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PŮVODNÍ PRÁCE

Periprotetické zlomeniny v oblasti kyčelního kloubu

Periprosthetic Fractures of the Hip

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ABSTRACT

PURPOSE OF THE STUDY

It is the aim of our study to present the results of our way of treatment of the periprosthetic fractures, with the cemented as well as the cement-free stems.

MATERIAL

From 1.1.1988 until 31.3.2005 we operated 42 periprosthetic fractures of the hip in 41 patients. 31 of our patients were females, 10 of them males. In 22 cases we operated the right side, 18 times the left side and once we had to operate both sides, but at different times. We used the Vancouver classification scale for the grading of the fractures. In our study we excluded type A fractures; we registered 41 type B fractures and one only type C fracture. The reason for periprosthetic fracture in all these 42 cases was definitely a trauma. In 6 cases we found pre-existing loosening of the stem.

We have grouped our patients under two headings:

1. Primary cemented stems (n=13)
2. Primary cement-free stems (n=29)

The average age at the time of primary operation was 63,6 years in the group of cemented stems and 67,2 years with the cement-free implants.

METHODS

The principle of this operation lies in a stable technique of osteosynthesis. If one operates on a stable stem one uses a one and only technique of osteosynthesis. Patients who also suffer from a loosening of the stem, are treated by replacement of the stem combined with a particular form of osteosynthesis. We generally use a transgluteal access with an L-shaped detachment of the Musc. vastus lateralis. In the group of cemented stems (n=13) we carried out a replacement of the stem 6 times and in the group of cement-free stems (n=29) we had to replace the implant on 7 occasions.

Analysing the osteosynthesis technique we find the use of titanium cerclages and titanium elements on 35 occasions, in both groups taken together. As implant for the stem we preferred the modulated revision stem according to Zweymüller.

Clinical post-operational examination of our patients was carried out according to the Merle d'Aubigne score and two x-rays at different levels.

RESULTS

After an average post-operational check-up time of 3 years and 2 months, we were able to examine 8 patients with cemented stems (61,5 %), 4 of whom had replacement of the stem by a cement-free implant. In the cement-free group we evaluated 24 patients after an average time of 4 years and 11 months. In this group we had 5x a replacement of the stem, 3x of these we could operate cement-free.

The post-operational radiological check showed an excellent building-up of bone structure without any dislocation of the implant in all 32 cases.

DISCUSSION

The average age of our patients shows 77 years with those with cemented stems and 74,5 years in the ones with cement-free implants. Analysis of the cemented stems shows a loosening rate of more than 50 %, which coincides with the findings of many other authors. After a couple of years using cups of polyaethylene we were confronted with the problem of the so-called Polyaethylene disease. These alterations may finally lead to a loss of bone quality, to mechanical loosening of the implant and an increase in danger of fracture. When we discuss the group of patients with cement-free stems and compare them to those with cemented ones, we find a number of quite different characteristics. B2 fractures appear in a quite higher number of patients with cemented and loosened stems. In this regard, our own study is congruent with the studies of other authors. In the cement-free group we had 75 % B1 fractures with a stable stem. The explanation for these figures is, that the cement-free implants were well incorporated in the bone structure.

CONCLUSIONS

The choice of operative procedure when treating periprosthetic hip fractures depends on the type of fracture and the stability of the prosthesis. Our own very positive experiences and the then emerging results lead to a certain strategy in procedure. That means, for us, the use of a cement-free modulated revision stem according to Zweymüller combined with a particular technique of osteosynthesis, using titanium cerclages and titanium elements.

Key words: periprosthetic femur fracture, cement-free stem, titanium cerclages and titanium elements.

1. INTRODUCTION

With an increase in life-expectancy in these last years, the frequency of operations of total hip-joint replacement has increased markedly. At the same time and as a result of the aforementioned, the number of periprosthetic fractures also has increased significantly.

Fractures of this kind may happen intraoperatively in about 1 % of the cases and post-operatively up to more than 5 %. In over more than 90 % of the cases the reason for a periprosthetic hip fracture is an unmistaken trauma. But spontaneous fractures also may happen as a result of a pre-existing loosening of the prosthesis.

As regards this subject, various descriptions in classification are to be found in medical literature. For instance, the Vancouver classification gives a good assessment dealing with the localisation of the fracture, the stability or instability of the prosthesis and also as concerns bone density.

The aim of our study is to present long-term results on the treatment of periprosthetic fractures of the hip with cemented as well as with cement-free stems.

2. MATERIAL AND METHOD

From 01. 01. 1988 until 31. 03. 2005 we operated 42 periprosthetic fractures of the hip in 41 patients. 31 of our patients were females, 10 of them males. In 22 cases we operated the right side, 18 times the left side and once we had to operate both sides, but at different times.

We used the Vancouver classification scale for the grading of the fractures.

In our study we excluded type A fractures; we registered 41 type B fractures and one only type C fracture.

The reason of periprosthetic fracture in all these 42 cases was definitely a trauma. In 6 cases we found a pre-existing loosening of the stem (incidently a cemented stem). 2 other patients with a fatiguing fracture and one female patient suffering from a pathological fracture were excluded from this study.

In a total number of 42 fractures we found a status post changing of the stem of the prosthesis in 8 instances; 4 of these had a cemented and the other 4 a cement-free stem.

Table 1 shows a synopsis of basic ailments in our patients with which we had to deal.

We have grouped our patients under two headings:
1. Primary cemented stems (n=13)
2. Primary cement-free stems (n=29)

Table 2 gives an indication as to the age of patients with primary cemented stem. It shows an average age of 63,6 years. The time span between the primary operated total endoprosthesis of the hip joint and the periprosthetic fracture lies within an average of about 13,5 years.

Table 3 provides a survey of the primary cement-free stems with an average patient age of 67,2 years. The average time between primary TEP operation and the event of the periprosthetic fracture indicates 7,3 years on average.

Table 1. Basic ailments

– Serious osteoporosis:	37 Pat.
– Cerebral sclerosis:	7 Pat.
– Diabetes mellitus:	8 Pat.
– Status post cerebral insult:	2 Pat.
– Polyarthritis chronica:	1 Pat.
– Multiple sclerosis:	1 Pat.
– Morbus Parkinson:	2 Pat.
– Serious deficiency of the kidneys:	2 Pat.

Table 2. Primary cemented stem (n=13)

Cemented total endoprosthesis of the hip joint:	9x
Hybrid:	3x
Cemented hemiprosthesis:	1x
Age with primary TEP	
Average 63,6 years (46–90 years)	
Time between primary TEP – periprosthetic fracture	
Average 13,5 years (2–23 years)	

Table 3. Primary cement-free stem (n=29)

Cement free TEP:	29x
Age at time of operation	
Average: 67,2 years (49–81 years)	
Time between primary TEP operation – periprosthetic fracture	
Average 7,3 years (2 months–18 years)	

Table 4. OP-Method cemented stems (n=13)

With replacement of the stem		6x
– plus cerclages of titanium + titanium elements:		
– cement-free with SLR Plus stem	1x	
– cement-free with Endo Plus modulated stem	2x	
– cemented with Link Long stem	2x	
– plus Titanium cerclages:		
– cemented with Link Long stem	1x	
Without replacement of the stem		7x
– Titanium cerclages + titanium elements.	2x	
– Broad DCP + Titanium cerclage:	1x	
– LISS + Titanium cerclage:	1x	
– Broad DCP (10–14 hole plate):	3x	

Table 5. OP-Method cement-free stems (n=29)

With replacement of the stem		7x
– plus Titanium cerclages + Titanium elements:		
– cement-free with Endo Plus modulated stem	4x	
– cemented with Link Long stem	3x	
Without replacement of the stem		22x
– Titanium cerclages:	5x	
– Titanium cerclages + Titanium elements:	12x	
– Broad DCP + Titanium cerclage:	1x	
– Broad DCP (10–12 hole plate):	4x	

Tables 4 and 5 show various methods of operation with cemented stems as well as with cement-free implants.

The principle of this operation lies in a stable technique of osteosynthesis. If one operates on a stable stem one uses a one and only technique of osteosynthesis. Patients who also suffer from a loosening of the stem,

Figure 1. Titanium cerclages and titanium elements

are treated by replacement of the stem combined with a certain form of osteosynthesis. We generally use a transgluteal access with an L-shaped detachment of the Musc. vastus lateralis right up to the Septum intermusc., and we then ligate the perforans vessels.

In the group of cemented stems (n=13) we carried out a replacement of the stem 6 times and combined this operation with cerclages and elements of titanium. With these 6 stem replacements we used 3x a cement-free so-called Revision-stem and 3x a Long-stem. In a total number of 10 patients we used Titanium cerclages.

In the group of cement-free stems (n=29) we had to replace the stem on 7 occasions. The seven patients with replacement of the stem are subdivided into two groups: 4 with cement-free modulated stems and 3 cemented Long-stems. In 25 patients we inserted titanium cerclages and titanium elements.

The technique with titanium cerclages and titanium elements is a relatively easy one *(Fig. 1).*

At first, the repositioning of the periprosthetic fracture takes place, then we apply from 2 to 4 titanium elements on the bone and fix them with bone-gripping-pliers. Having done this, we insert the titanium cerclage circular around the Femur and pull it tight with a spanner. We achieve a stable osteosynthesis of this intramedullar splinting by using this technique.

The *figures 2, 3 and 4* are typical examples of the loosening of a cemented stem (B2 fractures), which were treated with a cement-free Long-stem combined with titanium cerclages and titanium elements.

Figure 5 shows a B1 fracture in a cement-free Alloclassic-stem. We stabilized with a broad-dynamic-compression plate and a titanium cerclage.

The *figures 6, 7, 8 and 9* show loosened cement-free stems (B2 fractures). In these patients we replaced the standard stem with a cement-free Long-Revision-stem and combined it with titanium cerclages and titanium elements. In all of these cases, the cement-free implants were securely incorporated into the bone structure and the healing of the fracture of the bone presented no problem.

a b c

Figure 2a-c. Periprosthetic fracture with loosened cemented TEP (a); status post replacement of TEP with cement-free modulated revision stem after Zweymüller and osteosynthesis with titanium cerclages and titanium elements (10 months post operation), (b, c).

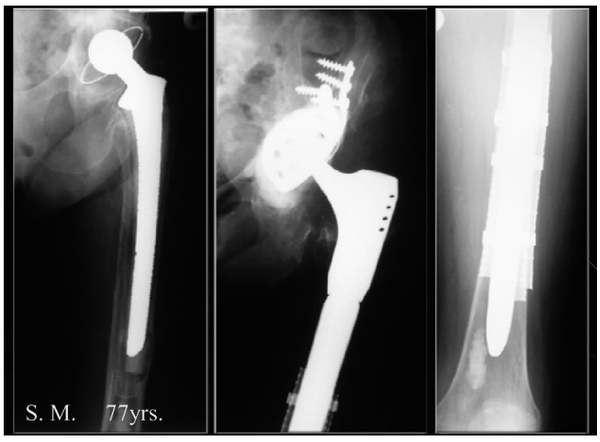
a b c

Figure 3a-c. Periprosthetic fracture and loosened cemented stem (a); status post replacement of stem with cement-free modulated revision stem after Zweymüller and osteosynthesis with titanium cerclages and titanium elements (8 months post operation), (b, c).

3. RESULTS

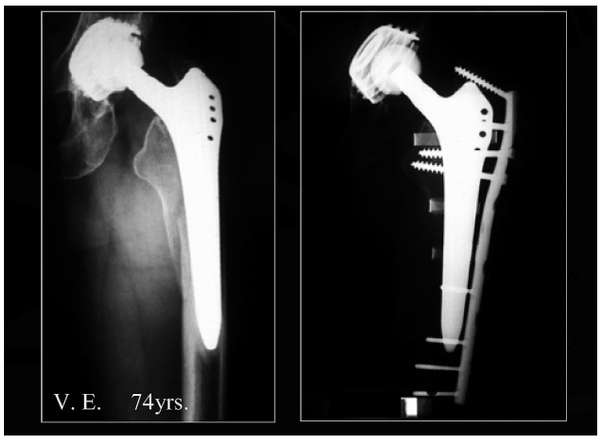
In the post-operational check-up and analysis, we again divided the patients into two groups:
1.Primary cemented stems (n=8)
2.Primary cement-free stems (n=24)

After an average post-operational examination lapse of 3 years and 2 months (6 months – 8 years) we were able to examine 8 patients with cemented stems (61,5 %). They were 7 females and one male. 5 patients suffering from fractures had died. The average age at the time of the post-operational check was 83,1 years (74–92 years).



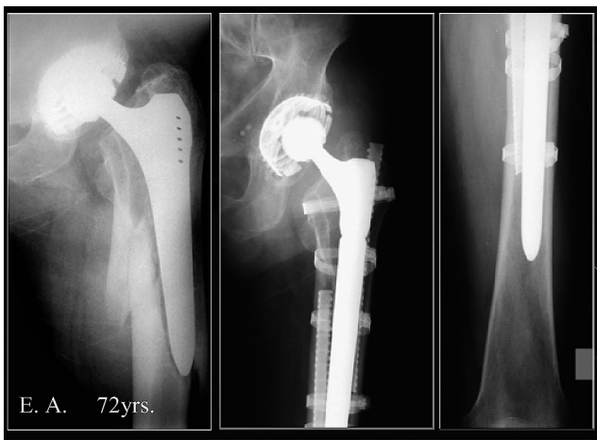
a b c

Figure 4a-c. Periprosthetic fracture with loosened cemented TEP (a); status post replacement of TEP with cement-free modulated revision stem after Zweymüller and osteosynthesis with titanium cerclages and titanium elements (12 months post operation), (b, c).



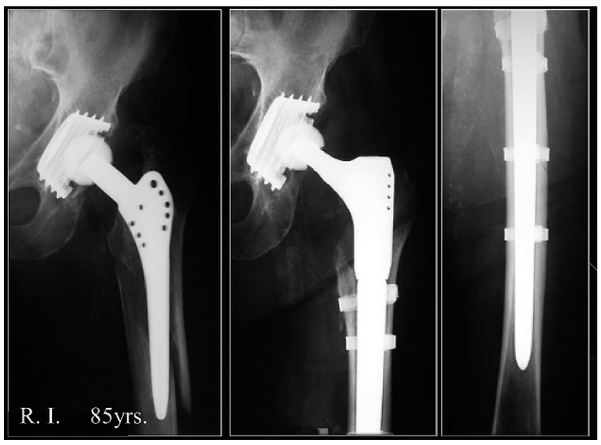
a b

Figure 5a-b. Periprosthetic fracture with stable cement-free alloclassic stem after Zweymüller (a); status post osteosynthesis with DCP and titanium plate (6 months post operation), (b).



a b c

Figure 6a-c. Periprosthetic fracture with loosening of cement-free Zweymüller stem (a); status post replacement of stem with cement-free modulated revision stem after Zweymüller and osteosynthesis with 6 titanium plates and 3 titanium elements (5 months post operation), (b, c).



a b c

Figure 7a-c. Periprosthetic fracture with loosening of cement-free Zweymüller stem (a); status post replacement of stem with cement-free modulated revision stem after Zweymüller and osteosynthesis with 4 titanium plates (6 months post operation), (b, c).

Table 6 gives a survey of the various methods of operation.

After an average time of 4 years and 11 month (8 month up to 11 years) we were able to control 24 patients with cement-free stems. By dividing the patients according to gender, we found 16 females and 8 males. 4 patients with fractures had already died. The average age at the time of the post-operational examination was about 78,5 years (67 years-90 years).

Table 7 presents the various methods of operation with cement-free stems.

Table 8 shows the results of the clinical post-operational examination (Merle d'Aubigne) of the cemented as well as the cement-free group.

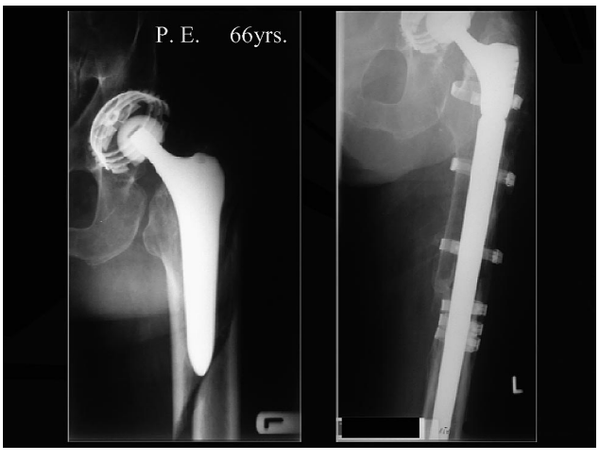
Table 6. OP-Method cemented stems (post-operational examination n=8)

With replacement of stem		4x
– plus Titanium cerclages + Titanium elements:		
– cement-free SLR Plus stem	1x	
– cement-free with Endo Plus modulated stem	2x	
– cemented with Link Long stem	1x	
Without replacement of the stem		4x
Titanium cerclages + Titanium elements:	2x	
Broad DCP + titanium cerclage:	1x	
Broad DCP (10–14 hole plate):	1x	

Table 9 shows the reasons for fair and poor results.

a b c

Figure 8a-c. Periprosthetic fracture with loosening of cement-free Zweymüller stem (a); status post replacement of stem with cement-free modulated revision stem after Zweymüller and osteosynthesis with 5 titanium plates and 2 titanium elements (8 months post operation), (b, c).



a b

Figure 9a-b. Periprosthetic fracture with loosening of cement-free Zweymüller stem (a); status post replacement of stem with cement-free modulated revision stem after Zweymüller and osteosynthesis with 6 titanium plates (12 months post operation), (b, c).

Analysis of the radiological examination (n=32) indicates 30x a normal healing of bone, and twice, a delayed building-up of bone structure after 9 to 12 months.

In the whole group of patients who underwent post-operational check-up, we failed to find the development of a "borderline" or "cuff" around the implanted stem, neither did the stem itself sink down vertically. 2 patients showed heterotop ossifications (grade 1 according to ARCQ), one of them had a cemented, the other a cement-free stem.

Complications

A review of our patients shows complications in 8 instances (19 %). We had to deal with 3 luxations in those with primary cement-free stems. 2 patients were treated in the conservative way with a closed reposition and then provided with an orthesis. One female patient had to undergo an open reposition, together with a replacement of the cup and then the usage of a snap inlay.

Altogether we registered 2 refractures, including a 101 year-old patient who fell out of his bed 3 weeks after the operation. Because of his very poor state of health in general, we could not operate on him. He died still on the extension 5 days after the trauma. Another this time a female patient, sustained a fracture because of fatigue in the osteosynthesis-material, 5 years after the operation. Because of her multimorbidity we could not reoperate her. Both these two patients had primary cemented stems in their hip prosthesis. Another was a patient who suffered from an infected haematoma, which was cured by operation.

Further complications included an incomplete paresis of the femoral nerve in one case, which later healed and regressed spontaneously. In another case we diagnosed a pseudoarthrosis with fatigue-breakage of the titanium elements and loosening of the titanium plates. In this exceptional case, we had to replace a cemented long stem by a cement-free modulated one. The subsequent consolidation of the bone continued without any trouble.

7 patients (16,7 %) suffered from internal problems. Pulmonal embolism occured twice, tachycard atrial

Table 7. OP-Method cement-free stems, post-operational examination (n=24)

With replacement of stem		5x
– plus Titanium cerclages + Titanium elements:		
– cement-free with Endo Plus modulated stem	3x	
– cemented with Link Long stem	2x	
Without replacement of stem		19x
– Titanium cerclages:	5x	
– Titanium cerclages + titanium elements:	10x	
– Broad DCP + titanium cerclage:	1x	
– Broad DCP (10–12 hole plate):	3x	

Table 8. Clinical post-operational examination (Merle d'Aubigne)

	Cemented n=8	Cemented-free n=24
Excellent:	0x	6x
Good:	7x	12x
Fair:	1x	5x
Poor:	0x	1x

Table 9. Clinical post-operational examination (Merle d'Aubigne, n=7)

Reasons for fair and poor results	
Fair:	1x patient completely bedridden
	1x St.p. cerebral insult
	1x St.p. TIA, senile decay
	2x cardiac insufficiency
	1x senile dementia
Poor:	1x patient bedridden, MS

scintillation, once, ileus, twice, grave kidney insufficiency, twice, fortunately, all these seven patients survived these complications.

4. DISCUSSION

Periprosthetic fractures are serious complications with the total endoprosthesis of the hip joint (15). The number of such occurrences is stated in medical literature from 1 % up to more than 5 % (2, 3, 12, 13, 21). With increasing life expectancy and the increase in implantation of total endoprostheses of the hip joint, also the number of periprosthetic fractures has risen significantly. Hence, especially elder people are afflicted. The average age of these patients with periprosthetic hip fracture lies according to numerous studies at the 65 years mark (21, 25). The average age of our patients is 77 years in those with cemented stems and 74,5 in the group of the cement-free stems.

To estimate the risk involved in these cases, one has to consider the factors that are specific to a particular patient and on the other hand factors specific to the implant used (3, 22). As our retrospective study shows, more than 80 % of the patients suffer from severe osteoporosis. Further risk factors are polyneuropathia, occuring very often with diabetes mellitus, cerebral sclerosis and Morbus Parkinson. In our own statistics, specification of risk according to gender shows a 75 % prevalence of females.

Analysing the cases with cemented stems we find a loosening rate of more than 50 %, which actually coincides with the number other authors provide (6, 11, 12, 13).

When using cups of polyaethylene, after a couple of years, we are confronted with the problem of the so-called Polyaethylene disease (7, 14, 19, 24, 26). In the proliferation of active fibrocytes in the tissue around the operated bone, numerous populations of multinuclear cells develop, which play an important role together with the abraded particles of the implant and likewise in the development of microparticles of bone cement and of bone tissue. These fibroproliferative processes can be seen as an immunological answer of the body against the implanted extraneous material. These alterations may finally lead to a loss of bone quality, to mechanical loosening of the implant and increase in the danger of fracture (18). These processes present a high risk in the development of late haematogene infections. This is also attested in several other publications (9, 10, 11).

When we discuss the group of patients with cement-free stems and compare them to those with cemented ones, we find a number of quite different characteristics. B2 fractures appear in quite a higher number in patients with cemented and loosened stems. In this regard our own study is congruent with the studies of other authors (12, 13). In the other group the one with cement-free stems, we operated only 25 % of B2 fractures, which also showed a traumatically loosened stem. 75 % of our patients were B1 types, with stable prostheses and were provided with various types of osteosynthesis. The reason for this is, that the cement-free implants were all well incorporated into the bone structure and in addition, a good bone quality itself prevailed in these patients. The time span between the implantation of the primary total endoprosthesis of the hip joint and the event of the periprosthetic fracture lies at about 13,5 years average with the cemented stems, whilst the cement-free ones have an average of 7,3 years. The explanation for these figures is simple: since the early nineties (of the last century) we preferred implanation of cement-free stems.

At present, there exist no clear guide lines as to the provisional treatment of periprosthetic hip fractures (2, 4, 8, 16, 21). Nevertheless, one should try – no matter whether the primary implant was cement-free or cemented – to replace a loosened stem with a longer implant together with the best possible intramedullar splint and a better stress-distribution. Whether one uses cemented or cement-free implants seems to be a matter of personal philosophy. We do believe, that it is better to use cement-free revision-systems and have them implanted under biological, distal, cortical fixation (20).

As the techniques used in osteosynthesis of periprosthetic fractures of the hip – whether together with replacement of the stem or without – have increased in such high numbers, and as the topic itself is rather complex, we cannot mention all of them in this article.

Nevertheless, it seems important to point out, that the so far traditional osteosynthesis plate system is used less and less. New angular stable plate systems are replacing the old traditional ones. These new angular systems will not so easily denude bone fragments and therefore the periostal blood circulation will be less irritated.

We now have to practicability of using mono- and bicortical angular screws and can also implant them in a minimal invasive way (8).

A review of our study on the various techniques of osteosynthesis shows that when treating 42 fractures, we used titanium cerclages and titanium elements on 38 occasions. Regardless whether dealing with a primary cemented or cement-free stem, the technique using titanium cerclages and titanium elements has now become state of the art. Lately, we started to use a cement-free revision stem, according to Zweymüller, or respectively a modulated stem.

Our rate of complications registers 19 % – the intern medical complication rate is 16 % and with these figures we lie within the international average (8, 12, 13, 16, 21, 23). Incidence of occuring luxations and refractures are not specific for the implants used. We have already referred to this matter.

The case with pseudoarthrosis originated in an operative defect. In the reoperation which followed, we scraped away all the cement and implanted a cement-free modulated stem. Together with the application of titanium cerclages and titanium elements, we finally achieved healing of the bone (17).

The primary goal of all the therapy has to be a stable osteosynthesis – with or without replacement of stem – and the earliest possible healing of the bone. Postoperative care and functional exercises should also start at the earliest possible time and the opera-

ted leg should be exposed to its permissible load as soon as can be.

When loosened stems together with major bone defects have to be revised, we can these days use cortical allografts (1). Sometimes it may not be possible to restore and reconstruct the zone of fracture because of bone defect or bone debris, especially in cases of grave atrophy of the bone. In such cases, one should try to fasten the anchorage on to the distal part of the femur or eventually on to the tibia. For that purpose, we use modulated resection-prosthesis for a stepwise replacement of the femur from the hip up to the knee (5).

5. CONCLUSION

The choice of operative procedure when treating periprosthetic hip fractures depends on the type of fracture and the stability of the prosthesis. All fractures of the coxial end of the femur with an already existing implanted prosthesis are very delicate and most difficult. They nevertheless can be well and successfully treated through the aforementioned techniques of operation. Our own very positive experiences and the then emerging results lead to a particular strategy in procedure. That means, for us, the use of a cement-free modulated revision stem according to Zweymüller combined with a special technique of osteosynthesis, using titanium cerclages and titanium elements.

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