gestegen tot 55 mm Hg.

RÉSUMÉ

J. G. JEROSCH, W. H. M. CASTRO et B. GESKE. Pression intracompartmentale des membres inférieurs après chirurgie arthroscopique.

Chez 53 malades les auteurs ont mesuré la pression intracompartmentale dans les loges antérieure, externe et postérieure de la jambe, après chirurgie arthroscopique. Avant de procéder à ces mesures, ils ont défini les valeurs normales chez 80 volontaires en bonne santé, en position couchée, assise et debout. Après des interventions courtes, telles le lavage, la méniscectomie partielle, l'extraction de souris articulaires et le «shaving», une pression pratiquement normale fut mesurée. Les auteurs firent les mêmes observations après section de l'aileron externe. Après des interventions de plus longue durée, telles les synovectomies totales ou les reconstructions du L.C.A., et surtout en cas d'abord postérieur, une augmentation notable de la pression intracompartmentale fut notée. Chez un malade, la pression atteignait même 50 mm Hg.

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INTRODUCTION

Today arthroscopy is a widely accepted diagnostic and treatment modality. Arthroscopic procedures are standardized (7, 8) and the patient can begin a rehabilitation program immediately. Although there are only a few papers in the literature describing complications in arthroscopic surgery (2, 15), the postoperative compartment syndrome is considered to be a specific procedure-related complication. Besides the lesion of the capsule, some authors postulate a defect in the fascia as a cause for the compartment syndrome after knee surgery. Fruensgaard (4) could not find a lesion of the fascia in a case of an arthroscopy-related compartment syndrome. In this prospective study, we measured the intracompartmental pressure in various muscle compartments of the lower leg after knee surgery.

MATERIALS AND METHODS

The intracompartmental pressure of 53 patients was measured in the anterior, lateral, and dorsal compartment of the lower leg after arthroscopic procedures. The pressure reading was noted after finishing the surgery and before releasing the tourniquet while the leg was elevated and the knee joint extended. For pressure registration we used an electronic monitoring system. A S.T.I.C. catheter (Stryker Deutschland, Ratingen) was subsequently inserted into each compartment. The catheter was linked with the measuring unit by a pressure detector (fig. 1). All arthroscopies were performed with a gravity-flow fluid-system. A fluid pump was not used. The fluid bags were elevated 1.5 m above the patient's knee level.

The arthroscopic procedures were categorized into 3 different types: type I (lavage, partial meniscectomies, cartilage shaving, removal of loose bodies), type II (lateral release, partial synovectomies), and type III (total synovectomies, ACL-reconstructions). There were 23 patients with type I procedures, 16 patients with type II, and 14 patients with type III procedures.

Prior to the study, the measuring system was calibrated with a Statham-Unit. We noticed a

difference of less than 1% between our system and the Statham-Unit in the range of 0 to 200 mmHg. In a preliminary study we examined 80 healthy volunteers who had no history of leg trauma. We measured the intracompartmental pressure in lying, sitting, and standing position and we documented the following items:

- intracompartmental pressures
- diagnosis
- operative procedure
- time/duration of procedure
- tourniquet time
- number of arthroscopic portals
- sex and age of the patient.

The statistical analysis was performed with a personal computer using the software package Biomed version 1.0 (Jungjohann Verlagsgesellschaft). Differences were judged as significant with $p < 0.05$.

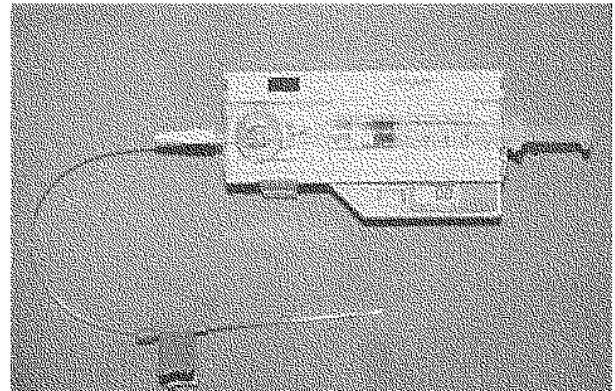


Fig. 1. — The measuring system consists of a S.T.I.C. catheter, which is connected to an electronic measuring monitor with a pressure detector. The catheter is introduced into the muscle compartment. A digital liquid display shows the intracompartmental pressure in mmHg.

RESULTS

The average values of the volunteer group are presented in fig. 2. Changing the position (lying, sitting, standing) resulted in a significant increase of intracompartmental pressure. After arthroscopy, the average pressure in the lateral compartment was 13 mmHg, in the anterior compartment

14 mmHg, and in the dorsal compartment 20 mmHg (fig. 3). There was no correlation with the sex or the age of the patient, whereas the type of surgical procedure, duration, and number of portals took influence on the postarthroscopic intracompartmental pressure. We noted almost normal or only slightly increased pressure in procedures with only 2 or 3 portals, such as : lavage, partial arthroscopic meniscectomy, removal of loose bodies, or cartilage shaving.

After lateral release we noted increased pressure which was of no statistical significance. A remarkably increased intracompartmental pressure resulted with synovectomies and in some cases of ligament reconstruction (ACL-reconstruction). In performing total synovectomies, we regularly used 5 arthroscopic portals (fig. 4). These procedures always took more than 60 minutes. With respect to the different compartments, the highest pressure was detected in the dorsal compartment, whereas the pressure in the lateral and anterior compartments was increased above the normal value (fig. 5). In one case the pressure was elevated to 55 mmHg, which surpassed the critical limit of 40 to 50 mmHg (1, 3, 9, 14, 16, 17). Continuous measurement in this patient using a slit catheter revealed a decrease in the pressure below 15 mmHg within the first 20 minutes after releasing the tourniquet.

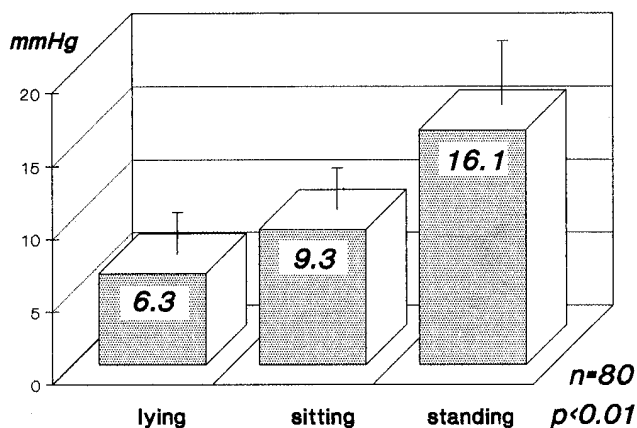


Fig. 2. — The average pressure in the lower legs in 80 volunteers shows a significant increase ($p < 0.01$) from lying (6.3 mmHg), to sitting (9.5 mmHg), and standing (16.1 mmHg) positions.

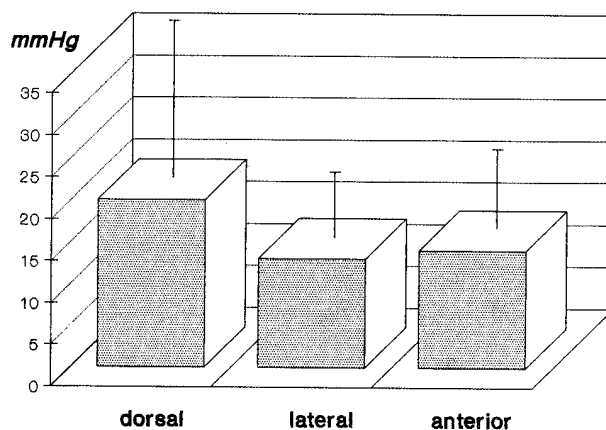


Fig. 3. — After arthroscopic knee surgery, the average pressure of the dorsal compartment was about 20 mmHg (range 1 to 55 mmHg), of the lateral compartment 13 mmHg (range 2 to 22 mmHg), and of the anterior compartment 14 mmHg (range 1 to 24 mmHg). There was no significant difference between the compartments.

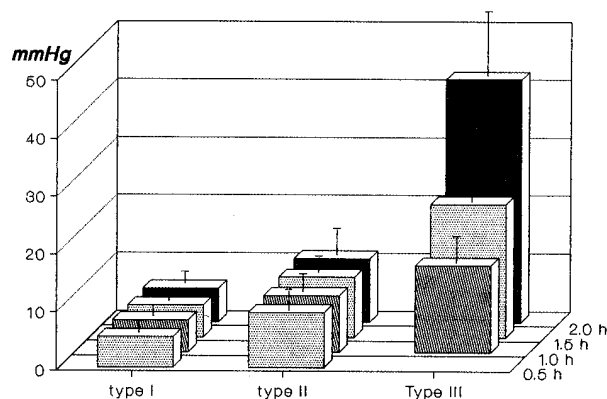


Fig. 4. — With respect to the highest pressure of all 3 compartments, in type I procedures (lavage, partial meniscectomies, cartilage shaving, removal of loose bodies) and type II procedures (lateral release, partial synovectomies) there was no correlation between intracompartmental pressure and length of time for surgery. In type III procedures (total synovectomy, ligament repair) there was a significant ($p < 0.05$) difference to type I and type II procedures and a positive correlation between the intracompartmental pressure and the length of time for surgery.

In our model, tourniquet time did not influence the intracompartmental pressure. We used the tourniquet in each procedure, and there was no difference in the pressure with respect to operating time in type I procedures, although there was a significant increase of pressure in type III procedures with more portals or larger capsular defects.

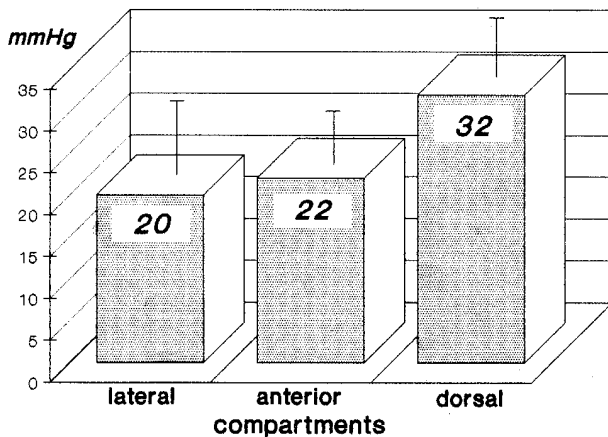


Fig. 5. — After total synovectomies with at least 5 portals, all compartments showed an increased pressure with 20 mmHg in the lateral, 22 mmHg in the anterior, and 32 mmHg in the dorsal compartment.

DISCUSSION

There are several reports of the postarthroscopic compartment syndrome in literature (4, 8, 10, 11, 12, 13). According to Whitesides (18) and Echtermeyer (3) the intrafascial pressure increases superproportionally owing to fluid retention. With an additional volume of 60% the pressure rises to 80 mmHg. The physiological capillary pressure is about 30 mmHg. If the intracompartmental pressure reaches or exceeds this value, the microcirculation will be interrupted — thus starting the vicious cycle of the compartment syndrome (5). The reason for the postarthroscopic compartment syndrome is controversial.

Peek and Haynes (13) maintain that capsule and fascia defects are mandatory for an increase in the intrafascial pressure, whereas Fruensgaard (4) described a compartment syndrome during an arthroscopic resection of a posterior medial meniscus flap without any capsule or fascia defects. Our results demonstrate that in standard arthroscopic procedures (lavage, partial meniscectomies, cartilage shaving, removal of loose bodies, lateral release), the postarthroscopic compartment syndrome is unlikely. In longer procedures the surgeon must be careful. The possibility for significant fluid or air leakage is always present, especially during procedures with dorsal portals. Even a case of a

pneumoscotum has been described (6). Good joint distension and visualization are maintained by constant fluid flow, although an exact fluid balance is impossible because of uncontrolled fluid loss onto the floor. In our study we documented a case of rheumatoid arthritis, treated by total synovectomy using 5 portals, which lasted 108 minutes, an increase in the intracompartmental pressure up to 55 mmHg in the dorsal compartment. After release of the tourniquet, the pressure spontaneously decreased to 15 mmHg within 20 minutes, so that fasciotomy was not needed. Our results indicate that a traumatic fascial rupture is not mandatory for a post-arthroscopic compartment syndrome. Even without a history of trauma the surgeon must be aware of this potential complication. Although we had no patients with an acute capsular defect, the risk for developing a compartment syndrome in this situation is probably higher.

The use of peridural anesthesia (PDA) for knee surgery is increasing, which is undoubtedly beneficial to the patient. Because they are pain-free, patients may start their rehabilitation program early, and the use of narcotics can be diminished. However as pain no longer serves as an early symptom of compartment syndrome, the postoperative care is very important, even after so-called "routine procedures". As soon as muscle tension pain, swelling of muscle compartments or pain at rest occur, the intracompartmental pressure should be measured, a procedure that only takes a few minutes. If the pressure remains above 40 mmHg, a fasciotomy is indicated.

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