

# The **M**odular - **V**ariable **S**houlder Prosthesis

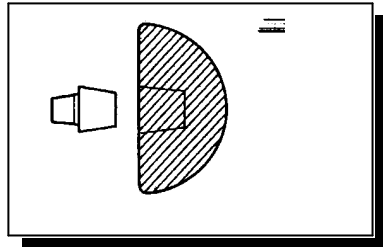
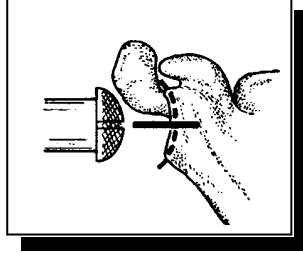
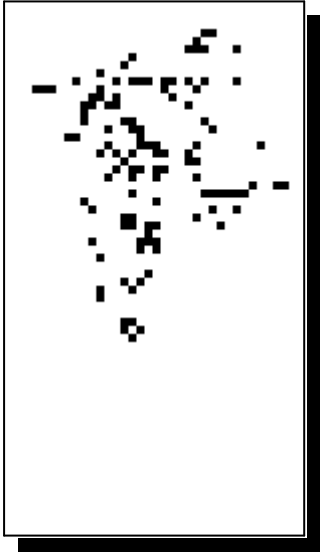
## Titanium -Ceramic shoulder endoprosthesis 3 different head- and cup options



- Partial shoulder replacement
- Special hemicup device for glenoid destructions
- Special cup device for loss of the rotator cuff
- Special tumor device
- Special trauma device

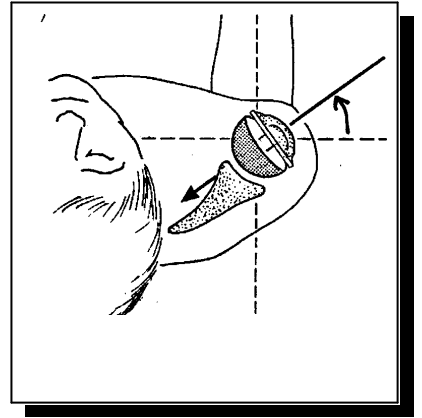
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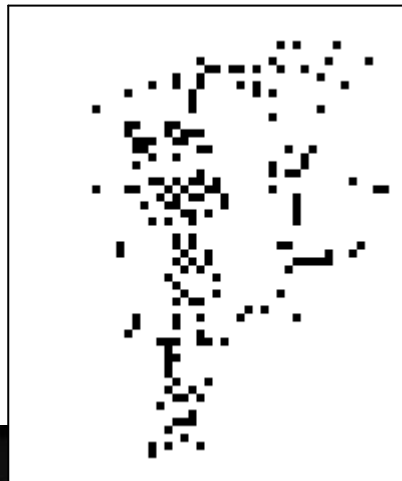
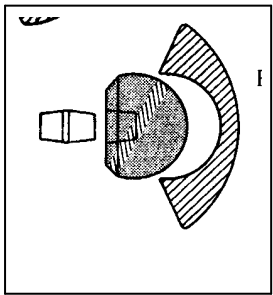
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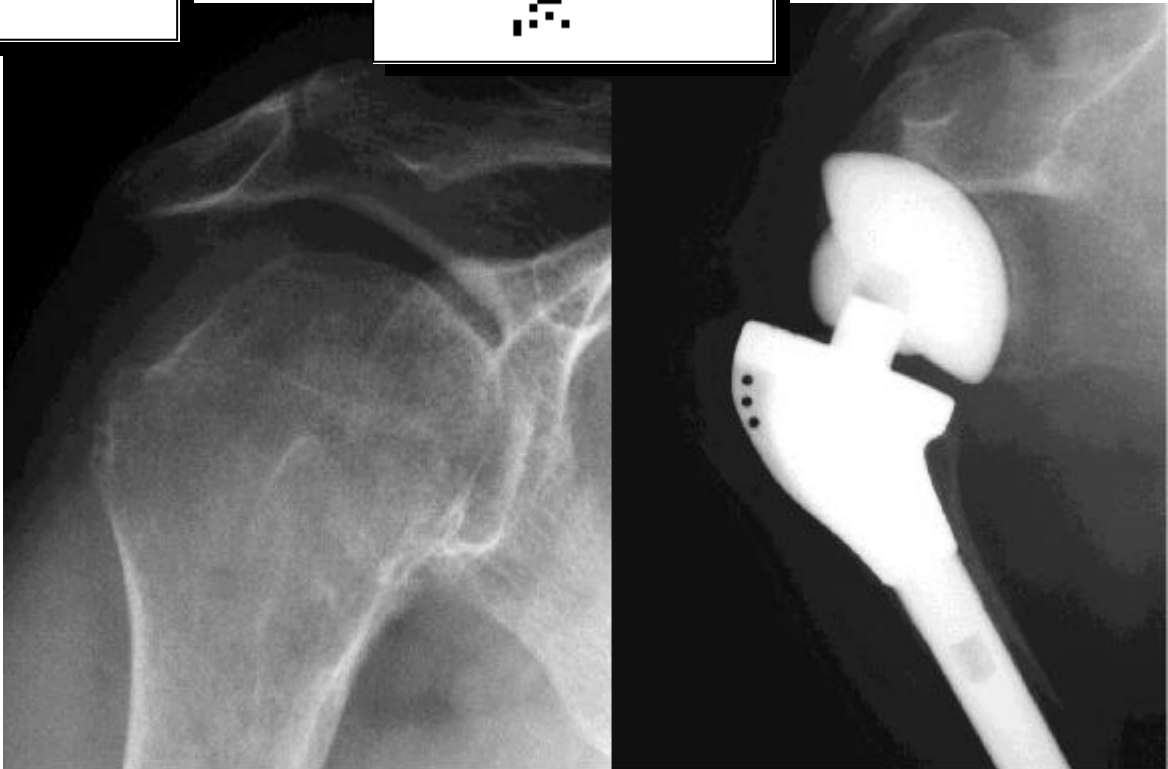
# The Hemi-cup

Centric glenoid preparation\*

30° Retroversion\*\*



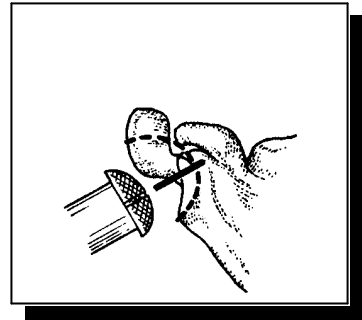
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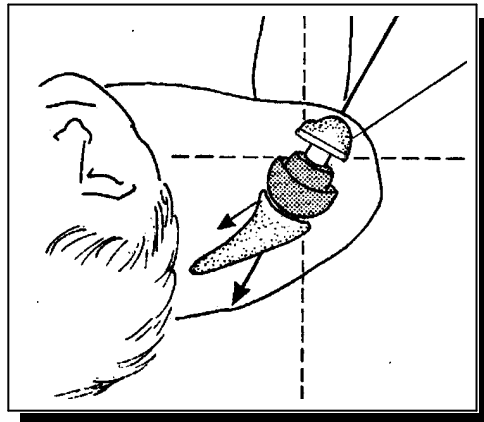


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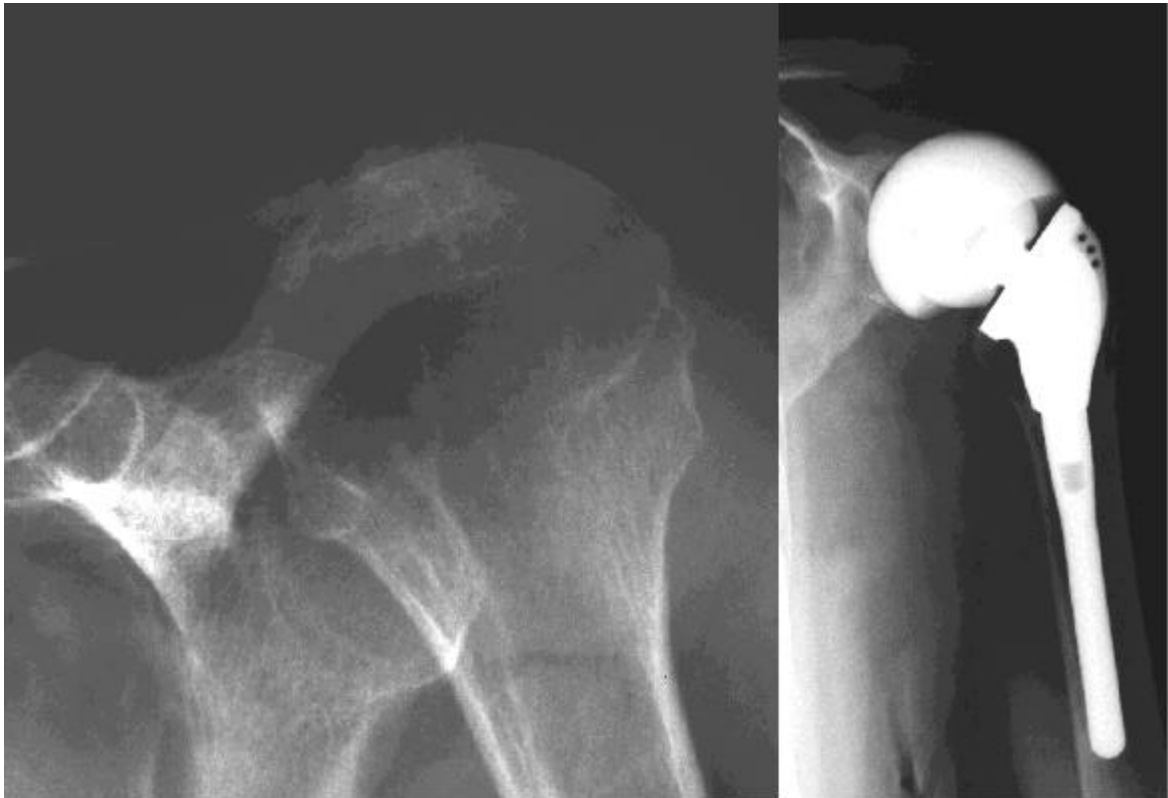
Excentric center of rotation



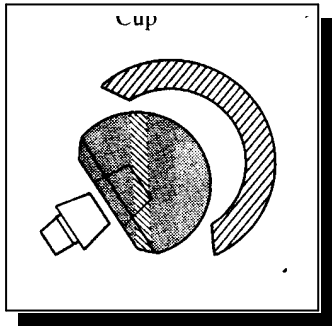
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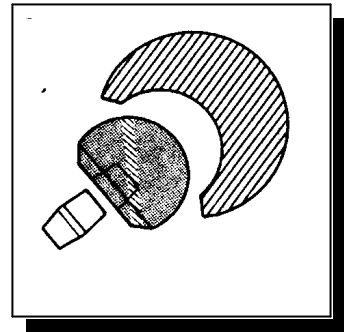
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version



Tumorcup version



Cup

Cups in different positions, showing the movement of the inner and outer shell

**Last publication:**

Submitted for the Journal of Shoulder and Ellbow Surgery

**Prosthetic replacement of the cuff-deficient shoulder joint**

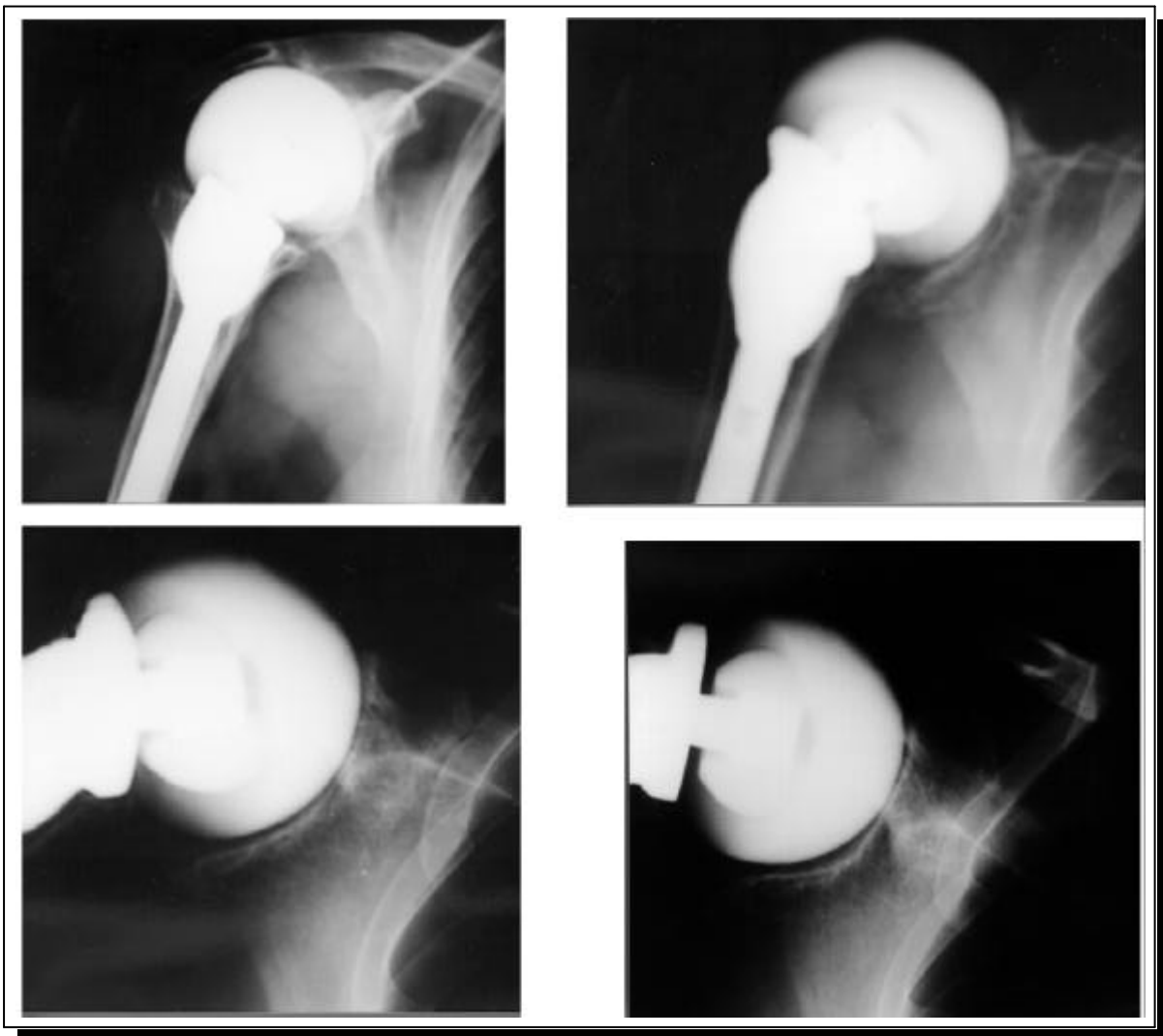
By

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**Abstract:** This report presents our experiences in the use of the



Modular-Vario-Shoulder-Prosthesis for the treatment of patients with major rotator cuff tears. A prospective study was done of 35 bipolar MVS-prosthesis in 34 patients with an average follow-up

of 3.6 years. In 20 patients with irreparable rotator cuff defects the bipolar MVS-cup-device was used. 15 shoulders with reparable rotator cuff and pivot medialisation due to glenoid erosion were treated with the bipolar MVS-hemicup-device. The preoperative diagnosis was rheumatoid arthritis in 27 shoulders and osteoarthritis in 8 shoulders. Because of the different status of rotator cuff integrity, the results of the bipolar-MVS-hemicup- and cup-devices were evaluated separately. Postoperative results were reviewed with the Constant score and Hospital for Special Surgery score. Complete pain relief was achieved in 80% of bipolar hemicup cases and in 60% of the bipolar cup replacements. 86,6% of the MVS-hemicup-prosthesis and 60% of the MVS-cup-replacements obtained a good and excellent rating (Hospital for Special Surgery Score > 70 points). Before surgery the average Constant score was 21,8 points for patients with MVS-hemicup prosthesis and 17,5 points for the bipolar MVS-cup cases. At final follow-up the average Constant score was 61,9 points for hemicup- and 50,2 points for cup-replacements. Bipolar shoulder arthroplasty offers excellent pain relief, satisfactory recovery of shoulder function, eliminates the potential risk of glenoid component loosening and represents an alternative to total shoulder arthroplasty.

**Key words:** bipolar shoulder replacement, rheumatoid arthritis, rotator cuff tear

## **Introduction:**

Glenohumeral replacement arthroplasty has become the procedure of choice in reconstructive surgery of the shoulder. Unconstrained total shoulder replacement as well as hemiarthroplasty have predictably provided adequate pain relief and restoration of function for a variety of conditions affecting the glenohumeral joint. However, loosening of the glenoid component, particular in cases with chronic rotator cuff insufficiency is a major concern. In 1975 Swanson et al. (64) first

introduced bipolar shoulder arthroplasty as a salvage procedure in shoulders with severe arthritic destruction and poor rotator cuff tissue. More recently several authors (41, 70,75,76) have reported favourable outcome within the use of bipolar shoulder arthroplasty. The purpose of this study was to determine prospectively the clinical outcome of a new bipolar shoulder system (Modular-Vario-Shoulder-Prosthesis) (23,65,66) in patients with severe glenohumeral arthritis and major rotator cuff tears.

## Material and Methods



**Fig.1:** The Modular-Vario- Shoulder

sizes with possible variation of different head-neck- and double conus length. The indication for the different bipolar components of the

The **Modular-Vario-Shoulder-Prosthesis** (Fig.1) was developed in 1991(Tschirren, Thabe) and has been used by the authors since 1992 (23,65,66). The bipolar implant (Fig.1) has an unfixed ceramic glenoid cup which articulates with a humeral ceramic head. The humeral component consists of a titanium stem and collar device.

Cementless, press-fit insertion is used for the humeral stem.

Modularity conception is achieved by different stem and collar

MVS-Prosthesis depend on rotator cuff integrity and glenoid bone stock.

**Figure 2** MVS-Prosthesis- hemicup.

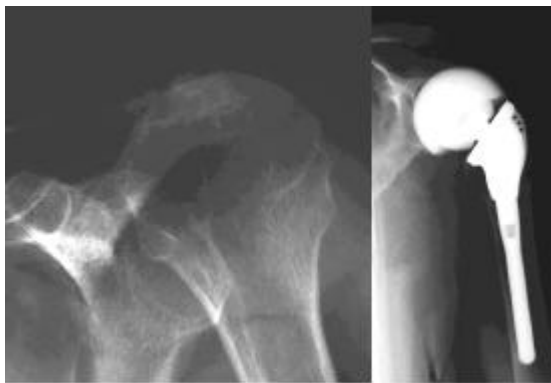
Pre- and postoperative x-ray.



**Hemicup:**

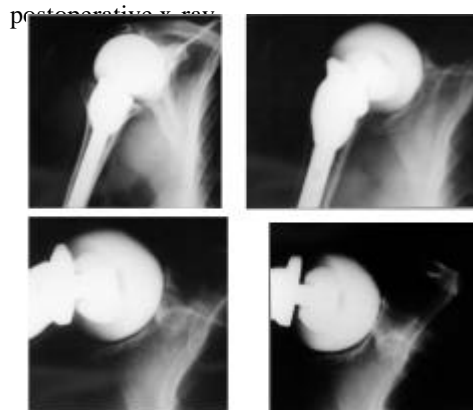
In patients with reconstructable rotator cuff and erosive glenoid changes with pivot medialisation we used the bipolar half-shell device, called hemicup (Fig.2). Modularly conception with possible variation of different head-neck length and double conus theoretically provides fulcrum lateralisation.

**Cup:**



In patients with massive, irreparable rotator cuff tears the bipolar-MVS-cup prosthesis is used.(Fig.3). In analogy to rotator cuff arthropathy with superior head migration and subacromial nearthrosis the outer cup provides concentric total contact for the shoulder cavity including the

**Figure 3** Bipolar MVS-Cup-prosthesis, pre- and



**Fig.4:** Radiographic evaluation of birotational head movement for different angles of shoulder flexion with the MVS-cup-prosthesis  
outer cup against the glenoid occurs beyond 60° of elevation.

coracoacromial arch and the glenoid fossa. The radiographic analysis for shoulder flexion in figure 4 demonstrates that motion first occurs between the ball-innercup interfaces, while rotation of the

The bipolar MVS-prosthesis was inserted in 35 shoulders of 34 patients between march 1994 and december 1997. 15 patients were treated with a bipolar hemicup and 20 shoulders underwent the bipolar cup procedure. Corresponding to the different preoperative bone and soft tissue conditions

the hemi- and cup implants were evaluated separately. Rheumatoid arthritis was the main diagnosis in both populations, leaving 8 osteoarthritis shoulders with rotator cuff arthropathy in the cup population. The distribution of age and sex as well as radiological staging was comparable in both groups. (for details see table I) The average follow-up was 3,6 (range 1-5) years in both populations. All shoulders which underwent MVS-cup arthroplasty presented a massive, irreparable rotator cuff tear at surgery. In all MVS-hemicup-procedures a stable reconstruction of the rotator cuff was possible. 8 patients presented intraoperatively a complete tear of the supraspinatus tendon and in 5 shoulders a cuff attenuation was described. **Table I: patient data**

prosthesis	follow-up	diagnosis	sex	mean age (years)	Rotator-cuff-pathology
<b>hemicup (n=15)</b>	42,4 month	R.A.: 15	female: 12 male: 3	60,1 y. onset R.A.: 14,2y. shoulder involvement: 8,7y.	rupture: 8 attenuation: 5 normal cuff: 2
<b>cup (n=20)</b>	41,3 month	R.A.: 12 OA.: 8	female: 15 male: 5	59,2 y. onset R.A.: 13,9y. shoulder involvement: 7,1y.	massive rupture: 20

A detailed clinical and radiological examination was carried out for each patient preoperatively and in regular postoperative intervals. The clinical evaluation included objective and subjective parameters according to the rating system of Constant (20) and the Hospital for Special Surgery score (44).

Shoulder function was assessed according to the patients ability to perform 15 activities of daily living as purposed by the American Shoulder and Ellbow surgeons (6). The radiographic analysis included the preoperative classification of Larson-Dahle-Eeck (39) and a postoperative evaluation

of prosthesis interface, instability and glenoid bone wear.

## Results:

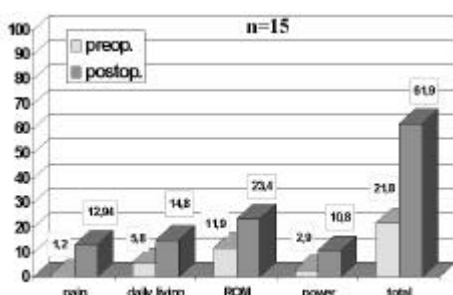
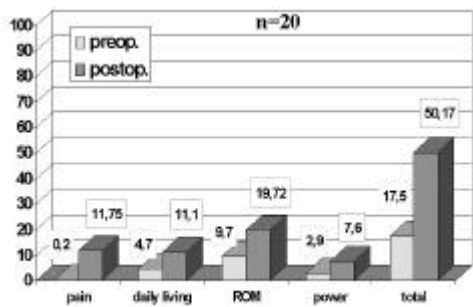


Fig. 5: Results with bipolar-MVS-hemicup-prosthesis

Using the Constant (20)100 points scoring system the average patients with hemicup-MVS-prosthesis (Fig. 4) improved from a preoperative score of 21,8 points (range 8- 45 points) to a



postoperative score of 61,9 points (range 47-80 points).

Fig.6: Results with bipolar-MVS-cup-prosthesis using the Constant-score

The 20 patients which underwent bipolar-MVS-cup prosthesis (Fig.5) increased from preoperatively 17,5

points (range 7-28 points) to 50,2 points (range 32-64 points) after surgery.

In comparison with the rating system of Constant and Murley the HSS-score results were more satisfactory in both groups. This difference is mainly caused by the higher impact factors for pain and

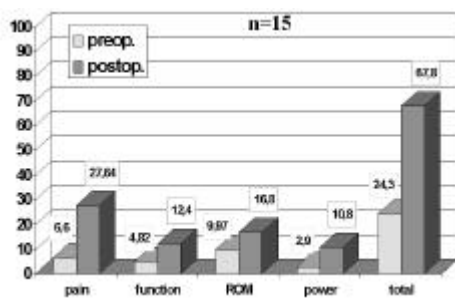


Fig. 7: Results with bipolar-MVS-hemicup-prosthesis using the HSS-score

function. The average HSS-score result increased for the hemicup (Fig.6) patients from preoperatively 24,3 points (range 15,5-49,5 points) to 67,8 points (range 53-93,3 points) after surgery. 3 shoulders with hemicup procedure rated excellent and 10 rated good, while 5 fair results were obtained.

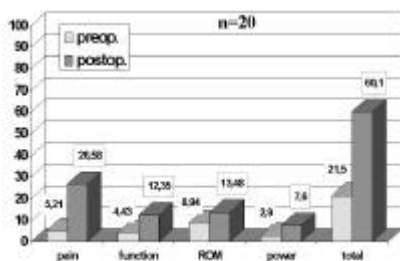


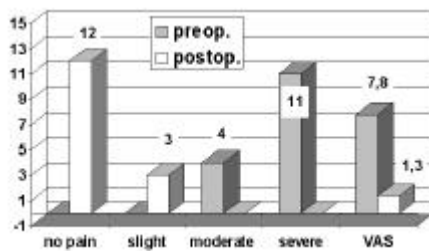
Fig.8: Results with bipolar-MVS-cup-prosthesis using the HSS-score

The 20 bipolar cup implants (Fig.7) improved from a preoperative HSS-score of 21,5 points

were evaluated good in 9 patients, leaving 11 fair results.

(range 17,7-37,8) to an average postoperative value of 60,1 (range 43-83,5) points. The clinical results

The absolute scoring results have to take in account the worse preoperative condition of our patients and the generally restricted functional capacity by multiple joint involvement of rheumatoid patients.

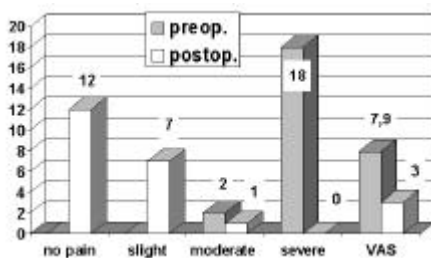


**Fig.9:** Pain relief after bipolar-MVS-hemicup prosthesis

The most benefit was achieved in pain relief and restoration of shoulder function. Moderate pain at rest and severe pain on shoulder motion was reported by all patients before surgery.

Complete pain relief was achieved in 12 patients

(80%) of the hemicup-MVS- prosthesis group, while 3 patients (20%) complained slight pain after heavy shoulder activity. Pain at rest was denied by every patient after bipolar-MVS-hemicup arthroplasty. This subjective pain relief corresponds to a decrease in visual analog scale from preoperatively 7,8 (range 6-10 points) to 1,3 (range 0-4,5 points) points at follow-up.



**Fig.10:** Pain relief after bipolar-MVS-cup prosthesis

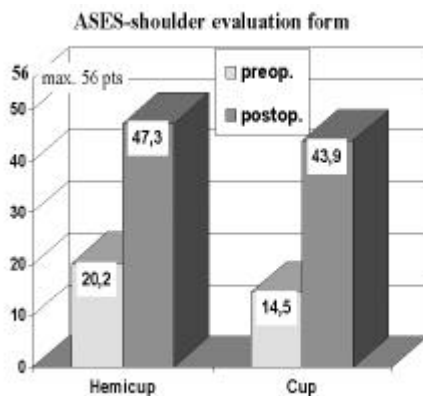
The MVS-cup-population proved a comparable pain reduction. 12 (60%) patients achieved complete pain relief after surgery, while 7 (35%) complained slight pain after heavy shoulder activity. Moderate pain with

activity was still present in one patient after bipolar cup replacement. The mean pain rating in visual analog scale decreased from 7,9 (range 6-10 points) to 2,6 points (range 0-5) after surgery.

Shoulder anteversion improved for the bipolar-MVS-hemicup prosthesis from an average value of 71,9° (range 30-160°) to a postoperative average of 110,3° (range 80-160°). The arc of abduction increased from a preoperative mean of 49,3° (range 15-120°) to a postoperative mean of 91,2 (range 60-130°). Average external rotation changed from an average preoperative value of 17,4° (range -10-50°) to a postoperative value of 38,8° (range 20-70°).

Improvement in motion was less optimal for the patients with irreparable cuff-defects and bipolar-MVS-cup replacement. The average arc of anteversion increased in the bipolar cup replacements from a preoperative measurement of 50° (range 10-95°) to 87,4° (range 60- 150°) after surgery. Abduction improved from an average value of 43,8° (range 10-70°) to a postoperative average of 70.5° (range 40-100°). Average external rotation changed from an average preoperative value of 13,8° (range -20-40°) to a postoperative value of 28,8° (range 10-60°). The obvious restriction in external rotation is caused by increased repositioning of the

bipolar-MVS-cup implant to avoid anterior instability.



**Fig. 11:** Results with bipolar-MVS-hemicup and cup-prosthesis using the ASES-shoulder evaluation form

Shoulder function was assessed by the ability of the patients to perform various functions of daily living using the shoulder. The questionnaire was based on the American Shoulder and

Elbow Surgeons evaluation form (Fig.8). A

perfect score results would have been 56 points. Before operation the mean score values were 20,2 points (range 6-39 pts) for hemicup and 15,2 points (range 5-29 pts) for bipolar cup prosthesis.

After surgery the average score increased to 47,3 points (range 42-54 pts.) for the hemicup replacements, representing a mean functional gain of 25 +/- 5.98 points. All activities of daily living improved for bipolar cup replacements to an average postoperative value of 43 points (range 16-54), representing an average increase of 23,9 +/- 7,65 points to a postoperative average of 70.5° (range 40-100°). The good functional recovery closely corresponds to pain relief and the rotational capacity of the operated shoulder joint. When asked for their opinions of the procedure all but two patients felt that they were „very much improved“, and only one patient regretted having undergone

the operation.

### **Radiographic analysis:**

The preoperative x-rays were assessed using the classification of Larson Dahle and Eek(39). 20 patients were stage IV- and 15 with stage V radiological destruction.

Cementless, press-fit insertion was performed for all humeral stems in this series. There was no incidence of radiolucency along the stem-bone interface of any humeral components evaluated on follow-up x-rays. Subsidence or migration of the humeral stem was not observed.

One patients developed superior subluxation two years after hemicup procedure. The sonographic examination detected a recurrent rotator cuff tear. Revision surgery with bipolar cup implant will be performed soon.

### **Complications:**

In the hemicup population we observed this mentioned proximal cup migration, due to recurrent rotator cuff tear. The patient complained painfull restriction of shoulder movement at follow-up.

We noted one case of anterior luxation after bipolar cup prosthesis. Revision surgery was performed including anterior soft tissue stabilisation, increased stem retroversion and postoperative cast immobilisation. At follow-up complete pain relief was achieved but the patient complained a lack of active shoulder movement.

A recurrent infection, neccitating removal of the prosthesis was our third complication. The patient was operated with a bipolar cup prosthesis after a superinfected and severly displaced humeral head fracture. He developed recurrent infection 6 month after prosthetic surgery. A sine-sine arthroplasty was performed as salvage procedure.

### **Discussion:**

Total shoulder replacement today is a well established method for the treatment of various shoulder disorders. Whereas satisfactory pain relief is consistently achieved after surgery in 80-93% (5,7,12,15,27,50,51,63,62,68,69) the functional recovery is variable and dependant on diagnostic category, integrity of rotator cuff, bone stock and the capacity of the patients to perform sufficient postoperative physiotherapy.

The inferior functional recovery in patients with rheumatoid arthritis reflects the massive soft tissue destruction and poor bone quality. In comparison to more favourable diagnostic categories, the rheumatoid patient is expected to regain inferior shoulder motion ranging between 50 and 60% of the normal (7,27,63,67,68,69).

**Table II:** Literature review: results after total shoulder replacment in rheumatoid arthritis

<b>author</b>	<b>n</b>	<b>follow-u p (y.)</b>	<b>pain reduction</b>	<b>ROM (Elv.)</b>
Thornhill (68) (1983)	<b>105</b>	<b>2,5</b>	<b>91%</b>	<b>88,1 (+30°)</b>
Figgie (27) (1988)	<b>50</b>	<b>5</b>	<b>96%</b>	<b>105° (+30°)</b>
Franklin (28) (1988)	<b>50</b>	<b>3,5</b>	<b>94%</b>	<b>+29°</b>
Barrett (7) (1989)	<b>140</b>	<b>5</b>	<b>93%</b>	<b>90° (+34°)</b>
Torchia, Cofield (69)(1994)	<b>53</b>	<b>12,2</b>	<b>81%</b>	<b>118° (+40°)</b>
Stewart, Kelly (63) (1997)	<b>58</b>	<b>9,5</b>	<b>78,3%</b>	<b>75° (+22°)</b>

Prosthetic replacement of the glenoid is the most worrisky aspect of total shoulder arthroplasty in rheumatoid arthritis. Beside anatomical (52) and biomechanical limitations, excentric glenoid loading in cases of instabiliy (45) and rotator cuff deficiency are the main critical aspects. Recurrent tearing of the rotator cuff ist the third most frequent complication in total shoulder arthroplasty. Although postoperative tearing is considered common after shoulder replacement the average prevalence of 2

% is surprisingly low (16,33,74). Sonographic examination (23,46,65) after shoulder arthroplasty have revealed the realistic incidence of recurrent cuff tears. The reported postoperative cuff tear rates of 30% support the critical argumentation concerning the predictive value of rotator cuff repair in long-standing cuff deficiency. Our prior sonographic studies (23,65,66) 4,5 years after reconstructive shoulder surgery have shown in 16% major rotator cuff tears and cuff attenuation in 22%. Patients with irreparable rotator cuff tears or dysfunctional rotator cuff musculature have a tendency towards proximal migration of the humeral component, which can lead to excentric superior loading of the glenoid component. Franklin et al. (28) referred to this phenomenon as the „rocking horse“ glenoid. and theorized that excentric loading of the glenoid may result in loosening and superior tilting of the component. Several authors (6,9,27,28,34) have noted a relationship between this phenomenon and the progression of glenoid lucencies and consequently restricted the use of glenoid resurfacing to patients with adequate bone stock and functional rotator cuff muscles (2,3, 26, 37, 74).

Glenoid loosening after total shoulder arthroplasty counts for one third (16,34,74) of all complications that are associated with this operation. A metaanalysis (6, 11, 27, 28, 29, 30, 37, 44, 68) shows a controversial discussion because of the discrepancy between the high incidence of radiolucent lines around the glenoid component and the low rate of symptomatic loosening in midterm reports. Most series of total shoulder arthroplasty in patients with rheumatoid arthritis agree that radiolucent lines around the glenoid component are expected in 30 upto 90%(table III).

Table.III: literature review: glenoid loosening after total shoulder replacement

author	follow-up (y.)	radiolucent lines	radiographic loosening	revision
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Thornhill (68) (1983)	<b>2,6</b>	<b>88%</b>	<b>4,8%</b>	<b>-</b>
Kelly (37) (1987)	<b>3</b>	<b>80%</b>	<b>2,7%</b>	<b>2,7%</b>
Mc Coy (44) (1989)	<b>3</b>	<b>86%</b>	<b>3,4%</b>	<b>-</b>
Friedmann (30) (1994)	<b>4,5</b>	<b>42%</b>	<b>8%</b>	<b>-</b>
Barrett (7) (1989)	<b>5</b>	<b>82%</b>	<b>9%</b>	<b>-</b>
Torchia (69) (1994)	<b>12,2</b>	<b>71,3%</b>	<b>44%</b>	<b>5,6%</b>
Stewart (63) (1997)	<b>9,5</b>	<b>88%</b>	<b>27%</b>	<b>5,6%</b>

In contrast to the anatomical, biomechanical and technical concerns about glenoid resurfacing, the average incidence of symptomatic glenoid loosening, requiring revision surgery in literature (16,33,74) is extremely low, ranging between 2 and 4,7%. Inappropriate short term follow-up, averaging 3,5 years and low responder rates might be the reason for this difference. Despite the theoretical concerns regarding glenoid resurfacing in rheumatoid shoulder the midterm results of total shoulder arthroplasty could not demonstrate a higher incidence of glenoid loosening in this specific population (7,27,28,29,30,37,44,68). These results reflect the low functional demands on shoulder arthroplasty in rheumatoid patients because of prominent painful disorders in neighbouring joints. This argumentation explains reported revision rates of 5% despite of radiological loosening in 50% of the reviewed total shoulder arthroplasties (7,27,44,37,68). Long term studies (62,63,69) with systematic follow-up over 10 and 15 years have detected the real complications of glenoid fixation in total shoulder arthroplasty. In summary most reported series (62,63,69) of total shoulder arthroplasty in rheumatoid arthritis proved surprisingly low revision rates despite a high incidence of radiolocial loosening.

The potential advantages of glenoid resurfacing are a better fulcrum for improved strength and

motion, increased stability, decreased friction and elimination of glenoid socket pain. Main argumentation against hemiarthroplasty are the potential risk of continued pain and dysfunction in the face of an arthritic glenoid wear. The advantages of humeral head replacement include less operation time, less blood loss and avoidance of a higher rate of revision surgery. Only a few reports have (8,10) compared the results of hemiarthroplasty with those of total shoulder replacement. The majority of the studies have shown a more reliable pain relief and functional recovery for TSA in patients with osteoarthritis and rheumatoid arthritis. Several shoulder surgeons therefore recommend glenoid resurfacing in these patients, when adequate bone stock and intact rotator cuff muscles are present. On the other hand several studies (38,43,62,78) have documented good and excellent results with hemiprosthesis replacement of the shoulder. Glenoid erosion has not been a clinically significant problem in most reports over a long term period. Current development in humeral head replacement (59,65,66) include modular humeral head components and the introduction of bipolar prosthesis design. The theoretical advantages of a modular shoulder system include increased numbers of humeral-head stem combinations to better adjust soft-tissue tension and the ability to optimize the adaptation between head geometry and the natural shape of the glenoid. The lateral offset build into the bipolar shoulder system theoretically (75,76) restores the deltoid and supraspinatus lever arms without the problems associated with the insertion of a glenoid component. Weak rotator cuffs are functionally supported and the lengthening of the momentum arm between the fulcrum and the muscle insertion increases the efficiency of deltoid pull (35,55,57). The birotational head motion theoretically (53,76) increases stability and decreases wear against the glenoid. In conclusion the question whether the glenoid should be replaced or not remains controversial. In agreement with several authors (4,25,38,43,62,75,78) we prefer a hemiarthroplasty of the shoulder joint to avoid the critical glenoid fixation.

The literature (2,3, 18,19, 22, 26, 40,54, 58 72, 73,77) currently supports the use of hemiarthroplasty rather than TSA for patients with glenohumeral arthritis and cuff deficiency. Patients with severe rheumatoid arthritis are likely to have eroded glenoid bone stock as well as contracted and deficient rotator cuff. The incidence of intraoperatively correlated rotator cuff abnormalities is reported in literature (1,7,12,17,24,27,34,37,58,60,67,71) between 30 and 90%. Rotator cuff pathology was a common feature in our rheumatoid patients (24,65,66). In reconstructive surgery of the rheumatoid shoulder, corresponding to radiological classification LDE 4-5 a 69% incidence of rotator cuff pathology was observed. 47% of these tears were major defects. Frequently these large rotator cuff defects are difficult to repair because of long-standing cuff deficiency with poor tendon quality, leaving technical demanding procedures as tendon-shift and deltoid flap. Massive, irreparable rotator cuff deficiency is reported in literature (7,27,44,67,71) between 10 and 20%. Glenohumeral arthritis with massive rotator cuff tear remains a challenging problem in reconstructive surgery of the shoulder. In literature different treatment options ranging from shoulder arthrodesis to constrained or inverse shoulder arthroplasty are discussed. Shoulder arthrodesis (17) was recommended till the late 80<sup>th</sup> for cuff deficient shoulders associated with glenoid joint destruction and loss of deltoid function. Today the indication is restricted to severe joint destruction with major bone loss and abnormal deltoid function as well as a salvage procedure after periprosthetic infection. Since 1970 several constrained total shoulder devices (13,31,32,42,56,61) have been developed to restore stability of the shoulder joint by coupling the humeral head and the glenoid component. The constrained design of these non-anatomical shoulder prosthesis proved only limited clinical success combined with high complication and revision rates (13,31,32,42,56,61). Mechanical loosening, instability, failure of the implant and fracture were the main complications of constrained shoulder arthroplasty in literature. Some authors (31,36,74) restrict the indication for salvage procedures

after resection of tumors and glenohumeral instability. However the large number of complications reported in literature (13,31,32,42,56,61) support the question for the efficiency of constrained total shoulder arthroplasty even as a salvage procedure.

The development of semiconstrained devices with enlarged glenoid components and proximal hood to restrict subluxation was accompanied by a significant higher incidence of radiolucent lines (1,21,25,48). In finite element analysis (52) hooded glenoid components were associated with increased compressive stresses. The abnormal stresses will result in an increased tendency for the glenoid component to tip superiorly and risk of early loosening.

The literature (2,3, 18,19, 22, 26, 40, 54, 58 72, 73,77) currently supports the use of humeral hemiarthroplasty for patients with glenohumeral arthritis and cuff deficiency. Slightly oversized prosthesis heads are used to obtain the best conformity of the head with the remaining glenoid fossa and the inferior aspect of the acromion. With humeral hemiarthroplasty a normal glenohumeral relationship is not achieved (54). The in situ humeral head replacement preserves the pathological fulcrum of cuff-tear arthropathy with upward subluxation of the humeral head, articulating with the subacromial surface and the superior glenoid. A relocation of the humerus down to the glenoid to restore the normal glenohumeral relationship is not possible (54). Despite the mechanical considerations several reports (2,3, 18,19, 22, 26, 40,54, 58 72, 73,77) could demonstrate good pain relief and surprising functional gains in patients with adequate deltoid function and preserved coracoacromial arch. Anterior-superior instability in cases with loss of coracoacromial arch was the most devastating complication after humeral head replacement (2,3, 18,19, 22, 26, 40, 54, 58 72, 73,77).

Swanson et al (64) pioneered the use of bipolar shoulder arthroplasty for arthritic shoulders with loss of rotator cuff function. More recently several authors (4, 41, 70,75,76) have reported

favourable outcome within the use of bipolar shoulder arthroplasty. The theoretical advantages (4, 41, 64, 70,75,76) of a bipolar shoulder arthroplasty include:

1. restoration of glenohumeral biomechanics. The outer cup acts as a subacromial spacer, reconstructing the joint pivot and increasing the efficiency of deltoid pull by the enlarged momentum arm between the fulcrum and the muscle insertion.

2 Persisting birotational head motion theoretically decreases wear against the glenoid and the overhanging acromion because motion occurs both at the glenoid outer-cup interface and the bipolar cup interface.

3. No fixation of a glenoid component is necessary

The literature review (41, 70,75,76) in bipolar shoulder arthroplasty confirms excellent pain relief, recovery of shoulder function and a moderate increase in active shoulder movement (table IV). The results compare favourable with many reports (2,3, 18,19, 22, 26, 54, 58 73) describing the outcome of hemiarthroplasty in patients with cuff-deficient shoulders.

Table IV: literature review: results with bipolar shoulder prosthesis

<b>author</b>	<b>prosthesis</b>	<b>n</b>	<b>ROM (ELV.)</b>	<b>pain reduction</b>
Schill/Thabe (1997) (59)	<b>bipolar</b>	<b>20</b>	<b>88° (+37°)</b>	<b>95%</b>
Watson (70) (1996)	<b>bipolar</b>	<b>14</b>	<b>ROM-Score: 7,1 20,1 (max. 25 pts)</b>	<b>71%</b>
Worland (75) (1998)	<b>bipolar</b>	<b>22</b>	<b>+23°</b>	<b>91%</b>
Petroff (53) (1999)	<b>bipolar</b>	<b>25</b>	<b>+22,4°</b>	<b>84%</b>
Swanson (64) (1994)	<b>bipolar</b>	<b>44</b>	<b>82°</b>	<b>93%</b>

## **Conclusion:**

The midterm results of bipolar shoulder arthroplasty in rheumatoid patients with reconstructable rotator cuff have been promising. Bipolar shoulder arthroplasty theoretically restores the glenohumeral fulcrum without the problems associated with the insertion of a glenoid component.

Persisting birotational head motion theoretically increases stability and decreases glenoid wear. Our early results compare favourable with many reports of total shoulder arthroplasty in patients with functioning rotator cuff.

Patients with irreparable rotator cuff tears and severe glenohumeral arthritis remain a difficult challenge in shoulder surgery and the ideal procedure has not yet been found. Pain relief and modest increase in active motion are the main goals in operative treatment. Bipolar shoulder arthroplasty represents an adequate alternative to currently favoured hemiarthroplasty in patients with cuff-deficient shoulders. The bipolar cup device helps to relocate the humerus and theoretically increases the efficiency of deltoid by restoration of the lever arm. Persisting birotational head movement decreases wear against the glenoid and the overhanging coracoacromial arch. Longer follow-up is necessary to determine whether the initial pain relief and functional recovery is maintained over time.

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