

# Initial Experience Using the Inverse Prosthesis of the Shoulder

## Počáteční zkušenosti s použitím inverzní endoprotézy ramenního kloubu

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### ABSTRACT

#### PURPOSE OF THE STUDY

The aim of our retrospective study is to show that in cases of very serious degenerative alteration of the shoulder as well as massive Cuff arthropathy, there is a valid reason for the indication of an inverse prosthesis of the total shoulder joint.

We therefore describe operation technique as well as evaluation of our own results, including complications.

#### MATERIAL

From October 2000 to October 2005, 24 patients had 25 Delta prostheses implanted. All these 25 implantations were carried out by the author personally, using the Delta prosthesis, in Hybrid technique.

#### METHOD

In all 25 implantations we used a lateral access by splitting the Deltoideus. We implanted the Glenoid component cement free, and we cemented the prosthesis of the Humerus in all our cases.

After an average post-operational examination time of 3 years and 9 month, we examined clinically and radiologically, 23 patients (92%) with 24 implants. Pain, mobility and activity in every-day life were considered in the clinical post-operative check up.

#### RESULTS

Evaluation of pain showed that 14 patients (60,9 %) were free from pain and 9 patients (39,1 %) showed a great improvement in their medical state. In all cases we could clearly see that as far as mobility and activity in every-day life were concerned, a significant improvement had occurred. The post-operative rate of complications showed the figure of 2 luxations (8 %).

The luxation of the first patient could be repositioned in a non-operative way. The second patient was reoperated twice and we exchanged the shaft of the Humerus. In no instance did we discover any obstacle to the healing of wounds or any infections.

#### DISCUSSION

When the indication is carefully handled the inverse prosthesis of the shoulder is an excellent way of treatment of serious degenerative alteration of the shoulder joint and major Cuff arthropathy. The operation, which is technically demanding, should only be carried out by an operator experienced in shoulder operations. The rate of luxations can certainly be lowered with the accumulation of experience and strict adherence to the precise way in technique called for by this operation.

#### CONCLUSION

With elderly patients the inverse shoulder prosthesis is a good alternative way of treatment of serious degenerative alteration of the shoulder and massive Cuff arthropathy.

**Key words:** omarthrosis, rupture of the rotator cuff, inverse prosthesis of the shoulder.

## INTRODUCTION

The Delta prosthesis is constructed according to an inverse principle. That means that on the one hand, the head of the Humerus is not on the shaft, but on the Glenoid and on the other hand, the Glenoid takes its position on the shaft of the Humerus. The Delta prosthesis was conceived by Grammont in Lyons in 1981 (4). The main reason for this was, that one obtained very low, unfavourable results with the hemi prosthesis or total prosthesis of the shoulder joint constructed so far, and very often, a rupturing of the Rotator cuff occurred. The concept of this new prosthesis is converting the natural anatomy between Scapula and Humerus by interchanging the two parts of the socket (1, 4).

The „new centre of rotation“ is relocated 1 cm medial and distal from its original position in the human shoulder. By medialisation and distalisation the lever action of the Musculus deltoideus is widened and its efficiency increased by about 25%.

The capacity of compression which is the result of the abduction has a direct effect upon the sphere of the Glenoid through the stable centre of rotation (3, 6). For this reason, the glenoidal component must be free of cement and has to be fixed with a so-called Press-fit implantation. The indication for this operation, as we see it, is a very serious Omarthrosis with Subtotal or Total rupture of the Rotator cuff and also the necrosis of the head of the Humerus, together with an insufficient tendinous capsule (4, 9, 11). Also, an indication for Delta prosthesis is a failed and/or fracture of the prosthesis, that has subluxiated forwards and upwards together with serious Cuff arthropathy (2, 8, 13).

The inverse principle of the Delta prosthesis makes the replacement of the Glenoid obligatory. This means, that as one cannot apply any hemi prosthetic procedures, therefore, in all cases, we have to replace the Glenoid.

We see a wider indication in the treatment of Four-part-fractures in elderly people who also suffer from damage to the Rotator cuff (13).

## MATERIAL AND METHODS

In the Orthopaedic Department of the General Public Hospital of Zwettl, 25 Delta prostheses were implanted from October 23rd, 2000 to October 31st 2005. These 24 patients were 13 female and 11 male; we operated 19 times on the right shoulder and

6 times on the left one. All 25 implantations were carried out by the author of the article personally.

In 23 cases the indication as far as our patients are concerned, was a very serious Omarthrosis with complete and/or subtotal rupture of the Rotator cuff and in 2 instances there existed a total necrosis of the head of the Humerus.



Figure 1. Beach chair position



Figure 2. Landmarks

## Operation technique

The operation is carried out under common anaesthesia, the patient lying on the back with elevated thorax and freely mobile arm (Fig. 1).

We use a lateral access with a splitting of the Deltoideus (Fig. 2, 3). After the exposition of the head of the Humerus we open the marrow hole with an awl, fit in the resection jig at 0 degrees and then start with the resection of the calotte of the Humerus head. We then prepare the marrow hole with a reamer (Fig. 4). Having done this, we insert the proximal gauge grater, according to size, and execute the preparation of the proximal part of the Humerus with a hand rasp (Fig. 5, 6).

Now, we decide the size of the Humerus component. Should there exist Apophytes on the medial side of the Humerus, they have to be scraped away with the Luer or a chisel, in order to prevent an impingement. After we have decided on the Epiphysical component (Fig. 7) and mounted it on the test shaft of the Humerus, we now lift up the Glenoid with the help of a Hohmann lever.



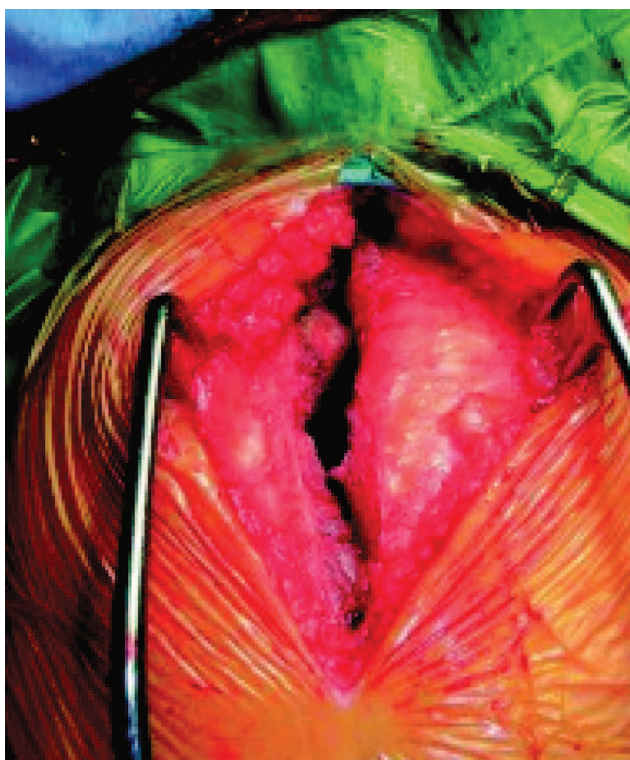


Figure 3. Lateral approach , deltoideussplitting



Figure 4. Initial preparation of the humerus

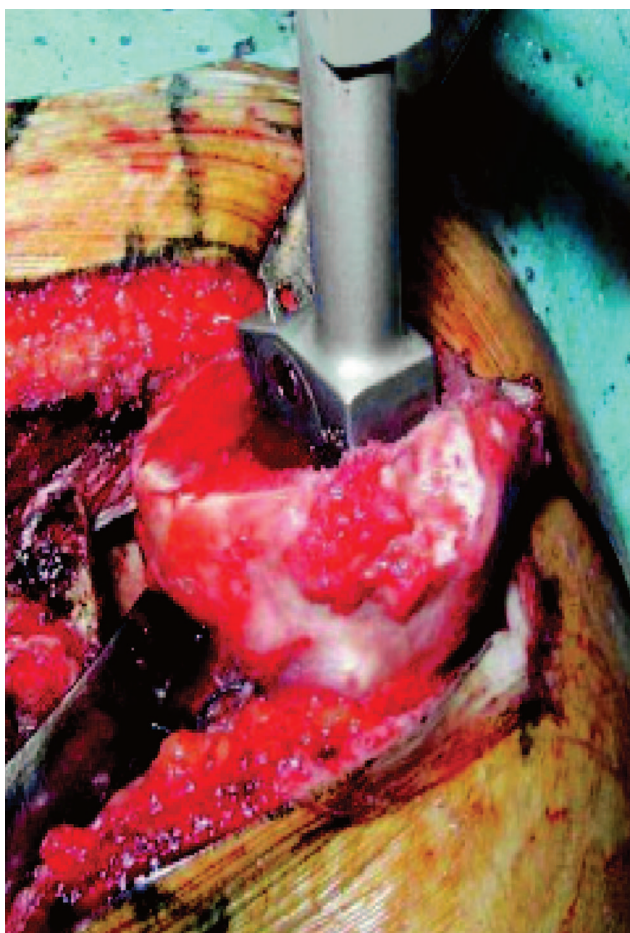


Figure 5. Distal preparation of the humerus

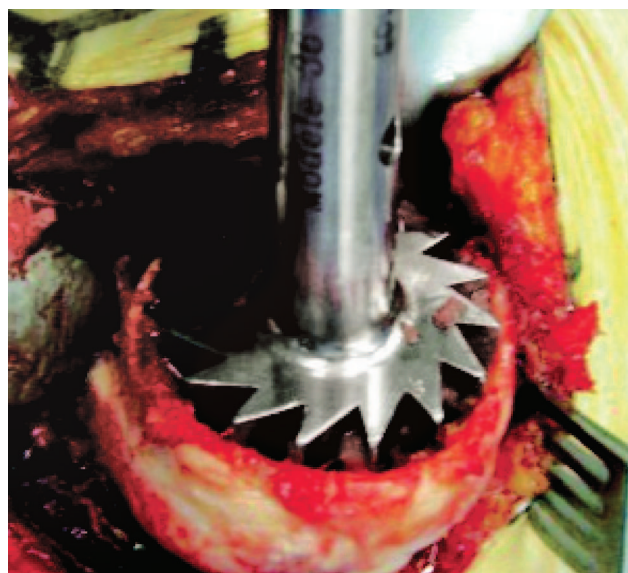


Figure 6. Proximal preparation of the humerus



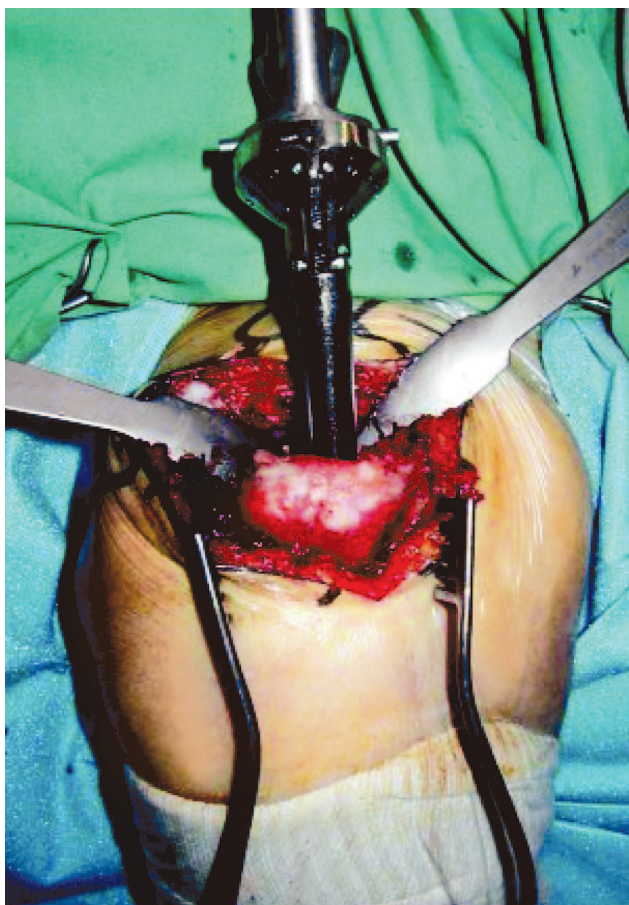


Figure 7. Implantation of the humerus trial prosthesis

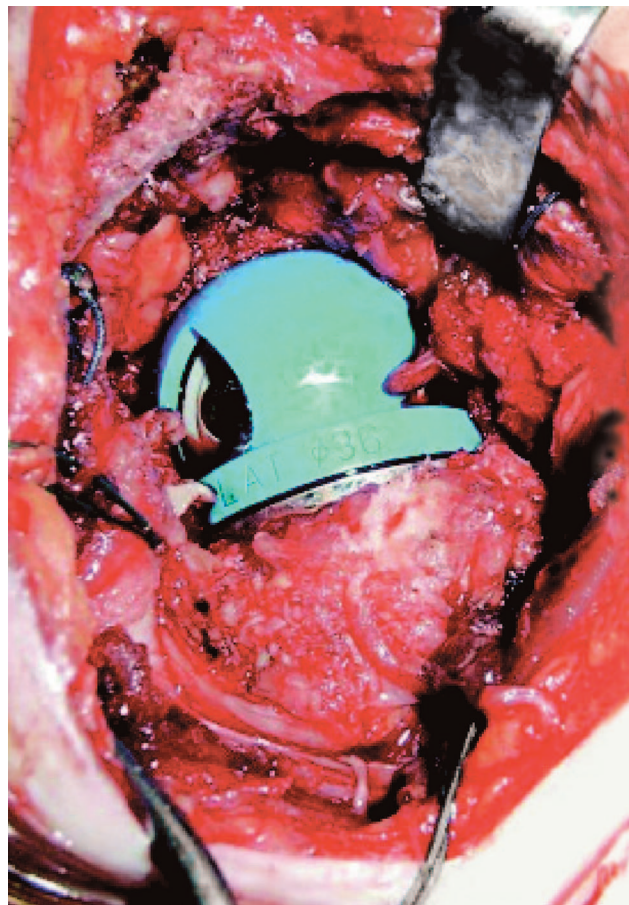


Figure 8. Complete trial prosthesis

Figure 9. State after implantation



The centre of the Glenoid is now marked with a cautery 2 mm dorsal and caudal is marked the point of entrance for the drill-fitted wire. Having fitted the wire vertically, we begin with a large Glenoid frazer and fresh up the surface of the Glenoid, removing Apophytes which might exist on the sides in order to even it up.

Then, the cement-free Metaglenoid is implanted with the help of an induction instrument, fitting is carefully with gentle taps of the hammer.

The next step is to drill four holes. After we have measured the length of the screws we fit in the upper and lower one at a stable angle. Then the Glensphere and the Humerusinlay are fitted as temporary components (Fig. 8). The reposition of the joint is now executed and a test run is carried out; also, stability and mobility are checked. One has to be extremely careful to get rid of any Apophytes on the Tuberculum infraglenoidale in order to prevent Impingement and/or a lever mechanism, with a secondary danger of luxation (7, 10).

Having finally removed all test components the cement-free Glensphere is implanted and fixed with a central screw. As next step, a marrow-hole-stopper is implanted in the marrow hole; the marrow hole is then filled with cement, a drainage already in place and then,

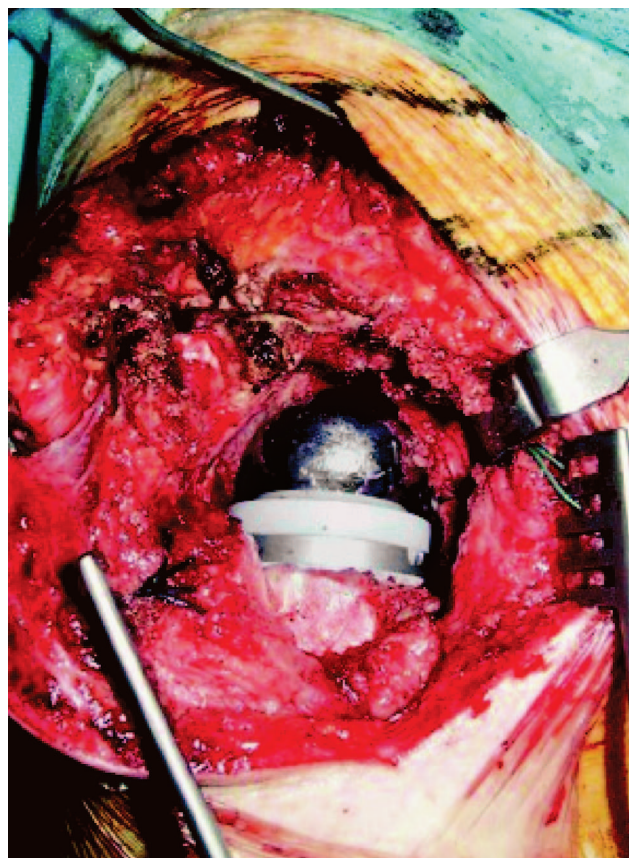


Figure 10a. Omarthrosis with total rupture of the rotator cuff

Figure 10b. Correct position of the inverse prosthesis



a|b

Figure 11a. Luxation of the prosthesis

Figure 11b. State after closed reposition



a|b

the composite Humerus component is inserted in a neutral position.

When the cement has hardened the Polyethyleninlay of the Humerus is set in place. Then follows again the reposition of the joint and another check for mobility and stability is carried out (Fig. 9). After another drainage is put in place, the wound is closed shiftwise and the arm rested in a Gilchrist bandage.

All our 25 implants have been carried out using a Hybrid technique. This means, that all Glenoid components are cement-free and Humerus components are cemented.

#### Postoperative care

All 24 patients were provided postoperatively with a Gilchrist bandage for 4 weeks and after one week alre-



ady we commenced physiotherapy. Depending individually upon the patient, we started in the third or in the fourth postoperative week with active remedial gymnastics. We very carefully watched that no movements were performed that involved an outside rotation during the first eight weeks.

### Postoperative checks

Postoperative check-up time (table 1): n=24.

After an average postoperative check-up time of 3 years and 9 month (from 17 month to 6 years and 3 month), 23 patients (92 %) with 24 implants were clinically and radiologically examined (table 1).

In the first postoperative clinical check-up, pain, mobility and activities in daily life were taken into consideration.

For radiological control we carried out an x-ray of the operated shoulder on two planes (Fig. 10 a, b).

Tab. 1.

< 2 years:	6 patients
2–3 years:	5 patients
3–7 years:	13 patients

## RESULTS

Pain ratings indicate 14 pain-free patients (60,9%) and 9 cases with little pain (39,1%). Improvement in mobility is shown in table 2.

The evaluation according to the **Constant-score** shows an average of 68 points (table 3).

An analysis of activity in every-day life displays an impressive increase in general quality of life in all of our patients.

Tab. 2.

Flexion:	Ø 40°	(0°–100°)
Extension:	Ø 14°	(0°–50°)
Rotation outwards:	Ø 10°	(0°–40°)
Rotation inwards:	Ø 17°	(0°–30°)
Abduction: active:	Ø 52°	(20°–135°)
passive:	Ø 28°	(10°–70°)

Tab. 3.

Pain	12 (max. 15 points)
Power	18 (max. 25 points)
Activities of daily living	12 (max. 20 points)
Range of motion2	6 (max. 40 points)
	68 (max. 100 points)

### Complications

A review of our patients records shows complications in 2 instances. That is, in 8 % of the sum total.

The first patient moved his arm abruptly upwards and in so doing, rotated it, thus suffering a luxation, which could be repositioned without any difficulties and in a non-operative way (Fig. 11 a, b).

When checked again during our routine postoperative examination, this patient had to be included in the group with excellent results.

Two months after his operation, a second patient suffered from a spontaneous luxation. The result of the first re-operation – four months after the first operation – showed only a temporary stability. We had to remove several Apophytes on the lower rim of the Glenoid as well as on the Humerus. Because of the very loose condition of the soft parts of the shoulder, luxation reappeared. When we reoperated for the second time we replaced the inlay with a Dysplasia component and exchanged the shaft of the Humerus, thus lengthening the Epiphysis. A following examination showed that this shoulder also had become stabilized and hence the patient could be recorded in the group of patients who experienced little pain.

In no instance did we discover any obstacle to the healing of wounds or any infections and also no complications of any nerves, but some minimal atrophy of the deltoideus muscle.

Regarding internal postoperative diseases: we recorded one peripheral pulmonal embolie, which occurred in a patient on the 6th postoperative day, even though we had carried out thrombosis prophylaxis. But this complication also healed up completely without any further ill-effects.

The intraoperative test for germs showed a *Propionibacterium acnes* once only and was therefore treated for 3 weeks with antibiotics.

## DISCUSSION

Our experience shows that the inverse prosthesis of the shoulder is – under certain circumstances – a good method of treatment for patients with a serious Cuff arthropathy.

By relocating the centre of rotation medial and distal from its original position the lever action of the *Musculus deltoideus* is widened and its efficiency increased by about 25%. De Wilde's biomechanical studies show very well the prolongation of the lever of the *Musculus deltoideus* and therefore explain the positive functional results we find when we implant an inverse shoulder prosthesis in cases where the patient suffers from serious cracks in the rotator cuff (3). When we check the appropriate literature we find, although the postoperative check-up time is short, that the aforementioned authors confirm that the reasons for an early mechanical loosening of the prosthesis are to be found in a wrong positioning of the components of the prosthesis (6, 7).

In agreement with our own experiences, we can say that the main reason lies in the incorrect implantation of the Glenoid component. As other authors have published, the problem lies in the fact that the Metaglenoid is too far cranial positioned and therefore tilts (6, 7, 10).

Then an impingement results between the Humerus component and the Tuberculum infraglenoidale, for example, the lower neck of the Scapula, and through lever mechanism, luxation occurs.

Because the operation itself is technically very demanding, only experienced operators should deal with it. The choice of access to the field of operation as well as a meticulous operational technique play an important role when one implants an inverse prosthesis of the shoulder, especially as concerns the correct biomechanics and function of the implanted endoprosthesis. Sosna and co-workers assert that operational technique is of major importance when the indication for this operation is a trauma (12). Also, currently, quite a number of improvements in instruments as well as implants themselves need to be registered.

The clinical postoperative examinations show that in all patients there is a significant reduction in pain symptoms, together with a significant improvement in their quality of life. Even the strength-deficit due to serious damage to the Rotator cuff – was at least partially compensated for, which is indisputably confirmed by other authors (5, 9, 11).

Analysing the sum total of our patients, we have a complications rate of 8 %. This co-relates with other sources. Impingement and rate of mechanical loosening are in the foreground of all complications (4, 5, 11).

Analysis of both our patients who suffered luxation, shows that one has to radically remove any Apophytes, namely, such as exist on the corner of the cup or on the lower rim of the head of the Humerus, in order to avoid later impingement and the cause of later luxation. Boileau and co-workers also refer to this problem (2).

It is of equal importance to perform bone-saving operation on the proximal end of the Humerus, in order to achieve suitable tension in the soft parts and an ideal fit for the joint after implantation.

## CONCLUSION

With elderly patients suffering from serious degenerative alteration in the shoulder, as well as from a massive Cuff arthropathy, the inverse prosthesis of the shoulder is seen as a good alternative way of treatment. Taking into consideration the rather precise operating technique required, one can certainly achieve excellent clinical and radiological results.

## ZÁVĚR

U starších pacientů s degenerativním onemocněním ramenního kloubu včetně rozsáhlých lézí rotátorové manžety je za metodu volby považována inverzní (reverzní) endoprotéza. Při dodržení přesného operačního postupu lze dosáhnout výborných klinických a radiologických výsledků.

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