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PŮVODNÍ PRÁCE

Experiences with the Two Incision Minimal Invasive Hip Replacement in 150 Cases with a Proximally Hydroxyapatite Coated Implant

Zkušenosti s dvouincizní minimálně invazivní technikou náhrady kyčelního kloubu u 150 případů s použitím impantátu s proximální hydroxyapatitovou povrchovou vrstvou

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ABSTRACT

BACKGROUND
In this retrospective study we describe our experiences in minimally invasive two incision total hip replacement (THR).

METHODS
We performed 150 fluoroscopy-assisted two incision minimally invasive THR on 148 patients using a proximally coated hydroxyapatite implant. Clinical (Harris Hip Score (HHS), surgical time, blood loss, length of hospital stay) and radiographic data (leg length discrepancy, cup abduction angle, stem alignment) were collected.

RESULTS
The HHS increased from 54.7 preoperatively to 92.6 postoperatively. Mean surgical time was 103 minutes. Mean intraoperative blood loss was 410 ml. There were 11 (7.3%) complications including two dislocations (1.3%), one deep wound infection (0.7%), three minor calcar fractures (2.0 %), one periprosthetic femur fracture (0.7 %), two subsided stems (1.3%) and two femoral nerve palsies (1.3%). One of the femoral nerve palsies remained unresolved. The prevent femoral nerve palsies we used somato-sensory evoked potentials (SSEP) after the 48th case and there were no further nerve palsies. Ten complications were in the first 48 cases. In the first 28 cases the anterior skin incision was parallel to the femoral neck and then changed to parallel the intertrochanteric line. Mean length of stay was 2.2 days. Mean cup abduction angle was 39.4° and mean cup anteversion was 34.6°.

CONCLUSION
The initial complication rate can be related to the learning curve using a new surgical technique. In the subsequent 102 surgeries there was one stem subsidence.
The minimally invasive approach in THA remains new technique and carries additional risks. Secondary to the learning curve comparable short and long term follow up's are necessary.

Key words: minimal invasive, total hip arthroplasty, two incision technique, cementless THR.

INTRODUCTION

Minimally invasive surgery has the potential for minimizing surgical trauma, pain and recovery in many surgical procedures (3). A great deal of interest surrounds the minimally invasive total hip arthroplasty (THA). The first minimally invasive THA was performed in the 1990s (20). The initial reason for performing minimally invasive total hip replacement (THR) was to reduce the pain, speed recovery, reduce blood loss and decrease surgical trauma for patients so that function was significant improved earlier postoperatively (8, 20). All procedures we reported were done in the US, were the two incision technique is more popular than in Europe.

The absence of intraoperative landmarks makes minimally invasive THA more difficult compared to the stan-

dard approaches. Currently there are various techniques and approaches (16). Recently new or modified one or two incision approaches have been developed (2, 3, 5, 13, 16), with or without the fluoroscopy to verify the implant positioning intraoperatively (7, 14, 19).

In this paper we describe our experiences in 150 minimally invasive fluoroscopy-assisted two incision THR using an HA proximally coated stem beginning with the first case and we present the results of a retrospective study using normally recorded in- and out-hospital data.

MATERIALS AND METHODS

Using the fluoroscopy-assisted two incision technique in minimally invasive hip replacement, in 148 patients were 150 primary total hip arthroplasty procedures carried out by one surgeon (N.G.S.). All procedures were performed cementless. The study group included 62 women and 86 men. Age range at the time of surgery was 33 to 79 years, median age was 61 years. Average follow up is 2.3 years, range 1.1-3.4 years (Table 1).

In the first 28 procedures an anterior incision parallel to the femoral neck was used. The anterior incision was then made parallel to the intertrochanteric line to facilitate femoral implant insertion. The initial interval between the M. sartorius, the M. tensor fasciae latae as well as medial retraction of the M. rectus femoris then remained the same. A complete anterior capsulectomy was done in each case.

Cup was implanted as usual without C-Arm using anatomic landmarks for orientation (17). The proximal femur was prepared in slide hip flexion, adduction and external rotation with C-Arm and anatomic landmarks (i.e. the lesser trochanter and flare of the greater trochanter) for anatomic femoral orientation.

In all cases we used the same posterior incision. This secondary incision had a length of 2 to 4 cm. Preoperatively we appointed the patients age, gender, leg length discrepancy, weight and height as well as the Harris Hip Score (11) (HHS) with the categories pain, deformity, gait, activity and function (Table 2). The estimated blood loss was measured intraoperatively. Postoperatively we performed the surgical time, the cup abduction angle, the cup version using the technique of Widmer (22), the stem alignment, the leg length discrepancy, the length of hospital stay, and the HHS at most recent follow up. Stem alignment was classified as varus, neutral or valgus. The leg length discrepancy was measured from the inter-teardrop line to the lesser trochanter (24).

Because the surgeon selected patients to have a minimal invasive hip replacement primarily because of the body habitus, most of the patients had a body mass index (BMI) lower than 30. For evaluation, the mean as well as the standard deviation was calculated. The examination of the significance was done applying the t-test and the one-way variance analysis. A p value of <0.05 was considered to be significant.

Table 1. Patient demographic characteristics

	preoperatively	postoperatively
No. of patients	148	148
No.of hips	150	150
Age* (yr)	61 (33-79)	–
Gender (♀/♂)	62 / 86	62 / 86
Body mass index (BMI)	25.5 ± 4.7	–
Preoperative diagnosis		
Ostoarthritis	106	–
Congenital dysplasia	3	–
Protrusion	5	–
Coxarthrosis assoziated with rheumatism	6	–
Osteonecrosis	27	–
Other	3	–

* The values are given as the average and the range in parentheses.

Table 2. Clinical and hospital data

	preoperatively	postoperatively
Harris Hip Score†	54.7 ± 12.1	92.6 ± 11.8
Average surgical time* (min)	–	103 (65 – 240)
Average intraoperative blood loss* (mL)	–	410 (100 – 750)
Average lenght of hospital stay* (days)	–	2.2 (1 – 7)
No. (%) of patients discharged home	–	119 (79)
No. (%) of patients discharged to a rehabilitation facility	–	31 (21)

* The values are given as the average and the range in parentheses.
† The values are given as the average and the standard deviation.

Table 3. Intra- and postoperative complications

Intra- and postoperative Complications			
Major complications	**Case 1 to 48**	**Case 49 to 150**	**revised**
No. (%) of patients with dislocations	2 (1.5)	0	1
No. (%) of patients with femoral nerve palsy – resolved	1 (0.7)		–
No. (%) of patients with femoral nerve palsy – unresolved	1 (0.7)	0	–
No. (%) of patients with deep wound infection	1 (0.8)	0	1
			–
Minor complications			–
No. (%) of patients with minor calcar femur fractures	3 (2.0)	0	–
No. (%) of patients with subsided stems	2 (1.5)	0	1
No. (%) of patients with postoperative periprosthetic femur fractures	1 (0.7)	0	

RESULTS

Clinical Results

The average HHS rose from 54.7 to 92.6 point ($p<0.001$). The data of the average surgical time, the intraoperative blood loss, length of hospital stay and the percentage of patients with were discharged at home or in a rehabilitation unit are shown in Table 2.

Eleven procedures (7.3 %) were associated with intraoperative or postoperative complications (Table 3). Ten of these complications were found in the first 48 cases. Five of the eleven complications were classified as major

Figure 1. AP X-ray of the right hip of a 67-year old female patient. X-rays show the right hip one year after a calcar fracture treaded with a cerclage wire.

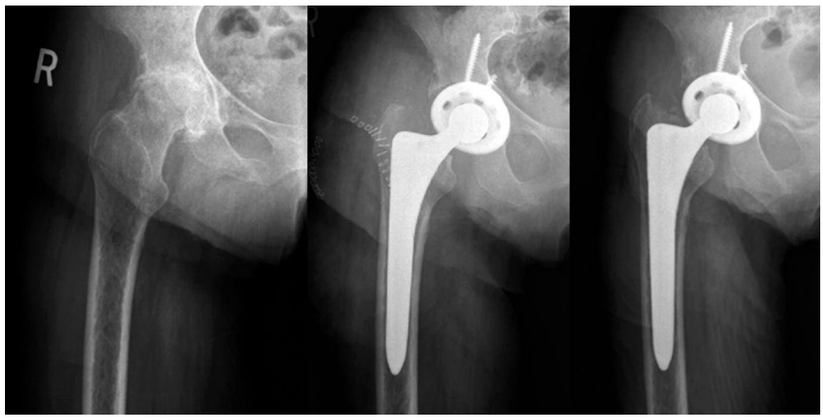

Figure 2. AP ray of the right hip of a 52-year old female patient. X-rays show the right hip preoperatively (left), one day (middle) and 5 month (right) postoperatively. In comparison of the postoperative X-rays the stem was subsided about 5 mm.

complications. Two were anterior dislocations. Both had a cup abduction angle greater than 50°. One of them required a cup revision. There was one partial femoral nerve palsy that completely resolved in two months. An serious unresolved femoral nerve palsy occurred during the 48th procedure and after 1.5 years has not recovered. The patient refused operative exploration at 9 months. Since this time somato-sensory evoked potentials (SSEP) have been used without any intraoperative increases in latency or subsequent nerve palsies. In the future we will most likely discontinue the use of SSEPįs.

We had one deep wound infection treated with incision, drainage and a 6 week administration of intravenous antibiotics with no subsequent reinfection after 1.7 years.

We considered six complications as minor, these includes three intraoperative calcar fractures treated with cerclage cables and limited weight bearing (Figure 1) and one periprosthetic femur fracture that occurred after a fall at home five days postoperatively. That was treated non-operatively. Two subsided stems (5 to 10 mm) were observed (Figure 2). One of them was revised in an other hospital 4 months after index arthroplasty. The stem was founded to be well fixed and there was no subluxation or dislocation. The stem was revised for subsiding of 10 mm and limb length instability.

Radiographic Results

Postoperatively the leg length discrepancy was reduced significant (p=0.02). The measured mean cup abduction angle was 39.4° ranged from 30° to 58°. Components were defined as outliners when the cup abduction angle was out of the range of 30° to 50°. In only 3 of 150 (2 %) procedures were the measured cup abduction angles greater than 50° (Table 4). The measured mean cup anteversion was 34.6° ± 5.6°.

In 144 procedures (96%) a normal stem alignment was considered. Only in six procedures (4%) was a varus positioning observed (Table 4).

DISCUSSION

The ideal minimally invasive THR would cause a less tissue disruption and thus less pain. It would be followed by significantly shorter rehabilitation period and

Table 4. Radiographic data

Radiographic Data		
	preoperatively	**postoperatively**
Leg lenght discrepancy† (mm)	-9.1 ± 7.3	-2.1 ± 5.8
Cup abduction angle* (deg)		39.4 (30 – 58)
No. (%) of cups with abduction 30° and 50°	–	147 (98)
No. (%) of cups with abduction angle < 30°	–	0 (0)
No. (%) of cups with abduction angle > 50°	–	3 (2)
Cup anteversion angle† (deg)	–	34.6 ± 5.6
Stem alignment		
No. of stems in varus (%)	–	6 (5)
No. of stems in neutral (%)	–	144 (96)
No. of stems in valgus (%)	–	0 (0)

* The values are given as the average and the range in parentheses.
† The values are given as the average and the standard deviation.

would produce results equal or better than those of the regular approach (9, 23). However, the experiences in the use of minimally invasive THR are very various. Woolson et al. (24) reported that there was no difference in the surgical time, blood loss and length of hospital stay between the mini incision group and the standard group. At the same time the mini incision group had a higher risk for malpositioning and wound complications causing by skin irritation. Other authors described advantages of the mini incision in intraoperative blood loss, length of hospital stay and the use of canes (6, 12, 15, 21). Berger et al. (4) reported a rapid rehabilitation protocol for patients after minimally invasive THA. DiGioia et al. (7) proved advantages in minimally invasive THR using a navigation system until one year postoperatively. In the presented results were complications in 11 of 150 procedures (7.3 %). All complications were in the first forty four cases. Ten cases out of forty eight, this is a high complication rate compared to our standard procedure (17). However there were no complications in 139 patients (92.7 %).

Stehlík et al. (18) described the results of a prospective study using a minimally invasive anterolateral approach in 162 patients with successful outcomes including less pain, earlier mobilization and few low complication rate. Using this approach in combination with short stems we found comparable results (10, 23).

The authors attribute the initial complication rate to learning curve using new surgical techniques especially in minimally invasive THR (1). The senior author was also self taught without formal instructional training which was unavailable. Berger et al. (4) reported about a rapid rehabilitation and recovery after minimally invasive THA. In the presented study the length of hospital stay variegates from one to seven days with a mean of 2.24 days. There was only one fifty six year old male who stayed in the hospital for seven days postoperatively. He had a diagnosis of hospital acquired pneumonia. All other patients we discharged at the first, second or third day postoperatively.

Compare to standard procedure or other minimally invasive approaches the need of fluoroscopy is a disadvantage of the method.

We did not compare the presented results with our results using a standard incision. But in the rehabilitation and recovery after minimally invasive THR our experiences are comparable with Berger et al. (4) especially in our last 100 procedures.

Less tissue disruption is the major advantage of the minimally invasive THR compared to standard procedures. It makes a rapid rehabilitation and recovery possible (4). The data of the current study and the results of Archibeck et al. (1) suggest that patients characteristics and surgeons experience have a significant effect on the prevalence of complications with the minimally invasive THR. At the beginning the minimally invasive techniques carry some additional risks (e.g. nerve palsy, implant malpositioning, wound complications) (23, 24) compared to different standard approaches. Our presented data suggest that the minimally invasive THR is a safe surgical procedure when the surgeon has transcended his learning curve.

ZÁVĚR

V retrospektivní studii jsou popsány zkušenosti s minimálně invazivní dvouincizní technikou totální náhrady kyčelního kloubu.

Provedli jsme 150 náhrad kyčelního kloubu minimálně invazivní dvouincizní technikou u 148 pacientů a implantovali jsme dřík proximálně pokrytý hydroxyapatitovou vrstvou. Sledovali jsme klinický stav (pomocí Harris Hip Score), operační čas, krevní ztráty, délku hospitalizace a radiografická data, jako je rozdíl délky končetin, úhel inklinace jamky a úhlová odchylka dříku.

Harris Hip Score se zvýšilo z předoperační hodnoty 54,7 na 92,6 pooperačně. Průměrný operační čas byl 103 minut. Průměrná peroperační krevní ztráta byla 410 ml. Zaznamenali jsme 11 (7,3 %) komplikací, včetně dvou luxací (1,3 %), jedné hluboké infekce (0,7 %), třech minimálních zlomenin calcaru (2,0 %), jedné periprotetické zlomeniny femuru (0,7 %), dvou zapadnutí dříku (1,3 %) a dvou paréz femorálního nervu (1,3 %). U jedné z paréz n. femoralis nedošlo k návratu funkce. K prevenci postižení n. femoralis jsme od 48. případu používali monitoraci somatosenzorických evokovaných potenciálů a další parézu jsme již nezaznamenali. Deset komplikací se vyskytlo u prvních 48 případů. V prvních 28 případech byla přední kožní incize vedena paralelně s osou krčku, posléze byla změněna na paralelní k intertrochanterické linii. Průměrná délka hospitalizace byla 2,2 dne. Průměrná inklinace jamky byla 39,4° a průměrná anteverze jamky 34,6°.

Počáteční komplikace přisuzujeme učební křivce při použití nové operační techniky. U následujících 102 výkonů jsme zaznamenali pouze 1 zapadnutí dříku. Minimálně invazivní přístup u náhrady kyčelního kloubu zůstává novou technikou a přináší s sebou dodatečná rizika. Vedle učební křivky je nezbytné zhodnotit srovnatelné krátkodobé a dlouhodobé výsledky.

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