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Results of revision rods in total hip prostheses

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Abstract:
Background: *Revision prosthetic surgery is one of the major challenges of modern orthopedics. It is a complex surgery with more uncertain results than primary arthroplasty and with higher complication rates. The lifespan of an implant therefore decreases with the number of surgical revisions.*
Methods: *We carried out a retrospective study of 20 cases of femoral revision, collected between 2009 and 2017 in the orthopedic traumatology department B at the UHC Hassan II in Fez.*
Our objective through this series was to study the therapeutic techniques, the evolutionary profile, the functional and radiological results of the femoral revision by a revision implant while tracing the experience of the B4 traumatology department, in terms of taking into burden of this pathology and by comparing our results with those of the literature.
Results*: 20 femoral revision surgeries were performed with the same implant: an uncemented modular stem with the press-fit concept (REVITAN®). The indications for revision were in 40% of cases a dislocation, in 30% of cases aseptic loosening, 15% of septic loosening and in 10% a scanning of the cervical screw.*
Conclusions: *Overall, the results obtained at the radioclinical level are within the range of those published in the literature. At the follow-up considered - which can be described as short term for arthroplasty, the results are encouraging.*
Keywords: *Total hip arthroplasty, revision, aseptic loosening, infection, dislocation.*

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I. Introduction:

Total hip arthroplasty (THA) is one of the most successful reconstructive orthopedic procedures available today for reducing pain associated with hip joint disease [1,2]. It is estimated that more than 400,000 hip replacements are performed annually in the United States compared to 150,000 in France [3], with an expected increase in prevalence over time [4,5]. Some cases require revision surgery, re-intervention to replace a new hip prosthesis, to treat the different modes of mechanical or biological failure, the most common causes of revision were instability / dislocation (22,5 %), mechanical loosening (19.7%) and infection [2]. Due to the estimated increase in demand for HAT procedures among the Moroccan population, given the improvement in the quality of life and the increase in life expectancy, an increase in the frequency is to be expected of revision surgery, without ignoring the significant mortality as well as the cost of management of this pathology which could compromise the financing of many health systems like that of Morocco [5].

Numerous studies have evaluated the potential risk factors associated with recovery failure, including the cause of recovery, implant composition, surgical technique, patient demographics and many others [6– 8].

The objective of this work is to study the therapeutic techniques, the evolutionary profile, and the functional results of the femoral recovery by a revision implant while retracing the experience of the trauma service B4 of UHC Hassan 2 of Fez, in terms treatment of this pathology and compare our results with those of the literature.

II. Materiel And Methods :

Our purely retrospective study was carried out in the orthopedics-traumatology department of the Hassan II University Hospital in Fes, between January 2009 and December 2017 and which was devoted to femoral revision surgeries with or without acetabular revision by a revision rod type REVITAN ® (Hip System Revision, Zimmer Biomet®).

A total of 20 patients were operated on for revision. All the patients requiring acetabular revision without femoral revision were excluded, as were patients lost to follow-up, not followed or not treated after the diagnosis of the complication. (Figure 1).

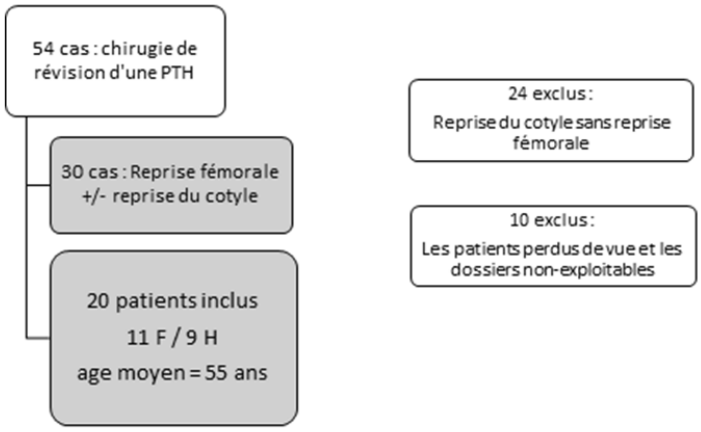

Figure 1: Flowchart

We have established a comprehensive logbook for this purpose, where all parameters and information have been drawn from patient records, registers and reports. The functional assessment is based on the Postel and Merle d'Aubigné functional score (PMA) [9] and the Harris functional score [10].

All our patients underwent a complete clinical examination looking for an underlying pathology, an infectious focus and its treatment were systematic (bacteriological samples were taken systematically at each intervention).

The femoral radiographs were analyzed to allow evaluation of preoperative femoral defect according to the SOFCOT classification and according to Paprosky [11]. The evaluation of the wear of the cortical zones was carried out taking as reference the zones defined by GRUEN [12], the index of Hoffman [13].

Other radiological investigations were performed including a standard x-ray of the knees, face and profile.

CT has been requested in some patients, if deemed necessary by the staff.

We then divided the patients, as proposed by Clohisy [14], into three epidemiological groups:

1. Short-term failures (<1 year).
2. Medium-term failures (1 to 10 years).
3. Long-term failures (> 10 years).

Rehabilitation was undertaken as soon as the Redon drains were removed. It consisted of foot mobilization exercises, and a few isometric contractions but with limitation of stress, especially in patients with a significant loss of bone capital.

All patients underwent a frontal and lateral X-ray immediately postoperatively and at each follow-up appointment (at 2 weeks, 6 weeks, 3 months, 6 months, 1 year and 2 years).

Surgical technique:

It is a femoral revision surgery with or without acetabular revision by a revision rod type REVITAN® (Revision Hip System, Zimmer Biomet®) without cement, in titanium alloy whose primary stability is obtained exclusively by means of a press-fit anchor.

III. Result :

Preoperative:

The mean age of the series is 55 years with a slight female predominance, sex ratio 0.81 (9 M / 11F), the initial indication was dominated by primary hip osteoarthritis by 7 cases (35%) then pertrochanteric fractures come in the second place by 3cases (15%) of the indications (Figure 2).

Figure 2:THA with revision rod on a scan of the cervical screw.
A: Osteosynthesis by a standard gamma nail of an unstable pertrochanteric fracture
B: Evolution towards a scan of the cervical screw 3 months postoperatively
C: Revision with a total hip prosthesis with revision rod type REVITAN®

The average lifespan of prostheses has been estimated at 5 years. We found 4 patients who presented with short-term failure, 9 medium-term patients and 4 long-term patients.
Late dislocation of the prosthesis (40%) and aseptic loosening (30%) (Figure 3) are the main causes of femoral revision, followed by septic loosening (15%) (Table 1). 14 were bipolar revisions (70%) and 6 were isolated revisions of the femoral implant (30%).

Figure 3: Bipolar loosening of a THA with screwed acetabulum and cemented stem.

Radiological evaluation: Of the 17 patients wearing a first-line rod: 13 patients had a well-centered rod and 4 patients had a deviated rod, including 2 in varus and 2 in valgus. Of the 17 patients with hip prostheses 16 patients presented at least one wear area, GRUEN areas 2 and 6 were the most affected by the wear, observed in 13 patients. In second place comes zone 5 observed in 5 patients.
The inclination of the acetabulum preoperatively was on average 39.5 ° (35 ° -47 °): among the 14 patients wearing a total hip replacement:
-11 patients presented with a well-positioned acetabulum with an inclination angle between 40 ° and 50 °.
- 2 patients had a degree of inclination> 50 ° of the acetabulum.
- Only one patient had an insufficient degree of tilt <40 °.
All acetabular cups were anteverted except for 2 patients.

Postoperative

Revision was completed in one step for 17 patients.
3 patients who presented with septic loosening benefited from an irrigation-drainage and reimplantation system in 2 stages spaced 6-8 weeks apart with ablation of the prosthesis and replacement by a Spacer cemented with ATB then resumed with systematic coverage by antibiotic therapy adapted according to the antibiogram for a period of 3-4 months.
The new implanted rod was well centered in 15 patients, ie 75%. , The stem was valgus in 4 patients, ie 20%, and the stem was varus in a single patient, ie 5%. Anteversion of the cervix adjusted intraoperatively was between 10 ° and 20 ° in all patients in our series.
Implant-bone contact: The length of the implant-bone contact area was on average 29.75mm with values varying between 20mm and 35mm and the average Hoffman index at 10 cm from the lesser trochanter was 43.4% (32 % -61%).
A trochanterotomy with complement by cerclage at closure was performed in 7 patients, 2 of whom presented a curved femur in profile and straight on the face. In 13 cases, primary stability was obtained in the metaphyseal region (65%), in 7 cases in the diaphyseal region (35%).
A femur fracture occurred intraoperatively following a false route in 2 patients.
For the patients who required bipolar revision, 9 patients benefited from a Kerboull Cross-type acetabular framework with an autograft, 4 patients with a cemented cup of which one cup was cemented with antibiotic cement and 3 patients operated on by a screw-retained cup.

Table 1: The causes of femoral revisions.

Surgical indication	Number of patients	Percent
Dislocation	8	40%
Aseptic loosening	6	30%
Septic loosening	3	15%
Cervical screw scan	2	10%
Aseptic osteonecrosis	1	5%
The dislocation of the total hip prosthesis predominates over the causes of revision in our series.		

The inclination of the acetabulum postoperatively was on average 41 °.

Recoil Assessment:

Of the 20 patients in our series, 2 patients died and therefore were excluded from the study.
After an average follow-up of 29 months, with extremes ranging from 3 to 67 months; the clinical results of our study were assessed by the different functional scores of the hip (Table 2).

Table 2: Comparison between functional scores preoperatively and last follow-up

Case	PMA		HHS	
	preoperative	recoil	preoperative	recoil
1	9	12	69	85
2	7	15	54	96
3	7	16	63	90
4	8	12	57	91
5	8	15	55	86
6	6	12	61	85
7	6	13	31	78
8	8	13	52	88
9	7	deceased	47	deceased

10	9	15	68	91
11	6	13	45	83
12	6	12	51	86
13	9	12	65	89
14	9	12	65	75
15	6	11	42	79
16	9	13	63	90
17	8	12	64	83
18	8	13	50	84
19	7	deceased	67	deceased
20	9	15	57	81
Average scores	8,44	13,11	62,55	85,55
Number of cases by functional class	Bad (20cas)	Medium (12 cas) Good (5 cas) Bad (1 cas)	Bad (20 cas)	Good (10cas) Excellent (5cas) Correct (3cas)

X-ray: The prosthetic depression was measured against a stable radiopaque mark (cerclage, inferior border of the lesser trochanter, visible top of the greater trochanter, etc.). In our series we found 6 patients (33.33%) with a significant depression of an average of 6.33mm (5-9mm), we also note the presence of a peri-prosthetic border in the proximal metaphyseal zones (1 and 7 in front and 8 and 14 in profile).

The average Hoffman's index 10 cm from the lesser trochanter was 47.05% (35-65%), with an average gain of 3.65%.

No case of acetabular loosening was found at the last follow-up.

Complication: An early dislocation was deplored which required surgical reduction without recurrence and a case of early infection returned in favor of staphylococcus aureus which benefited from simple washing and appropriate antibiotic therapy. Both complications occurred within the first year after implant placement. No greater trochanter pseudarthrosis noted in patients who underwent trochanteric osteotomy.

Complications occurred within the first year after implant placement. No greater trochanter pseudarthrosis noted in patients who underwent trochanteric osteotomy.

IV. Discussion

Revision surgery for total hip prostheses quickly required analysis of the loss of bone substance in order to codify the therapeutic management, the type of means used, in particular the implants, their sizing, their fixation and the use of equipment. Additional to ensure their maintenance in the desired anatomical positions. Loosening is the most serious progressive problem in total hip arthroplasty. This problem consists of a progressive failure of the fixation of the implants. Which are linked to mechanical (stress deviations) and biological factors (reactions to the wear debris of the prosthesis: polyethylene, cement, metal [15,16]; From the concept of primary endomedullary self-blocking or “press-fit” of the Wagner rod [17,18], Le Béguec [19] has developed a modular implant with a conical and straight rod with surface effect and retaining the cervical lever arm.

17 cases of revision of total hip prosthesis and 3 cases of revision of osteosynthesis material by the same revision rod. This number is rather small compared to the Western series, the female predominance of 53% noted in our series is consistent with the results of the series by Le Béguec et al. [19] with a follow-up of 2 years and 3 months which was sufficient compared to other studies in the literature [20,21].

In our series the primary etiology of the initial PTH is primary hip osteoarthritis with 41% of cases, which is not the case for the DAO thesis [22] where dysplastic pathology comes first with a percentage of 44 %; otherwise the causes of revision were predominated by dislocation in 40% of cases and aseptic loosening in 30% of cases, followed by septic loosening (15%). In the series by Le Béguec et al. [19], femoral loosening was the main cause (52% aseptic and 3% septic).

The mean preoperative PMAP score is 7.6 with extremes of 6 and 9. This is low compared to the series by Le Béguec et al. [19], with an average of 10.92 and SOFCOT Symposium [23] with an average of 10.3 preoperatively.

For Harris' average score, it is 55.95 with extremes of 31 and 69, close to that of Le Béguec and AL [19] with an average of 49.71.

The purpose of the preoperative radiographic analysis is to identify the various obstacles that can be encountered during a revision and which may prevent a rigorous application of the concept chosen by the operator.

In our series, 40% of patients were classified as stage 1, 40% classified as stage 2 and 20% classified as stage 3 according to the SOFCOT classification. For the Paprosky classification: 55% of patients are classified stage 2a, 25% stage 2b, 15% classified stage 2c and only 5% classified stage 1.

These are the series of Tabutin et al. [24] (52% of SOFCOT I and IIa stages) and Le Béguec [19] (43% of Sofcot I stages) which most closely match our work in terms of preoperative assessment of bone damage. In the other studies, the bone alterations are more advanced and the comparison of clinical and radiological results is therefore more delicate.

In our study, we find the same distribution of wear zones, zones 2 (52.94%) and 6 (47%) of Gruen were the most affected, followed by zone 5 (29.4%) then zones 3, 7, 9 and 13, present in the same number of patients. Returning to the series of DAO [22], the main areas affected in decreasing order were: zone 6 and 13 with 85% for each, zones 9 (76%) and 2 (72%), zones 10 (50%) and 3 (43%), then zones 5 (24%) and 12 (20%). The other areas [1, 4, 7, 8, 11, 14] were not affected by the wear.

For the resumption, Apart from this present work and the work by Le Béguec [19] which adopted 152 REVITAN type PFMRs, there is another exclusive series of PFMR (70 PFMR) published by B. Frye et al. [25] in 2006, fixation was metaphyseal-diaphyseal in 65%, these results are satisfactory since proximal fixation is always preferable when choosing a cementless rod.

In our study of 20 patients, 16 underwent acetabular surgery of which 9 patients received a Kerbroull cross.

In the Mc Innis series [26], 66.66% of the revisions were bipolar, with a complete acetabular revision.

The mean Hoffman index 10 cm from the lesser trochanter was 43.4% (32% -61%) in our series, For DAO [22], The Hoffman cortical index to the lesser trochanter immediately postoperatively was calculated at 33,8.

In our series, we had a case of early infection, i.e. 5% came back in favor of a staphylococcus aureus which benefited from simple joint lavage and appropriate antibiotic therapy, a case of dislocation requiring surgical reduction without recurrence and 2 cases of intraoperative femoral fracture

In our series, we found an improvement in the total PMA score from 8.44 to 13.11 (i.e. + 64%), pain from 1.9 to 4.97, walking 2.6 to 4.35 and mobility to 3.79. The results of the SOFCOT Symposium [23] are better (total PMA goes from 10.3 to 15.6) preoperatively and postoperatively, i.e. a gain of 60.7% which is comparable to that of our series, with also an improvement in mainly on the pain score (+ 92%). For the Harris score, it went from 62.55 preoperatively to 85.55 at the longest follow-up, ie a gain of 23 points in our series.

In Le Béguec's series [19], the PMA score increased from 10.92 to 15.04, ie a gain of 4.12 with a major increase in the PMA pain score (2.93 to 5.63); Harris' score rose from 49.71 to 83.26, a gain of 33.56 points. The figures given by Boisgard [20] for his series of patients are little different for pain, a little better for mobility and less good for walking.

The minimum threshold above which we can speak of sinking is 5mm.

In our series we found 6 patients with a significant depression of an average of 6.33mm (5-9mm) or 33.33%. The Mc Innis series [26] shows a high sinking rate (56%), this can be explained by the advanced decline compared to the Le Béguec series [19] and ours. However, the peri-prosthetic edges were noted in the proximal metaphyseal zone (zone 1 and 7 on the face and zone 8 and 14 on the profile).

The Hoffman index seems to be a good index of overall bone reconstruction since it takes into account the three variables likely to change, namely the width of the canal and the two cortical thicknesses.

In our series and after a decline of 2.4 years we obtained an average gain of 3.65%. We compared this result with the series of DAO [22] and May [27].

Our femoral implant revision rate is 0%, no revision was performed. It is identical to the rate found in the Migaud [21] (0%), Raman [28] (0%) and Gie [29] (0%) study. It is higher in the series of Boisgard [20] (4%), Chandler [30] (4%), Le Béguec [19] (3%).

Apart from the series of Raman and Migaud, the absence or the low rate of surgical revision in these series, can be explained by the limited follow-up ranging from 2.4 in our series to 3.6 years in that of Boisgard.

V. Conclusion

Revision arthroplastic surgery is one of the major challenges of modern orthopedics. It is a complex surgery with more uncertain results than primary arthroplasty and with higher complication rates. Thus, the life of an implant decreases with the number of surgical revisions

Revision surgery requires careful preoperative planning. The operative report must describe the anatomical state of the femoral structures.

After having exposed the concept of primary stability by metaphyseal-diaphyseal or diaphyseal press-fit, the study of this continuing series of modular straight-shank revision prostheses allows us to offer the following conclusions in response to the questions initially posed. Overall, the results obtained at the radioclinical level are within the range of those published in the literature. At the follow-up considered to be short-term for an arthroplasty, the results are encouraging with the revision an overall PMA score of 13.11 and a Harris score of 85.5 (81-96).

Disclaimer: The use of the data, the analysis of the parameters and the discussion of the results are completely objective and are not influenced by the attitudes of the department or any other organization.

Origin of the aids: this work is the fruit of my own work without outside help in the form of a subsidy, material, medicine or other support element.

Declaration of no conflict of interest: I declare on my honor, and all participants in this study, that we have no affiliation (financial or otherwise) to disclose, with a for-profit or non-profit organization which can influence the results and analysis of this study.

Contribution of the authors:
- Mohammed Lahsika (Principal author): planning the study, exploitation of the archives, analysis of the results and writing of the manuscript
- Said Senhaji and Benchekroun Seddik: Exploitation of the archives, analysis of the results.
- Mohammed El Idrissi, Abdelhalim El Ibrahimi and Abdelmajid El Mrini: Critical review and final approval

Number of figures: 3 figures
Figure 1: Flowchart

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Figure 3: Bipolar loosening of a THA with screwed acetabulum and cemented stem.

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