Acta Orthop Scand 1988;59(1):16–18

Intraarticular pressure during operation of cervical hip fractures

Bo Jacobsson[1], Nils Dalén[2], Brynjolfur Jonsson[1] and Per Ackerholm[3]

The intraarticular pressure was measured during nailing of femoral neck fractures in 21 patients. A three-flanged nail or three screws were used randomly. During traction and inward rotation of the leg, the intracapsular pressure increased over diastolic values, but as soon as the lateral cortex was penetrated, the pressure dropped. The hammering of the nail did not increase the intraarticular pressure.

Animal experiments have demonstrated that hip joint tamponade may cause osteonecrosis of the femoral head (Woodhouse 1964). Recently, this chain of events had been reported following trauma to the hip from intraarticular hematoma (Strömqvist et al. 1985, Bauer 1985, Wingstrand et al. 1986).

We have studied whether intraarticular tamponade is present during nailing of cervical hip fractures.

Patients and methods

Twenty-one patients with femoral neck fractures (5 men and 16 women, mean age 73±12 years, mean body weight 63±11 kg) were included in the study. Depending on their year of birth, they were allocated to operation with a three-flanged Thornton nail or three screws (Scand Hip Pins). There were no differences between the two groups concerning age and weight. The preoperative fracture dislocation was graded according to Garden (1961).

The intraarticular pressure was recorded continuously with 1:1 mm nylon catheter connected to a pressure conductor (Gould Statham P 50). To check the position of the catheter radiographically, a minimum amount of contrast was injected. Capsular ruptures were noted in 4 cases, and these were excluded. The pressure was recorded 1) with the patient on the operating table with the leg in the neutral position, 2) after fracture reduction with traction and the leg rotated inwardly, 3) when the cortex was perforated and drilled, 4) and when the nail or screws were inserted. Finally, the pressure was recorded 5) after the operation when the traction had been eliminated and the hip rotated to the neutral position.

Skeletal scintimetry was performed and the head-to-head ratio (Strömqvist 1983) was calculated before and after the operation. Computed tomography of the hips was performed with a Philips Tomoscan 310 to measure the distension of the capsule with 9-mm-thick slices; a high dose was used to minimize the artefacts from the osteosynthesis metal. The width of the capsule was measured in millimeters perpendicular to the femoral neck and compared with the width of the capsule on the intact side.

The Student's *t*-test was used.

Results

The intraarticular pressures were about 60 mmHg preoperatively and about 50 mmHg postoperatively (Table 1). During traction and inward rotation of the leg, the pressure increased to about 140 mmHg. As soon as the lateral cortex was penetrated, however, the pressure decreased dramatically. The insertion of the nail or screws had no influence on the intraarticular pressure.

Departments of Orthopedics at [1]Skövde Hospital and Karolinska Institute at [2]Danderyd Hospital, and [3]Department of Radiology, Skövde Hospital, Sweden

Correspondence: Dr. Bo Jacobsson, Department of Orthopedics, University Hospital, S-750 14 Uppsala, Sweden

Table 1. Intraarticular pressures (P) during operation of cervical hip fractures

A	B	C	D	E	F	G	H	I	K	L	M	N	O
67	F	T	1	13	13	4.0	3.5	33	163	58	33	30	40
67	F	T	2	10	9	1.4	2.4	70	200	90	70	95	25
69	M	T	4	8	11	1.3	2.1	67	126	90	60	25	25
83	F	T	3	9	8	0.7	0.3	130	150	180	150	128	88
59	M	T	1	15	15	2.4	1.2	98	130	6	20	99	177
85	F	T	4	13	14	1.6	3.8	75	150	87	60	60	91
44	F	S	2	16	15	2.7	1.1	80	130	100	90	80	32
74	F	S	3	12	14	1.0	0.6	25	324	127	114	102	16
53	F	T	4	13	14	1.0	0.9	20	55	37	30	30	8
94	M	S	2	15	17	0.6	0.6	51	64	64	64	64	62
89	F	T	4	13	14	1.6	2.5	107	324	65	67	60	109
76	M	S	4	9	9	1.3	0.8	22	35	29	25	25	30
75	F	T	4	11	11	1.4	1.3	36	46	33	30	27	23
50	F	S	4	12	11	1.5	1.6	52	75	23	54	28	4
83	F	T	3	12	13	0.7	0.6	89	190	90	71	61	18
85	F	T	1	11	11	1.2	2.8	55	158	58	58	42	44
76	F	S	2	15	14	1.6	1.8	70	120	75	75	75	88
Mean				12.2	12.5	1.53	1.64	64	144	71	63	62	52
SD				2	2	1	1	30	81	41	32	31	44
Range				8–15	8–17	0.6–4.0	0.3–3.5	20–130	35–324	6–180	20–150	25–128	4–177

A age,
B sex,
C procedure: T Thornton nail, S Scand Hip Pin,
D disclocation according to Garden,
E preoperative width of the ventral joint capsule (mm),
F postoperative width of the ventral joint capsule (mm),
G scintigraphy preoperatively (head-to-head ratio),
H scintigraphy postoperatively (head-to-head ratio),
I P preoperatively (mmHg),
K P during traction and inward rotation,
L P at perforation of lateral cortex,
M P during drilling,
N P during nailing,
O P postoperatively.

In 4 patients, capsular rupture was seen on the TV-image intensifier. Their intraarticular pressure was not increased during inward rotation of the leg, and these patients were not included in Table 1.

When the two different osteosynthesis methods were compared, no difference in the intraarticular pressure was noted. Nor were there any differences in the distension of the capsule measured with CT or in the head-to-head ratio measured by scintimetry (Table 1).

Discussion

High intraarticular pressures can cause necrosis of the femoral head in dogs (Woodhouse 1964) and may cause femoral head ischemia in patients, and this ischemia may be reversed by aspiration (Strömqvist et al. 1985).

The circulation of the femoral head is dependent on the intraarticular pressure being well below the diastolic blood pressure (Launder et al. 1981, Drake & Meyers 1984, Tachdjian and Grana 1968). The intraarticular pressure, however, is dependent on the position of the hip; it is low in flexion and outward rotation and high in extension and inward rotation (Lloyd-Roberts 1953, Drake and Meyers 1984).

Most patients with a fresh fracture have their hip in flexion and outward rotation, and their intraarticular pressure may be well below their diastolic blood pressure; and preoperative aspiration of the joint, as has been suggested (Trueta and Harrison 1953), would not influence the circulation of the femoral head (Drake and Meyers 1984). During extension and inward rotation of the hip, as during surgery, the intraarticular pressure is well above the diastolic blood pressure. This high pressure, however, was eliminated as soon as the lateral cortex was perforated (Table 1).

The vascular damage to the femoral head occurs mainly at the moment of fracture, but it has been shown that further damage is added at operation if a nail is used instead of pins (Strömqvist et al. 1984). In our study the hammering of the nail as a piston into its predrilled hole did not increase the intraarticular pressure or the intraarticular hematoma measured by CT, nor did it decrease the head-to-head scintimetry ratio (Table 1). Thus, the choice of osteosynthesis method probably has no marked influence on the intraarticular pressure.

References

Bauer G C H. Femoral head necrosis following traumatic hip joint tamponade. A case report. Acta Orthop Scand 1985;56(3):275–6.

Drake J K, Meyers M H. Intracapsular pressure and hemarthrosis following femoral neck fracture. Clin Orthop 1984;(182):172–6.

Garden R S. Low angle fixation in fractures of the femoral neck. J Bone Joint Surg (Br) 1961;43:647–63.

Launder W J, Hungerford D S, Jones L H. Hemodynamics of the femoral head. J Bone Joint Surg (Am) 1981;63(3):442–8.

Lloyd-Roberts G C. The role of capsular changes in osteoarthritis of the hip joint. J Bone Joint Surg (Br) 1953;35:627–42.

Strömqvist B. Femoral head vitality after intracapsular hip fracture. 490 cases studied by intravital tetracycline labeling and Tc MDP radionuclide imaging. Acta Orthop Scand 1983;(Suppl 200):1–71.

Strömqvist B, Hansson L I, Palmer J, Ceder L, Thorngren K G. Scintimetric evaluation of nailed femoral neck fractures with special reference to type of osteosynthesis. Acta Orthop Scand 1983;54(3):340–7.

Strömqvist B, Hansson L I, Nilsson L T and Thorngren K G (1984). Two-year follow-up of femoral neck fractures. Comparison of osteosythesis methods. Acta Orthop Scand 55, 521–425.

Strömqvist B, Wingstrand H, Egund N, Carlin N O, Gustafson T, Herrlin K, Nilsson L T, Thorngren K G, Önnerfält R. Traumatic hip joint tamponade. Two cases with femoral head ischaemia. Acta Orthop Scand 1985;56(1):81–5.

Tachdjian M O, Grana L. Response of the hip joint to increased intra-articular hydrostatic pressure. Clin Orthop 1968;61:199–212.

Trueta J, Harrison M H M. The normal vascular anatomy of the femoral head in adult man. J Bone Joint Surg (Br) 1953;35:442–61.

Wingstrand H, Strömqvist B, Egund N, Gustafsson T, Nilsson L T, Thorngren K-G. Hemarthrosis in undisplaced cervical fractures. Tamponade may cause reversible femoral head ischemia. Acta Orthop Scand 1986;57(4): 305–308.

Woodhouse C F. Dynamic influences of vascular occlusion affecting the development of avascular necrosis of the femoral head. Clin Orthop 1964;32:119–29.