



The significance of hand dominance in hip osteoarthritis

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ABSTRACT

Objectives: Hip arthroplasty registries, encompassing all-cause end-stage hip degeneration, have shown that slightly more right hip replacements are performed than left. Given that greater than 85% of individuals are right-handed, we sought to investigate the association between side of hand dominance and side of hip osteoarthritis.

Methods: This Level III observational study evaluated exclusively end-stage osteoarthritis of the hip, using 3 independent centres totalling 386 consecutive arthroplasty patients. Logistic regression was used as a statistical model.

Results: In total, 322 patients with hip osteoarthritis were included in the final analysis, including 146 (45.5%) women and 176 (54.5%) men, with a mean age of 68.1 years (SD = 9.5 years). There were 133 (41.2%) right, 73 (22.6%) left, and 116 (35.9%) bilateral hips where the contralateral side had been previously replaced. The proportion of individuals requiring unilateral hip arthroplasty on their dominant side was 67.4%.

Conclusions: In the development of hip osteoarthritis, one is significantly more likely to require hip arthroplasty on their dominant side than in the contralateral hip. Assessment of hand dominance identifies cerebral laterality as a contributing factor in predisposing one's dominant side to hip osteoarthritis.

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Introduction

Hip osteoarthritis is a major cause of pain and disability. Depletion of cartilage biosynthesis, exceeded by cartilage degradation and mediated by biomechanical and inflammatory factors leads to osteoarthritis. The condition is strongly age related, most commonly presents with pain, and has been associated with obesity, and genetic and environmental risk factors [1].

Handedness is evidence of brain function lateralisation, where various cognitive functions tend to be dominated by one side or another, although not exclusively so. Antenatal evidence of handedness has been shown through ultrasound, as 90% of foetal thumb sucking is done with the right hand [2]. Footedness is significantly associated with handedness, with crossed preferences in approximately 5%, occurring more so in men and in left-handed

people [3]. The LRRTM1 gene was the first gene to be linked with increased odds of being left-handed [4]. Left-hand dominance occurs in approximately 8–15% of people [5].

Gait analysis has shown some evidence of asymmetry in able-bodied individuals and could be associated with the different contributions of the lower limbs in carrying out propulsion and control tasks [6]. The dominant limb is typically used for forward propulsion, while the non-dominant limb is used for postural stabilisation [7,8]. Spatiotemporal and kinematic parameters demonstrate asymmetry including velocity, step, stride length, foot placement angle, and range of joint motion [9–11]. Bone mineral densities (BMD) have been demonstrated as higher in the non-dominant femur and tibia [12]. Higher frequencies of calosities have been observed in the preferred foot reflecting unevenly applied mechanical forces or differential mechanical demands between the lower extremities during voluntary motor acts [13]. Turning towards the dominant limb has been shown to be more consistent and contribute higher propulsion forces [14]. The effects of laterality or cerebral dominance on dominant versus

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Table 1
Multiple logistic regression

Predictor, n = 322	Demographics	Odds ratio (OR)	95% CI for OR	p Value
Age group < 70: > 70 years	150: 172	0.91	(0.81, 1.02)	0.14
Gender	176 m: 146 f	1.1971	(0.53, 2.66)	0.65
Hand	293 R: 29 L	0.63	(0.40, 0.99)	0.05

non-dominant lower limb co-ordination, particularly at the hip joint, remain unclear [15]. Joint registries demonstrate that there are a slightly greater number of right-sided hip arthroplasties performed than left [16,17]. However, this pertains to all-cause hip arthritis and has not been ascertained in an exclusively osteoarthritic population. It is worth noting that the incidence of cases of developmental dysplasia of the hip, Legg–Calves–Perthes disease, slipped upper femoral epiphysis, and spontaneous femoral head osteonecrosis is each more likely to affect the left. Therefore, we sought to establish if there was a link between side of right–left hand dominance and corresponding side hip osteoarthritis.

Methods

A questionnaire was issued to all pre-operative patients undergoing unilateral hip arthroplasty for osteoarthritis in 3 independent elective orthopaedic centres from 2010 to 2013. Assessment of hand dominance involved questions on writing, self-care, manual tasks, and eating. Patients were classified as right or left-handed if all of the above tasks were carried out with a single hand. A power calculation (Minitab[®] 85 v16) indicated that 339 patients would be required to find an odds ratio of 3, which was thought to be clinically significant with a 92% right-handed population [3]. Articles citing sidedness in symptomatic hip disease and arthroplasty, we had an expectation that approximately 30% of patients would suffer from contralateral hip arthritis [1]. Having completed the power analysis, patients were enrolled as they appeared. The diagnosis was made in each case pre-operatively by the operating surgeon and confirmed intra-operatively.

Exclusion criteria were patients with evidence of inflammatory arthritis, post-traumatic arthritis, gout or osteonecrosis leaving only patients with osteoarthritis. Bilateral arthritis was further split into equivalent (same chronicity and severity of each side) and non-equivalent (the side deemed more appropriate to consider for arthroplasty first). Bilateral hip arthroplasty was not done simultaneously on any patient but sequentially over an undefined

period, where the patient was enrolled upon presentation for their contralateral procedure. Patient questionnaires and diagnoses included in the research protocol were approved by the relevant institutional review boards before commencement of each study, with informed patient consent in each case.

The statistical analysis (Minitab[®] 102 v16) consisted of a nominal logistic regression model fitted to the response of hip arthritis, including unilateral (right side, left side), bilateral non-equivalent (right worse than left, left worse than right), and bilateral equivalent arthritis. There were 2 logistic regressions performed: one for left versus right hip and another for right hip worse versus left hip worse. The response was binary, left and right only in the first regression, and left worse and right worse in the second. This model was used to study the association between dominance and hip osteoarthritis. Potential confounding variables of age and gender were controlled using multiple logistic regression. Age was grouped as “less than 70 years” and “greater than 70 years” (Table 1). Two-tailed $p < 0.05$ were considered significant. The contralateral hip was also used as a control as the unaffected hip in the unilateral hips group and as the less symptomatic hip in the bilateral hips group. Given that the control was from the same individual, this analysis did not warrant age or gender matching.

Results

A total of 386 patients were surveyed, all with hip osteoarthritis. All patients were of Caucasian origin. Overall, 15 (3.9%) patients had mixed hand dominance or ambidexterity and 49 patients had bilateral equivalent hip osteoarthritis (right = left). These 2 groups were analysed separately. The analyses of 322 patients with hip osteoarthritis included 146 (45.5%) women and 176 (54.5%) men, with a mean age of 68.1 years (SD = 9.5 years). There were 133 (41.2%) right, 73 (22.6%) left, and 116 (35.9%) bilateral (non-equivalent) hip osteoarthritis. Analyses of patients according to handedness are demonstrated in the Figure.

Evaluation of unilateral osteoarthritis demonstrated that more arthroplasties were done on the right than the left (1.8:1). Included in these were patients that had 9 ipsilateral, 5 contralateral, and 13 bilateral knee/hip combination arthroplasties. Overall, 9% (29) of patients displayed left-handedness (15 m:14 f).

Patients were significantly more likely to require hip arthroplasty on the same side as their dominant hand (Table 2; OR = 3.3; CI: 1.2–9.1; $p = 0.02$). Overall, 58.6% of patients with bilateral hip arthroplasty displayed worse symptoms on the side of their dominant hand (Table 3; $p = 0.08$) and 1.42 times that of the

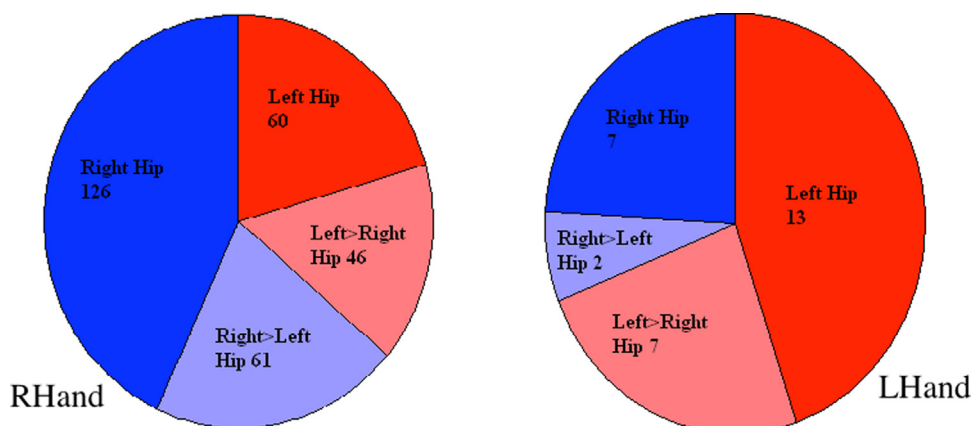


Fig. Side of handedness broken down by type of hip arthritis. RHand: Right-handed patients with unilateral right hip osteoarthritis, unilateral left hip, bilateral right hip worse, and bilateral left hip worse. LHand: Left-handed patients with unilateral right hip osteoarthritis, unilateral left hip, bilateral right hip worse, and bilateral left hip worse.

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