



## Physicians versus surgeons. A pilot study on hand dexterity within a controlled population

Sergio FIGUEIREDO, Luis MACHADO, Ana Daniela PEREIRA LOUSADA, Luis SA CASTELO, Maria Luisa FARDILHA, Antonio SA

*From the Department of Orthopaedics II, Centro Hospitalar de Leiria, Leiria, Portugal*

**Introduction :** Hand dexterity is defined as the innate or acquired capacity of performing any given procedure with one's hands. This study seeks the role of regular hand training on hand dexterity over time. **Materials and Methods :** Pilot study composed by two independent groups with 28 subjects each (surgeons and physicians), stratified according to gender and age. Measurement of hand dexterity using Lafayette's Purdue Pegboard through the sum of the first three exercises as well as the assembly exercise. No difference was found between groups in regards of gender, age, time of practice and hand size ( $p = 0.415$ ;  $p = 0.225$ ;  $p = 0.267$ ;  $p = 0.937$ ). Statistical significance was assumed when  $p < 0.050$ .

**Results :** Surgeons performed better but a statistically significant difference was not observed both on the assembly score ( $p = 0.560$ ) and three tests sum score ( $p = 0.244$ ). The decay of dexterity over time happened in a homogeneous fashion in the surgeons' arm ( $p < 0.001$  and  $p = 0.043$ ) but not in the physicians' arm ( $p = 0.157$  and  $p = 0.098$ ).

**Discussion :** Surgeons seem to perform better than physicians in regards of hand dexterity, although no definitive conclusion was possible given our small sample. It is well known that aging worsens hand dexterity, but our study suggests it happens much more homogeneously within surgeons.

**Keywords :** hand/physiopathology ; adult ; physicians ; surgeons.

## INTRODUCTION

Hand dexterity, as defined by Backman, consists on fine, voluntary movements used to manipulate small objects during a specific task (1). Dexterity, however, is perceived to improve over regular hand training despite the fact that there may be an innate component to it. Bearing this in mind, several assessment tests, created with the aim of aiding industry choosing the best candidates for an assembly line, became powerful medical tests. Their use is particularly relevant on patients recovering from major neurological damage, with both therapeutic

- 
- Sergio Figueiredo<sup>1</sup>.
  - Luis Machado<sup>1</sup>.
  - Ana Daniela Pereira Lousada<sup>1</sup>.
  - Luis Sa Castelo<sup>2</sup>.
  - Maria Luisa Fardilha<sup>3</sup>.
  - Antonio Sa<sup>1</sup>.

<sup>1</sup>Department of Orthopaedics II, Centro Hospitalar de Leiria, Leiria, Portugal.

<sup>2</sup>Department of Orthopaedics, Centro Hospitalar de Tras-os-Montes e Alto Douro, Vila Real, Portugal.

<sup>3</sup>Department of Orthopaedics, Unidade Local de Saude do Nordeste, Macedo de Cavaleiros/Bragança, Portugal.

Correspondence : Sergio Figueiredo, Department of Orthopaedics II, Centro Hospitalar de Leiria, Rua das Olhalvas, Pousos, 2410-197 Leiria, Portugal.

E-mail : sergio.figueiredo@gmail.com

© 2016, Acta Orthopædica Belgica.

---

*No benefits or funds were received in support of this study. The authors report no conflict of interests.*

Acta Orthopædica Belgica, Vol. 82 - 3 - 2016

and evaluation purposes. Yankosec and Howell identified the most reliable tests both for manual and fine finger dexterity assessment, the latter being Purdue Pegboard (PP) Test, from Lafayette Instrument Company (9). It consists of a perforated board and assembling pins, collars and washers, used through three simple sequential tests and a fourth assembly test. The first three tests (placing pins with the dominant hand, nondominant hand and both hands in 30-second runs) are then summed up for a conjugate score. The fourth test, running for 60 seconds, consists on assembling sequentially with both hands a structure composed of a pin, a washer, a collar and a second washer.

Hand dexterity training is of major importance within musicians but surgeons are also assumed to perform better than the general population, with this including their nonsurgeon counterparts. Some studies have revealed the absence of major differences on hand dexterity between medical students or residents in spite of their preference for a surgical specialty (4-6). Others have revealed decay over time on hand dexterity, not particularly assuming differences on manual activity between elements (2, 7,8). To our knowledge, what happens over time between manual workers and non-manual workers, here personified as surgeons and physicians, is still not well known. The purpose of this study is to establish the role of regular hand training on avoiding the decay of hand dexterity over time.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

## MATERIALS AND METHODS

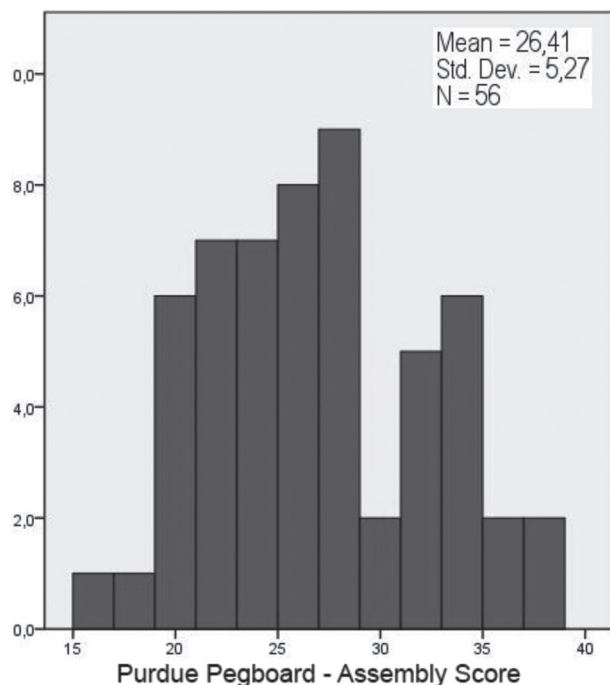
As there were no previous publications on the subject, we opted for a controlled pilot study comparing hand dexterity on surgeons and physicians. We built two independent groups stratified according to gender and age, consisting of 28 elements each. Both residents and specialists were included, from general surgery, orthopaedics and gynaecology/obstetrics for the surgeons' arm and from internal medicine, paediatrics and general practice for the physicians' arm. Information regarding gender, age, time of practice, dominant hand and glove size as an indirect measurement on hand size were collected, as these could represent potential confounders. There were no statistically significant differences between groups regarding the mentioned variables ( $p = 0.415$ ,  $p = 0.225$ ,  $p = 0.267$ ,  $p = 1.000$  and  $p = 0.937$ , respectively) (Table I).

The test used to access fine hand dexterity, Lafayette's Purdue Pegboard, consists of four exercises involving a pegboard and metal pins, tubes and washers. The first exercise is performed with the dominant hand, for 30 seconds, fetching and placing sequentially each pin in its respective hole. The second and third exercises closely resemble the first except being performed with the nondominant hand and both hands, respectively. The fourth exercise requires the sequential assembly of a structure consisting on a pin, a washer, a collar and a washer for a 60 second run. A fifth score is obtained through the sum of the first three exercises (dominant, nondominant and both hands). For the purpose of this study, we used both the fourth and fifth scores, from now on referred to as assembly score and sum score.

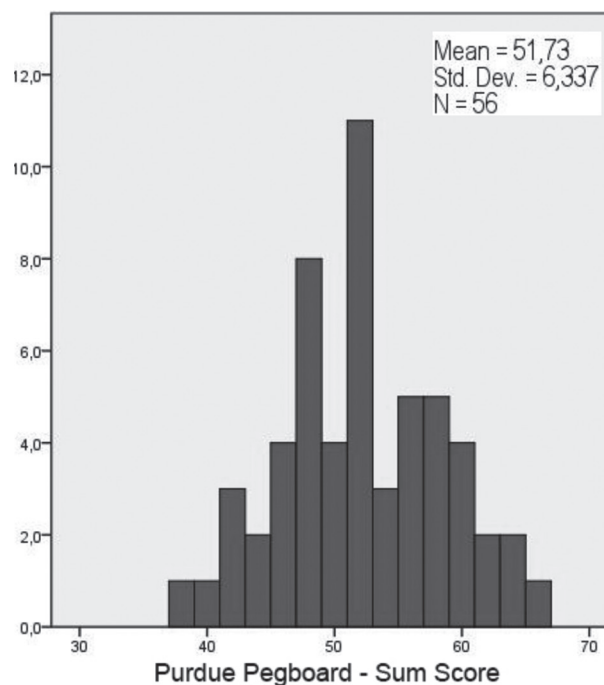
Due to the small sample size, we opted for nonparametric comparison between groups on assembly and sum scores, through Mann-Whitney's U-test. The same was

Table I. — Characteristics of physicians and surgeons enrolled in the study

	Physicians (n = 28)	Surgeons (n = 28)	p-value
Gender ratio (women:men)	18:10	15:13	0.415
Age (years) [median (interquartile range)]	37.66 (24.65)	40.36 (23.96)	0.225
Time of practice (years) [median (interquartile range)]	9 (20)	13 (21)	0.267
Glove size [median (interquartile range)]	6.5 (0.5)	6.5 (0.5)	0.937
Dominant hand ratio (left:right)	1:27	2:26	1.000



**Fig. 1a.** — Histogram on Purdue Pegboard assembly score for both physicians and surgeons.



**Fig. 1b.** — Histogram on Purdue Pegboard sum score for both physicians and surgeons.

performed within each group on time of practice, for [0,5[, [5,15[, [15,30[ and [30,40] year intervals. We also sought for a linear regression within each group, assuming time of practice continuously as the independent variable and assembly and sum scores as the dependent ones.

Statistical analysis was performed using *IBM SPSS Statistics v.20.0.0*, from *International Business Machines Corporation*, assuming statistical significance when  $p < 0.050$ . Whenever variable adjustment was needed, we used Bonferroni's correction.

## RESULTS

Hand dexterity as measured by assembly and sum scores followed a heterogeneous distribution, irregularly approaching a normal curve, for all individuals, as may be seen in figures 1a and 1b.

Hand size seemed to play a role on hand dexterity, with a smaller hand achieving better assembly and sum scores ( $p = 0.001$  and  $p = 0.037$ , respectively). Further tests were then performed after adjustment for hand size.

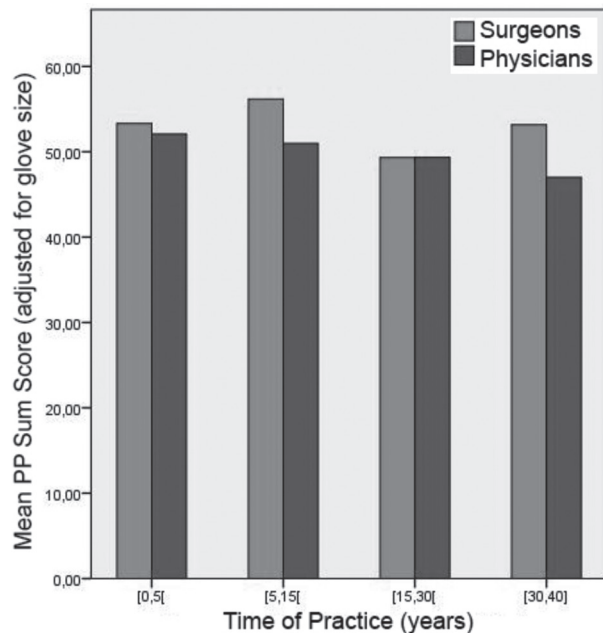
When comparing both groups in regards of assembly and sum scores, despite better performance

on the surgeons group, a statistically significant difference was not observed ( $p = 0.560$  and  $p = 0.244$ , respectively). Major differences on hand dexterity were seen for a time of practice of [5-15] years ( $p = 0.570$ ;  $p = 0.215$ ; respectively), as seen in figures 2a and 2b.

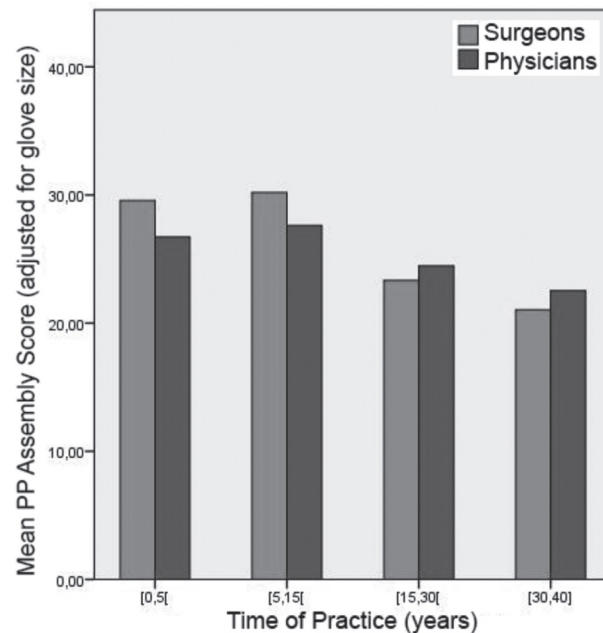
Lastly, the decay over time on hand dexterity within the surgeon group was the only one found to be roughly homogeneous, achieving statistical significance following Bonferroni's principle on the assembly score ( $p < 0.001$ ), and almost achieving it on the sum score ( $p = 0.043$ ). The physicians group, on the other hand, observed no such linearity on its decay ( $p = 0.157$  and  $p = 0.098$ , respectively). Hand dexterity distribution scores over time for both may be seen in figures 3a to 3d.

## DISCUSSION

The role of regular hand exercise on hand dexterity is commonly perceived as beneficial, particularly within musicians. Intensive practice during procedures, as well as training on surgical models, is



**Fig. 2a.** — Purdue Pegboard assembly score according to age groups for physicians and surgeons, already adjusted for glove size. Statistical significance was not observed between study groups ( $p = 0.585$ ).



**Fig. 2b.** — Purdue Pegboard sum score according to age groups for physicians and surgeons, already adjusted for glove size. Statistical significance was not observed between study groups ( $p = 0.206$ ).

considered as particularly useful for surgeon residents on their quick-run to achieve the required technical skills to become senior surgeons (4-6).

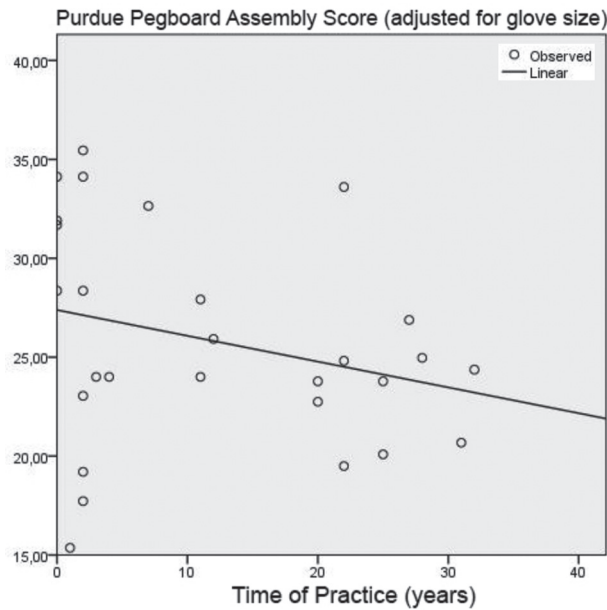
It could be that medical students entering a surgical specialty were already predisposed to technical tasks but this has been proven wrong by Lee and colleagues who found no significant difference in innate motor dexterity between applicants (6).

Senior physicians and surgeons are not particularly different on hand dexterity alone, as Squire and colleagues pointed out (8). What is known to affect the hand dexterity is both age and hand size (2,3). The former is explained as a local projection of a systemic loss of motor skill. The latter is easily understood as a smaller hand finds any dexterity test larger in size, by comparison, thus easier to manipulate. In practical terms this could mean that surgeons with smaller hands are more capable of smaller tasks. The latter also explains why women seem to perform better in these tests, as their hands are smaller in average, although some studies revealed

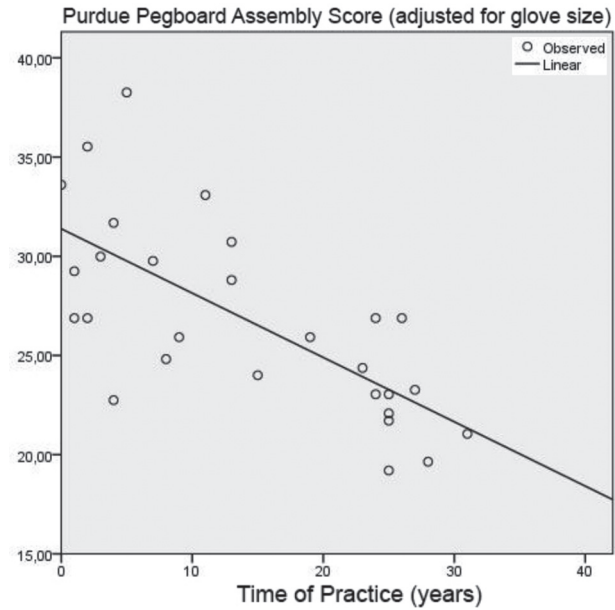
the opposite in surgical simulation scenarios (4,7). All of these aspects were perfectly seen in our study: aged physicians and surgeons performed worse, those with smaller hands, most frequently women, performed better.

In our study, surgeons seem to perform better than physicians, but the difference is not as obvious as expected, thus coming far from achieving statistical significance. What is particularly interesting is to observe what regular hand activity does over time to both populations. There is an obvious decay over time in both groups, but only the surgical ones decays in a linear, organized way. This could mean loss of dexterity is unavoidable, but that regular hand practice makes it more predictable and, possibly, smaller over time.

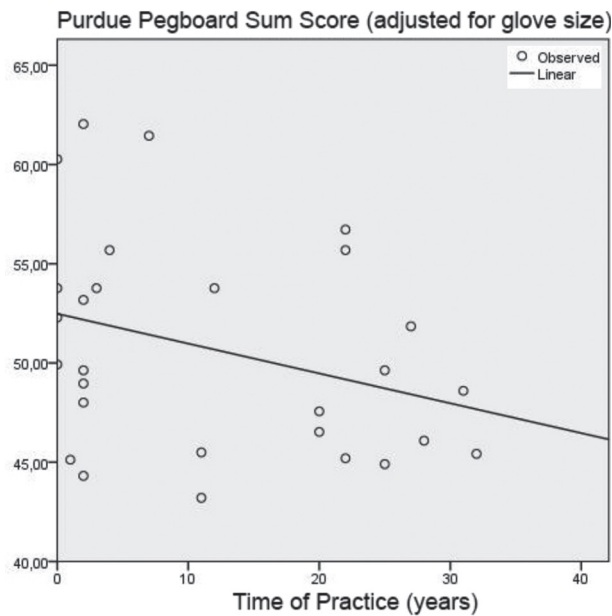
Our study presents some limitations, first of all because of the sample size. Since there are no other projects on the subject, we performed a pilot study relying on non-parametric tests. Our hope is that the achieved results will aid in calculating the sample



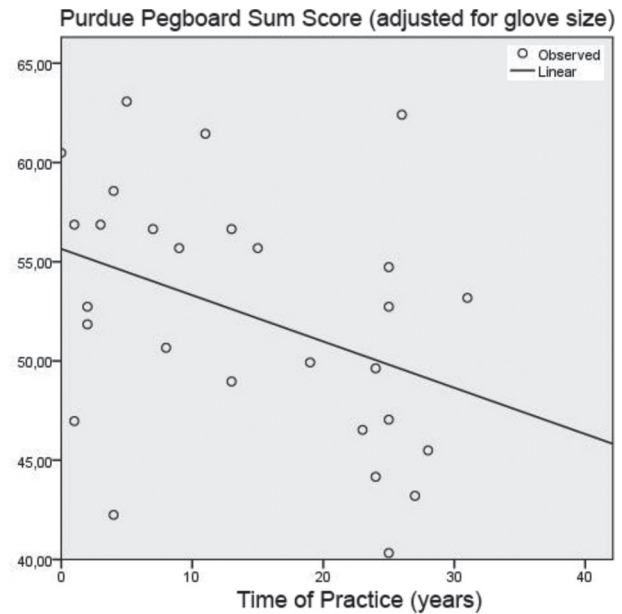
**Fig. 3a.** — Linear regression analysis for the Purdue Pegboard assembly score in physicians, already adjusted for glove size. Statistical significance was not observed ( $p = 0.157$ , r-squared : 0.075,  $f(x) = -0.130x + 27.383$ ).



**Fig. 3c.** — Linear regression analysis for the Purdue Pegboard assembly score in surgeons, already adjusted for glove size. There was statistical significance ( $p < 0.001$ , r-squared : 0.491,  $f(x) = -0.324x + 31.383$ ).



**Fig. 3b.** — Linear regression analysis for the Purdue Pegboard sum score in physicians, already adjusted for glove size. Statistical significance was not observed ( $p = 0.098$ , r-squared : 0.102,  $f(x) = -0.150x + 52.479$ ).



**Fig. 3d.** — Linear regression analysis for the Purdue Pegboard sum score in surgeons, already adjusted for glove size. Statistical significance was not observed, after applying Bonferroni's principle ( $p = 0.043$ , r-squared : 0.149,  $f(x) = -0.233x + 55.645$ ).



size in future projects, thus allowing stronger evidence. We also assume that an average score calculated from three or more repetitions would give us more reliable results, but as we found out, it would decrease significantly the will to participate of our colleagues and therefore diminish an already small population. Despite our concern on hand handicap, reason why we established it as a criterion of exclusion, we gave no importance on any other kind of regular hand training. It is most likely few of our participants were also amateur musicians. The hand dexterity tests were performed with no gloves on, which is not the way surgeons practice. Although Fry and colleagues pointed out no significant difference when surgeons performed the PP test with no gloves on, a pair of gloves or two pairs of gloves, we don't know if it would affect physicians, not as used to tasks involving glove dressing (3).

In conclusion, we cannot assume regular hand practice as a grant for better hand performance, at least not in dexterity terms. Our data suggests that regular hand practice turns dexterity decay into a more predictable and apparently slower process while aging. This may be useful for rehabilitation procedures following hand and wrist surgery. Further studies are required to support this hypothesis.

## REFERENCES

1. **Backman C, Cork S, Gibson G, Parsons J.** Assessment of hand function : the relationship between pegboard dexterity and applied dexterity. *Can J Occup Ther* 1992 ; 59 : 208-213.
2. **Blasier RB.** The problem of the aging surgeon : when surgeon age becomes a surgical risk factor. *Clin Orthop Relat Res* 2009 ; 467 : 402-411.
3. **Fry DE, Harris WE, Elizabeth NK, Twomey CL.** Influence of double-gloving on manual dexterity and tactile sensation of surgeons. *J Am Coll Surg* 2010 ; 325-330.
4. **Grantcharov TP, Bardram L, Funch-Jensen P, Rosenberg J.** Impact of hand dominance, gender, and experience with computer games on performance in virtual reality laparoscopy. *Surg Endosc* 2003 ; 17 : 1082-1085.
5. **Hughes DT, Forest SJ, Foitl R, Chao E.** Influence of medical students' past experiences and innate dexterity on suturing performance. *Am J Surg* 2014 ; 208 : 302-306.
6. **Lee JY, Kerbl DC, McDougall EM, Mucksavage P.** Medical students pursuing surgical fields have no greater innate motor dexterity than those pursuing nonsurgical fields. *J Surg Educ* 2012 ; 69 : 360-363.
7. **Ruff RM, Parker SB.** Gender- and age-specific changes in motor speed and eye-hand coordination in adults : normative values for the Finger Tapping and Grooved Pegboard Tests. *Percept Mot Skills* 1993 ; 76 : 1219-1230.
8. **Squire D, Giachino AA, Proffitt AW, Heaney C.** Objective comparison of manual dexterity in physicians and surgeons. *Can J Surg* 1989 ; 32 : 467-470.
9. **Yankosec KE, Howell D.** A narrative review of dexterity assessments. *J Hand Ther* 2009 ; 22 : 258-270.