Original Article
Clinical evaluation of hip joint position sense in patients with hip resurfacing arthroplasty versus conventional total hip arthroplasty

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Abstract: The study aimed to compare the hip joint position sense (JPS) of patients undergoing conventional total hip arthroplasty (THA) or hip resurfacing arthroplasty (HRA). A total of 40 patients who underwent hip arthroplasty (20 THA and 20 HRA) for unilateral coxarthrosis in our department from January 2008 to July 2009 were reviewed. Both groups of patients were matched in age, gender, body-mass index, postoperative rehabilitation and clinical outcomes, and were followed up for > 3 years. The clinical assessments of hip JPS using Active-active method in supine position were performed at preoperatively, postoperative 6, 12, 24 and 36 months. Both groups of patients had similar absolute angle error preoperatively (P = 0.71) and decreased absolute angle error. The THA group had higher mean absolute angle error than that of HRA group at postoperative 6 month and 12 month (both P < 0.01), thereafter, both groups had similar absolute angle error. During the follow up, a tendency towards decreased absolute angle error from 6 month to 36 month was witnessed in both groups. Especially between 6 month and 12 month and between 12 month and 24 month, there were significant differences in absolute angle error (all P < 0.05). After one year, both group of patients had stable absolute angle error (all P > 0.05). Hip JPS after HRA and THA were similar in the long term. In short term, however, HRA was associated with a more improved hip JPS than THA.

Keywords: Arthroplasty, total hip, hip resurfacing, joint position sense

Introduction
In the past, hip replacement is mostly performed in elderly sedentary patients, however, in recent years, an increasing number of young and active patients require replacement [1], causing a growing interest for the development of newer prostheses restoring patient’s anatomy better [2] and physiological loading as well as more durable bearing surfaces [3]. Large diameter metal-on-metal (LDMOM) hip arthroplasty has become an attractive option for the treatment of these younger patients recently [4]. Compared with conventional total hip arthroplasty (THA), the LDMOM hip prosthesis offers greater range of motion (ROM), more durable bearing surfaces, and lower rate of dislocation [5, 6].

As one of the LDMOM hip arthroplasty, hip resurfacing arthroplasty (HRA) is designed specifically to meet the high expectations of younger and more active patients [7]. Vail et al. reported that both HRA and conventional THA showed improvement in HHS, pain, activity and ROM, and had similar early complication and reoperation rate [8]. However, Pollard et al. found HRA was associated with higher activity, ROM and lower rate of dislocation than THA [9]. The design of large femoral head of HRA makes the prosthetic head must cover more displacement to come out of the cup and dislocate [5]. Besides, short-term gait analysis research also revealed enhanced postural stability, more symmetric gait pattern, and increased gait speed after HRA [10, 11]. This was supported by the work by Girard et al. who proposed that HRA allowed a more anatomical reconstruction of the hip anatomy than conventional THA [2].

As more recent literatures have raised concerns about the hip function after LDMOM HRA, however, few studies on the proprioception
have been reported. Proprioception, an awareness of one’s body and limbs in relation to their surroundings, is determined by the sensation of joint motion (kinesthesia) and joint position sense (JPS) [12]. Joint position sense is the conscious awareness of joint position in space with respect to other parts of the body—the static aspect of proprioception [13]. As the recovery of proprioception is also of great importance for patient’s daily life after hip arthroplasty, this study aimed to compare the static aspect of hip proprioception of patients undergoing THA or HRA by assessing JPS.

Patients and methods

Patients

This study reviewed 40 patients who underwent hip arthroplasty (20 THA and 20 HRA) for unilateral coxarthrosis in our department from January 2008 to July 2009. All the patients were followed up for more than three years. The two groups were matched in age, gender, body-mass index, postoperative rehabilitation and clinical outcomes (Table 1). Any patient who had dislocation or loosening of prosthesis and walking inconvenience was excluded.

For experiments involving human subjects, the study approval was obtained from the institutional review board of the ethics committee of Shanghai First People’s Hospital and the study was performed according to the Declaration of Helsinki. For retrospective study, formal consent is not required.

Each surgery was performed through a posterolateral surgical approach by the same surgical team. In the HRA group, the Durom hip-resurfacing system (Zimmer, Warsaw, USA) was implanted according to the instructions provided by the manufacturer. For the THA group, a CLS Spotorno (Zimmer, Warsaw, USA) titanium uncemented femoral stem (Zimmer) was used with a 28 mm Metasul femoral head (Zimmer) articulated with a Metasul bearing insert fitted into an uncemented acetabular cup (Zimmer, Warsaw, USA). All the surgeries and postoperative rehabilitation procedures were standardized.

Joint position sense (JPS)

The clinical assessments of hip JPS were performed at preoperatively, postoperative 6, 12, 24 and 36 months using Active-active (A-A) method in supine position [14, 15]. This test evaluated hip flexion in the sagittal plane using an instrumented spatial linkage (ISL), that is, the ability of patients to reproduce the hip angles actively which were previously determined actively. Briefly, patients were placed in a supine position and blindfolded to eliminate visual cues. The test started at neutral position (0°) and patient actively flexed the hip toward the flexion target position of 45°, which was indicated by a mechanical obstruction. After holding that position for 5 s, patient focused and remembered the angle, and brought the joint actively back to the neutral starting position. Then, patient was asked to actively reproduce the target position without the mechanical obstruction and hold at where he/she felt it was the just position. Five repetitions were performed for each leg and “absolute angular error” values were obtained from the start and stop angles. The “average absolute angle error” was finally calculated as the difference between the patient’s repeat works.

Statistical analyses

All statistical analyses were performed using SPSS 20.0 (SPSS Inc, Chicago, IL, USA) and $P <$
0.05 was considered as statistically significant. The average absolute angle error between the HRA group and THA group in every follow-up time were compared by multivariate analysis of variance. Comparisons between the respective time points for each group were analyzed with One-way ANOVA.

Results

During the following up, no patient had infection, dislocation or loosening of prosthesis, fractures around prosthesis, inflammatory pseudotumor or walking inconvenience. The JPS test was performed successfully in all the patients. The mean absolute angle error between the HRA group and THA group in every follow-up time are summarized in Table 2. There was no difference in absolute angle error between the two groups preoperatively (P = 0.71). After surgery, both groups of patients had decreased absolute angle error. The THA group had higher mean absolute angle error than that of HRA group at postoperative 6 month and 12 month (both P < 0.01), thereafter, both groups had similar absolute angle error.

During the follow up of 36 months, a tendency towards decreased absolute angle error from 6 month to 36 month was witnessed in both groups. Especially between 6 month and 12 month and between 12 month and 24 month, there were significant differences in absolute angle error (all P < 0.05). After one year, both group of patients had stable absolute angle error (all P > 0.05). Patients with typical unilateral coxarthrosis were shown in Figures 1, 2.

Discussion

Good functional recovery is the ultimate goal of all hip arthroplasty, and as part of the joint function, proprioception following arthroplasty is also of great importance. The performance of the proprioceptive system plays an integral role in maintaining functional joint stability [16], and can be a contributory cause of cartilage lesion [17]. Our study analyzed the static aspect of hip proprioception, as measured by JPS in patients with THA and HRA. The results showed that absolute angle error of both groups was decreased within postoperative 12 months and thereafter stable in the following 24 months.
Besides, patients undergoing HRA had lower absolute angle error than that of THA group within 12 months after surgery.

In this study, we chose the supine position to test the hip flexion in the sagittal plane, because patients in a supine position would have more supporting and hence focus more on the hip joint. No focus will be necessary to keep balance [15]. The average absolute angle error value was conversely correlated to proprioceptive sensibility [18-20]. Larger absolute angle error were witnessed in HRA group than that of THA group in this study at postoperative 6 and 12 months but not in the following months, suggesting that HRA facilitated a greater improvement in JPS than THA in short term. The better biomechanical reconstruction by LDMOM prosthesis system of the HRA might be responsible for the improved JPS, as well as the faster functional recovery to some extent (not analyzed in this study). However, Larkin et al. reported that total hip resurfacing arthroplasty did not result in improved proprioception compared with THA [21]. This could be explained by several reasons: first, the assessment method was different, as we detected JPS for static proprioception whereas they applied an advanced testing device to objectively quantify dynamic postural stability; second, our patients were in supine position whereas their patients were kept in erect position.

Nevertheless, during the long term, HRA and THA didn’t differ in hip JPS as evidenced by the absence of a difference in “error” from 24 to 36 months after surgery. This was supported by previous studies, as reported that, proprioception receptors were located in skin, muscles, and joints [16, 22]. The strength size, heavi-
ness and joint position, which involved in proprioception, were attributed to the tendon organs of limb and possibly also muscle spindles [16, 22, 23]. Therefore, it was presumed that the preservation of the femoral head and neck were not the key for JPS, but the extracapsular components such as stretch receptors in the adjacent ligament and muscles may mainly influence hip proprioception.

Several limitations to this study must be addressed. First, the cases of unilateral coxarthrosis patients with THA and HRA were insufficient, and it might affect the statistical accuracy. Second, JPS in transverse plane and frontal plane were not assessed. Not with standing its limitation, this study did demonstrate that hip JPS after HRA and THA were similar in the long term. In short term, however, HRA was associated with a more improved hip JPS than THA.

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Disclosure of conflict of interest

None.

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References


