



## Hand dominance in orthopaedic surgeons

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**Handedness is perhaps the most studied human asymmetry. Laterality is the preference shown for one side and it has been studied in many aspects of medicine. Studies have shown that some orthopaedic procedures had poorer outcomes and identified laterality as a contributing factor. We developed a questionnaire to assess laterality in orthopaedic surgery and compared this to an established scoring system.**

**Sixty-two orthopaedic surgeons surveyed with the validated Waterloo Handedness Questionnaire (WHQ) were compared with the self developed Orthopaedic Handedness Questionnaire (OHQ).**

**Fifty-eight were found to be right hand dominant (RHD) and 4 left hand dominant (LHD). In RHD surgeons, the average WHQ score was 44.9% and OHQ 15%. For LHD surgeons the WHQ score was 30.2% and OHQ 9.4%. This represents a significant amount of time using the non dominant hand but does not necessarily determine satisfactory or successful dexterity transferable to the operating room. Training may be required for the non dominant side.**

**Keywords :** laterality ; hand dominance ; handedness ; orthopaedic handedness ; orthopaedic surgery training ; Waterloo Handedness Questionnaire.

### INTRODUCTION

Handedness is perhaps the most studied human asymmetry and laterality is the preference of using one side of the body over the other. Approximately 90% of the population shows a preference for the

right hand. Individuals not only use their preferred hand for most unimanual motor tasks, but they are also more proficient with their preferred hand across a wide range of other tasks. Previous studies suggest there is a fundamental discontinuity between humans and other primates in relation to the predominantly human pattern of right-handedness and the left-cerebral representation of language in the study of laterality and evolution and we may even have a dextral gene (3,4).

Laterality in many branches of medicine and surgery has been examined (1,9,11,12,13,18). Laterality in orthopaedic surgery has been examined previously : it was reported that right sided Total Knee Arthroplasty (TKA) had improved outcomes at 1 year compared to left side TKA done by a single right hand dominant surgeon (14), and left sided sliding hip screws, inserted for fractured neck of

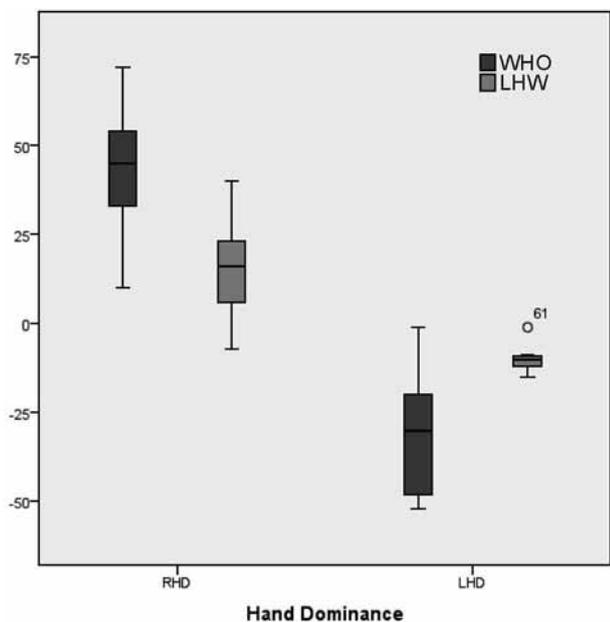
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**Fig. 1.** — WHQ and OHQ compared in RHD and LHD Orthopaedic Surgeons. (+)100% denotes right side laterality and (-)100% denotes left side laterality. A score of 0% indicates an ambidextrous laterality. Laterality is the preference shown for one side.

femur, performed by right hand dominant surgeons, had more technical failures (15).

Left hand shops exist because tools such as scissors need to be made specifically for left handed people in mind. Medical components such as endoscopic equipment are expensive and two sets of instruments would be required to cater for laterality (11) but it is recognized that the techniques are biased towards right hand dominant surgeons (17).

We aimed to examine the laterality of orthopaedic surgeons by questioning them with regards to their hand preference when using instruments, surgical techniques or preference for positioning at the patient. We used a validated questionnaire and developed our own to assess laterality to determine how often we utilise our non dominant hand.

## METHODS

Sixty-two orthopaedic surgeons including orthopaedic trainees were surveyed. Two questionnaires were given

to each surgeon. We used a validated laterality score, the Waterloo Handedness Questionnaire (WHQ) to assess an individual's use of his/her non dominant hand (2,16). We compared it with our self developed Orthopaedic Handedness Questionnaire (OHQ). Steenhuis & Bryden (1989) developed the 32 stem WHQ and analysed the test-retest reliability. The WHQ determines preference of hand dominance or even how ambidextrous one actually is, by asking questions such as : Which hand would you use to pour a cup of coffee ; which hand would you adjust the volume knob on the radio with or which hand would you use to brush your teeth. These can be scored as : Always Left, Usually Left, Both Equally, Usually Right or Always Right which gives a range of laterality or hand preference (19). This is not a tool to determine the quality of the dexterity of the subject, merely, the dominance which their hands play.

Both questionnaires were 100% fully completed. The WHQ is scored from negative (-) 72 to positive (+) 72. The OHQ is scored from negative (-) 44 to positive (+) 44. A score of zero implies ambidexterity. The more negative a score, the more left handed one is and the more right handed, the more positive the result. The scores were analyzed by SPSS v16 software. Pearson Correlation and paired t Tests were performed. WHQ was directly compared with the OHQ as a whisker and boxplot graph. The questionnaires have been included as an appendix.

## RESULTS

Sixty-two questionnaires were sent out ; 100% were completed and returned. Fifty-eight of the surgeons were right hand dominant (RHD) and 4 left hand dominant (LHD). There were 5 female RHD surgeons but no female LHD surgeons. There were 46 Non Consultant Hospital Doctors (NCHD) with a mean 5.2 years of experience (range : 1-10) and 16 Consultants with a mean of 22.6 years of experience (range : 12-38). Bivariate Pearson Correlation performed showed a positive correlation with the OHQ ( $p < 0.01$ ). Paired Samples t Tests were performed comparing mean scores of the WHQ and OHQ. There were statistically significant differences between the results obtained with the validated Waterloo Handedness Questionnaire (WHQ) and the Orthopaedic Handedness Questionnaire (OHQ) ( $p < 0.01$ ). In RHD surgeons the WHQ mean was 44.9% ; specifically related to

orthopaedic surgery, the OHQ mean was 15%. In LHD surgeons the WHQ mean was 30.2% and the OHQ mean was 9.4%. There was no significant difference in WHQ or OHQ scores between Consultants and NCHD's on independent samples t test of means.

## DISCUSSION

Laterality is the preference of hand dominance and hand preference is the most studied human asymmetry. Previous studies have concentrated on improving training for left handed surgeons or physicians (1,5). However, it was the recent orthopaedic research which identified that the problem was not strictly left handed surgeons fitting into a right handed world but that right handed surgeons might also require left handed training (14,15).

The aim of this study was to validate the self developed Orthopaedic Handedness Questionnaire (OHQ) with the Waterloo Handedness Questionnaire (WHQ) and assess hand preference. The Waterloo score gives an insight into the subject's everyday routine laterality. The Waterloo score confirmed our group of orthopaedic surgeons were predominantly right handed in activities such as turning up the volume on a radio, flip a coin, carry a suitcase or erase a blackboard. However, when operating, they do not tend to reposition themselves to utilise their dominant hand but instead use their non dominant hand. There may not be a choice. For example, when performing a left hip sliding hip screw for a fractured neck of the femur, the operator regardless of his hand preference usually uses the left hand to hold the driver for the guide wire by virtue of the neck shaft angle and position of the image intensifier. It would be awkward, but not unfeasible, to use the right hand to drill the guide wire into a left hip. Compare this to performing a total knee replacement where an operator has a choice to stand either on the left or the right. In order to perform a left total knee replacement a right handed surgeon can stand on the right side and lean over the patient for example to use the oscillating saw or use the left hand from the left side. It can be argued that leaning over the patient can potentially lead to inaccurate bony resection (14).

When we look at the LHD group we can see that they are closest to the 0% mark and therefore exhibit a more ambidextrous tendency. This may be rooted in the methodology of teaching or the nature of the equipment, such as lack of left handed scissors. Previous studies suggest left handed training may be required (13). LHD people live in an approximately 90% RHD biased world. However, we do not want to specifically focus on left handed training for left handed surgeons but to examine non dominant hand training to improve dexterity for either RHD or LHD surgeons.

It may be useful to have specific training in surgery for the non dominant hand. Surgeons should have good 3D spatial awareness, dexterity of accuracy and precision as well as adaptable laterality. A previous study of psychomotor skills in endoscopic surgery showed that right handed subjects perform less errors and exhibit better first time accuracy. Hanna *et al* showed that the parameters that improve with practice, reflect the positive effect of training, whereas, errors rate and first time accuracy reflect innate abilities (10).

Hand dominance in surgery is not a new concept for scrutiny, but in this era of European Working Time Directives, surgeons have less time to train to achieve what their predecessors accomplished. If we are to hone our skill sets, adaptability and deftness with procedures we should acknowledge there is a skill in itself to be able to operate tools and instruments with both hands. This is particularly poignant in training others when the teacher will be on the opposite side of the table and potentially a side he is uncomfortable with.

Adusumilli *et al* examined the amount of training or mentoring for left handed people. They found that 3% of left handed surgeons had received specific mentoring whilst 10% of medical schools have laterality programmes and 13% provide left handed instruments. Interestingly 10% of left handed surgeons expressed concerns of another left handed surgeon operating on them (1). Danmore *et al* confirm that left handed paediatric trainees are biased against learning new techniques such as intubation or suturing and do not receive special training resulting in two handed or non dominant hand use (5). Some surgeons have tried to pass on their

knowledge for navigating the difficulties of minimally invasive surgery as a left hander (12).

Recognition of limitations could even extend to increased depressive disorders (7) and those who are completely ambidextrous may even have deficits in cognitive ability (6). It also has implications in hand washing when examining phylotypes of bacteria on hands (8).

The prevalence of left handed surgeons in our study was 6.4% ; less than the average 7.4% in the general population (or dental students 8.6% and orthodontists 17.2%) (11).

There are weaknesses to our study, such as the small sample size. We did not correlate laterality with outcomes and a prospective trial is warranted to further investigate hand preference.

In conclusion, we found that Orthopaedic Surgeons demonstrate a high degree of laterality in routine life as seen in their validated Waterloo scores. When surveyed, RHD surgeons exhibit 44.9% and LHD surgeons 30.2% laterality in routine life. We validated our OHQ against the WHQ. When performing specific orthopaedic procedures, RHD individuals scored 15% and LHD 9.4% suggesting that in the operating room orthopaedic surgeons demonstrate more ambidexterity. However, this report of increased non dominant hand use in theatre does not necessarily translate to both hands being used with equal accuracy or deftness. We agree with previous studies that further education is required to train our non dominant hands regardless of the surgeon's laterality.

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## WATERLOO HANDEDNESS QUESTIONNAIRE

**Instructions :** Please indicate your hand preference for the following activities by circling the appropriate response. If you always (i.e. 95% or more of the time) use one hand to perform the described activity, circle “Right Always” or “Left Always”. If you usually (i.e. about 75% of the time) use one hand circle “Right Usually” or “Left Usually” as appropriate. If you use both hands equally often (i.e. you use each hand about 50% of the time) circle “Both Equally”.

	Always Left	Usually Left	Both equally	Usually Right	Always Right
1. Which hand would you use to adjust the volume knob on a radio ?					
2. Which hand would you use a paint brush to paint the wall ?					
3. With which hand would you use a spoon to eat soup ?					
4. Which hand would you use to point at something ?					
5. Which hand would you use to throw a dart ?					
6. Which hand would you use the eraser on the end of a pencil ?					
7. In which hand would you hold a walking stick ?					
8. With which hand would you use an iron to iron a shirt ?					
9. Which hand would you use to draw a picture ?					
10. In which hand would you hold a mug full of coffee ?					
11. Which hand would you use to hammer a nail ?					
12. Which hand would you use the remote control for a TV ?					
13. With which hand would you use a knife to cut bread ?					
14. Which hand would you use to turn the pages of a book ?					
15. Which hand would you use a pair of scissors to cut a paper ?					
16. Which hand would you use to erase a blackboard ?					
17. With which hand would you use a pair of tweezers ?					
18. Which hand would you use to pick up a book ?					
19. Which hand would you use to carry a suitcase ?					
20. Which hand would you use to pour a cup of coffee ?					
21. With which hand would you use a computer mouse ?					
22. Which hand would you use to insert a plug into an outlet ?					
23. Which hand would you use to flip a coin ?					
24. With which hand would you use a toothbrush to brush your teeth ?					
25. Which hand would you use to throw a baseball ?					
26. Which hand would you use to turn a doorknob ?					
27. Which hand would use for writing ?					
28. Which hand would you use to pick up a piece of paper ?					
29. Which hand would you use a hand saw ?					
30. Which hand would use to stir a liquid with a spoon ?					
31. In which hand would you hold an open umbrella ?					
32. In which hand would you hold a needle while sewing ?					
33. Which hand would you use to strike a match ?					
34. Which hand would you use to turn on a light switch ?					
35. Which hand would you use to open a drawer ?					
36. Which hand would you use to press buttons on a calculator ?					

### ORTHOPAEDIC HANDEDNESS QUESTIONNAIRE

	Always Left	Usually Left	Both Equally	Usually Right	Always Right
37. Which hand do you tie surgical knots with ?					
38. Which hand do you use for a scalpel ?					
39. Which hand do you use for a surgical drill ?					
40. Which hand do you use for screw driver in theatre ?					
41. Which side would you stand on to do a <b>LEFT</b> TKR ?					
42. Which side would you stand on to do a <b>RIGHT</b> TKR ?					
43. Which side do you stand on to do a <b>LEFT</b> carpal tunnel ?					
44. Which side do you stand on to do a <b>RIGHT</b> carpal tunnel ?					
45. Which side do you stand on to do a <b>LEFT</b> bunion surgery ?					
46. Which side do you stand on to do a <b>RIGHT</b> bunion surgery ?					
47. If you are retracting with your <b>LEFT</b> hand and you are required to cut a suture which hand do you use ?					
48. If you are retracting with your <b>RIGHT</b> hand and you are required to cut a suture which hand do you use ?					
49. If you are doing a <b>LEFT TKR</b> which hand do you use for the saw ?					
50. If you are doing a <b>RIGHT TKR</b> which hand do you use for the saw ?					
51. If you are retracting with your <b>LEFT</b> hand and you are required to use a drill which hand do you use ?					
52. If you are retracting with your <b>RIGHT</b> hand and you are required to use a drill which hand do you use ?					
53. Is there any reason (i.e injury) why you have changed your hand preference YES/NO For any of the above activities ?	YES			NO	
54. Have you been given special training or encouragement to use a particular hand for certain activities ?	YES			NO	
55. If you have answered YES for either question 53 or 54 please explain :					

How often do you use your **NON-DOMINANT** hand in theatre to do the following ? (please tick)

	Whenever I need to	Frequently when it would be best	Occasionally when it would be best	If I have to	Never
1. Use a scalpel ?					
2. Cut sutures ?					
3. Use scissors for blunt dissection ?					
4. Use a drill ?					
5. Use a screwdriver ?					
6. Use a saw ?					

