Acta orthop. scand. 48, 80–85, 1977

THE EFFECT OF FENESTRATION ON INTRAOSSEOUS DRAINAGE IN OSTEOARTHRITIS OF THE HIP

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Eight patients with osteoarthritis of the hip, rest pain and intraosseous hypertension of the proximal femur obtained ameliorated rest pain and reduced intraosseous hypertension 3 months after a fenestration operation in the region of the greater trochanter. They were investigated with intraosseous phlebography of the proximal femur. Six patients showed delayed intraosseous drainage and 7 had altered patterns of drainage before the operation. Three months after the operation the phlebograms showed an even more prolonged drainage time. However, this difference was not of a statistically significant magnitude. Drainage patterns remained mainly unchanged.

Key words: fenestration; intraosseous phlebography; intraosseous pressure; osteoarthritis

Accepted 25.ix.76

In osteoarthritis of the hip, venous drainage from the proximal part of the femur is delayed and often shows an altered pattern with dilated intraosseous vessels and diaphyseal sinusoids (Phillips 1966, Arnoldi et al. 1972). Arnoldi et al. (1971) considered venous engorgement with stasis and intramedullary hypertension to be a probable cause of the rest pain frequently present in this disease. After osteotomy with subsequent relief of rest pain, a "normalization" of the intraosseous blood drainage has been reported by Phillips et al. (1967). Recently one of the authors (Åström, to be published) found a significant reduction of the elevated intraosseous pressures in the proximal femur and amelioration of rest pain 3 months after a fenestration operation in the region of the greater trochanter in patients with osteoarthritis of the hip.

The aim of this study was to investigate whether or not amelioration of rest pain and reduction of increased intraosseous pressure in the proximal femur in osteoarthritis of the hip was associated with normalization of routes and speed of intraosseous drainage.

PATIENTS AND METHODS

Eight patients (3 women and 5 men with a mean age of 56 and an age range of 35–72) suffering from osteoarthritis of the hip were selected for this investigation using the criteria of intraosseous hypertension as defined below and rest pain as a dominating symptom. They underwent a fenestration operation in the trochanteric region (Åström 1975). Intraosseous pressure measurements in the femoral head and neck were performed under local anaesthesia a few

days before and 3 months after the operation. Pressure measurements were performed according to Arnoldi et al. (1971).

All patients included in this series had a preoperative femoral head pressure over 40 mmHg and/or a femoral neck pressure over 30 mmHg. The preoperative mean pressure in the femoral head was 59.9 mmHg (range: 48.8–85.1) and the mean pressure of the femoral neck was 44.3 mmHg (range: 16.2–79.0) (Table 1). At the follow-up investigation 3 months after operation, 2 patients had obtained complete relief of rest pain and the other 6 reported partial relief of rest pain (Table 1). The postoperative pressure recordings in the femoral head and neck showed a mean reduction of 9.7 mmHg for both measurement sites. This difference is significant at the 5 per cent level (Wilcoxon's signed-rank test). The mean reduction was 8.9 mmHg in the femoral head and 10.4 mmHg in the neck. These reductions for each site alone are not statistically significant at the 5 per cent level.

Radiographic method

Intraosseous phlebography was performed through one of the needles previously introduced for pressure measurements in the femoral head and neck. Two ml of the contrast medium Isopaque Cerebral (Nyegaard & Co) was injected manually at an even rate. In the preoperative investigations the injection time in 4 patients was 30 seconds. In the other 4 patients the injection evoked a reaction of moderate or intense pain and the injection time had to be extended to a maximum of 70 seconds. In the postoperative investigations one injection was performed in 45 seconds because of pain and the other 7 were performed within 30 seconds each. A tube (Bi 150/30/50 R, Siemens) with a focus of 0.6 mm × 0.6 mm was used. The focus-film distance was 90 cm. An AOT film changer (Elema-Schönander) with high-speed intensifying screens was used. The films (Rapid R 100 FW, Ilford) were exposed with the patient in the supine position using 70 to 75 kilovolts and 400 milliamps with an exposure time of 0.16 seconds. Only anterior-posterior series were done.

The first film was taken immediately after injection of the contrast medium and further films were exposed every 5th second during the first minute, every 15th second during the 2nd and 3rd minute, then every 2nd minute for 12 minutes and finally every 5th minute for 15 minutes. Thus the exposure program ran for 30 minutes. All phlebographic examinations were done immediately after previous pressure recordings. In the postoperative investigation an attempt was made to position needles as closely as possible to the same points as prior to operation.

The phlebograms were assessed with regard to the drainage pattern and drainage time of the injected contrast medium. The drainage pattern shows the distribution of contrast outflow between intramedullary sinusoids (Figure 1) and extraosseous veins (Figure 2) from the neck or head of the femur. The extent of drainage through these channels was recorded. The outflow through different extraosseous veins was not studied in detail.

The drainage time was taken as the number of minutes elapsing between the injection of contrast medium and the first film obtained completely free of visible contrast medium. Pooling of contrast medium around the tip of the needle was ignored. The drainage time was recorded separately for the intraosseous vessels and extraosseous veins.

RESULTS

Before the operation, 7 patients showed pathological phlebograms with a more or less distinct intramedullary drainage pattern (Figure 1). The postoperative drainage patterns were mainly unchanged compared with the preoperative ones in 5 patients (Table 1). Two patients (Nos. 3 and 4) showed a more pronounced intraosseous drainage pattern after the operation and one became more extraosseous (No. 2).

The preoperative drainage time from the intraosseous space was over 6 min in 6 patients (Table 1). In 5 patients an increase in intraosseous drainage time was recorded postoperatively. The time for visible contrast in extraosseous veins remained essentially unchanged (Table 1).

DISCUSSION

The level of the intraosseous pressure in the femoral neck in the nonarthrotic hip has been reported by Arnoldi et al. in 1971 (mean: 18.7 mmHg; range: 12.9–23.5 mmHg; *n*: 11). The normal pressure in the greater trochanter was reported by Arlet et al. in 1968 (mean: 17.2 mmHg;

Table 1. Intraosseous pressures, roentgenological and clinical observations pre- and postoperatively in 8 patients with osteoarthritis of the hip undergoing fenestration operations.

Patient no.	Site of injection	Preoperative observations						Postoperative observations						Effect on rest pain[3]
		Pressure (mmHg)		Drainage pattern		Drainage time (min)		Pressure (mmHg)		Drainage pattern		Drainage time (min)		
		head	neck	E[1]	I[2]	E	I	head	neck	E[1]	I[2]	E	I	
1	neck	62.4	31.0	++	(+)	4	8	57.4	23.4	++	(+)	4	20	+
2	head	85.1	65.0	0	++	-	48	75.6	43.8	+	+	0.3	20	+
3	neck	61.5	21.0	++	(+)	3	1.5	38.2	20.0	(+)	++	4	25	+
4	head	49.1	16.2	+	+	6	30	59.4	32.3	0	++	-	6	+
5	neck	49.0	49.8	(+)	++	1.5	30	46.9	54.4	0	++	-	>30	+
6	head	57.0	35.7	+	+	3	15	31.6	14.7	+	+	3	25	++
7	neck	48.8	57.0	++	0	15	-	67.5	65.7	++	0	30	-	++
8	neck	65.9	79.0	(+)	++	4	30	28.9	27.9	(+)	++	10	>30	+

E designates extraosseous drainage and I intramedullary drainage.

[1] 0 = no contrast flow visible in extraosseous veins.
\+ = drainage partly by extraosseous veins.
++ = drainage mainly or all by extraosseous veins.
(+) = a few extraosseous veins filled.

[2] 0 = no contrast flow visible in intramedullary sinusoids.
\+ = drainage partly by intramedullary sinusoids.
++ = drainage mainly or all by intramedullary sinusoids.
(+) = a few intramedullary sinusoids filled.

[3] \+ = less pain postoperatively.
++ = no pain postoperatively.

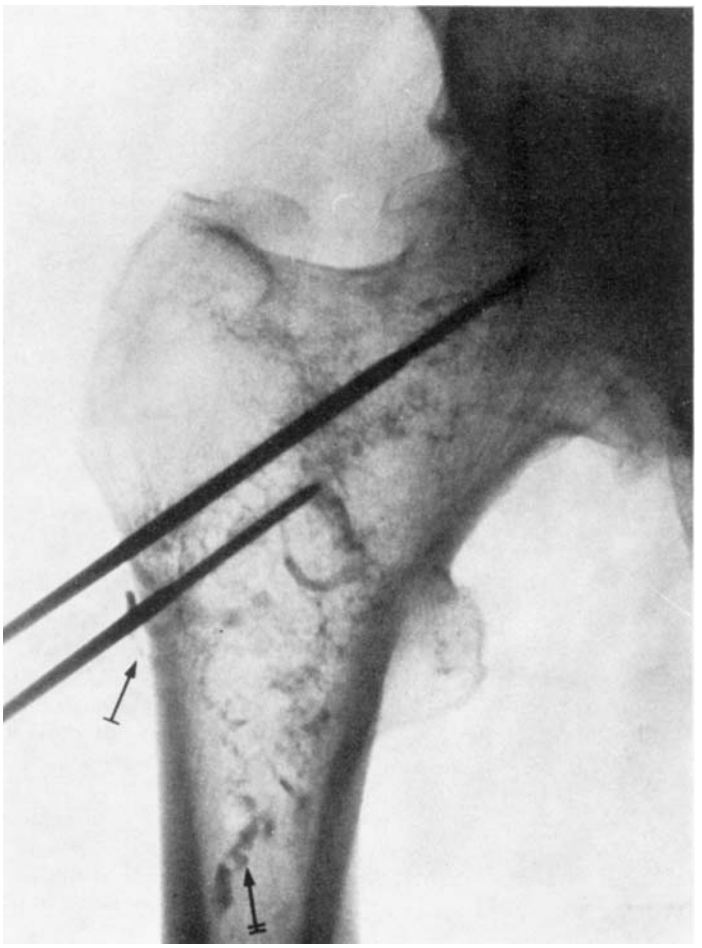

Figure 1. (Patient No. 8). Preoperative phlebogram (25 sec after injection) demonstrating drainage mainly or all by intramedullary sinusoids (||→). Only a few extraosseous veins (|→) are contrast filled.

range: 12–26 mmHg; *n*: 9). Ficat & Arlet (1972) indicated 30 mmHg as the upper limit of the normal intraosseous pressure in the greater trochanter. Arlet et al. (1972) have reported measurements of the intraosseous pressure in the femoral head of normal hips (mean: 24 mmHg; range: 20–30 mmHg; *n*: 4). No other investigations of the pressure in normal femoral heads have been found in the literature. However, in osteoarthritis of the hip the pressure in the head is about 10 mmHg higher than in the neck (Arnoldi et al. 1971, Åström 1975). In accordance with these investigations we have presumed intraosseous hypertension to be present in the proximal femur when the pressure of the head was found to be over 40 mmHg and/or the pressure of the neck over 30 mmHg.

Elimination of intraosseous contrast medium in the normal hip was reported to be completed 6 minutes after the injection by Arnoldi et al. (1972) and 5 minutes after the injection by Arlet et al. (1971). In our material, all patients except one exceeded these limits of "normal" intraosseous drainage time.

The results of this investigation suggests a more pronounced abnormality of drainage time after the fenestration operation, but the difference between pre- and postoperative investigations is not significant.

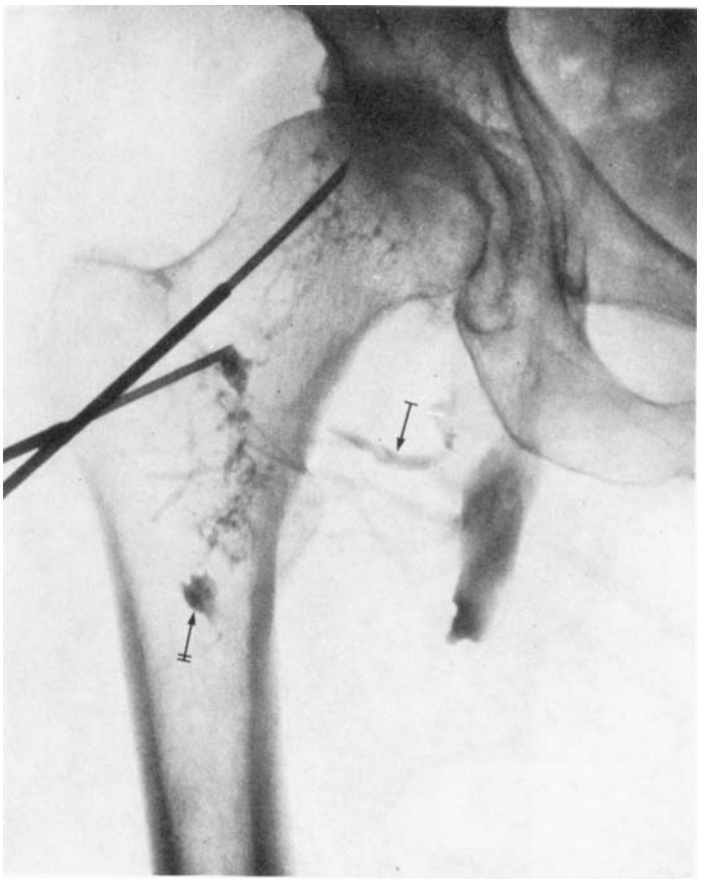

Figure 2. (Patient No. 1). Preoperative phlebogram (30 sec after injection) demonstrating drainage mainly by extraosseous veins (|→). Some intramedullary sinusoids (||→) are also contrast filled.

In their study of venous drainage after osteotomy, Phillips et al. (1967) assumed intramedullary hypertension by venous congestion to be the cause of rest pain in osteoarthritis of the hip. They found a normalization of venous drainage 12–20 months after intertrochanteric osteotomy and therefore suggested amelioration of pain to be a consequence of the reduced venous congestion. In contrast to the observations of Phillips et al., we were not able to record a similar normalization of venous drainage after fenestration in spite of reduced intraosseous hypertension and ameliorated rest pain. The results of this study therefore do not support the hypothesis of a causal connection between impaired venous drainage and intraosseous hypertension. The discrepancy between the observations of Phillips et al. and ours concerning the venous drainage pattern in patients with postoperative amelioration of pain might be explained by the following differences. Firstly, there is the difference in the time interval between operation and postoperative phlebography. Secondly, there is a difference in anaesthetic technique in the study by Phillips et al. who used general anaesthesia in preoperative examinations but local anaesthesia in the postoperative ones, whereas we used local anaesthesia in both preoperative and postoperative investigations. This difference in anaesthetic technique also constitutes a possible difference in the speed of injection of contrast medium pre- and postoperatively in the study by Phillips et al. because

of a lack of reaction to pain as a limiting factor to the rate of injection in their preoperative examination. This factor is of great importance since most patients with intraosseous hypertension experience intense pain during rapid intraosseous injection of fluid.

Our findings do not support the assumption (which was the original reason for this work) that ameliorated rest pain and decreased intraosseous pressure in the proximal femur after fenestration in osteoarthritis of the hip are associated with a normalization of intraosseous blood drainage in the proximal femur.

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