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1 LIST OF ORIGINAL PUBLICATIONS

I   Lehtimäki MY, Kaarela K, Hämäläinen MMJ. Incidence of hip involvement and need for total hip replacement in rheumatoid arthritis. Scand J Rheumatol 1986;15:387‑91.

II   Lehtimäki MY, Kautiainen H, Hämäläinen MMJ, Lehto UK, Ikävalko M. Repo AB, Kotaniemi HA, Kaarela K. Hip involvement in seropositive rheumatoid arthritis. Survivorship analysis with a 15-year follow-up. Scand J Rheumatol 1998;27:406‑9.

III   Lehtimäki MY, Kautiainen H, Lehto MUK, Hämäläinen MMJ. Charnley low-friction arthroplasty in rheumatoid patients. A survival study up to 20-years. J Arthroplasty 1999;14:657‑61.

IV   Lehtimäki MY, Lehto MU, Kautiainen H, Savolainen HA, Hämäläinen MMJ. Survivorship of the Charnley total hip arthroplasty in juvenile chronic arthritis. A follow-up of 186 cases for 22 years. J Bone Joint Surg [Br] 1997;79Br:792‑5.

V   Lehtimäki MY, Lehto MUK, Kautiainen H, Lehtinen K, Hämäläinen MMJ. Charnley total hip arthroplasty in ankylosing spondylitis. Survivorship analysis of 76 patients followed for 8‑28 years. (Accepted)

VI   Savolainen HA, Lehtimäki M, Kautiainen H, Aho K, Anttila P. HLA-B27: a prognostic factor in juvenile chronic arthritis. Clin Rheumatol 1998;17:121‑4.

2   ABBREVIATIONS

AS   Ankylosing spondylitis
CI   Confidence interval
JAS   Juvenile ankylosing spondylitis
JCA   Juvenile chronic arthritis
JRA   Juvenile rheumatoid arthritis
HAQ   The Finnish version of the Stanford Health Assessment Questionnaire disability
        index
RA   Rheumatoid arthritis
SD   Standard deviation

3 INTRODUCTION

The frequency of hip involvement in patients with rheumatoid arthritis (RA) has been difficult to estimate. Typically increasing hip discomfort over a few months can be found but the pain may be either in the hip or in the knee as pain referred from the hip. The patient usually limps on the affected side. Hip involvement is perceived clinically by limitation of motion and bony crepitation in the case of cartilage destruction. Radiological narrowing of the joint space points to hip involvement. Erosions may be present or not and the femoral head may be destroyed and collapse, and the acetabulum may protrude either medially or cranially (Vainio and Pulkki 1961, Gschwend 1980, Poss and Sledge 1989). Although some facts regarding the natural history of the hip involvement in RA are known, prospective long-term follow-up studies on hip involvement or risk factors influencing hip destruction in RA are hitherto lacking. Previous cross-sectional retrospective studies have had only short follow-up (< 10 years) and show a relatively low incidence of hip involvement (Vainio and Pulkki 1961, Gschwend 1980, Eberhardt 1995). Studies with longer follow-up have reported a higher incidence rate of hip involvement (Duthie and Harris 1969, Hastings and Parker 1975).

Comparison of the results given as per cent of the population in different studies is difficult, mainly because of differences in the length of follow-up and in patient selection. On the other hand survivorship analysis affords a useful tool for epidemiological and long-term clinical studies (Kaplan and Meier 1958, Dobbs 1980). In the present series survivorship analysis was used to evaluate hip involvement (event equals hip destruction) in an epidemiologically selected patient cohort.

Surgical management of the hip joint in osteoarthritis and RA has been revolutionized by the introduction of acrylic cement-stabilized joint replacement. Although total hip arthroplasty has been extensively employed since 1938, the employment of wear-resistant high-density polyethylene and noncorrosive stainless steel stabilized by acrylic cement was only introduced in 1962 by John Charnley (1966). Acrylic cement made it possible to bond artificial joint prostheses mechanically to the bone and produce an insensitive near-normal functioning hip joint. Pain relief is complete and the functional improvement more predictable than in any other previously recommended surgical operation for the purpose. For this reason, total hip arthroplasty has almost completely replaced the use of any other reconstructive procedures of hip joint.

Sir John Charnley introduced the concept of Low-Friction Arthroplasty at the beginning of sixties and in 1961 postulated: "In considering how arthroplasty of the hip can be improved, two facts stand out: 1. After replacement of the head of the femur by a spherical surface of inert material, the failures are essentially long-term. At first the patient may notice no difference between the artificial head and the living one which preceded it. Our problem is to make this temporary success permanent. 2. Objectives must be reasonable. Neither surgeon nor engineers will ever make an artificial hip-joint which will last thirty years and at some time in this period enable the patient to play football" (Charnley 1961).

Charnley total hip arthroplasty (later Charnley prosthesis) components were released for general use from 1968 only to surgeons who had acquainted themselves with the technique by attending teaching session, until in the second half of the1970s components were released for general use without this condition (Charnley 1961,1966, Wroblewski and Siney 1993). Possibly for this reason the survival rate of the Charnley prosthesis in osteoarthritis at twenty years has been as good as 80%-87% (Wroblewski and Siney 1993, Schulte et al 1997).

Unfortunately there have been no good randomized comparative studies of the different modes of total hip arthroplasty. The best researches that correlating with the clinical use of the total hip arthroplasty have been survival analyses from national registers covering the total use of the different types of total hip arthroplasty within one country (Furnes et al 1996, Nevalainen et al 1997, Herberts and Malchau 1997). According to Murray and associates (1995) 62 different primary total hip arthroplasties were identified in the United Kingdom; half of them had been introduced in the previous five years and only 30% had any result published in peer-reviewed journals. For three implants (Charnley, Stanmore and Müller) there were ten-year survival results, for two (Charnley and Stanmore) 15-year survival results, and for only one (Charnley) a 20-year result has been published. The two cheapest implants had the longest follow-up results. In the Finnish Arthroplasty Register a total of 57 754 hip arthroplasties was recorded for the years 1980 to 1996. During that period 113 different types of prostheses had been used. The ten most commonly used prostheses include about 60% of cases. The survival rate of five most common cemented prostheses in osteoarthrosis in females is about 80% and in males about 74% at 13 years, and that of uncemented prostheses about 67% and about 67% respectively at 11 years (Nevalainen et al 1997).

At the Rheumatism Foundation Hospital the Charnley prosthesis was introduced in 1971 after a training session in Wrightington (Charnley 1970). Since then up to the end of 1999 more than 50 surgeons have performed more than 3500 operations for different types of rheumatoid and osteoarthritic patients.

This thesis discusses the incidence of hip involvement in RA based on a unique 8- and 15-year prospective clinical and radiographic follow-up study, and the longevity of consecutive Charnley prostheses in rheumatoid arthritis (RA), juvenile chronic arthritis (JCA) and ankylosing spondylitis (AS) patients together with factors influencing them, using survivorship analysis, the operations having been performed in hospital specializing in the treatment of postulated arthritic patients.

4 REVIEW OF THE LITERATURE

4.1 Destruction of the hip

4.1.1 Destruction of the hip in patients with rheumatoid arthritis

Hippocrates mentions a joint disease which sets in at the age of 35 years and affects hands and feet and subsequently elbows, knees and hips and can result in the destruction of joints (Copeman 1964, Gschwend 1980). The fact that RA initially affects smaller joints and subsequently the hip joints is a trait still recognized in the modern concept of the course of RA (Kaarela 1985). The etiology of the RA is still unsolved. The disease can cause destruction of the joint cartilage, the bony structure underneath and ligaments and tendons with their sheaths, which are overstretched, broken up and finally destroyed. Changes in the tendons and tendon sheaths as well as in muscles near the joints interfere with articular function by influencing the finely balanced equilibrium of the muscles acting on joints. These changes lead to an abnormal position which contributes to the ultimate destruction of the joint primarily involved (Gschwend 1980). RA is clinically diagnosed following certain criteria. The latest revised American Rheumatism Association (ARA) classification criteria for RA were introduced in 1987 by the American College of Rheumatology (ACR) (Arnett et al 1988).

Synovitis around the femoral neck in patient with RA

The incidence of RA in Finland has been 39/100 000 in the population of ≥16 years of age (Kaipiainen-Seppänen et al 1996) and in Sweden 51/100 000 in the population 20-74 years of age (Simonson et al 1999). Involvement of the hip in RA is clinically observed by limitation of motion and radiologically by narrowing of the joint space and destruction of the femoral head and widening of the acetabulum protruding either medially or cranially (Vainio & Pulkki 1961, Gschwend 1980). Although some aspects of the natural history of the hip involvement in RA are known, we found no previous prospective long-term follow-up studies on hip involvement or risk factors influencing hip destruction in RA. Previous cross-sectional retrospective studies with short follow-up (<10 years) have shown a 5-17% incidence of hip involvement (Vainio & Pulkki 1961, Gschwend 1980, Eberhardt et al 1995). Studies with longer follow-up have reported

36‑40% incidence rates for hip involvement (Duthie and Harris 1969, Hastings and Parker 1975). However, comparison of results in different studies is difficult, mainly owing to differences in the length of follow-up and in patient selection. Survivorship analysis affords a tool for epidemiological and long-term clinical studies (Dobbs 1980).

4.1.2 Destruction of the hip in patients with juvenile chronic arthritis

Juvenile chronic arthritis (JCA) is the term coined in 1977 by members of the European League Against Rheumatism (EULAR) to describe a clinically heterogeneous group of idiopathic arthritides, including JRA, occurring in children younger than 16 years. In the same year, the American Rheumatism Association, now the American College of Rheumatology, adopted the term juvenile rheumatoid arthritis (JRA) for these disorders with a definition slightly different from that of the European League Against Rheumatism (Woo and Wedderburn 1998). The incidence of JRA in Finland is 14.1/100 000 children < 16 years of age (Kaipiainen-Seppänen and Savolainen 1996). The frequency of the systemic form of JRA arthritis is 3‑14% and in 83% of cases there is hip involvement within 10 years (Savolainen 1999). In a study by Hayem and colleagues (1994) patients with systemic form of JCA had a mean interval of 6.3 years between the onset of the disease and the onset of hip symptoms. Out of 59 patients 28 (48%) evinced hip involvement. Unfortunately little information is available regarding hip involvement in adulthood.

Total hip arthroplasty is sometimes needed in adolescence. According to Williams and McCullough (1993) operations have been performed on 34 adolescents aged 13‑24 years and Witt and colleagues (1991) had patients with an average age of 11‑26 years (Witt et al 1991, Williams and McCullough 1993). Patients aged less than thirty years who require total hip arthroplasty form only a small fraction (< 1%) of the typical arthroplasty population even at specialist tertiary referral units, and three quarters of these have some form of inflammatory hip involvement (Sochart and Porter 1997).

4.1.3 Destruction of the hip in patients with ankylosing spondylitis

AS is an inflammatory rheumatic disease predominantly affecting the sacroiliac joints, the spine and frequently the peripheral joints. AS is diagnosed clinically on criteria accepted at the conference in New York in 1967 (Moll 1973). Annual incidences of adult AS have been 6.9‑7.3/100 000 adult inhabitants in Finland (Kaipiainen-Seppänen et al 1997). The incidence of AS in Finland is much lower than that of RA (39/100 000) (Kaipiainen-Seppänen et al 1996). According to a report by Lehtinen (1983) the incidence of clinical hip involvement has been 38% in patients with AS after 30 years of disease duration and ankylosis of the hip was found in 2‑4% (Lehtinen 1979). Thus AS disables the hip by impairing movement and destroying the hip joint. Flexion contracture, pain and destruction have been the main indications for arthroplasty.

4.1.4 The role of HLA-B27 as a prognostic factor in rheumatoid arthritis and juvenile chronic arthritis

Elevated frequencies of HLA-B27 in patients with juvenile chronic arthritis (JCA) were reported soon after the discovery of the close association between HLA-B27 and AS and related seronegative spondyloarthropathies (Rachelevsky et al 1974, Edmonds et al 1974, Buc et al 1974, Hill 1977, Gershwin et al 1977, Dequeker et al 1978, Mäkelä and Tiilikainen 1978, Arnett et al 1980, Morling et al 1985, Schuchmann et al 1984). Above-normal frequencies have been found in JCA patients with both the polyarticular and the pauciarticular-onset subtypes (Rachelevsky et al 1974, Buc et al 1974, Hill 1977, Gershwin et al 1977, Dequeker et al 1978, Mäkelä and Tiilikainen 1978, Morling et al 1985), although in some series this phenomenon has seemed to be restricted to late-onset pauciarticular disease (Hall et al 1975, Brunner et al 1993). Only a few studies have shown elevated frequencies in seropositive adult-type JCA (Schuchmann et al 1984) or in Still's disease (Mäkelä and Tiilikainen 1978, Morling et al 1985), whereas several others have revealed normal (Buc et al 1974, Hall et al 1975, Miller et al 1985, Morling et al 1985, Brunner et al 1993) or only marginally elevated frequencies in these subtypes of JCA or in JCA patients in general (Edmonds et al 1974, Mitsui et al 1977, Nissilä et al 1975, Hall et al 1989). The possible role of HLA-B27 in JCA has not been studied. We report here the frequent occurrence of this allele in JCA patients with incapacitating disease.

4.2 Hip prosthesis
4.2.1 Development of the hip prosthesis

The first known alloplastic hip reconstruction was undertaken in 1890, when a German professor Themistokles Gluck replaced the femoral head with an ivory ball fixed with nickel-plated screws. Philip Wiles performed the first total hip replacement in 1938. There the cup was stabilized by three projecting loops secured by screws and the femoral head fixed by sliding bolts passing through the neck into a hole in a plate bolted to the outer surface of the shaft of the femur. The first tailor-made femoral head replacement prosthesis with intramedullary stem was implanted by Austin Moore in 1940 after excising an osteoblastoma. McBride developed a stainless steel collarless implant and the first operation was performed on 24th December, 1948. Eicher, who had worked with McBride, conceived the notion of a smooth intramedullary stem and a femoral neck calcar. The first implant operation was performed in June 1950. Austin Moore further developed his femoral head replacement implant, which was inserted for the first time in January 1951, and Thompson developed his own design. His first use of the prosthesis was in February 1951. All encountered the problem of twisting in the medullary cavity on its long axis. The last two hemiarthroplasties -Austin Moore and Thompson- have even today been used in the treatment of certain femoral head fractures, the Moore as uncemented and the Thompson as cemented hemiarthroplasty (Charnley 1961, 1970b, Habermann and Feinstein 1978, Kuokkanen 1992, Marcus et al 1992, Niinimäki 1995, Older 1986, Swansson et al 1992, Thanner 1999).

John Charnley was an engineer before he became an orthopedic surgeon and qualified to apply biomechanical principles to the problem of the human joint. He reasoned: "For a skate sliding on ice μ the coefficient of friction has been estimated at 0.03, which indicates that an animal joint is rather more slippery (μ = 0.02) than ice. Engineering science knows no way of approaching such low figures for μ in a plane bearing when the application concerns reciprocating motion at slow speed and under heavy loads. Nature has solved completely the most difficult set of lubrication which ever face the engineer". Charnley studied lubrication and the hydrodynamic of the joints and decided in 1958 that the only chance of success in lubricating an artificial joint was by using surfaces which were intrinsically selflubricating irrespective of whether or not tissue fluid was present. In the late 1950s Charnley, looking for a substance to support the cup and femoral prosthesis in bone, acquainted himself with the acrylic cement used by dental surgeons. Acrylic cement has been used since the 1930s in dentistry and for reconstruction of the skull, and it seemed ideal for anchoring the femoral stem. It was first used in arthroplasty by Harbous in 1953. Charnley studied first a polytetrafluorethylene cup with cup arthroplasty by Smith-Petersen but found that the originally splendid results began to decline after nine to 12 months. He then continued with a large metallic femoral head (41 mm' Thompson) prosthesis and a relatively thin polytetrafluorethylene socket and finally a small head (22.2 mm) and a thick socket after concluding that rotation of the socket against the bone is less likely with a small head and thick socket than with a large head and thin socket as a result of differences in the moment of the frictional force arising from differences in the radii of the socket and the prosthetic head. After about 300 total hip operations had been performed between 1958-1961 he abandoned polytetrafluorethylene. Although there was failure with polytetrafluorethylene, he had learned the basic operating technique and seen the superiority of the fixation of implants with acrylic cement. In 1961 Charnley came round to high-density polyethylene, which had a coefficient of friction not as low as that of polytetrafluorethylene and was at least 500 times more wear-resistant than polytetrafluorethylene. Clinical use was introduced in November 1962. This marked the opening of a new era in hip implant arthroplasty (Charnley 1961, 1970b, Urist 1975, Habermann and Feinstein 1978, Marcus et al 1992, Niinimäki 1995, Older 1986, Tanner 1999).

John Charnley not only initiated the use of acrylic cement in the fixation of his prosthesis but studied the effect of joint lubrication and the friction of the joint as well as the muscular forces acting on a femoral head in walking and standing up. Charnley was a pioneer and he sought to document his results properly. He only released his design under pressure in November 1966 to those who had a training session in Wrightington. General release of the Charnley prosthesis dates from January 1968, but even then a training session was required up to the second half of the 1970s (Charnley 1961, 1966, Wroblewski and Siney 1993).

After the first 500 operations Charnley considered that aseptic loosening of the acetabular component might with time become an increasing problem. This promoted several modifications in the design of the acetabular component. In 1976 he introduced a flange to improve pressure injection and later, in 1981, with the availability of cross-linked polyethene, he modified the shape of the flange to an ogee pattern (ogee is an architectural term for a change in the direction

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of a curved plane). Hodgkinson and colleagues (1993) and Shelley and Wroblewski (1988) have shown less demarcation with the flanged acetabular component.

Thanks to Charnley's scientific enthusiasm, we can now correlate the results of the modern cemented or uncemented prosthesis to his prosthesis results. His ideas and thoughts are still quite modern and the basic structure of the Charnley prosthesis is still the same as in the sixties; there are changes only in the metallurgy and the diameter of the neck and above-mentioned flanged acetabular component.

4.2.2 Fixation of total hip arthroplasty
4.2.2.1 Survival rates of cemented and uncemented total hip arthroplasty

Fixation of the prosthesis is an essential element in total hip replacement. Components can be fixed by a cemented or uncemented technique (Charnley 1961, 1970b, Follacci and Charnley 1969). Cementless fixation was developed in the 1970s in the hope of improving the durability of the implants, but there have been many drawbacks in the development of this mode (Huiskes 1993).

The uncemented technique has led to results contrary to expectations. The Swedish Hip Arthroplasty Register shows a survival rate of 69% (95% CI 64-74) at 13 years during the period 1979 to 1984 for uncemented implants. During the years 1985 to 1989 it was 85% (95% CI 82-87) at 11 years and from 1990 to 1995 97% (95% CI 96-99) at 5 years. The survival rates for the Charnley prosthesis at equivalent time points were 88% (95% CI 87-89) at 16 years, 94% (95% CI 93-94) at 10 years and 99% (95% CI 98-99) at 5 years (Herberts and Malchau 1997). In the Norwegian Arthroplasty Register the most commonly used prosthesis in Norway was taken as the reference arthroplasty (Charnley prostheses fixed with high-viscosity cement containing antibiotic and systemic antibiotic prophylaxes). At five years the cumulative survival rate was 98% (95% CI 97-98) with reference prostheses, 96% (95% CI 95-96) with all primary total hip arthroplasties and 74% (95% CI 67-81) in Coxa/Femora uncemented prostheses (Furnes et al 1996). In Finland Puolakka and associates (1999) found that the 9-year survival of all arthroplasties using uncemented Biomet cups was only 65% (95% CI 61-69).

4.2.2.2 Cementing technique

Charnley emphasized the importance of careful surface preparation, the removal of loose debris and control of bleeding with the manual impaction of the cement (Charnley 1979). His method represents the first-generation cementing technique.

The so-called second-generation cementing technique introduced at the end of the1970s brought a number of improvements such as high-pressure pulse lavage, the use of an intramedullary plug and the use of a cement gun to pressurize the cement in a retrograde fashion from the intramedullary plug (Bourne et al 1998).

At the beginning of the 1970s both Charnley and Lee turned the attention to the pressurization of the acetabular component. Lee introduced an Exeter pressurizer and Charnley a flanged socket. An unflanged socket with an insertion force of 8 kg produced a peak pressure of 46 mmHg, a flanged socket a peak pressure of 185 mmHg and the Exeter pressurizer a peak pressure of 193 mmHg. The Exeter pressurizer must be removed in order to apply the socket. Initially cement intrudes into the anchor holes and cancellous bone, but extrusion of cement commences when the pressure is removed as with the unflanged socket; however, the rate of extrusion slows as the cement polymerizes. The modest insertion force of 8 kg has proved adequate in producing a pressure of at least 170 mmHg under an ogee-flanged socket, and this pressure can be maintained for the duration of polymerization (Shelley and Wroblewski 1988). Wroblewski (1993) made a survival analysis of flanged and unflanged sockets in patients under 51 years of age at the time of the Charnley prosthesis and found 97% (flanged) and 90% (unflanged) results at 17 years.

McCaskie and associates 1997 showed the cement-gun method to be associated with the greatest interface pressure and to cause less physiological disturbance such as hypotension and cardio-vascular collapse than the lower-pressure finger-packing technique. Lavage and brushing reduce the amount of material available for embolization and give a clean proximal surface for cementing. The insertion of a cement restrictor helps to compartmentalize marrow, fat and blood, but finger-packing will tend to pressurize residual debris against the restrictor. This effect appears to be more important than the pressure generated at the cement-bone interface.

Havelin and colleagues (1995) brought out highly significant differences in the survival rates of 8 579 Charnley total hip arthroplasties according to the different types of cement used. At 5.5 years a survival rate for the femoral component fixed with high-viscosity cement was 98.1% (95% CI 97 - 99) and with low-viscosity cement 94.1% (95% CI 92 - 96). This was confirmed by Herberts and Malchau (1997), who found that the low viscous types have an inferior outcome with a 25% increase in risk of revision. There are also interesting differences between normoviscous and high viscous types. The best performance was observed with Palacos ®. Their most surprising finding was an increase in revision risk during the two to three years postoperatively associated with vacuum mixing. They also showed a difference between various hospitals. The risk ratio varied between 0.6 and 1.7 independent of surgeon's ability to perform the operation or choice of implant but according to whether modern surgical and cementing principles have been adopted.

Herberts and Malchau have shown (1997) that the cement application technique is extremely important. The multivariate analyses in their work strongly support retrograde filling of the femoral canal by a cement gun, a distal plug, a proximal seal and pressurization of the acetabulum as factors of equal importance. This third-generation cementing technique has been well accepted in Sweden, in sharp contrast to attitudes in British hip surgery, where only 25% of surgeons apply modern third-generation cementing techniques (Hashemi-Nejad et al 1994).

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4.3 Operative technique

Charnley preferred lateral exposure with elevation of the greater trochanter (Charnley 1970b), but anterolateral or posterior approaches can also be used. The frequency of dislocation has been shown to be higher in the posterior approach (9.5%) than in the anterolateral or in the transtrochanteric approach (2.2%) (Vicar and Coleman1984) or the lateral approach without osteotomy (2.5%) (Foster and Hunter1987, Hardinge 1982). The simple supine position and osteotomy of the greater trochanter helped Charnley to orient the socket in relation to the pelvis with greater precision than in posterolateral or posterior exposure, and allowed deepening of the socket without danger of shortening the anterior wall. The simple supine position facilitates operations on the second hip in the same session without turning the patient. This exposure makes it possible to mobilize the whole upper end of the femur from the side wall of the pelvis, a procedure often needed in very stiff hips and in difficult revisions. Charnley reattached the greater trochanter with wire in advanced position. (Charnley 1970b, Urist 1975).

Two particular features of Charnley's approach are (1) the use of a small-diameter prosthetic femoral head and (2) reconstruction of the hip in order to change the moment of force in the joint to reduce the total load on the artificial component. Charnley lengthened the lever arm in the hip joint by completely overcoming the external rotation constrictures and re-attaching the trochanter more laterally than normal. This deepens the acetabulum so as to move the centre of rotation of the artificial joint nearer to the midline of the body, and produces a lever ratio of almost 1:1. At this ratio, the load on the socket is only twice that of body weight, and less than the load on the normal hip joint. Charnley also contended that a reduced load on the artificial joint increases the life expectancy of the bone cement interface while reducing the rate of wear of the plastic socket (Charnley 1970b, Urist 1975).

4.4 Survival analysis

In many estimation problems it is inconvenient or impossible to make complete measurements on all members of a random sample. For example, in medical follow-up studies designed to determine the distribution of survival time after operation, contact with some individuals will be lost before their death, and others will die of causes it is desired to exclude from consideration. In survival analysis, medical follow-up and fields, observation of the time of occurrence of the event of interest (death, equals revision in this study) may be prevented in respect of some items in the sample by the previous occurrence of some other event (called loss). Losses may be either accidental or controlled, this latter resulting from a decision to terminate certain observations (censored). In either case it is usually assumed that survival time is independent of the potential loss time; in practice, however, this assumption deserves careful scrutiny (Kaplan and Meier 1958).

Survival analyses have been widely used in oncology but can be used in any other study where patients enter and leave the study at different times. It is recommendable to present the estimated probability of surviving beyond a specified time or the median survival time, stating how reliable the estimate is. The width of the confidence interval depends on the confidence level (e.g. 95%) and the amount of data. Increasing the confidence level broadens the confidence interval, while increasing sample size narrows it (Dobbs 1980, Simon and Lee 1982, Carr et al 1993). Survival analysis can also be used to predict the radiological loosening of prosthetic components or the rate of revision of any component. Revision of total hip arthroplasty as the end-point in our survival study shows good correlation to the clinical significance of component loosening as widely used in recent reports (Joshi et al 1993, Partio et al 1994, Shulte et al 1997). Survival analysis based on revision as the end-point is more predictable than evaluation based on aseptic loosening only because reported loosening rates are dependent upon the definition selected (Brand et al 1986). In a study by Murray an associates (1993) 70% of the reviewed 35 survival analyses had revision as end point.

Survival analysis can be reconstructed in two different ways. The first is a life table method. To construct a life table, the number of joints being followed is determined for each year after follow-up or operation. The first year starts with the total number of cases in the study and in subsequent years this number gradually falls away as "deaths" (i.e. failures, e.g. destruction of the joint or revision of the prosthesis) occur, if the follow-up is long enough, to zero. For each year of follow-up, the failure rate is calculated from the number of failures and the "number at risk". The annual success rate, determined from the failure rate, is summed to give the survival rate for each successive year. This can therefore be changed only once a year. The second method is the product-limit method, where the survival rate is recalculated each time a failure occurs, as is done in the Kaplan-Meier method (Carr 1993, Murray 1993).

The result of a survival analysis may depend on how we deal with cases of loss to follow-up. Survival analyses assume that procedures in patients who are 'withdrawn' (or censored) have the same chance of failure as those in patients who continue under review. The withdrawn group includes patients who reach the end of the trial, die or are lost to follow-up.

Thus patients lost to follow-up have usually been treated as equivalent to having died. The assumption that implants in patients who die during trials have the same annual failure rates as those in survivors has been questioned by Murray and colleagues (1997). Patients lost or dying during follow-up can be treated as having been revised (a worst-case curve) because it could be shown that patients with problems tend to avoid follow-up whereas those who had died had no significant difference from their matched controls. The authors indicate a simple method to assess the reliability of a survival analysis, namely by a loss-to-follow-up quotient, calculated by dividing the number lost by the number of failures: the lower the quotient the more reliable the data. If a quotient is greater than one, then little reliance can be placed on calculated survival rates (Murray et al 1997).

5 AIMS OF THE STUDY

The objectives of the present study were:

to assess the clinical and radiographic outcome of the rheumatoid hip.

to evaluate risk factors and long-term survival rates in total hip arthroplasty (Charnley prosthesis) in patients with RA.

to evaluate risk factors and long-term survival rates in total hip arthroplasty (Charnley prosthesis) in patients with JCA.

to evaluate risk factors and long-term survival rates in total hip arthroplasty (Charnley prosthesis) in patients with AS.

to evaluate the role of the HLA-B27 factor in hip destruction in patients with RA and JCA.

6 PATIENTS AND METHODS

6.1 Patients and methods

6.1.1 Survival analysis of hip involvement in patients with rheumatoid arthritis

In the period 1973‑1975 a total of 441 patients with early‑onset articular complaints were referred to the Rheumatism Foundation Hospital, Heinola. During that time a total of 332 patients were collected from the collection area proper (260 000 inhabitants), and 109 patients came from other parts of Finland (Isomäki et al 1978). Patients aged 16 years or more, with swelling in at least one joint, and a duration of joint disease of at most six months, were accepted for the evaluation material. RA was initially diagnosed in a total of 121 patients. These formed the principal evaluation cohort at onset. The participants were studied as in‑patients at onset and after one and three years (Nissilä et al 1983). By the 8‑year check‑up in 1982, 103 patients were found to have erosive RA; of these 100 were seropositive (Waaler‑Rose test ≥ 32 at least once in 94 and Latex test ≥ 64 at least once in six patients), and three seronegative patients had at least five erosive joints (Kaarela 1985). In subsequent evaluations they fulfilled 1987 the American College of Rheumatology classification criteria for RA (Arnett et al 1988). Seven of the 103 patients at 8‑year check‑up turned out to have a diagnosis other than RA, leaving 96 patients (28 men and 68 women), who had seropositive and erosive RA at 15‑year check‑up. Subsequent to the 8‑year check‑up 18 patients had died. Four did not attend the 15‑year follow‑up, leaving 74 (18 males and 56 females) still participating at that point. The patient demographics are shown in table 1.

Table 1: Demographic data on patients with rheumatoid arthritis

	No of patients	mean	range	SD
Age at onset (years)	96	44	17‑69	13.6
Body mass index	74	24.4	16‑36	4.1
Follow‑up period (years)	96	14.2	7‑17	2.7

In addition to the 3‑,8‑ and 15‑year follow‑up examinations, the patients attended an outpatient clinic for antirheumatic therapy and, when required, evaluations for diagnostic measures, for conservative and operative treatment. At the 15‑year follow‑up physical examination of the hip joints was carried out and duration of hip symptoms recorded.

   Radiographs were scheduled for the 8‑ and 15‑year follow‑up examinations. Additional radiographs were taken whenever any symptomatic joint called for evaluation. All radiographs

taken during the 15 years were assessed. Hip X-rays were read separately before assessment of clinical data by author. Radiographical hip destruction was assigned according to Larsen grades (Larsen et al 1977). Whenever the hip joint was graded Larsen 3-5 (minimum joint space ≤2 mm, normal ≥4 mm) it was grouped as a failure and survival time was determined according to that radiograph. Separate evaluation of the state of the femoral head and acetabular protrusion with reference to Köhler's, ilioischial and teardrop lines was recorded (Wetherell et al 1989). In addition, sacroiliacal joints were evaluated by Kaarela according to the New York Classification (grades 0-4) . Body mass index was measured at the 15-year check- up.

Radiographs of hands and feet were read and assigned by Kaarela to form a Larsen score of 0-100 (the sum of Larsen grades of 10 metacarpophalangeal joints, wrists, 8 metacarpophalangeal joints) (Kaarela 1985, Kaarela and Kautiainen 1997, Larsen et al 1977)

The activity of the disease was measured by ESR and CRP. HLA-B27 was also determined (Kaarela 1985). Reactive secondary amyloidosis was sought via needle biopsy of abdominal subcutaneous fat tissue (Tiitinen et al 1993). Disability was assessed by the Finnish version of the Stanford Health Assessment Questionnaire disability index (HAQ) (Fries et al 1980).

Cranial joint space narrowing (Grade III) in the hip of 18 years old female.

Medial protrusion of the femoral head eight years later (Grade V)

6.1.2 Charnley low-friction arthroplasty in patients with RA, JCA and AS.

Between the years 1971 and 1991 1812 consecutive Charnley prosthesis operations were performed on 1256 patients with RA, JCA and AS at the Rheumatism Foundation Hospital, the procedures involving more than 40 surgeons. The cases were carefully followed up to the end of 1993. The data on the AS group (juvenile onset AS included) was updated in October 1999. Other arthritic diseases and osteoarthritis were excluded from this study. Patient demographics are presented in Table 2. Operations were carried out as described by Charnley (1970a) up to the first half of the 1980s and the lateral approach without osteotomy was used from 1984 onwards

(Hardinge 1982). Postoperatively patients were encouraged to walk with protected weight-bearing for two months, and for six months if bone grafts were used. The length of stay in the hospital after surgery for rehabilitation varied from the minimum of four weeks until the late 80s to two week after that.

Table 2. Demographic data on the different patient groups

	RA (N=1086)	JCA (N = 116)	AS (N = 54)
Hips (No.)	1553	186	76
Age (y) [mean (SD)]	53 (11)	32 (11)	40 (13)
Weight (kg) [mean (SD)]	62 (11)	51 (11)	62 (11)
Use of systemic steroids [No., (%)]	753 (49%)	70 (37%)	23 (30%)
Bleeding (mL) [mean (SD)]	1450 (722)	1274 (566)	1272 (435)

Radiological and clinical assessments were carried out immediately postoperatively, six and twelve months after the operation, and then every fourth year, at the Rheumatism Foundation Hospital. If there was any suspicion of loosening of prosthetic components the patient attended for radiological assessment once a year.

The following risk factors were analysed: age, weight, gender, use of corticosteroids, concurrent incidence of amyloidosis, use of bone grafts, peroperative bleeding and the experience of the surgeon.

6.1.3 HLA-B27 factor in juvenile chronic arthritis

In the analysis of the outcome of JCA three patient groups treated at the Rheumatism Foundation Hospital were constructed. The first comprised 101 (26 male, 75 female) consecutive patients ≤16 years of age who fulfilled the European League Against Rheumatism criteria for JCA (Wood 1978). All patients with JAS and arthritis associated with inflammatory bowel disease were excluded. Patients were checked at a given time-point and the number of HLA-B27-positive vs -negative patients in remission and with still active disease were registered and compared with each other.

The second patient group comprised 51 patients (10 male, 41 female) with JCA and secondary reactive amyloidosis, and the third consisted of those 91 patients (11 male, 80 female) with JCA who required total replacement of their hip or knee joint. Only 12 of the patients had had only one operation. These groups were initiated in 1989 and retrospective recruitment was undertaken. Thereafter patient retrieval was carried out prospectively in combination with

clinical work. In the second and third groups comparisons were made between HLA-B27-positive and -negative patients in respect of amyloidosis development rate and time of arthroplasty.

HLA-B27-positive patients with disease onset at the age of six or later and with amyloidosis and arthroplasty were retrospectively investigated for development of AS after a disease duration of 15 to 32 years. Thirteen patients five female and eight male fulfilled the modified New York criteria for AS (van der Linden et al 1984) and were excluded from the study.

In all of these three groups RF-positive patients were excluded as probably suffering from a disease distinct from JCA. Latex titres >64 and Waaler-Rose titres >32 on two occasions were considered significant. All patients whose HLA-B27 status could be verified were included.

In addition, a control group was included consisting of 37 patients: 15 boys (three of them HLA-B27-positive) and 22 girls (seven of them HLA-B27-positive) with rheumatoid factor-negative polyarthritis.

The mean ages at onset of JCA in patient groups 1 - 3 were 5.9 years (SD 4.2) and 4.8 years (SD 3.8) for HLA-B27-positive and -negative patients, respectively. The difference was not statistically significant (p=0.065). The male: female distribution was 21:63 for the HLA-B27-positive and 16:90 for the HLA-B27-negative patients.

6.2 Statistical methods

6.2.1 Survival results of hip involvement in patients with rheumatoid arthritis

Survivorship analysis was carried out according to the life table method (Dobbs 1980). An interval of two years was chosen to give a suitable number of intervals. Patients whose first hip was involved and graded Larsen 3 - 5 were grouped as failures. Statistically significant differences between survival curves were determined using the Mantel-Cox test. The significance of other variables was tested by Mann-Whitney and Chi-square tests.

6.2.2 Survival rate of Charnley low-friction arthroplasty

The survival tables were reconstructed as standard life tables with one-year intervals with the date of termination at the end of 1993 (AR, JCA) or 1999 (AS). Additional survival curves were reconstructed using the standard Kaplan-Meier technique (Kaplan and Meier 1958). There were two possible designations for each hip; removal of the prostheses or death of the patient. If only one component was replaced in surgical revision, this first revision was the end-point in estimating the overall survival curve. When the survival curves were estimated separately for the acetabular and femoral components, the revision was the end-point only if the component under study had been removed in revision. The Mantel-Cox test was used to decide whether the differences between the curves were significant. Cox proportional hazard regression analysis was used to calculate multivariate risk ratios.

6.2.3 HLA-B27 factor in juvenile chronic arthritis

Survival curves were reconstructed using the standard Kaplan-Meier technique (Kaplan et Meier 1958). The significance of variables was tested by Mann-Whitney test.

7 RESULTS

7.1 Hip involvement in patients with rheumatoid arthritis

7.1.1 Eight- and fifteen-year check-up

At the 8-year check-up 20 patients out of the total 103 betrayed clinical and/or radiological hip involvement. Radiological involvement of the hip joint was recorded in 13 (13 per cent) patients at the 8-years' follow-up study. Pain was present in 11 patients and measurable limitation of motion was found in eight. Severe radiological changes, Larsen 4 or 5, were seen bilaterally in three patients. In one of these cases acetabular protrusion of 4 mm was noted. Moderate changes, Larsen 3 and joint space < 2 mm, were additionally recorded in 10 patients. The 13 patients with radiologically ascertained hip involvement (six men and seven women) were aged 17-66 years, mean 44 (SD 18), at the onset of the disease.

During the 15-year follow-up 31 patients (32%) out of the 96 developed radiologically verified hip involvement. The radiological changes were assigned Larsen grade 3 (joint space < 2 mm) in 15 and grade 4 - 5 in 16. At check-up medial protrusion had developed according to Köhler's line 1 - 24 mm, (6.3 mean, SD 7.4) in five patients, all bilaterally. Cranial protrusion of 1 - 23 mm (8.5 mean, SD 7.5) was found in six patients (eight hips). Only three hips in two patients had cranial protrusion without medial protrusion. Altogether 11 total hip replacements (THR) had been performed on eight patients during the follow-up. These were classified as failures at the time when the hip joint was classified as Larsen grade 3 to 5.

Cranial protrusion of the 46 years old female preoperatively.

Well fixed components 10 years later

There were 28 HLA-B27-positive patients, but none evinced any degree of radiological change in sacroiliac joints.

Eight of the 11 patients with secondary reactive amyloidosis had destruction of the hip, which rate was significantly (p=0.002) higher than in patients without amyloidosis.

In survivorship analysis the overall predicted rate of survival of the RA hip joint with no destruction was at six years 95% (95% CI 90 to 99), at 10 years 82% (95% CI 74 to 90) and at 14 years 80% (95% CI 71 to 88) (Figure 1). When analyzed according to HLA-B27 the rate of radiological survival of the hip joint for the 19 patients found positive was at six years 89% (95% CI 77 to 100), at 10 years 66% (95% CI 48 to 84) and at 14 years 62% (95% CI 44 to 81) and for the nine negative at six years 97% (95% CI 94 to 100), at ten years 88% (95% CI 80 to 96) and at 14 years 87% (95% CI 78 to 95). The difference between the survival curves is statistically significant (p=0.02).
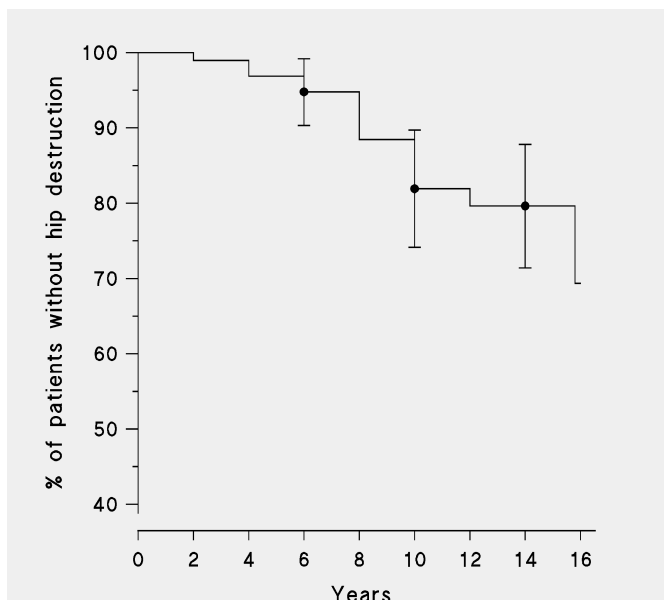

Figure 1. Graph showing survival curve with 95% CI (life table method) for Larsen 0-2 grade hips in 96 patients with RA, with Larsen grade 3 as end point.

At the 15-year check-up the patients with and without hip involvement were grouped according to risk factors and all differences between the groups were significant; Larsen scores 56.4 vs 37.5 (p=0.015), HAQ 1.09 vs 0.38 (<0.001), mean ESR 46.6 vs 25.2 (<0.001), CRP 26,9 vs 11.0 (0.004) and use of glucocorticoids (p=0.01)], only exception being the difference for body mass indices 23.5 vs 24.7 (p=0.24) respectively.

7.2 Survival rate of Charnley low-friction arthroplasty

7.1.2 Survival rate of Charnley low-friction arthroplasty in patients with rheumatoid arthritis

Patient data are shown in Table 3. The overall survival of Charnley prostheses was 90.5% (95% CI 88.7 to 92.2) at ten and 83% (95% CI 80.3 to 85.7) at fifteen years (Figure 2). The survival of the femur component was 93.2 % (95% CI 91.8 to 96.7) and 89.9% (95% CI 88.0 to 93.0) at ten and fifteen years, and that of the acetabulum 93.6% (95% CI 92.1 to 95.1) and 87.1% (95% CI 84.6 to 89.5), respectively. Fifty patients entered the 20th year of review without undergoing revision. At that point the overall survival rate of the sixty-four hips involved was 75.5% (95% C.I. 70.8 to 80.3). The survival of the femur (69 hips) was 85.5% (95% C.I. 81.6 to 89.4) and that of the acetabulum (68 hips) 80.7% (95% C.I. 76.2 to 85.7).
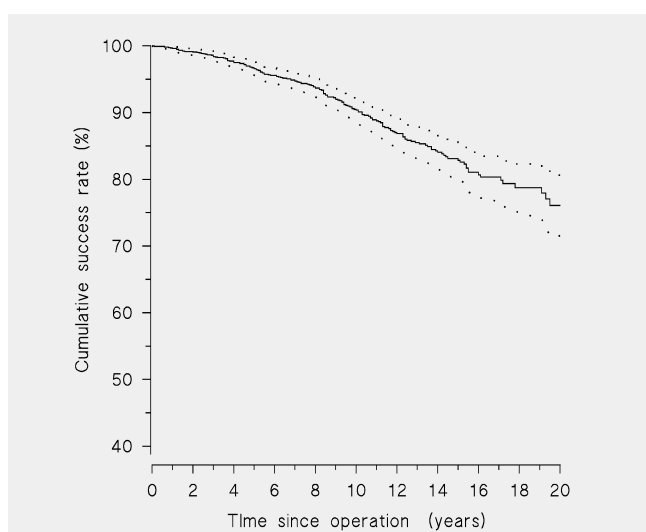

Figure 2: Kaplan-Meier survival curve with 95% CI of the 1553 consecutive Charnley prostheses in patients with rheumatoid arthritis.

Table 3. Demographics data on patients with rheumatoid arthritis

	Male (N = 240)	Female (N = 846)	All (N=1086)
Hips (No.)	317	1236	1553
Age (y) (mean [SD])	52 (11)	53 (11)	53 (11)
Weight (kg) (mean [SD])	70 (11)	60 (10)	62 (11)
Use of systemic steroids (No. [%])	156 (49)	597 (48)	753 (49)
Incidence of amyloidosis (No. [%])	18 (6)	117 (9)	135 (9)
Cases with bone graft (No. [%])	22 (7)	180 (15)	202 (13)
Bleeding (mL) (mean [SD])	1372 (735)	1469 (718)	1450(722)

The indication for revision was late deep infection in nineteen (1.2%) hips at an average of 5.0 years (range 1 - 11.3, SD 3.3) after the primary operation. All cases with infection had been primarily operated before 1984.

Fracture of the stem necessitated revision in six cases at an average of 8.7 years (range 5.0 - 12.9 years, SD 3.0) after the primary operation performed during the years 1971 - 1980. No stem fractures occurred thereafter due to improvement of metallurgy.

Table 4 Proportional hazard model to determine the effect of variables on risk of loosening of the Charnley prosthesis in RA

Variable	Hazard ratio (95% C.I)	p-value
Age (per yrs.)	0.98 (0.97 to 0.99)	0.006
Sex (male)	1.74 (1.18 to 2.55)	0.005
Amyloidosis	1.60 (1.02 to 2.51)	0.039
Weight (per kg)	1.00 (0.98 to 1.01)	0.68
Steroids	1.06 (0.78 to 1.44)	0.7
Bone graft	1.46 (0.86 to 2.49)	0.16
Bleeding (>median)	1.02 (0.50 to 2.14)	0.93

Table 5. Patient-related variables and prosthetic survivorship in RA

	5-Year % (95% CI)	10-Year %(95% CI)	p-value *
Sex			0.002
Male (n=317)	84 (78 to 90)	76 (67 to 85)	
Female (n=1236)	98 (89 to 94)	85 (80 to 88)	
Steroids			
Yes (n=753)	90 (87 to 93)	81 (78 to 84)	0.5
No (n=800)	91 (88 to 93)	84 (81 to 88)	
Amyloidosis			
Yes (n=135)	88 (81 to 95)	71 (60 to 84)	0.02
No (n=1418)	91 (89 to 92)	84 (81 to 87)	
Bone graft			
Yes (n=203)	91 (87 to 96)	72 (**)	0.38
No (n=1350)	91 (89 to 92)	83 (80 to 86)	

* Mantel-Cox test for difference in survival curves between groups.
** Not calculated due to small number of hips

Statistical data on risk factors for revision are given in Table 4. Patient-related variables and prosthetic survivorship are shown in Table 5. Adjusted for age, sex, use of glucocorticoids and weight experience (ordinal of operations per surgeon) of surgeons did not predict the survival of the Charnley prosthesis (RR=1, p=0.65).

The following risk factors were identified: 1. Age was grouped according to median; 55 years in males and 54 years in females. The survival rate fell with increasing age, but it appeared that only the acetabular component was at risk (p=0.002). 2. Male sex reduced the survival of femoral components (p<0.001). 3. Also amyloidosis reduced the survival of acetabular components (p=0.018).

7.1.3 Survival rate of Charnley low-friction arthroplasty in patients with juvenile chronic arthritis

Patient demographics are shown in Table 6. The overall survival of Charnley prostheses was 91.9% (95% CI 88 to 97) at ten and 83.0% (95% CI 76 to 90) at 15 years (Figure 3). The survival of the femur component was 95.6 % (95% CI 92 to 99) at ten years and 91.9% (95% CI 87 to 97) at fifteen, and that of the acetabulum 90.1% (95% CI 92 to 98) and 87.8% (95% CI 82 to 94), respectively. There were two late deep infections; one was revised and the other (streptococcal infection) treated with long-term antibiotics.
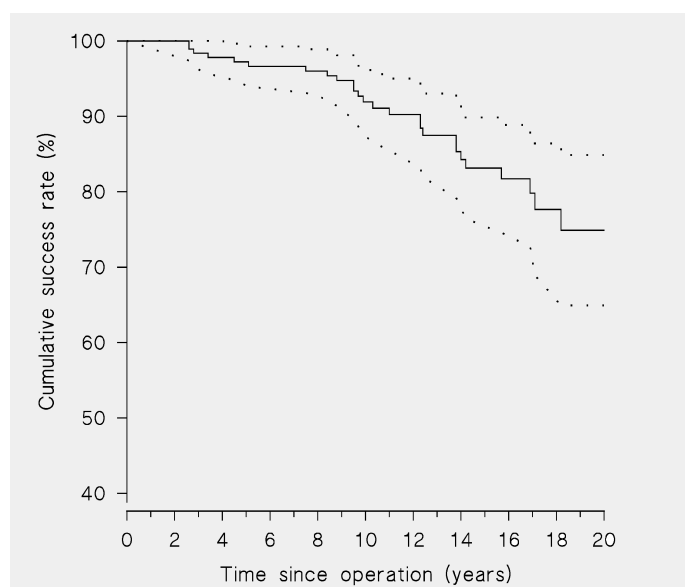

Figure 3. Kaplan-Meier survival curve with 95% CI of the 186 Charnley prostheses in patients with juvenile chronic arthritis.

Table 6. Demographics data on patients with JCA

	Male (N = 14)	Female (N = 102)	All (N=116)
Hips (No.)	22	164	186
Age (y) (mean [SD])	32 (12)	32 (12)	32 (12)
Weight (kg) (mean [SD])	60 (18)	51 (9)	52 (11)
Use of systemic steroids (No. [%])	9(41)	61 (37)	70 (38)
Incidence of amyloidosis (No. [%])	3 (14)	23 (14)	26 (14)
Cases with bone graft (No. [%])	4(18)	9 (5)	13 (7)
Bleeding (mL) (mean [SD])	1302 (550)	1270 (569)	1274 (565)

The use of glucocorticoids significantly impaired Charnley prosthesis survival (Tables 7 and 8): factors such as sex, age, weight, peroperative bleeding and bone grafting proved not to be statistically significant.

Table 7. Proportional hazard model to determine the effect of variables on risk of loosening of Charnley prosthesis in JCA

Variables	Hazard ratio (95% C.I)	p value
Age (yrs)	1.00 (0.97 to 1.04)	0.85
Sex (male)	1.68 (0.48 to 5.88)	0.41
Weigth (kg)	1.03 (0.98 to 1.07)	0.23
Steroids	2.64 (1.09 to 6.35)	0.03
Amyloidosis	1.20 (0.37 to 3.90)	0.77
Bone graft	0.52 (0.06 to 4.63)	0.56
Bleeding (>median)	0.69 (0.30 to 1.59)	0.38

Table 8. Patient-Related Variables and Prosthetic Survivorship			
Patient Demographics	5-Year	10-Year	p value (Mantel-Cox)
Sex			
Male (n=22)	100	80.3 (*)	0.16
Female (n=164)	97 (94 to 100)	93 (89 to 97)	
Steroids			
Yes (n=70)	96 (91 to 100)	90 (82 to 98)	0.04
No (n=116)	98 (96 to 100)	93 (88 to 98)	
Amyloidosis			
Yes (n=26)	96 (*)	92 (*)	0.61
No (n=160)	97 (95 to 100)	92 (87 to 97)	
Bone graft			
Yes (n=13)	100	88 (*)	0.94
No (n=173)	97 (94 to 100)	92 (92 to 96)	
*=Not calculated			

7.1.4 Survival rate of Charnley low-friction arthroplasty in patients with ankylosing spondylitis

Patient demographics are shown in Table 9. The overall survival of the Charnley prosthesis in patients with AS was 80% (95% CI 68 to 87) at ten years, 66% (95% CI 53 to 76) at fifteen years and 62% (95% CI 49 to 72) at twenty (Figure 4). The survival of the femur component was 82 % (95% CI 71 to 89) at ten years, 79% (95% CI 68 to 87) at fifteen and 77% (95% CI 64 to 85) at twenty, and that of the acetabulum 87% (95% CI 77 to 93), 77% (95% CI 64 to 85) and 73% (95% CI 60 to 82), respectively.

Table 9. Details of the 54 patients (76 hips) with ankylosing spondylitis.			
	Male (N = 37)	Female (N = 17)	All (N = 54)
Number of hips	54	22	76
Age (yrs), mean (SD)	38 (11)	44 (16)	40 (13)
Weight (kg), mean (SD)	64 (10)	57 (12)	62 (11)
Number using steroids (%)	18 (33%)	5 (23%)	23 (30%)
Number with amyloidosis (%)	4 (7%)	1 (5%)	5 (7%)
Bleeding (mL/kg/min.), mean (SD) median	0.22 (0.07) 0.22	0.30 (0.14) 0.24	0.24 (0.10) 0.23

One male patient weighing 79 kgs had a fracture of the femoral stem. The primary operation was performed in 1978 and revision 60 months later. Two male patients (2,6%) developed deep infection two and four years after the operation. Both were revised, but one revision proved fatal to the patient.
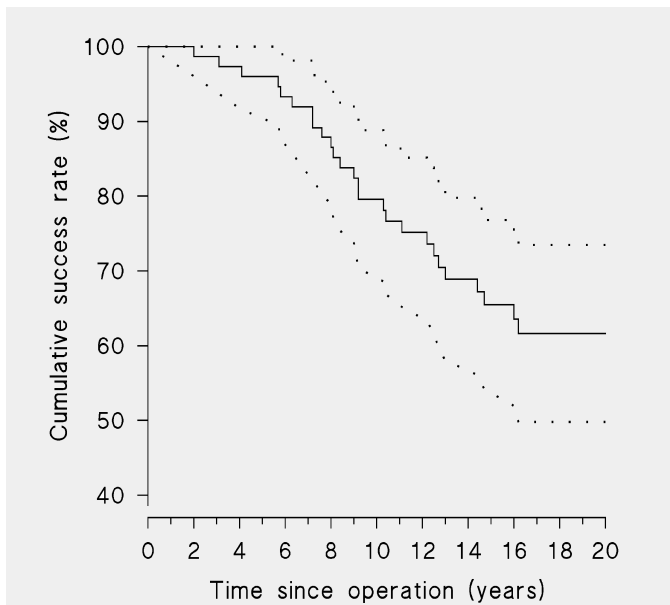

Figure 4. The Kaplan-Meier survival curve with 95% CI of the 76 Charnley prostheses in patients with ankylosing spondylitis.

There was no risk factor which significantly impaired Charnley prosthesis survival. The statistical data presenting the risk factors for revision are given in Table 10. Risk factors such as sex, age, weight, use of glucocorticoids and bleeding at the time of operation proved not to be statistically significant.

Table 10. Proportional hazard model to determine the effect of variables on risk of loosening of Charnley prosthesis in ankylosing spondylitis.

Age (per yrs.)	0.98 (0.95 to 1.01)	0.15
Sex (female)	1.7 (0.66 to 4.40)	0.27
Weight (per kg)	1.03 (0.99 to 1.07)	0.21
Steroids	1.23 (0.82 to 1.83)	0.32
Bleeding (>median)	0.85 (0.37 to 1.98)	71

7.2   HLA-B27 factor in juvenile chronic arthritis

The present study series covered 190 patients, 37 male and 153 female, of whom 84 (44%) carried the HLA-B27 antigen. Twenty-one boys (57%) and 63 girls (41%) were HLA-B27-positive; this difference, however, was not statistically significant (p=0.09). HLA-B27 was found in 43/101 (43%) of the polyarthritic patients treated with azathioprine. Only 2/15 (13%) patients who were

in remission at the follow-up examination carried the HLA-B27 allele, as against as many as 41/86 (48%) patients who had active disease (p=0.013).

Fifty-one patients had developed amyloidosis, of whom 29 (57%) were HLA-B27-positive. Amyloidosis developed in a significantly shorter time in HLA-B27-positive than in HLA-B27-negative patients (mean duration 13.0 vs 18.9 years, median 9.8 vs 16.5: Mann-Whitney test, (p=0.038).

Arthroplasty of the hip or knee joints had been performed on 91 patients, of whom 39 (43%) were HLA-B27-positive. In HLA-B27-positive patients the mean duration of the disease up to the arthroplasty was 17.2 years and in HLA-B27-negative patients 20.0 years, median 15.6 vs. 19.1 years. (Mann-Whitney test, p=0.050).

Ten of the 37 patients (27%) in the control group consisting of patients with uncomplicated seronegative polyarthritis were HLA-B27-positive.

8 GENERAL DISCUSSION

8.1   Hip involvement in rheumatoid arthritis

The incidence of severe radiological hip involvement and acetabular protrusion (32 and 5%, respectively) over the 15 years' follow-up in the present study is comparable to that reported by Duthie and Harris (1969) and Hastings and Parker (1975) who have give a 36 - 40% incidence of hip involvement and a 5 - 17 % incidence of acetabular protrusion. When the follow-up period was shorter (< 10 years) the incidence was also lower in our first study (13%), as in the studies by Vainio & Pulkki (1961)(10%), Gschwend (1980)(17%) and Eberhardt et al 1995 (13 - 17%).

Survivorship analysis is superior to simple reporting of a percentage of failures, in that it takes into account the fact that patients enter and leave the study at different times and some may have died or been lost during the study. The life table method was chosen due to the small number of cases and the fact that the patients were reviewed after certain intervals. In our study only four patients were lost in not being able to attend the 15-year check-up. Their situation was calculated according to the 8-year check-up or the last visit to the out-patient department with adequate information and X-rays. Thus, our result approximates as closely as possible to the true survival curve (Murray et al 1993).

We considered it unethical to take hip radiographs every two years in our follow-up study. Scheduled radiographs of the hips were thus taken at the 8- and 15-year check-ups or when there were symptoms suggested hip involvement. For example, at the 15-year check-up eight asymptomatic patients with hip destruction were detected for the first time (II). There was therefore a slight tendency to overestimate the survival time.

The present study showed that patients with hip destruction have a higher activity of disease and more severe destruction of peripheral joints than those without. Body mass index was not a risk factor and was not associated with total hip replacement, as shown by Wolfe and Hawley (1994). In the present study total hip replacements were performed on altogether eight patients (8.3%). In the report by Wolfe and Hawley (1994) the incidence of total joint replacements (hip and knee) was 16.6% and that of total hip replacement alone 9.5% after 15 years, which is comparable to our result.

In Finland HLA-B27-haplotypes in RA patients have been more frequently revealed among HLA-DR1 or in HLA-DR4-positive subjects than among HLA-B27-haplotype found in a control population (Ilonen et al 1991). The high frequency (26 - 33%) of HLA-B27 in Finnish patients with RA, which differs from the 14.5% in the whole population, has previously been discussed (Kaarela and Kautiainen 1997). In this material 28 (29%) of the patients were HLA-B27-positive. HLA-B27 related diseases such as spondylarthropathies were carefully excluded at 3 and 8 years of follow-up (Nissilä et al 1983, Kaarela 1985). In survivorship analysis an overall predicted rate of survival of the hip joint was 80% after 14 years of RA. When analyzed according to HLA-B27 the rate of radiological survival for patients with a positive test was 62% and 87% for HLA-B27-negative patients (p=0,02).

The use of glucocorticoids can be considered contemporaneous with the severity of RA (Hansen et al 1996). On the other hand glucocorticoids induce both osteopenia and osteoporosis (Dykman et al 1985, Hansen et al 1996). Accelerated bone loss occurs in patients with active RA compared to healthy controls, although immobility is also an important factor. Glucocorticoid-induced control of joint inflammation may counteract a decrease in bone mineral density by improving physical activity via the anti-inflammatory action of these drugs (Hansen et al 1996). It is also well known that glucocorticoids may induce osteonecrosis (Usher and Friedman 1995); among our patients, however, it could not be established whether glucocorticoids had induced hip destruction.

As previously reported, less than a half of the patients with hip destruction have symptoms (Duthie and Harris 1969). In this present study we noted that 50% of the patients with and 46% of those without radiographic hip changes had symptoms. In patients with JCA joint capsule distension was found at sonography and the intracapsular pressure was increased in patients with severe synovitis revealed at arthroscopy (Rydholm 1986). It has been suggested that the hip may be painful because of intra-articular pressure and that pain will diminish if the synovitis is subdued (Kallio and Ryöppy 1985), at this silent stage there is "a wearing of cartilage". Pain may reappear in late stages of destruction. In patients with RA, knee pain may be referred from the hip and/or hip pain may be covered by knee pain. In our opinion every patient with knee symptoms should have a clinical examination of the hip joints. Any restriction of hip movements should be taken as an indication for X-ray examination.

In conclusion, patients with active RA and severe peripheral arthritis should be carefully followed up and monitored for an increased risk of hip involvement.

8.2 Survival of Charnley low-friction arthroplasty

The author of the present study has worked in the Rheumatism Foundation Hospital between the years 1983 and 1993, and during that time had a close focus on these patients. At the out-patient department after filling the follow-up chart the patient's next visit was always scheduled. If the patient did not attend that appointment she or he was asked the reason and encouraged to do so. Usually only poor general condition hindered attendance, but even then it was checked whether the subject's hips had been revised or not. There were some patients in whom radiological loosening of one or both components was seen but whose the general condition did not allow the revision operation. The exact number in this patient category is not known.

In this study revision was designated as the end-point. To save time we were simply using the X-ray results to determine whether or not the prostheses were loose and were therefore not concerned with any other X-ray changes which might or might not be present. In other studies a careful assessment of both radiological loosening and clinical outcome has been made (Munuera and Garcia-Cimbrelo 1992, Kobayashi et al 1997). Although it has not been correlated, it seems that occurrence of radiological loosening has been 5-10% higher at the 15-year point than the rate of revision. Radiological loosening or infection always precedes revision. Revision of

arthroplasty is the most widely applied definition of failure of total hip arthroplasty because using it is simple and reproducible (Murray 1993).

To our knowledge these present studies cover one of the largest patient populations and longest follow-ups of survivorship of total hip arthroplasty in patients with RA, JCA and AS. Our survival rates in patients with RA and JCA are comparable to those in other studies of long enough follow-up. Table 11 summarizes the survivorship analysis of total hip arthroplasty studies with the Charnley prosthesis (Jinnah et al 1986, Hozack et al 1990, Garcia-Cimbrelo and Munuera 1992, Dall et al 1993, Devitt 1997, Creighton et al 1998, Joshi et al 1993, Lehtimäki et al 1994, Önsten et al 1994, Schulte et al 1997, Sochart 1997a, Sochart 1997b, Wroblewski 1998).

Colville and Raunio (1978, 1979) have previously reported a short-term follow-up of the first 378 and 59 arthroplasties in the present series in successive patients with RA and JCA. Evaluation in patients with RA yielded good results both radiologically and clinically (95% pain-free and 94% good range of motion). Most of our patients had multiple joint involvement and 45% of them had had bilateral hip arthroplasty performed during the follow-up. Some of them had undergone more than 20 different operations due to the destructive nature of RA. Most of the patients were self reliant and were able to do light house-work as well as to walk without support. RA patients with hip destruction have, however, a continuously destructive and severe disease which reduces the functional outcome during follow-up, and this destruction continues even after twenty years in other joints (Kaarela and Kautiainen 1997). It is thus impossible in polyarthritic patients to assess the functional score of the hip joint alone. The functional score, which includes hips, knees, ankles and feet, correlates to the severity of RA but not to the success of total hip arthroplasty. According to Munuera and Garcia-Cimbrelo (1992) and Wroblewski and colleagues (1993) the functional improvement gained by total hip arthroplasty can be maintained over 10-15 years when dependent on the hip alone.

Groups under Jinnah (1986) and Hozack (1990) have documented that age and weight constitute risk factors for failures. In our study age was divided by the median. Young age predicted a poorer survival rate for the acetabular component in patients with RA. During the eighties uncemented total hip arthroplasty was commonly used for young patients. The mean age during the eighties was therefore higher, but our patients were still young when compared with the osteoarthritic series. Weight did not affect our results, possibly because the patients were on average of low weight.

Although our patients were young, the results do not parallel those given in reports by Chandler and colleagues (1981) and Dorr and colleagues (1990), with high revision rates of 32% to 39% in less than ten years' follow-up, although Chandler's group (1981) declare that patients with JCA seem to obtain better results than "the average patient", but rather the results of Jinnah and colleagues (1986), Hozack and colleagues (1990), Garcia-Cimbrelo and Munuera (1992), Dall and colleagues (1993), Joshi and colleagues (1993), Schulte and colleagues (1993)

Table 11. Incidence of revision of Charnley prosthesis in other published series

		Overall survival rate at		
	No of Charnley prostheses	10 years	15 years	20 years
Jinnah et al 1986	149	83		
Hozack et al 1990	1041	87		
Garcia-Cimbrelo et al 1992	680	92	85	
Joshi et al 1993	218	93	87	75
Schulte et al 1993	330			80
Dall et al 1993	811	87		
Önsten et al 1993	OA 201 RA 201	95 89		
Lehtimäki et al 1994	OA	98	94	
Creighton et al 1998	RA 103	93		
Sochart 1997a	AS 43	91		73
Sochart 1997b	OA 66 AR 100	86 96		52 77
Devitt 1997	167 OA 45 AR 44			75 80 64
Wroblewski 1998	258 (26 AR)	94	85	
Present study	JCA 186 RA 1553 AS 76	92 91 80	88 83 66	

OA=Osteoarthritis
RA=Rheumatoid Arthritis
JCA=Juvenile Chronic Arthritis
AS=Ankylosing Spondylitis

and Önsten and colleagues (1994). Their overall survival rate varies from 83% to 93% at ten and from 85% to 87% at fifteen years. In our survivorship study of the Charnley prosthesis in juvenile chronic arthritis the respective figures were 92% at ten and 83% at fifteen years.

Other authors have obtained results parallel to ours with more problems involving the acetabular component (Joshi et al 1993, Önsten et al 1994), while some have more problems with the femoral component (Garcia-Cimbrelo and Munuera 1992, Schulte et al 1993). There has, however, been improvement in cementing technique and in acetabular cup design. Recently both acetabular and femoral component revision rates for the Charnley prosthesis have decreased (Malchau et al 1993, Wroblewski and Siney 1993).

The results of hip arthroplasty in JCA have not usually been encouraging. Mogensen and colleagues (1983) report a revision rate of 19% in 33 patients with 41 hips at an average follow-up of six years three months. The average age of the patients in that study was 26 years. Scott and colleagues (1984) had a 7% revision rate but the follow-up was short, i.e. 5 years. According to Williams and McCullough (1993), operations, performed on 34 adolescents have shown an overall loosening rate of 25% at an average of 4.7 years follow-up. Witt and associates (1991) noted that patients of an average age of 16.7 years had a revision rate of 25% at an average follow-up of 9.5 years. In our study the long-term durability of the Charnley prosthesis seems better. We did not have many adolescents and the mean age at time of operation was higher. It may be that the activity of the disease had burned out in some of our patients. On the other hand 38% of cases were on glugocorticoids, indicating activity of the disease. It must also be borne in mind that juvenile ankylosing spondylitis (JAS) has a different outcome. Hence it has to be excluded when studying JCA (Petty 1990) and included in studying AS.

Osteoporosis of the juxta-articular bone is the cardinal diagnostic criterion for RA. The use of glucocorticoids >5 mg/day is shown to induce osteoporosis in both genders. Bone loss occurs first in the trabecular bone and later in the proximal femur, a predominantly cortical site (Joffe and Epstein 1991, Pearce et al 1998). Kotaniemi (1997) has studied osteopenia in JCA and found significant osteopenia at both the lumbal spine and femoral neck if the children in question have the polyarthritic form of JCA, and only in the femoral neck if patients have the oligoarthritic form. Will and colleagues (1989) have shown osteoporosis of a femoral neck and lumbar spine found in an early stage of AS. The pattern of bone loss in these patients indicates early loss of trabecular bone in AS, possibly due to a systemic cause, but biochemical indices of calcium turnover were similar in patients and controls. Åkesson and colleagues (1994) have shown that the increased bone turnover in the acetabulum compared with that in the femur may be important for the higher rate of acetabular component migration and subsequent loosening after in RA. The use of glucocorticoids may influence results by inducing osteopenia, which may affect the longevity of the Charnley prosthesis (Als et al 1985). However, glugocorticoids did not affect our results excluding JCA and we did not perform any measurements of the degree of osteoporosis to confirm the findings of Åkersson's group (1994). In studies by Hansen and associates (1997) the use of glucocorticoids in patients with RA did not induce osteopenia and may only indicate higher disease activity and lower functional capacity.

There is only one long-term follow-up study in AS. Sochart and Porter (1997) reported on 43 total hip arthroplasties in 24 patients less than 40 years old. The probability that both components would survive was 91% at ten years, 73% at twenty years, and 70% at thirty years. Altogether 88% of patients were pain-free and the remainder had only occasional discomfort. There was also improvement in total range of movement (ROM) and joint function. This result is comparable to other studies of Charnley prostheses in patients with distinct diagnosis in Table 11. Our result on AS patients, 96% at five years, 80% at ten years, 66% at fifteen and 62% at twenty can be considered moderate, but is much less than the high revision rate of 32% to 39% in the reports of groups under Dorr (1990) and Chandler (1981) with less than 10 years' follow-up. During the years from 1971 to 1991 2013 Charnley prosthesis operations were performed at the Rheumatism Foundation Hospital. The operations of all patient in these studies have been performed by the same 40 specialists.

We have found that HLA-B27-positive patients in rheumatoid factor-positive RA run a higher risk of hip destruction and in JCA HLA-B27 correlates with the severity of the disease. It would have been interesting to have the HLA-B27 test performed on all patients with Charnley prosthesis and assess the significance of findings for the outcome. Patients with AS are 95% B27-positive. Studying the association between hip involvement and/or survivorship of and B27 subtypes may prove rewarding.

In a study by Myllykangas-Luosujärvi and colleagues (1998) it was noted that subjects with AS have an increased incidence of deaths from accidents and violence. Uncontrolled use of alcohol is an important determinant in the 'surplus' of deaths and violence in Finnish patients with AS. The proportion of such deaths was highest in the youngest age group. Our patients were quite young, an average of 39 years, at time of operation. Espehaug (1997) observed an increased revision risk among patients drinking more than four units of alcohol per week. It would also be interesting to study the role of lifestyle in relation to the survival rate of the Charnley prosthesis in AS.

Male gender increased the risk of femoral component revision, as shown by Hozack and group (1990). Both genders had been operated on at about the same age. Males can be more active before and after hip replacement and have less disease-related osteoporosis (Jonsson and Larsson 1990) and have greater muscular strength producing more torsional forces for the femoral component than females. In our studies male gender predicted poorer outcome in patients with RA.

Factors which may influence the result are use of nonsteroidal anti-inflammatory drugs and chemotherapy (e.g. methotrexate). During the seventies mainly indomethacin was used, during the eighties a great variety of nonsteroidal anti-inflammatory drugs. Wheeler and group (1995) have shown that methotrexate has adverse short- and long-term effects on bone. The use of chemotherapy increased during the eighties in the treatment of RA. The mechanism of action of methotrexate and thus some adverse reactions in RA are not fully understood and warrant further studies (Kremer 1996).

Deep infections of Charnley prostheses were observed in 1.2% of cases. The infection rate varies according to different authors from 0,3 to 2% (Malchau et al 1993, Schulte et al 1993, Wroblewski and Siney 1993). These late infections are regarded as hematogenous infection and the risk of them is higher in RA (Wyomenga et al 1992). In operating patients with inflammatory joint disease, it must be borne in mind that many of them have been treated with corticosteroids (49% in RA, 38% in JCA and 30% in AS) or they may be receiving immunomodulatory treatment. In addition to general joint disease, moreover, they may have diabetes. All these factors influence the immune system and at the time of operation some patients may be open to all of them. Our infection rate (1.3%) is nonetheless very low. We found 23 (11 males, 12 females) infections altogether over an average of 5.3 years (SD 3.3) after the primary operation: 14 of the patients were using steroids, one had amyloidosis. All except one with streptococcal infection were revised.

Bone grafts were used during the eighties to remould the protruded acetabulum to near-normal anatomy. Here bone grafting did not seem significantly to impair the survival of the acetabular component . No doubt, however, the operation should be performed before acetabular protrusion has taken place.

When performing a survival study it is of the utmost importance that the follow-up of patients be organized regularly. Follow-up in this series took place every fourth year. If there was any suspicion of loosening of the prosthetic components, we performed radiological assessment once yearly. Attendance at check-up with clinical and radiological evaluation was eminently satisfactory. Therefore we propose that revision of any component of the Charnley prosthesis as the end-point in our survival study bears good correlation to the clinical significance of component loosening as has been widely used in recent reports (Joshi et al 1992, Shulte et al 1993, Partio et al 1994). We emphasize that survival analysis based on revision as end-point is better predictable than evaluation based on aseptic loosening only. Moreover, a reported loosening rate is dependent upon the definition selected (Brand et al 1986).

Our results in patients with RA and JCA can be considered good or excellent and they are comparable to those given by other authors with a long enough follow-up. Joshi and colleagues (1992) had 141 patients who were 40 years old or younger at the time of operation. At twenty years the overall survival rate was 75%. The survival of the femur component was 86% and that of the acetabulum 84%. The overall survival was much better (96%)in rheumatoid patients than in patients with osteoarthritis (51%). Schulte and associates (1993) evaluated 330 Charnley total hip arthroplasties with 20 years' follow-up and presented an 80% overall survival rate at this point. Wroblewski and group (1998) had a study of 258 young patients with distinct underlying pathology (10% RA, 3% AS). Their overall survival rate was 95% (95% CI 98 to 93) and 88% (95% CI 94 to 83) at 10 and 15 years subsequently. Wroblewski and Siney (1992) report that 79% of their young patients (average 41 years) were pain-free. In our pilot study of the present material the survivorship of the Charnley prostheses in patients with osteoarthritis was 98% at ten and 94% at fifteen years (Lehtimäki et al 1994).

There was some progress in surgical technique and cement application during the 20-year follow-up in our study. The effect of technical improvements in for example bone grafts, however, can be seen only after ten to fifteen years; so far there was no statistical difference whether bone graft was used or not. There has also been development in uncemented total hip arthroplasty, but the survival rate of 57 and 65% at eight and nine years is far too low (Owen et al 1994, Puolakka et al 1999). According to Huiskes (1993) many innovative devices introduced in recent years have failed as motion between the modular parts create wear, abrasion and corrosion. Thus, a substantial number of patients might have been better off with conventional Charnley or similar-procedure.

Despite all possible efforts, arthroplasty does unfortunately eventually fail, and objectives must thus be reasonable (Charnley 1961). If we can help more than 80% of our young RA or JCA patients with their problems of daily activity for fifteen years, it is justified to conclude that the long-term durability of the Charnley prosthesis in RA and JCA is satisfactory and comparable to any other long-term results. The Charnley prosthesis can be referred to as the "gold standard" in AR and JCA. Patients with AS seem to carry some unknown risk factor, if not the disease itself, predicting poorer outcome. This needs further evaluation.

It is of the utmost importance to choose the method that has been shown to yield good long-term results. In the Norwegian Arthroplasty Register comparison of the reference arthroplasty (Charnley, N = 4 970) with a 2.2 % cumulative probability of revision and all other primary arthroplasties (N = 24 027) with a 4,4 % cumulative probability of revision at five years gave an extra revision cost estimated at about 1.7 million USD per year (Furnes et al 1996). Only established implant designs with good long-term results should be used. The cemented Charnley prosthesis has been documented to yield good results, and can be continuously recommended for general use.

Kreder an associates (1997) reported that surgeons who do a low volume of total hip arthroplasties have higher mortality rates, more infections, poorer survival. In our study we found no support for this. The results of this study were obtained in a clinic specializing in patients with different types of inflammatory arthritis. Every new surgeon and any new team member has been supervised by a more experienced surgeon or staff member until they have demonstrated sufficient capacity for the procedure and rehabilitation. The surgeon has to be acquainted with the proper operation technique and understand the biomechanics and rehabilitation of the hip joint. John Charnley was an example in this. He applied himself not only in the operating theatre but also in the engineering workshop. Charnley believed that all young surgeons should spend time working on a lathe to improve their manual dexterity. He found it difficult to understand why a person would spend a great deal of time and money perfecting a game of golf but make no such effort to improve surgical technique (Older 1986).

8.3 HLA-B27 factor in rheumatoid arthritis and juvenile chronic arthritis

The frequency of HLA-B27 among the Finnish population is 14.5%, which is about twice as high as among most other Europeans. This relatively high percentage is probably also reflected in our patients, who had rather high frequencies of HLA-B27. The prevalence of HLA-B27 among the small control series of unselected JCA patients with seronegative polyarthritis included in the present study was 27%. An earlier paper has dealt with the occurrence of HLA-B27 among JCA patients from Oulu University Hospital, in the northern part of the country (Mäkelä and Tiilikainen 1978); the frequency of HLA-B27 in patients with seronegative polyarthritis was 30%. These figures are twice as high as those among the general population, but clearly lower than in our patients in the three study groups: 43, 57 and 43%, respectively. In this context it may be stated that there are no regional differences in the prevalence of HLA-B27 in the Finnish population. The figure of 27% is well in accord with results published elsewhere in as much as the prevalence is somewhat higher than in the basic population (Rachelevsky et al 1974, Edmonds et al 1974, Buc et al 1974, Hall et al 1975, Hill 1977, Gershwin et al 1977, Dequeker et al 1978, Mäkelä and Tiilikainen 1978, Arnett et al 1980, Morling et al 1985, Schuchmann et al 1984). It is also the same as that observed in adult Finnish patients hospitalized for rheumatoid arthritis (Tiitinen et al 1992, Isomäki et al 1975). Since our patients had been on cytostatics and/or had contracted amyloidosis and/or had undergone major prosthetic surgery, they can be considered severe cases. The frequency of HLA-B27 among them, 44%, compared with 27% and 30% in two unselected series, indicates that in JCA HLA-B27 is associated with poor outcome. The same has been noted in adult patients with Yersinia arthritis (Leirisalo-Repo and Suoranta 1988). Since the HLA-B27 antigen has been reported to be associated among Caucasians with several DR-locus alleles (Westman et al 1994), the direct role of HLA-B27 cannot be regarded as firmly established.

Some of the HLA-B27-positive patients here may have had undifferentiated spondyloarthropathy (enthesitis related arthritis). Indeed, the HLA-B27-positive patients were at the onset of disease slightly older than the HLA-B27-negatives and there was some excess of boys among them. All patients with undifferentiated spondyloarthropathy could not be identified, because, due to the partly retrospective nature of the study, information on family history and on the presence of enthesitis was not reliable. In this context it is of interest to note that undifferentiated spondyloarthropathy is in most instances considered a benign disease. If there were patients with this disease among the severely incapacitated patients, this would mean that its outcome is strikingly bimodal.

The fact that more secondary amyloidosis is seen in Finland than in other Western countries (Woo 1992) has never been satisfactorily explained. One possible contributory factor could be the higher prevalence of HLA-B27 in the Finnish population. A higher frequency of HLA-B27 among JCA patients with secondary amyloidosis than among patients without this complication has been reported in Germany (Schuchmann et al 1981), whereas no difference has been found

in the United Kingdom (Burmann et al 1986). In the present series, amyloidosis developed not only more frequently in HLA-B27-positive individuals but also in a shorter time. The increased frequency of HLA-B27 among adults with rheumatoid arthritis and hip destruction in Finland has been described in our study.

In summary, the frequency of HLA-B27 was compared in patient groups; 1) remission or not, 2) secondary reactive arthritis, 3) duration of disease up to arthroplasty; and in each instance those carrying this allele had a poorer outcome. In all instances the differences were statistically significant. We conclude that HLA-B27-positive cases accumulate among the most severe cases of JCA in Finland.

9 CONCLUSIONS

The hip survives in 80% of patients without destruction during the first 15 years of RA. The clinical severity of the disease is the main prognostic factor for destruction of the hip in this disease.

The overall survival of the Charnley prosthesis in RA was 90.5% (95% CI 88.7 to 92.2) at ten and 83% (95% CI 80.3 to 85.7) at fifteen years. Young age, male sex and amyloidosis seemed to involve poorer prognosis.

The overall survival of the Charnley prosthesis in JCA was 91.9% (95% CI 88 to 97) at ten and 83.0% (95% CI 76 to 90) at 15 years. Only the use of glucocorticoids seemed to entail poorer prospect of survival of the prosthesis.

The overall survival of the Charnley prosthesis in AS was 80% (95% CI 68 to 87) at ten and 66% (95% CI 53 to 76) at 15 years. None of the risk factors examined predicted the poorer outcome.

HLA-B27 seems to accumulate among patients with more severe form of disease and with earlier hip destruction in both RA and JCA.

In a prospective survey of recent arthritis 96 patients had erosive and seropositive RA. Severe radiological changes in the hip joint (Larsen grade 3 - 5) were observed in 13 (13%) 8 years and in 31 (32%) patients 15 years after the onset of arthritis, acetabular protrusion in one (1%) and five (5%) patients, respectively. At the end of follow-up the Larsen score 0 - 100 for peripheral joints (p < 0.015, 54.6 vs 37.5), HAQ (p < 0.001, 1.09 vs 0.39), ESR (p < 0.001, 46.6 vs 25.2) and CRP (p < 0.01, 26.9 vs 11.0) were significantly higher in patients with hip joint destruction than in those without. Secondary amyloidosis was found in eight patients with and in three patients without hip involvement (p = 0.002). In survivorship analysis (Larsen 0 - 2 grade hips) the overall predicted rate of survival was 80% after 14 years of rheumatoid arthritis. When analyzed according to HLA-B27 the rate of radiological survival for the patients with a positive test was 62% and 87% for the remainder (p = 0.02). In conclusion, RA patients with a high number of destructive peripheral joints (Larsen score) and high ESR or CRP should be carefully monitored in view of the increased risk of hip destruction.

The survivorsihip of 1553 consecutive Charnley prostheses in 1086 patients with (RA) was analyzed. There were 846 female (1236 hips) and 240 male patients (317 hips), with a mean age of 53.1 years (range 24 to 77 years, SD 10.7). The overall survival of the prosthesis was 90.5% (95% CI 88.7 to 92.2) at ten and 83% (95% CI 80.3 to 85.7) at fifteen years. The survival of the femur component was 93.2% (95% CI 91.8 to 96.7) and 89.9% (95% CI 88.0 to 93.0) at ten and fifteen years, and that of the acetabulum 93.6% (95% CI 92.1 to 95.1) and 87.1% (95% CI 84.6 to 89.5), respectively. Indication for revision was late deep infection in nineteen patients (1.2%), and in others aseptic loosening of prosthetic components. Young age, male sex and secondary reactive amyloidosis significantly impaired the survival of Charnley prostheses in the RA patients.

The survivorsihip of 186 consecutive Charnley prostheses in 116 patients with JCA was analyzed. There were 102 female (164 hips) and 14 male patients (22 hips), with a mean age of 32 years (SD 12). The overall survival was 92.0% at ten years and 83.4% at fifteen. The survival of the femur component was 95.6 % at ten and 91.9% at fifteen years, and that of the acetabulum 90.1% and 87.8% respectively. Only the use of corticosteroids significantly impaired the Charnley prosthesis survival.

Seventy-six consecutive Charnley prostheses were inserted due to AS. The survivorship of Charnley prostheses in 17 female and 37 male patients with a mean age of 39 years at the time of operation was analyzed. The end-point of our study was revision, death or the end of the year 1999. The overall survival was 80% at ten, 66% at fifteen and 62% at twenty years. The survival of the Charnley prosthesis in the acetabular component was 91%, 77% and 73% at ten, fifteen and twenty years and that of femoral component 82%, 79% and 77%, respectively. We found no statistically significant risk factor associated with Charnley prosthesis survival.

The frequency of HLA B27 among patients with juvenile chronic arthritis (JCA) of varying severity and outcome was assessed by studying three patient categories: those in whom cytostatic

treatment with azathioprine had been started, those with secondary amyloidosis, and those with arthroplasty of the knee or hip joints. Among the 101 patients treated with azathioprine, 2/15 in remission were HLA B27-positive, whereas as many as 41/86 with still active disease were HLA B27-positive (p = 0.013). Of secondary amyloidosis patients 29/51 carried HLA B27. The HLA B27- positive patients contracted amyloidosis on the average 5.9, median 6.7, years earlier than HLA B27- negative patients (p = 0.038). Of arthroplasty patients 39/91 carried HLA B27. The HLA B27-positive patients underwent arthroplasty on the average 2.9, median 3.5, years earlier than HLA B27-negative patients (p = 0.050). We conclude that HLA B27-positive cases accumulate among the most severe cases of JCA.

When we can help more than 80% of our young RA or JCA patients with their problems of daily activity for fifteen years, it is justified to conclude that the long-term durability of Charnley low-friction arthroplasty in RA and JCA is satisfactory and comparable to any other long-term results. The Charnley prosthesis can be taken as the "gold standard" for THA in RA and JCA. Patients with AS seem to carry some unknown risk factor, if not disease itself, predicting poorer outcome. This needs further evaluation.

11 ACKNOWLEDGEMENTS

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13 ORIGINAL PUBLICATIONS