

## Hip Resurfacing Patient Activity Levels Measured Using Step Activity Monitors at Various follow-up stages.

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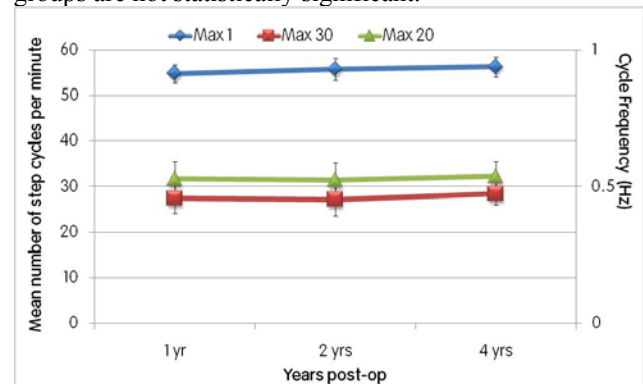
**Introduction:** Hip simulator studies have been carried out for decades to predict the longevity of novel bearings in total joint arthroplasty. The successes of these studies have been varied in terms of *in vivo* predictability. Heat treated, low carbide (high carbon) MoM devices have shown high wear and osteolysis.<sup>1</sup> However hip simulator results have shown no difference between high carbide and low carbide components. This may be due to fast, uninterrupted and identical motions of the hip simulator generating exaggerated lubrication regimes and protecting the bearings. A normal walking cycle would include an extensive range of kinetics and kinematics (including stop-start motion) at various walking speeds creating conditions less favorable in terms of fluid film generation. There is a paucity of objective evidence relating to the step rates of hip resurfacing arthroplasty patients in their daily lives.

The aim of this study was to determine the average walking pattern of a representative group of patients before and after hip resurfacing arthroplasty using Step Activity Monitors (SAM, Cymatech, Seattle WA, USA). A SAM is a small unobtrusive instrument that continuously measures an individual's steps during routine activity, providing a quantitative measure of their ambulatory activity over a period of time.

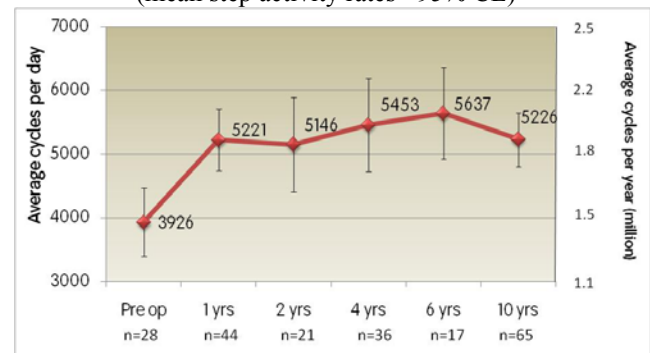
**Methods:** A set of 28 preoperative patients and 183 patients with a unilateral hip resurfacing arthroplasty at different stages of follow-up (1 to 10years) were included in a cross-sectional study after informed consent. Mean age of the patients at the time of follow-up was 54.4 years (range 32 to 65). The patients were advised to wear a SAM just above the lateral malleolus of the right leg or the medial malleolus of the left leg over a period of 5 to 7 days throughout the waking hours of the day. The temporal trend in change of step activity in these patients was noted. In a separate ongoing prospective study 25 consecutive male patients (average age 56 years) were recruited after informed consent if they received a resurfacing arthroplasty with a femoral head size of 50 mm. Their step activity was recorded at 1, 2, and 4-year follow-up stages. The SAM, which is attached to one leg records the heel strike, this is equivalent to two steps. Step activity has been defined as high (>40 steps/min), medium (16-40 steps/min) and low (0-15 steps/min) step rates<sup>2</sup>. Maximum sustained activity over a 'window' of the designated width (1 and 20 minutes) is derived as *Max 1* and *Max 20* respectively. 95% confidence intervals were used to test for significance of mean differences.

**Results:** The prospective study of 25 consecutive patients had a mean *Max 1* (maximum number of steps taken over a period of 1 minute continuous measurement) less than 60 steps per minute (1Hz). This time period constitutes to a small fraction of the total walking period. The *Max 20* gives an average step rate of less than 30 steps per minute

which corresponds to ½ Hz frequency in the hip simulator (Figure 1). In the cross-sectional group, the pre-operative patients had a mean step activity rate of 3926 cycles per day (equivalent to 1.5 Million cycles/year) compared to the follow-up patients whose mean was 5295 cycles per day (1.9 Million cycles/year), as shown in Figure 2. Each of the individual follow-up stage groups is also significantly higher than the preoperative cohort. However the differences between the individual follow-up groups are not statistically significant.



**Figure 1.** A prospective longitudinal study of patients 1, 2 and 4 years post operation showing Max 1, 20 and 30. (mean step activity rates  $\pm$ 95% CL)



**Figure 2.** SAM results of a cross sectional study of 211 individuals at different stage pre and post operative.

**Conclusions:** A significant improvement in patient activity was observed following the operation. There was no significant reduction of activity levels in the patient groups up to ten years post operatively. The average walking speed of patients was significantly lower than that used in hip simulator studies. Introducing lower test frequencies may improve the physiological relevance of the hip simulator studies. Further follow-up through wider longitudinal studies would be beneficial and comparison between activity and metal ion levels would be useful.

**References:** 1. McMinn D. *Proc I MECH E Part H J of Eng Med.* 2006;220(2):239-251. 2. McDonald CM *Arch Phys Med Rehabil.* 2005;86(4):793-801.