

Primary arthroplasty is better than internal fixation of displaced femoral neck fractures

A meta-analysis of 14 randomized studies with 2,289 patients

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Submitted 05-04-08. Accepted 06-01-13

Background The treatment of displaced femoral neck fractures has long been debated. 14 randomized controlled studies (RCTs) comparing internal fixation with primary arthroplasty may give material for evidence-based decision making.

Methods Computerized databases were searched for RCTs published between 1966 and 2004. 14 RCTs containing 2,289 patients were included in a metaanalysis regarding complications, reoperations and mortality. The analysis was performed with software from the Cochrane collaboration.

Results Primary arthroplasty leads to significantly fewer major method-related hip complications and reoperations, compared to internal fixation. There was no significant difference in mortality between the two groups at 30 days and 1 year. Most of the studies found better function and less pain after primary arthroplasty.

Interpretation Primary arthroplasty should be used in most patients with displaced femoral neck fracture. The healthy, lucid individual, 70–80 years old, should be given a total hip arthroplasty. The older, impaired or institutionalized patient would benefit from a hemiarthroplasty.

In an eloquent editorial in 1963, Nicoll requested a prospective study on the surgical treatment of femoral neck fractures, and many others repeated his proposal. In a metaanalysis in 1994 on the outcome

after displaced femoral neck fractures, Lu-Yao et al. (1994) found that more correctly randomized studies were needed to resolve the question of whether to retain or replace the femoral head. Until then, only 4 randomized controlled trials (RCTs) had been published. In the intervening years 12 other RCTs were performed. Bhandari et al. published a metaanalysis in 2003. Here we present an updated metaanalysis of RCT studies published up until the end of 2004.

Material and methods

We searched computerized databases for randomized controlled studies published between 1966 and 2004, and the searches were supplemented with manual searches of bibliographies of the published articles and major orthopedics textbooks, and personal files.

16 studies met the criteria of being a randomized controlled study comparing internal fixation with arthroplasty in patients over 60 years of age. One study had generated two papers (Skinner et al. 1989, Ravikumar and Marsh 2000), of which only the later published was finally included in the study. After enrolment of additional patients, one study population (Parker and Pryor 2000) became the basis of another paper (Parker et al. 2002). Thus, only the last published of these two studies was included in the metaanalysis, which left 14

RCTs, comprising 2,289 patients, for our study. One of the authors (CR) abstracted relevant data, i.e. failure, revision and mortality rates.

The metaanalysis was performed with software from the Cochrane collaboration (Revman version 41).

Summary of the 16 randomized studies

Söreide et al. (1979) found the Christiansen THA to be superior to von Bahr screws at a 1-year follow-up. The patients were ≥ 67 years old. This prosthesis had a very poor long-term outcome and is no longer used. Sikorski and Barrington (1981) compared Garden screws with Thompson hemiarthroplasty via the anterolateral or posterior approach in patients aged 70 and older, and recommended hemiarthroplasty with the anterolateral approach. Skinner et al. (1989) presented a comparison between the Richard hip screw and plate, the uncemented Moore hemiarthroplasty, and the Howse THA in 278 patients, and suggested after the 1-year follow-up that internal fixation, and particularly THA, should be considered for patients over 65 years old.

Ravikumar and Marsh (2000) followed the same material for 13 years and, due to good long-term results for THA, this was the method recommended for active patients. Van Vugt et al. (1993) found that for patients in good condition, aged 71–80 years, internal fixation with the dynamic hip screw and plate was better than the Stanmore bipolar hemiarthroplasty.

Jónsson et al. (1996) studied Hansson hook pins and Charnley THA, of which they recommended the latter for healthy individuals over 67 years of age who are not dependent on community help. van Dortmont et al. (2000) studied demented patients only and found that AO/ASIF screws had a failure rate of 21% after 2 years, as compared to 3% for the Thompson hemiarthroplasty. The methods led to the same functional outcome. Nevertheless, the authors recommended internal fixation, and stressed the importance of achieving good reduction.

Johansson et al. (2000) reported on 100 patients over 75 years of age in Sweden who were randomized to Uppsala screws or the Lubinus THA. Due to a higher Harris Hip Score after THA and more pain after internal fixation, THA was recommended for patients with normal mental status and

high functional demands. In patients with mental dysfunction, 32% had dislocations after THA as compared to 12% in lucid patients.

Neander (2000) presented another Swedish study: 100 patients aged ≥ 65 were randomly allocated to either Uppsala screws or the Bimetric THA. Dementia patients were excluded. THA was found to be better than internal fixation during a 4-year follow-up, and was consequently suggested for selected elderly patients.

Davison et al. (2001) followed 280 patients aged 65–79 for 3 years, after randomization to the Ambi compression hip screw and plate, the Thompson hemiarthroplasty, or the Monk bipolar hemiarthroplasty. Only mentally competent patients were included. Harris Hip Score was similar in the groups, but patients with a Thompson arthroplasty were more satisfied. The failure rate after internal fixation was considerably higher (34%) than after either hemiarthroplasty (3–5%), but the authors concluded that informed choice between internal fixation and hemiarthroplasty for each individual patient under 80 years was the best course of action.

Poulakka et al. (2001) stopped a randomized trial after inclusion of half of the intended number of patients. The authors considered it unethical to proceed with the randomization between Ullevaal screws and Thompson hemiarthroplasty, since the internal fixation method resulted in a reoperation rate of 40% compared to 0% after arthroplasty. The patients studied were over 75 years old and the study group included dementia patients.

Rogmark et al. (2002b) included 450 patients in a Swedish randomized, multicenter study comparing internal fixation with mainly Hansson hook-pins to total arthroplasty or hemiarthroplasty, and found primary arthroplasty to be superior to internal fixation, due to a better functional outcome and less pain. The failure rate after arthroplasty was 6%, as compared to 43% after internal fixation. The choice of THA or hemiarthroplasty was based on the patient's age and activity level.

Parker et al. (2002) randomized 455 patients to be treated either by Austin Moore hemiarthroplasty or internal fixation. In the internal fixation group, 90 patients required 111 additional surgical procedures while only 15 additional operations on the hip were needed in 12 patients in the arthroplasty

Major method-related complications

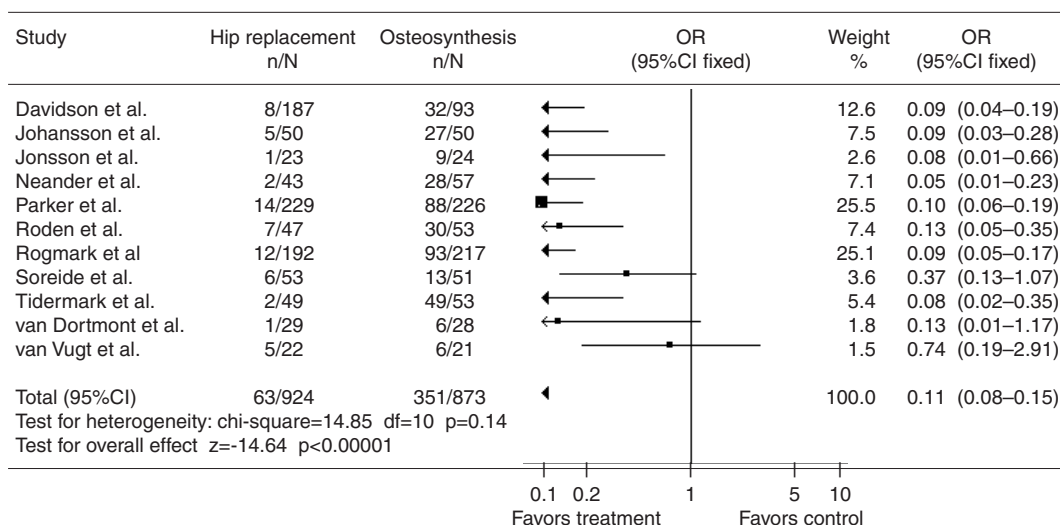


Figure 1. Major method-related complications (see text for definitions)

group. The authors recommended that displaced femoral neck fractures in the elderly should generally be treated by arthroplasty but that internal fixation may be appropriate for those who are very frail. Röden et al. (2003) compared 100 patients treated with von Bahr screws and bipolar Variokopf hemiarthroplasty and found a failure rate of 57% after internal fixation as compared to 15% after hemiarthroplasty.

In another Swedish study, Tidermark et al. (2003) randomized 110 patients to either 2 cannulated Olmed screws or a THA with Exeter stem and OGEE cup. Health-related quality of life was used as one of the outcome measurements. The results of the study strongly suggested that THA gives a better outcome than internal fixation in elderly, relatively healthy and lucid patients. In the last 4 studies, the patients included were aged 70 and older.

Results of metaanalysis

When they could be deduced, the results regarding “major method-related complications” have been interpreted on the basis of the same definitions as used in our randomized study (Rogmark et al. 2002b), i.e. for both groups: deep infection; and for internal fixation: early redisplacement, nonunion and avascular necrosis. In the arthroplasty group, 2 or more dislocations after THA, and a single dislocation or acetabular erosion after hemiarthro-

plasty, were classified as major complications, as were loosening or femoral shaft fracture adjacent to the prosthesis regardless of arthroplasty design. In “reoperations”, the removal of hardware after fracture healing and closed reduction of prosthesis dislocation were excluded.

We used both a fixed effect model and a random effect model and both gave similar results. In the figures, the fixed model is presented.

11 of the studies covered major method-related complications (Figure 1). Most studies except 3 did not cross unity, i.e. had significant results, and the metaanalysis based on 1,797 patients gave an odds ratio of four major method-related complications of 0.11 (0.08–0.15); there was no significant heterogeneity when tested for. Thus, we found clear support for the primary arthroplasty.

A major method-related complication may not lead to clinical problems severe enough to result in reoperation. Thus, we have also analyzed the reoperations, defined as open surgery (Figure 2). All RCTs included reported the results of reoperations in the 2,289 patients. Here, the trend was similar to that of the previous analysis, with an odds ratio for reoperations for primary arthroplasty vs. osteosynthesis of 0.12 (0.09–0.15), thus with a tight confidence limit. The test for heterogeneity was significant, but all studies did not give the same results. As shown in the figure, 3 studies

Reoperations

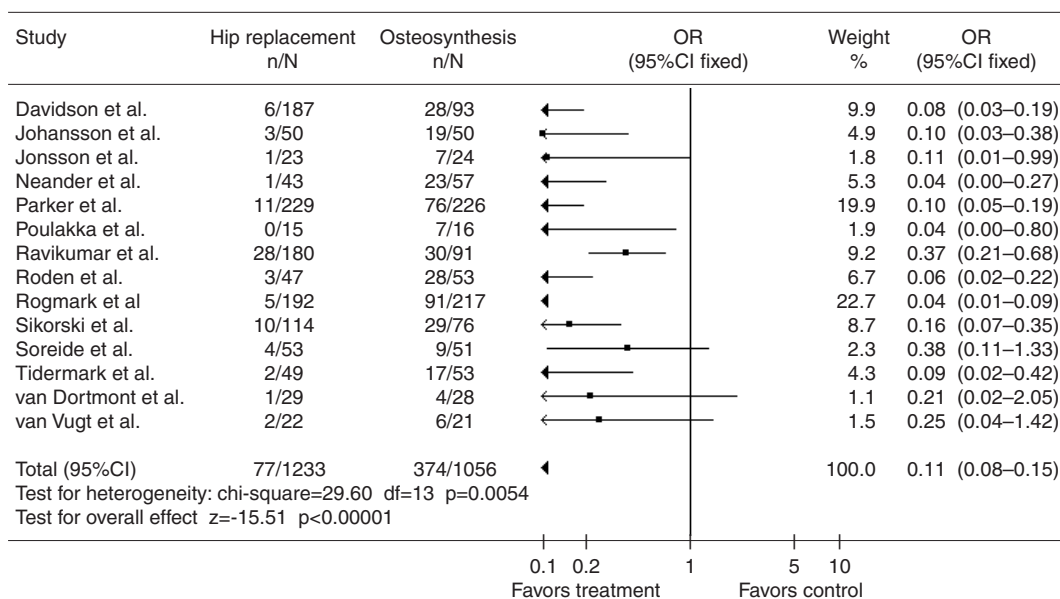


Figure 2. Reoperations (see text for definitions).

Mortality at 1 year postoperatively

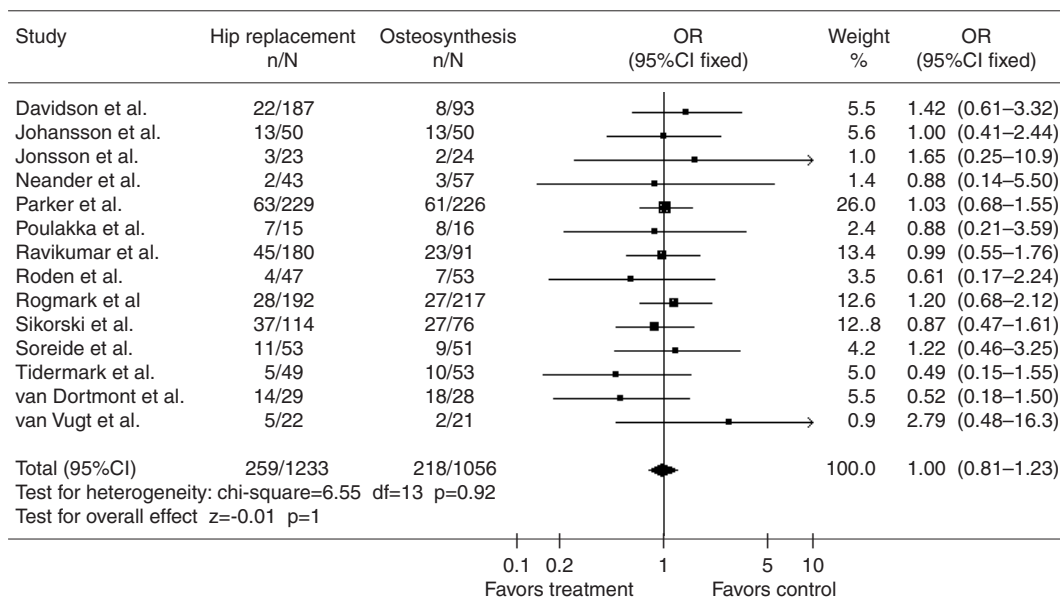


Figure 3. Mortality at 1 year postoperatively.

were not significant in this calculation. However, all odds ratios were below 1.

The mortality after 1 year was examined in all studies and in a metaanalysis showed an odds ratio

of 1.00 (0.81–1.23) and the test for heterogeneity showed a p-value of 0.92, i.e. no significant heterogeneity—no increased mortality after 1 year (Figure 3).

Mortality at 30 days postoperatively

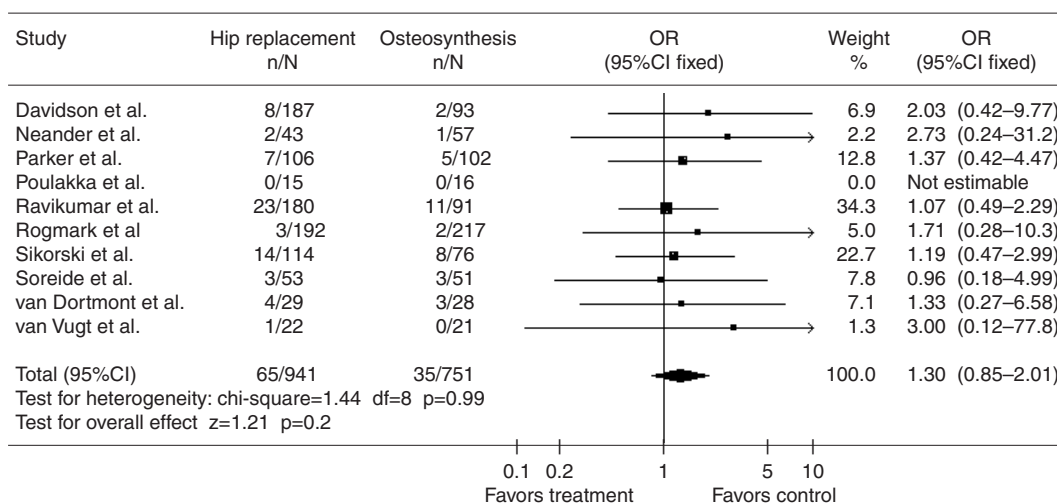


Figure 4. Mortality at 30 days postoperatively.

The mortality after 30 days was registered in 10 of the studies (Figure 4). The odds ratio for mortality within 30 days was 1.30 (0.85–2.01). There was thus no significant difference between the two operation methods. The test for heterogeneity did not show any heterogeneity.

Discussion

For decades, there was a lack of randomized studies comparing internal fixation with primary arthroplasty in patients with displaced femoral neck fractures. Söreide et al. (1979) published the first one in 1979, and this was followed by the studies of Sikorski and Barrington (1981) and Skinner et al. (1989). As early as the 1960s and 1970s, the question was vigorously debated and the proponents of the two different points-of-view were often unyielding in their opinions that one method was superior to the other. This dogmatic way of thinking was probably a decisive reason for why so few correctly randomized studies comparing primary arthroplasty and internal fixation were performed. Eventually several RCTs were performed, resulting in 16 reports.

Follow-up

All patient groups in the RCTs were followed for 2 years or more, except those in the Söreide

et al. material (1979). A study period of at least 2 years enables the authors to detect both early and late complications to some extent, but mechanical complications after arthroplasty may develop many years after the primary operation. The relatively high mortality rate in the hip fracture population appears to diminish this long-term risk, as shown by Ravikumar and Marsh (2000) with a reoperation rate of only 7% after THA at a 13-year follow-up.

Surgical methods and outcome

The surgical methods studied vary; the osteosynthesis was mostly performed with screws or hook-pins, but in 3 studies a sliding hip screw and plate were used. Regardless of the type of internal fixation, the failure rate was 21–57% and reoperations were performed in 14–53% of all the cases. In the 9 studies using THA, the failure rate was 4–11% and the reoperation rate was 2–8%. The corresponding numbers for hemiarthroplasty were 3–23% and 0–24%. In the metaanalysis, the odds ratio for both major method-related complications and reoperations for primary arthroplasty vs. osteosynthesis was 0.11–0.12, supporting primary arthroplasty.

Is the outcome of internal fixation dependent on the skilfulness of the surgeon? Clearly, a better result is found in both the studies by Tidermark et al. (2003) and by Parker et al. (2002), in which 2 surgeons and 1 surgeon, respectively, performed

the procedures. On the other hand, the study presenting the worst outcome, by Röden et al. (2003), stressed that only experienced surgeons did the operations. Obviously, good surgical technique is mandatory but this is not the only explanatory factor.

Functional outcome and postoperative pain

Most of the RCTs found less pain and better function after cemented arthroplasty, particularly THA, than after internal fixation (Söreide et al. 1979, Sikorski and Barrington 1981, Skinner et al. 1989, Jónsson et al. 1996, Johansson et al. 2000, Neander 2000, Ravikumar and Marsh 2000, Rogmark et al. 2002b, Tidermark et al. 2003). The explanation may be that during the time it takes to heal a fracture treated with internal fixation, pain prevents the patient from successful rehabilitation. In contrast, the cemented arthroplasty gives skeletal stability immediately and allows patients to move more freely. Certainly, the high rate of failure after internal fixation negatively affects the rehabilitation also. But even when only patients with fractures that finally heal are scrutinized and compared with those with successful arthroplasties, the internal fixation group has more pain and inferior function during the first months after the fracture (Neander 2000).

Mortality

Only Davison et al. (2001) found a difference in post-fracture mortality: a higher mean survival after internal fixation than after cemented hemiarthroplasty, at the 6-year follow-up. In our meta-analysis, we did not find any significant difference in mortality, either after 30 days or after 1 year. In their metaanalysis of 9 studies comprising 1,162 patients, Bhandari et al. (2003) found a trend toward an increase in the relative risk of death in the first four months after arthroplasty compared with the same period after internal fixation. They included 9 of the studies also included in our meta-analysis and found a relative risk of death of 1.04 at 1 year. However, in order to find a significant difference (with 90% power) regarding a 30-day mortality as found in our metaanalysis, about 4,500 individuals must be included in an RCT—which is quite a demanding task. If the worst suspicions are true—if there was really a somewhat higher mor-

tality during the first weeks or months, what would it lead to? Should we abandon the arthroplasty with its otherwise superior clinical outcome in order to postpone a very limited number of deaths? Hip fracture is a disease with known high mortality, regardless of the surgical procedure. Its mortality is on a level with different cancers. The same kind of palliative care should be given after a hip fracture, making the remaining years of the patient as good as possible. Relief from pain and ability to move as soon as possible must be two main goals in this effort. Tidermark et al. (2003) have shown that for selected patients, a THA leads to less of a reduction in quality of life after a hip fracture than internal fixation does.

Special considerations regarding hemiarthroplasties

The poorest results for hemiarthroplasty were reported by van Vugt et al. (1993), who concluded that their study group of independently living patients, aged 71–80 years, should not have a bipolar hemiarthroplasty due to their higher risk of acetabular protrusion and loosening. Davison et al. (2001) compared the functional results of the sliding hip screw and plate and the cemented hemiarthroplasty in the same patient group, and found no difference. Hemiarthroplasty does not seem to fulfill the functional demands of the active, independent patient, whereas studies comparing THA and internal fixation for these patients have found THA to be superior (Jónsson et al. 1996, Johansson et al. 2000, Neander 2000, Ravikumar et al. 2000, Rogmark et al. 2002b, Tidermark et al. 2003).

Parker and Pryor (2000) found that the uncemented Moore hemiarthroplasty gave the same function as internal fixation with screws. When comparing the Moore prosthesis with the Howse THA, both Skinner et al. (1989) and Ravikumar and Marsh (2000) found that the Moore model resulted in more pain and worse function, and gave a reoperation rate of 24% after 13 years. This suggests that the uncemented Moore hemiarthroplasty results should be abandoned in favor of more modern implants.

Special considerations regarding patients with dementia

Patients with dementia were included in 7 of the

studies. In studies of this group, ethical and practical dilemmas arise: how to obtain the patient's consent, how to evaluate the outcome etc. Senile dementia is a common co-morbidity in hip fracture patients, being present in approximately 20% of cases; it is a risk factor for post-fracture mortality, morbidity and poor function (Ceder et al. 1981, Clayer and Bauze 1989, Heruti et al. 1999). Special interest should be focused on the van Dortmont et al. material (2000), consisting of patients with dementia only. In spite of much higher failure and reoperation rates after internal fixation than after hemiarthroplasty, they recommended internal fixation, since the functional outcome was the same, and very bad. Two-thirds of the surviving patients were not mobile at four months, regardless of the surgical method used. The question arises as to whether this is due to a lack of resources for postoperative rehabilitation rather than being a result of the surgical treatment. In a prospective study, we found only 12% non-walkers 1 year after primary hemi-arthroplasty in demented and/or institutionalized patients (Rogmark 2002a). Successful rehabilitation has also been reported by other authors (Huusko et al. 2000, Beloosesky et al. 2001).

Considerations regarding age and activity in relation to implant choice

The lower age limits of the studies varied between 65 and 75 years, indicating an agreement that patients younger than this should be treated with closed reduction and internal fixation in an attempt to preserve the femoral head. The risk of failure after internal fixation increases with age (Barnes et al. 1976, Rodriguez et al. 1987, Nilsson et al. 1993). A differentiation between chronological and biological age must be made, the latter certainly being the most important one. The functional, preinjury status in terms of mental ability, walking ability and habitat must be considered, and influences the functional outcome (Greatorex and Gibbs 1988, Clayer and Bauze 1989, Sernbo and Johnell 1993).

Another limit to be decided is that between THA and hemiarthroplasty. A hemiarthroplasty gives unsatisfactory results in active patients under 75–80 years of age due to increased risk of acetabular wear and inferior function (Dorr et al. 1986, Phil-

lips 1989, Eiskjaer and Ostgard 1993, van Vugt et al. 1993, Davison et al. 2001). THA is unsuitable for patients with dementia due to their higher dislocation risk (Johansson et al. 2000), and leads to a high rate of revision when used in patients younger than 70 years (Greenough and Jones 1988).

Conclusion

This metaanalysis of randomized controlled trials, comparing hip replacement with internal fixation in displaced femoral neck fractures, has clearly shown that for major method-related complications as well as for reoperations with open surgery, there is an advantage to performing hip replacements with an odds ratio of about 0.12 with a tight confidence limit. One concern has been increased mortality. After 30 days, there was an odds ratio of 1.30 but no significant difference in mortality. After 1 year, the mortality was the same in both groups.

For a healthy, independent, lucid 70–80-year-old individual, there is an evidence-based rationale supporting the use of a primary THA. The older, impaired or institutionalized patient will benefit from a hemiarthroplasty. Patients with a biological age of under 65–70 years can be treated with closed reduction and internal fixation, since their capacity to withstand a secondary procedure, if necessary, is good.

Accordingly, the question of “fix or replace” has been satisfyingly answered. Further research in this field may concentrate for example on what type of prosthetic implant suits different patient groups best.

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