

CHRONIC COMPARTMENT SYNDROME : DIAGNOSIS AND MANAGEMENT

J. P. MOEYERSOONS¹, M. MARTENS¹

Young people active in sports, especially cyclists, runners and soccer players, may develop a chronic compartment syndrome, typically after a few years of athletic involvement. Complaints frequently appear when the intensity or frequency of training is increased. It is remarkable that runners develop mainly an anterior compartment syndrome, whereas soccer players and cyclists suffer mostly from a deep posterior compartment syndrome. The chief complaint is a cramp-like pain and weakness in the lower leg during effort. A compartmental tissue-pressure measurement must be performed to evaluate the severity of the compartment syndrome and to determine which compartments are involved. A clear clinical history and abnormal values of tissue-pressure measurements are indicative for a fascial release of the involved compartments and help assure a satisfactory result after surgery.

Keywords : pressure measurement ; chronic compartment syndrome.

Mots-clés : mesure de pression ; syndrome compartimental chronique.

INTRODUCTION

Effort-related acute compartment syndrome was described for the first time by Blandy (1) as "march gangrene". Reneman (11, 12) measured an increased tissue pressure in two cases of acute anterior compartment syndrome in comparison with the unaffected member. Only later was a chronic variant of the compartment syndrome identified. Mavor (9) was the first to mention a chronic form of compartment syndrome (CCS) at the level of the anterior tibial compartment.

French and Price (4) described the increased compartmental pressure in a chronic effort-related anterior compartment syndrome. These findings were later confirmed for a large group of patients by Reneman (11) and Matsen (5, 6, 7, 8).

A chronic peroneal compartment syndrome was described for the first time by Edwards in 1969 (3). The first clinical study of an effort-related compartment syndrome at the level of the deep posterior compartment dates from 1974 (10). Rorabeck (13) discussed the pathophysiology of the chronic compartment syndrome.

The aim of this study is to present the clinical picture, show the importance of tissue-pressure measurements and give the results of operative treatment for a large group of patients suffering from a chronic compartmental syndrome.

CLINICAL MATERIAL

Between 1976 and 1986, a chronic compartment syndrome was diagnosed in 100 patients at the three hospitals taking part in this study.

Eighty of these patients were treated at the University Hospital of Pellenberg, 16 in Maria Middelaars at Deurne, and 4 in the Military Hospital at Neder-over-Heembeek. There was a striking preponderance of male patients (81/19). Ninety-five percent of these patients regularly participated in sports activities (tabl. I).

The mean age at which the patients started their sports activities was 13.5 ± 3 years. It was only later

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Table I. — Sportsactivity

— Athletisme	30%
— Football	30%
— Athletisme and football	8%
— Cycle racing	14%
— Volleyball	7%
— Tennis	4%
— Gymnastics	2%

that symptoms arose, with a mean age for initial symptoms of 20 years.

Eighty-five patients were treated by a surgical fasciotomy. The other 15 patients preferred to stop their sports activities since none of the conservative measures brought any relief.

The results were studied by a follow-up consultation in 32 patients and a detailed questionnaire for the remaining 53 patients. The minimum follow-up time was 2 years.

CLINICAL SYMPTOMS

Effort related pain is “the” typical complaint suggesting a chronic compartment syndrome. Pain appears during effort at a well-determined intensity level of activity, differing from patient to patient, but quite constant for each patient. Complaints vary also to some extent according to the type of sports activity.

In runners, particularly long-distance runners, CCS usually develops gradually over the course of one or more years. Runners complain of a gnawing pain and weakness in the lower leg. A competitive runner can tell the exact distance needed to experience such pain, but the duration and intensity of pain is determined mainly by the distance and frequency of running. When the runner tries to continue running in spite of cramp-like pain, the pain often continues throughout the following night. If he pushes himself still further, the pain may remain until the following day.

For a bicycle racer pain nearly always occurs after a few days of intensive cycling in timed stretches, or at the end of a race during bursts of speed. Pain and weakness oblige the rider to drop out of the group and cycle on at a slower rate.

Soccer players complain of a intermittent cramp-like feeling at the level of the calf during games or intensive training. Pain disappears between efforts, but it interferes with their performance since they need time during the game to recover after any effort that causes this cramp-like feeling.

The patients often are able to localize symptoms with regard to the involved compartments (tabl. II).

Table II. — Localization of complaints

— Anterior	30%
— Anterior and lateral	12%
— Anterior and deep posterior	10%
— Lateral	3%
— Deep posterior	30%
— Deep and superficial posterior	3%
— All compartments	6%

We also recorded the time needed to initiate symptoms for one group of patients :

- Performing sports activity at maximal intensity, pain occurred :
 - from 1 to 5 min. : 30%
 - from 5 to 10 min. : 24%
 - from 10 to 15 min. : 19%
 - after 15 min. : 27%
- In 70% of the cases symptoms worsened over a period of several weeks or months. Symptoms became more severe in intensity in 12%, occurred earlier during effort in 26%, and both occurred earlier and became more severe in 32%.

The nature of the symptoms was recorded in every instance as follows :

- severe shooting pain : 25%
- cramp-like feeling : 50%
- ballooning of the involved compartment : 35%
- tingling or numbness over the lower leg and foot : 35%
- soreness on the dorsal or plantar side of the foot : 35%
- loss of strength or feeling of weakness at the level of the lower leg or foot : 65%

Most patients find that the feeling of pain remains for 10 to 15 minutes after intense physical effort. Patients sometimes mention soreness or stiffness of the lower leg for 1 or 2 days, after intense sports activity. After a few days, in most cases there was no longer any abnormal perception at the level of the affected compartment.

Table III. — Affected compartments at the lower leg according to tissue pressure measurement

— Anterior compartment	15%
— Deep posterior compartment	30%
— Anterior + deep posterior compartment	30%
— Anterior + lateral compartment	12%
— Anterior + lateral + posterior compartment	7%

Symptoms are often bilateral although not always of the same severity. Distribution of symptoms was as follows :

— similar complaints in both legs :	12%
— less pain in the other leg :	65%
— no complaints in the other leg :	23%

CLINICAL EXAMINATION

Clinical examination gives only a few signs of CCS. Only a few patients showed objective weakness of the involved compartment on testing shortly after intensive physical effort.

Sensitivity to pressure at the level of the affected compartment and a feeling of tight fascia were seen in only 35% of the patients shortly after an effort test. Furthermore, this is difficult to evaluate. In 40% of the patients muscular hernias were recorded.

TISSUE-PRESSURE MEASUREMENT

We used the wick catheter technique to record rest pressure in the supine position, tissue pressure immediately after standardized exercise and recovery time to rest pressure. We performed tissue-pressure measurements systematically in both lower legs, and in at least two compartments : the anterior and deep posterior compartment (fig. 1).

Measurements in the other compartments are also done in case of doubt on clinical grounds. Table II shows the frequency of positive measurements for the various compartments.

SURGICAL TREATMENT

Eighty-five of the 100 patients were prepared for fasciotomy in order to achieve decompression

of the affected compartments. Through two small (4-cm long) skin incisions which were 15 cm apart the involved compartments were released by a fasciotomy which was also carried out subcutaneously between the two skin incisions. Care was

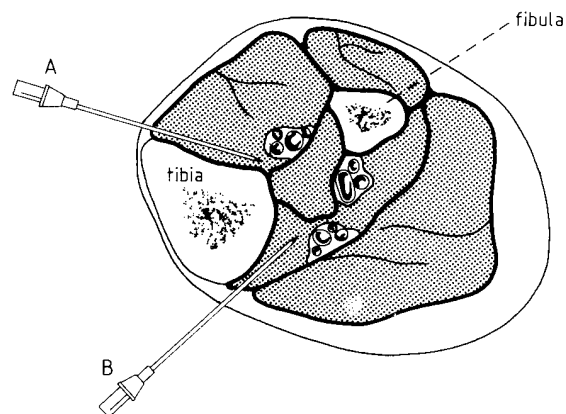


Fig. 1. — Pressure measurement in the anterior A and deep posterior compartment B.

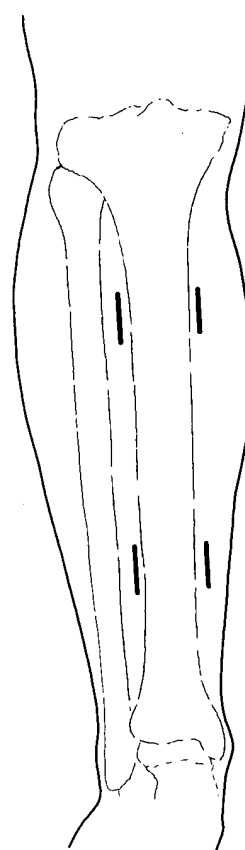


Fig. 2. — Skin incisions for fasciotomy.

taken not to sever venous and superficial nerve elements. The tibialis posterior muscle compartment must be decompressed separately in the case of a deep posterior compartment syndrome.

Postoperative case consisted of a compressive bandage and elevation for one day. Afterwards the patient was allowed to walk, but he had to wear compressive bandages. He was allowed to resume running after 5 to 6 weeks and full sports activities after 8 to 10 weeks.

RESULTS

Seventy-one patients obtained an excellent or good result with no further complaints and attained their previous levels of performance in sports activities. Many of them even surpassed their previous performances.

Fourteen patients experienced a fair result with little or no improvement. In 7 of these patients multiple compartment involvement was overlooked, and an incomplete fascial release was carried out leaving an affected compartment without decompression. This was documented with a postoperative tissue pressure measurement.

Two patients in this group of fair results were operated in spite of a previous history of crushing trauma. An entrapment of the deep peroneal nerve was overlooked. For 5 of the 14 patients with a fair result, no clear explanation could be given for the failure of the surgical release.

DISCUSSION

Our study may be compared with a study carried out by Detmer (2) which also covered more than 100 patients with CCS. Here too, the patients population consisted preponderantly of athletes (87%), and most of these were runners (69%).

	Detmer	Our study
- Average duration of symptomatology prior to operation :	22 months	24 months
- Average age at fasciotomy	28 years	22 years

For the study by Detmer a fasciotomy was carried out in 233 compartments, i.e. 2.3 compartments per patient, compared to 1.5 compartments per patient in our study.

The difference arises from the fact that Detmer further divides the deep posterior compartment into various subdivisions.

His study also shows a higher frequency of involvement of the anterior compartment (46%) as compared with the deep posterior (36%). This can be explained by the fact that our study included more soccer players, who seem to be predisposed to a deep posterior compartment syndrome, whereas runners more often suffer from anterior compartment involvement.

A comparison of the postoperative results yields the following figures :

	Detmer	Our study
- Excellent	73%	75%
- Good	11%	6%
- Fair	16%	19%

The fact that in 7 patients multiple compartment involvement was overlooked on clinical grounds indicates the importance of a careful preoperative examination by tissue pressure measurement of all suspect compartments.

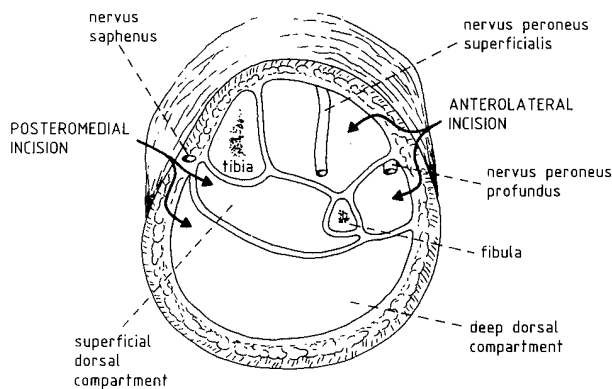


Fig. 3. — Fasciotomy of the anterior and deep posterior compartment.

CONCLUSION

Young athletes, mainly cyclists, runners, soccer players and sometimes soldiers, may develop chronic lower leg pain due to a chronic compartment syndrome. This typically causes an effort-related pain.

When a patient presents with complaints compatible with a compartment syndrome, a tissue pressure measurement should always be carried

out to confirm the diagnosis and to evaluate the extent of the CCS (one or more compartments). A typical clinical examination, backed up by positive pressure measurements, indicates a need for fasciotomy. For athletic patients a surgical fasciotomy of all involved compartments yields a favorable result in a high percentage of cases. It allows the patient to resume his sports activities with no further restriction due to lower leg pain, and he may be able to perform at a higher level.

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SAMENVATTING

J. P. MOEYERSOONS en M. MARTENS. Chronisch compartiment syndroom (CCS).

Jonge sportieve mensen, voornamelijk wielrenners, lopers, voetballers en soms militairen gaan, nadat ze

meestal reeds een vijftal jaren hun specifieke sporttak uitoefenen, soms last ontwikkelen in een spiercompartiment. Voor een groot deel onder hen is power-training en intervaltraining een belangrijke schakel geweest in het trainingsprogramma. De klachten gaan zich meestal voor het eerst manifesteren wanneer de trainingsfrequentie of de wedstrijdfrequentie worden opgedreven. Opvallend is dat lopers vooral klachten hebben in het anterior compartiment, in tegenstelling met voetballers en wielrenners waar de spierpijn zich diep dorsaal manifesteert. Hun voornaamste klacht is het gevoel van krachteloosheid en pijn dat optreedt bij ritmeversnelling na 10 tot 15 minuten sporten. Wanneer een patiënt zich aanmeldt met klachten, compatibel met compartmentsyndroom, dient steeds een drukmeting uitgevoerd om de uitgebreidheid (één of meerdere compartimenten) van het CCS te evalueren. Een significant klinisch onderzoek, gestaafd door een positieve drukmeting, verzekert een goed resultaat na fasciotomie. Deze fasciotomie is, in tegenstelling met wat algemeen gedacht wordt, een weinig invaliderende ingreep, welke een hernemen van de sport na twee à drie maanden waarborgt.

RÉSUMÉ

J. P. MOEYERSOONS et M. MARTENS. Le syndrome compartimental chronique.

Après plusieurs années de pratique sportive, certains jeunes sportifs, entre autres les cyclistes, les coureurs de fond et parfois les militaires, souffrent d'une gêne au niveau d'un des compartiments ou loges musculaires du membre inférieur. Dans leur schéma d'entraînement on retrouve le plus souvent des séances soutenues de musculation et d'entraînement alternées. On remarquera que les coureurs se plaignent le plus souvent de douleurs compartimentales antérieures tandis que les joueurs du football ou les cyclistes présentent plutôt une symptomatologie postérieure. Devant de telles plaintes ainsi que devant une sensation de fatigue s'installant après 10 à 15 minutes d'effort intensif on mesurera la pression au niveau des différentes loges du membre inférieur. Seul l'examen clinique minutieux, confirmé par la mesure d'une pression élevée au niveau du compartiment atteint, permet un diagnostic exact et garantit un bon résultat après fasciotomie. Cette intervention, contrairement à l'opinion reçue, est peu agressive et permet une reprise de l'activité sportive au plus haut niveau après deux à trois mois.