SEPTIC ARTHRITIS : ARTHROSCOPIC MANAGEMENT WITH LOCAL ANTIBIOTIC TREATMENT

J. JEROSCH, I. HOFFSTETTER, M. SCHRÖDER, W. H. M. CASTRO

In a retrospective study, the results of arthroscopic treatment of septic arthritis were evaluated in 12 patients. Ages ranged from 4 to 57 years. The knee joint was affected in 9 cases, the elbow in 2 cases, and the shoulder joint in one case. In 3 patients the infection was hematogeneous. Four patients had a postoperative infection and in 5 patients the infection followed an intraarticular injection. The indication for arthroscopic treatment was based on clinical findings, an increased ESR and/or CRP, an increase in leukocyte count in the joint fluid and no bone involvement on xray. Arthroscopic management was performed according to the intraoperative findings (lavage, debridement, synovectomy). The procedure was completed by intraarticular placement of an antibiotic collageneous fleece. Additionally, systemic antibiotics, active against staphylococcus aureus, were used for perioperative therapy before starting a specific antibiotic treatment according to the cultured organism. In 10 out of 12 cases the infection was cured by one operation. Because of the advantages of arthroscopic treatment, it should be performed as soon as joint infection is confirmed.

Keywords : joint infection ; arthroscopic management ; local antibiotic treatment.
Mots-clés : arthrite septique ; traitement arthroscopique, traitement antibiotique local.

INTRODUCTION

Septic arthritis is still a serious clinical problem (5, 31). Arthroscopy has opened a new therapeutic approach to this problem. In 1973 Jackson and Parson (17) described arthroscopic distension-irrigation in septic arthritis of the knee. Since 1981, debridement is performed in addition to arthroscopy, in knee infections (16). In severely infected cases, Jackson showed good results in terms of range of motion and pain by using arthroscopic distension-irrigation, local antibiotics, and synovectomy (16), but there are still some shortcomings to this approach.

One major problem is the set-up of the suction-irrigation system. The portals have to be kept watertight to avoid leakage of irrigation fluid and to guarantee sterile conditions. A crucial disadvantage of suction-irrigation systems is the so-called highway effect. By taking the path of least resistance, the irrigation fluid flows through the joint without necessarily reaching all joint compartments.

Based on the problems mentioned above, the intraarticular application of an antibiotic collageneous fleece was initiated after performing the arthroscopic irrigation, fibrinectomy and synovectomy.

The intraarticular application of gentamycin-PMMA-chains has already been proposed in septic arthritis (13). However, this technique has some disadvantages in patients with intact cartilage. For example, if early motion of the joint is indicated to avoid postoperative adhesions, additional mechanical damage is possible (33).

MATERIALS AND METHODS

From April 1992 through August 1993, 12 patients (8 males and 4 females) with septic arthritis were treated

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arthroscopically. The ages ranged from 4 to 57 years (average 34 years). Nine patients presented with knee joint arthritis, 2 with an infected elbow, and 1 with shoulder joint arthritis. In 3 cases the infection was hematogeneous, in 4 cases the infection developed postoperatively, and in 5 cases infection followed an intraarticular injection.

The diagnostic evaluation was based on the patient's history and clinical findings, local signs of inflammation, fever, increased WBC, ESR and CRP, increased leukocyte count and microscopic detection of microorganisms in the joint fluid, as well as xray and ultrasound investigations. For some patients, scintigraphy and MRI were available.

Arthroscopic treatment was performed in those cases with a typical history, with the characteristic local signs (local warmth, tenderness, pain on motion, swelling and joint effusion), with the laboratory findings mentioned above and without bone involvement on x ray.

The arthroscopic procedure performed depended on the stage of joint infection. In the early stages, treatment consisted of thorough irrigation. In cases of early postoperative infection, the postoperative hematoma (fig. 1) had to be removed with the shaver. In cases of more severe findings and progressive infection with fibrin clots, a complete fibrinectomy was performed using a motorized synovial resector. In hypertrophic synovitis (fig. 2) and synovial necrosis (fig. 3), the procedure was extended to partial or complete synovectomy. In cases with secondary changes in the joint cartilage, which was frequently seen in severe infections, loose and damaged cartilage was also resected in order to remove as much devitalized tissue as possible. All procedures were performed during a high irrigation flow with 5 to 25 liters. Surgery was completed by application of an antibiotic collageneous fleece, which is commercially available in rectangular sheets. For arthroscopic application they were cut in long, narrow strips for intraarticular placement using a large inflow cannula (fig. 4). Finally, a large redon drain was used in an overflow technique. Antibiotic active against staphylococcus aureus was used for initial therapy perioperatively. Specific intravenous antibiotic treatment followed when indicated by sensitivity testing ; and oral antibiotic therapy followed for 6 weeks to 4 months until the ESR and CRP levels were normal.

Physical therapy using continuous passive motion was started on the first postoperative day. Cryotherapy was also used. All operations were performed under general anesthesia.

Postoperative weight bearing was allowed according to local status and the documented intraarticular fin-

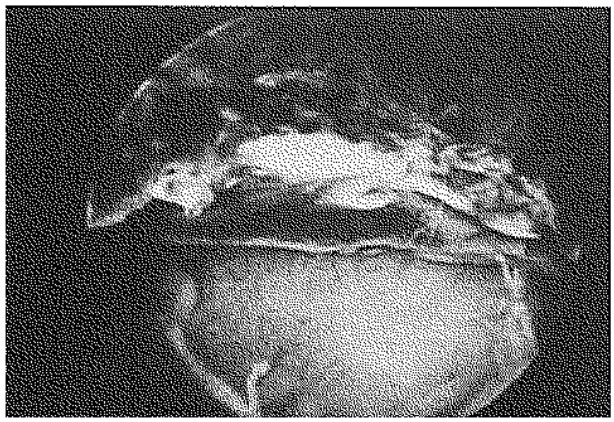

Fig. 1. — Infected postoperative hematoma of the superior recess of the knee joint.

Fig. 2. — Hypertrophic synovitis in the early stage of infection.

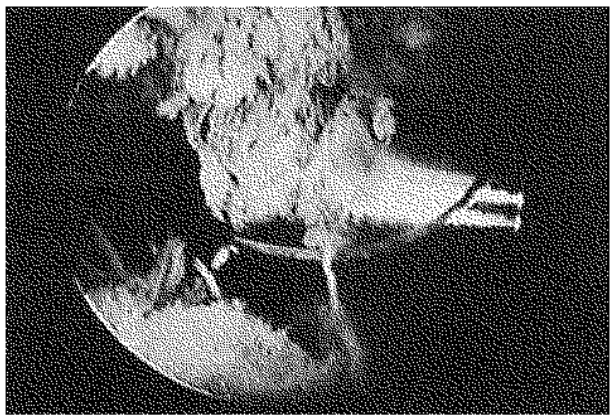

Fig. 3. — Necrotic synovitis in an infected knee joint due to intraarticular injection.

Table I. — Patient distribution including the preinfectious joint status (DJD = degenerative joint disease)

pat.	sex	age	joint	cause	preinfectious joint status
SW	f	19	knee	postop.	chondropat.pat. 1° - 2°
MS	m	4	elbow	hematogen	normal
GH	m	26	knee	postop.	chondropat.pat. 1° - 2°
ST	m	9	knee	hematogen	DJD 1° - 2° (hemophilic patient)
GF	m	28	elbow	hematogen	normal
WW	m	57	knee	postop.	DJD 3°
AS	m	42	shoulder	postop.	inpingement
HW	m	57	knee	postinject.	DJD 2° - 3°
GH	m	45	knee	postinject.	DJD 2°
KL	f	31	knee	postinject.	chondropat.pat. 1°
SD	f	19	knee	postinject.	chondropat.pat. 1°
GH	f	46	knee	postinject.	DJD 3°

dings. Earliest full weight bearing was allowed 6 weeks postoperatively.

The ESR, CRP, range of motion and xray results were the basis for evaluating the therapeutic results. A specific joint score could not be used because different joints with varying preoperative status were treated (table I).

RESULTS

In 10 out of 12 patients, the joint infection could be cured by a single operation ; no cases of secondary bone involvement were recorded. In 1 case of postoperative knee infection after arthroscopic lateral release, 7 revisions were necessary. Two arthroscopic and 5 open operations were performed to manage the relapsing infections caused by the pathogens Klebsiella oxytoca and Pseudomonas stutzeri, which indicated an exogenously aquired infection. The ultimate outcome for this patient was restricted range of motion (flexion/extension : 90° - 20° - 0°). One patient with a subacromial infection after arthroscopic subacromial decompression subsequently underwent 2 open surgical interventions to cure an infection. The final outcome in this patient, as with all other patients at the time of followup, was a painless joint with full range of motion (table II).

The immediate postoperative decrease in fever (fig. 5), as well as pain relief, indicated successful therapy. In the early postoperative course, the decrease in the ESR (fig. 6) and CRP (fig. 7) were used as monitoring parameters. Figures 6 and 7 show the delayed decrease in the ESR and the more rapid decrease in the CRP in the postoperative period. In 9 patients, the infectious organism could be identified (table III) ; in 3 patients the culture remained sterile. Postoperative disability in patients lasted an average of 3.6 months.

Table II. — Final range of motion at follow-up

pat.	sex	age	joint	final RW
SW	f	19	knee	90°/20°/0°
MS	m	4	elbow	130° /0° /0°
GH	m	26	knee	130° /0° /0°
ST	m	9	knee	120° /10° /0°
GF	m	28	elbow	140° /0° /0°
WW	m	57	knee	100° /15° /0°
AS	m	42	shoulder	normal
HW	m	57	knee	90° /10° /0°
GH	m	45	knee	110° /5° /0°
KL	f	31	knee	130° /0° /0°
SD	f	19	knee	130° /0° /0°
GH	f	46	knee	120° /0° /0°

DISCUSSION

Despite the high incidence of intraarticular injections, bacterial arthritis is still a rare complication (10, 24). A bacterial infection must be

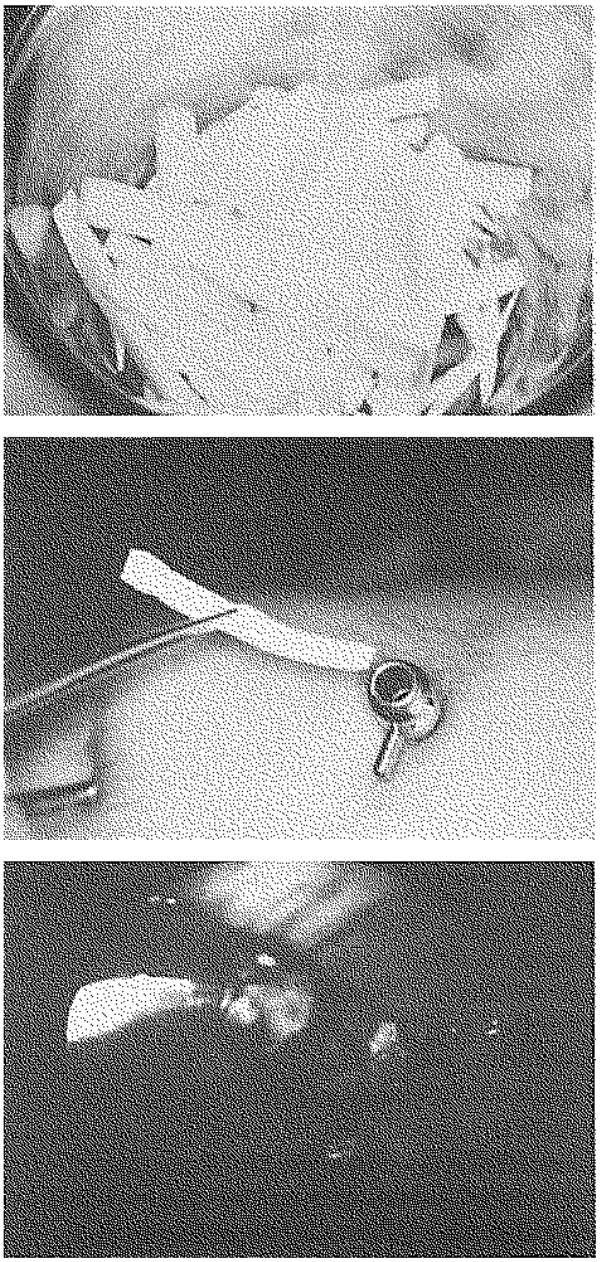

Fig. 4. — Strips of the antibiotic-loaded collagencous fleece (a) are inserted into the superior recess of the knee joint via the inflow cannula (b). The intraarticular placement can be arthroscopically controlled (c).

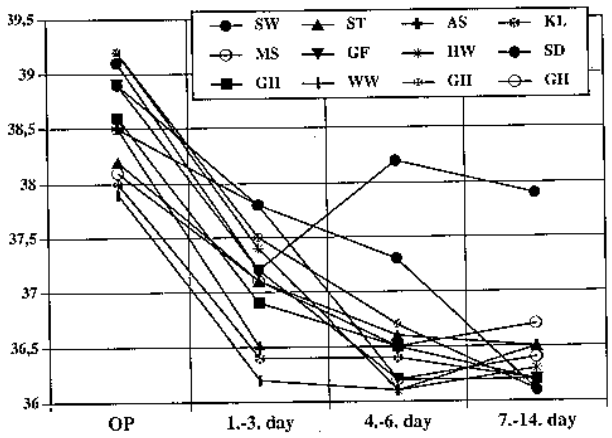

Fig. 5. — Postoperative body temperature.

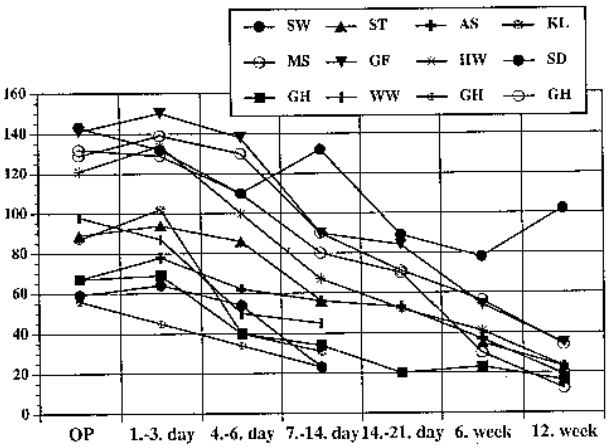

Fig. 6. — Postoperative ESR curve (first hour).

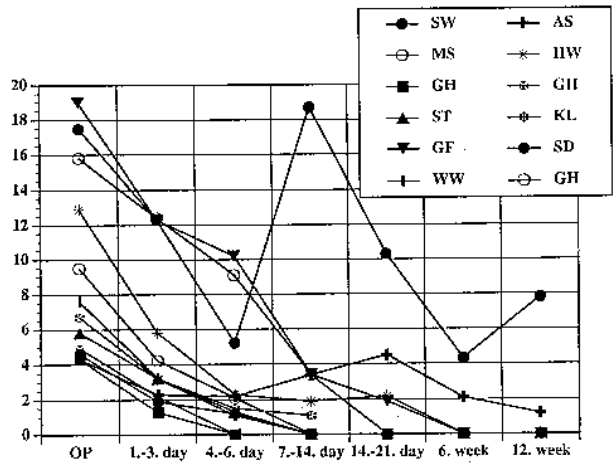

Fig. 7. — Postoperative CRP curve (mg/dl).

Table III. — Cultured organism

pat.	sex	age	joint	organism
SW	w	19	knee	Klebsiella oxytoca, Pseudomonas stutzeri
MS	m	4	elbow	Staph.aureus
GH	m	26	knee	Staph.aureus, Streptococci
ST	m	9	knee	negative
GF	m	28	elbow	Stap.aureus
WW	m	57	knee	Staph.aureus
AS	m	42	shoulder	Staph.aureus
HW	m	57	knee	Staph.aureus
GH	m	45	knee	Staph.aureus, Staph.epidermidis
KL	w	31	knee	negative
SD	w	19	knee	Staph.aureus, streptococci
GH	w	46	knee	negative

Table IV. — Differential diagnostic signs in joint irritation and joint infection

JOINT IRRITATION	JOINT INFECTION
early appearance of symptoms (within 12 hours)	decrease in or resolution of symptoms after 12 h to 5 d postoperatively
no fever	fever (not obligatory)
ESR/CRP not or only slightly increased	increased ESR/CRP
WBC < 25,000/ml in joint aspirate	WBC > 35,000/ml in joint aspirate

considered as a serious threat to any joint, even in this age of antibiotics (26). But given the high frequency of intraarticular injections, post-injection infection is still a rare complication (10, 24).

Arthroscopic procedures can also be complicated by infection of the joint. According to Gächter, 5-6 infections occur in 10,000 diagnostic arthroscopies (10). Jackson reported an infection rate of 0.4% (16), whereas large retrospective studies in the United States show an infection rate of 0.07-0.08% (34). According to Johnson, 10% of all complications after arthroscopic operations are due to infections (20). The risk of infection after arthrotomy is still considerably higher (1%) (24).

If joint infection after injection, aspiration, and surgery is suspected, the first question is whether the symptoms represent only joint irritation or true infection. The differential diagnosis is based mainly on the presence of leukocytes in the joint fluid and CRP levels (table IV). As described in the literature the CRP is particularly useful for the early diagnosis of joint infections (1, 23, 29, 30, 38). The CRP reacts to an acute infection within hours (3, 6) and with successful therapy, the CRP decreases by 50% per day (22).

In 80% of the cases, Staphylococcus aureus is the organism responsible for bacterial joint infections. Infections caused by Mycobacteria tuberculosis, gram-positive cocci and gram-negative bacilli are very rare (7, 9). Identifying the pathogen is not always possible. Thiery *et al.* (37) detected a positive culture in only 63% of those with a septic knee infection. Several authors showed the mechanism of bacterial joint destruction and its consequences for the knee joint (5, 8, 12, 28, 39) : proteolytic enzymes of polymorphonuclear leukocytes and synovial cells dissolve proteoglycans of the articular cartilage ; fibrin coatings inhibit the absorption mechanism and consequently interfere with the nutrition of the cartilage. The aggressive damaging effect of lysosomal enzymes to the cartilage within a few hours can be demonstrated histologically by animal experiments (4, 8, 36).

Recent experience indicates that an early operative intervention with debridement and resection of infected hematoma, fibrin clots, cell debris and

Table V. — Arthroscopic therapy of joint infection

Stage 1 :	joint lavage, bacterial count/culture, cell count
Stage 2 :	local synovectomy
	fibrinectomy with the shaver
Stage 3 :	extended synovectomy
	necrosectomy
	lysis of adhesions
	cartilage debridement

Table VI. — Arthroscopic staging of joint infection

Stage 1 :	opaque effusion with high cell count
	hyperemia of the synovium
Stage 2 :	putrid effusion
	synovial hypertrophy with petechial bleeding
	fibrin coatings
Stage 3 :	severe villus synovitis with (partial) tamponade of the joint
	synovial necrosis
	synovial adhesions
	cartilage destruction

necrotic synovial tissue, in combination with antibiotic treatment, seems to be a very effective therapeutic management. Sequential arthroscopic therapy is of particular value. The arthroscopic method shows significant advantages over conventional surgical procedures, where extended arthrotomies are necessary (18). The results presented here support the recommendations of the staging (table VI) and sequential arthroscopic therapy (table V) proposed by Jensen *et al.* (18). The two failures of arthroscopic treatment recorded in the authors' series make their experience consistent with the results published in the literature (18, 27, 37, 41).

The fact that an objective score was not used in the study presented does not adversely affect the evaluation. Available joint scores include a wide intra- and interobserver variance. Moreover, the subjective evaluation by the patient contrasts with the objective clinical findings (18).

The results are similar to those of other studies, but the treatment approach is different concerning the local postoperative therapy. A local antibiotic, administered in the form of collagenous fleece, is used instead of postoperative irrigation. This collagenous fleece, which continuously releases gentamycin, is resorbed within 8 to 14 days in well-vascularized tissue, thus avoiding a permanent implant and its inherent disadvantages (2, 35). Using this kind of local antibiotic, Letsch *et al.* found a concentration of gentamycin in the serum, urine and wound secretions that was higher than after application of PMMA-chains, without reaching a toxic serum concentration (21). The pharmacokinetics analyzed by v. Hasselbach (14) showed very high local activity (1300 mg/l) within the first 48 hours.

Considering comparable results published in the literature, the advantages and disadvantages using this collagen fleece in septic arthritis merits discussion (table VII). The high local concentration of the antibiotic and the possibility of immediate joint mobilization must be evaluated in light of the relatively high costs and any potential negative effects to the cartilage. Additionally, the risk of secondary contamination by postoperative manipulations is decreased. There were no problems due to synovial reaction, but further studies have to analyze the risk of a hypertrophic tissue reaction caused by the collageneous fleece and the resulting intraarticular adhesions. Should the use of this method become widespread, the technique of

Table VII. — Advantages and disadvantages of the suction-irrigation-procedure versus local antibiotic application

SUCTION-IRRIGATION-METHOD	LOCAL ANTIBIOTIC APPLICATION
advantages	advantages
mechanical cleansing	high intraarticular antibiotic concentration
well-known procedure	relatively undemanding operative procedure
	mobilization immediately postoperatively
disadvantages	disadvantages
high demanding procedure	
high nursing costs	high product costs
risk of secondary contamination	toxicity to the cartilage ?
early mobilization more difficult	adhesions ?
risk of sepsis	

application would require improvement. The commercially available rectangular sheets currently have to be cut in to small pieces for arthroscopic application ; and once the collageneous material is moistened, handling the material can become extremely difficult because of its very adhesive property. Preparation and packing alternatives may ease or eliminate these difficulties.

CONCLUSION

Given the advantage of a minimally invasive surgical procedure, the favorable outcomes of different authors as well as the real chance of restitutio ad integrum in case of early intervention, the arthroscopic procedure should be considered as soon as a joint infection is suspected. Infection has to be ruled out or confirmed and treated as soon as possible. The use of gentamycin fleece might be an additional advantage in the treatment of these disturbing complications.

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SAMENVATTING

J. JEROSCH, I. HOFFSTETTER, M. SCHRÖDER, W. H. M. CASTRO. Septische arthritis. Arthroskopisch beleid met lokale antibiotherapie.

In een retrospektieve studie werden de resultaten van de arthroskopische behandeling bij 12 patiënten voor septische arthritis beoordeeld. De leeftijd varieerde van 4 tot 57 jaar. Het knie gewricht was 9-maal getroffen. Bij 2 patiënten was de arthritis gelokaliseerd in het ellebooggewricht en bij een patiënt in het schoudergewricht. Bij 3 patiënten was de ontsteking hematogeen veroorzaakt. Vier patiënten vertoonden een postoperatieve infectie en bij 5 patiënten was de ontsteking ontstaan na een intra-articulaire injectie. De indicatie voor de arthroskopie was gebaseerd op de klinische bevindingen, een toegenomen bezinking en/of CRP, een toegenomen leucocytentelling in het synoviaal vocht en geen botaantasting röntgenologisch. Het arthroskopisch beleid werd intraoperatief bepaald (lavage, debridement, synovectomie). Op het einde van de ingreep werd een antibiotisch collageen vlies intra-articulair geplaatst. Bovendien werden perioperatief systemisch antibiotika gegeven, actief tegen S. aureus. Afhankelijk van het mikrobiologisch onderzoek werd dit antibiotika beleid nadien veranderd. Bij 10 van 12 patiënten kon de arthritis t.g.v. de arthroscopische ingreep uitgedoofd worden. Gezien het voordeel van de minimaal invasieve ingreep dient deze overwogen te worden zodra een gewrichtsontsteking wordt vermoed.

RÉSUMÉ

J. JEROSCH, I. HOFFSTETTER, M. SCHRÖDER, W. H. M. CASTRO. Arthrite septique. Traitement antibiotique local par arthroscopie.

Douze malades traités par arthroscopie pour arthrite septique du genou furent revus dans le cadre d'une étude rétrospective. L'âge variait de 4 à 57 ans. Dans 9 cas, le genou était atteint, dans 2 cas le coude et dans un cas l'épaule. Chez 3 malades, l'infection était d'origine hématogène. Dans 4 cas il s'agissait d'une infection postopératoire et dans 5 cas d'un sepsis après injection intra-articulaire. L'indication de l'arthroscopie était posée sur base des signes cliniques, d'une accélération de la sédimentation et/ou de la positivité de la CRP, d'une leucocytose dans le liquide synovial et sur l'absence d'atteinte osseuse à la radiographie. Les gestes arthroscopiques furent décidés au cours de l'intervention (lavage débridement, synovectomie). En fin d'intervention, une membrane collagène, porteuse d'antibiotiques, fut placée dans l'articulation. Au cours de l'intervention une antibiothérapie systémique, active contre le staphylocoque doré, fut administrée. Les antibiotiques furent par la suite adaptés aux résultats de l'examen bactériologique. L'arthrite septique put être contrôlée par intervention arthroscopique, chez 10 des 12 malades. Etant donné l'avantage de cette intervention peu invasive son indication est à considérer en cas de suspicion d'infection articulaire.