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The assessment and description of amputee activity

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Abstract

The activity achieved by a lower limb amputee is usually assessed by clinical judgement or physiological tests. The former is seldom absolute, being affected by factors such as patient age, and is expressed in categories which may not be equivalent to those used by other observers. Physiological testing provides a measure of the patient's capabilities, but not his activity which may be dependent more on social requirements than physical state.

This paper describes a method of questioning the patient using multiple choice answers attracting positive and negative scores, which summate to provide an overall "Activity Score". The procedure takes about 15 minutes and uses the minimum of observer judgement. The technique has been developed over six years and 2400 patients have been investigated. Validation procedures are described, including the use of step counters which show a substantially linear relationship between annual step rate and "Activity Score".

Introduction

If communication in medicine is to be of value, it is necessary to describe patients, their treatment and the results obtained in terms which can be understood by the reader. Thus any account of the rehabilitation of a lower limb amputee must include, not only a description of the patient and his treatment, but also a measure of the activity achieved with his prosthesis. Inclusion of such information could aid the monitoring of patient progress and assist in the evaluation of treatment methods.

Present methods of assessment include:

1. *Performance and/or physiological testing* which provides, usually in a laboratory environment, a measure of the patient's ultimate capability rather than his day to day activity. Whereas the heavily handicapped patient may need to walk as much as his physical state will allow, the less disabled amputee may never need or want to stretch himself to his physical limit.

2. *Step counting* using a miniature electronic counter gives an accurate measure of the activity level reached, (Holden et al, 1979) but would be costly and logistically difficult to apply to a large number of patients. Furthermore it has the disadvantage that modifications to the prosthesis are required.

3. *Clinical judgement* in which the observer questions the patient about his life and capabilities, compares his answers with those given by others and expresses the result in words or categories. This, the most commonly used method has advantages of cheapness and simplicity but is subject to certain inaccuracies. Various patient factors, such as age, site of amputation, gait and concurrent disabilities lead the observer to an expectation of activity which may influence his interpretation of the account given by the patient, and indeed pose problems of scale when trying to obtain some comparison with the "average amputee". This difficulty may be illustrated by considering two imaginary patients:

A is a young man with a B/K amputation, excellent gait and no other disability.

B is an elderly A/K amputee with peripheral vascular disease of the contralateral leg, who walks leaning on 2 sticks.

From these brief descriptions A could be expected to be more active than B, but questioning discloses that "A" has a sedentary occupation and spends his free time reading, while "B" is retired, but walks his dog every day and does some gardening. The difficulty in

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quantifying the difference between A and B from their descriptions is increased by the questioning which demonstrates that A is less and B is more active than some of their respective peers. If, to complicate the matter, A is taciturn and complaining while B is cheerful any fair comparison becomes almost impossible.

But even assuming that an assessment can be made how can it be expressed in a way which is understandable to other clinicians who might want to compare A and B with their own patients?

Proposal

Any improved system, based on the patients' usual activity must be unrelated to age, sex, gait and other disability. The method should be quick and simple to apply and use the minimum of observer judgement. Results should be expressed symbolically, rather than by verbal description and ideally should have some known relationship with the number of steps taken annually.

Method

This procedure, first formulated in 1974, refined during the next three years, but unaltered since 1977 has been applied to some 2400 patients. It derives a numerical ACTIVITY SCORE from the subject's answers to a series of formal questions put to him by an interviewer. (Fig. 1). The enquiries cover the ability to don and doff the prosthesis, the length of time it is worn, stairs climbing, details of employment, aids used, domestic responsibilities, regular walking habits and social activity. Some questions require a simple direct response, others are of the multiple choice variety. The interview, which takes about 15 minutes, should be conducted by someone with knowledge of amputee rehabilitation and who has been trained in this method, as he or she may need to ask supplementary questions if the patient appears to be exaggerating or diminishing his capabilities. The details of this training is beyond the scope of this paper but is quite simple and takes only a few hours. "Observer judgement" is limited to asking the patient to reconsider his answers if they appear unlikely. At no time should the interviewer alter a final answer without the patient's agreement.

The completed report sheet is inserted into a marking aid and the figure appropriate to each section determined (Fig. 2). Some of the answers attract simple positive or negative marks, whilst other scores awarded depend on the combination of answers to more than one question. The individual section scores are summed to provide the overall ACTIVITY SCORE, which will lie between −70 and +50. It should be emphasized that marking is a straightforward office procedure, taking about two minutes, and requires no interpretation providing that the interviewer has completed the form in detail.

This system appears to satisfy the criteria suggested earlier, but its validation must be considered. Throughout the period of

Table 1. Clinical Assessment

ACTIVITY SCORES	Very High	High	Average	Restricted	Inactive
More than + 30	100%	10%	—	—	—
+ 10 to + 29	—	58%	7%	—	—
− 9 to + 9	—	32%	56%	3%	—
− 40 to − 10	—	—	35%	61%	—
Less than − 40	—	—	2%	36%	100%

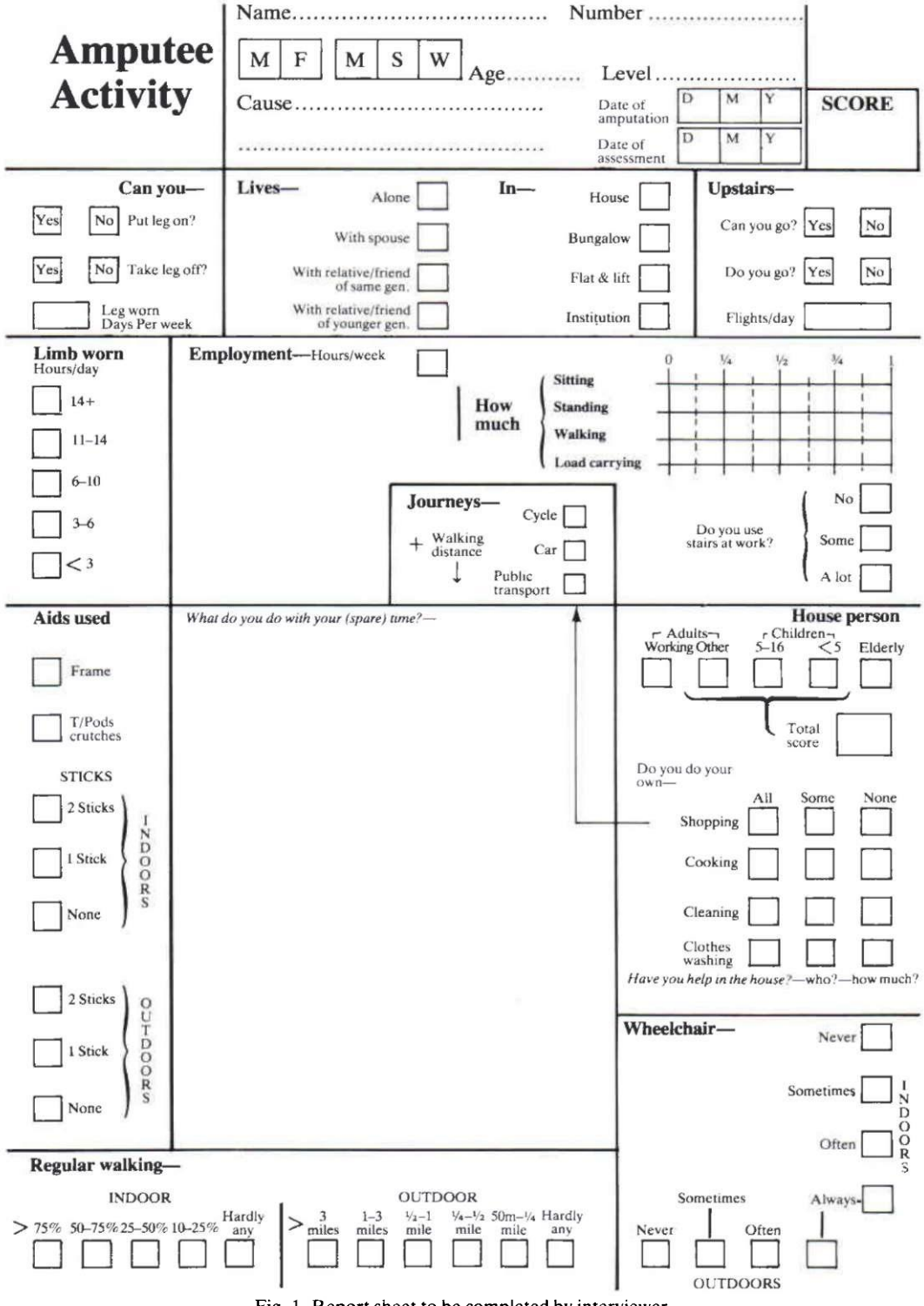

Fig. 1. Report sheet to be completed by interviewer.

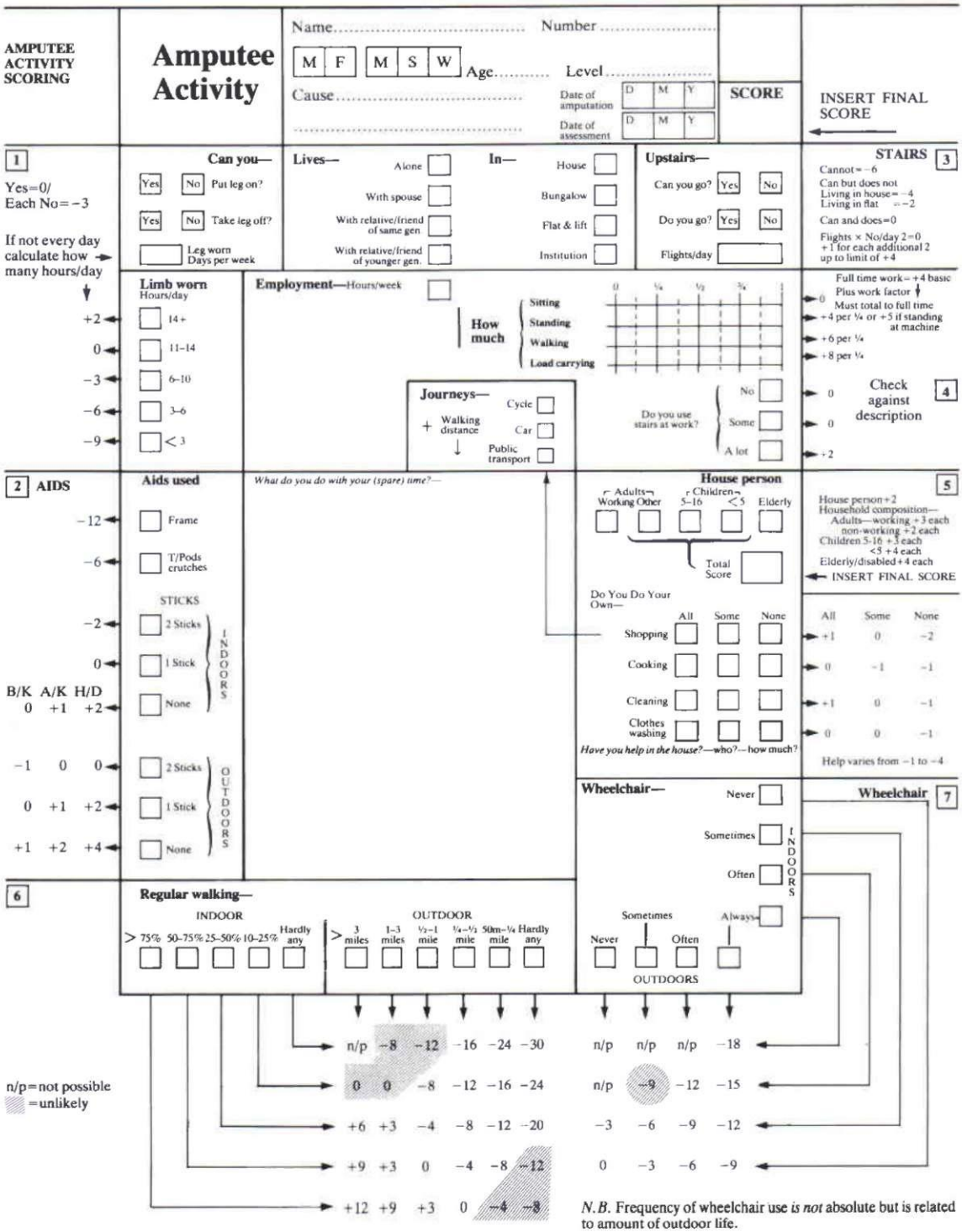

Fig. 2. Marking aid with report sheet inserted (see text).

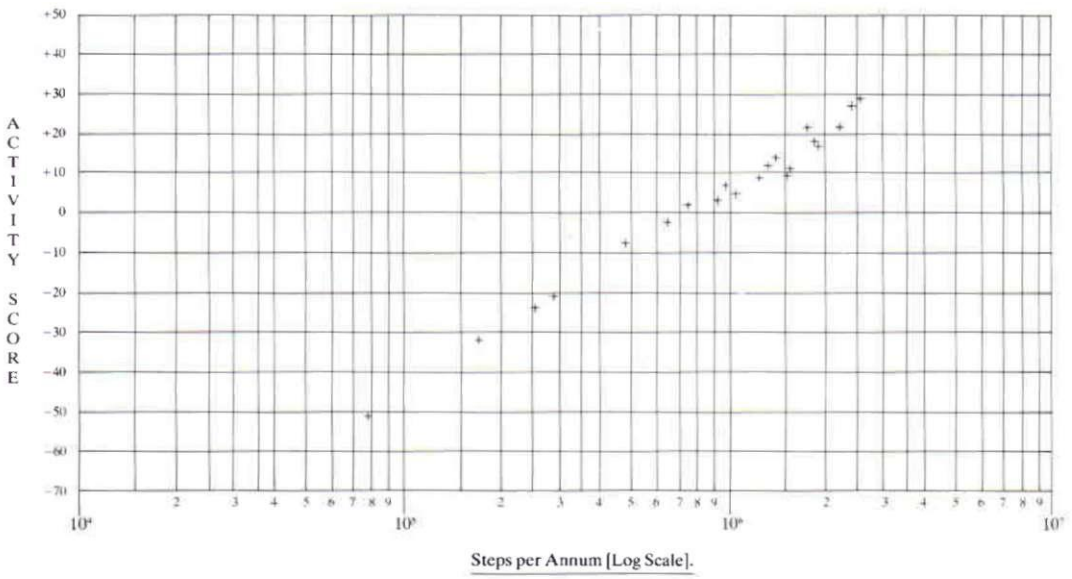

Fig. 3. Annual step count plotted against the activity score confirms linearity of the scale.

development various tests were applied and it was in response to their result that refinements were made. The following validation procedure applies to the final method and is in three parts.

1. Some 390 patients were independently assessed by experienced clinicians and assigned to one of five categories: Very High, High, Average, Restricted and Inactive. These assessments were compared with the activity scores obtained (Table 1).

In each of the intermediate three categories some 40% of patients have scores outside the appropriate band. If the distribution of error was normal we would expect about 20% of those in each category to score either side of the band, but in each case far more score below than above. This indicates either optimism in the clinical assessment or pessimism in the questionnaire method. Examination of clinical records indicate that over optimism is the prime cause of error and indeed all those categorized as Inactive actually scored less than −50. The shift in the three intermediate groups of 11%, 15% and 16% respectively, confirm or are confirmed by the results of a separate small survey using only 3 categories of activity, High, Average or Low which showed an optimistic shift of 12%.

2. The second validation procedure is to test the system's repeatability. In a small number of amputees the process was repeated after an interval of a few months. In every case in which the two scores obtained differed by more than 5 points, a reason was clearly shown in the clinical records. Those whose score had increased had either returned to full time employment or undergone a successful reconstructive operation on the contralateral dysvascular leg in the period between the assessments. In those whose score had decreased, the symptoms and signs of further handicap had appeared and been noted before the second assessment.

3. Finally, it is necessary to correlate, the score with the annual step rate to confirm the linearity of the scale and to equate this to the amount of walking actually done.

A counter using C-MOS logic was designed. (Day et al 1978). This self powered unit, small enough to allow easy attachment to the prosthesis is connected by a thin cable to a flat foot switch which can be fastened temporarily with adhesive tape to the underside of the heel inside the shoe. After wearing the unit for about ten days the subject is questioned and a score derived in the usual way. An external interrogator determines the number of steps taken during the trial. This number is converted to an annual step count and the result plotted against the Activity Score (Fig. 3).

To date 21 patients have been investigated. The annual step rates range between 79,000 and 2,588,000 relating to scores of −52 and +29 respectively. The curve of the score plotted against the logarithm of the annual step count is substantially linear, but work continues to confirm this and to determine the end points. It will be noted that within the range of −50 to +25 an increase of 15 in the score is roughly equal to doubling the annual step count.

Conclusion

The method presented provides a means of assessment which is unaffected by consideration of age, disability etc. The result is described as a numerical score, providing no difficulties in communication, which can be related to an actual step rate with a substantially linear scale.

The method can be used internationally, metrication posing no difficulty, but for use in some societies individual questions, though not their score weighting, might require alteration. Indeed the system could be adapted for use with other locomotor disabilities.

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REFERENCES

DAY, H. J. B., MANN, A., and NEAL, A. (1978). Step counting. In: *D.H.S.S. Biomechanical Research and Development Unit,* Report, 253–257.

HOLDEN, J., FERNIE, G. R., and SOTO, M. (1979). An assessment of a system to monitor the activity of patients in a Rehabilitation programme. *Pros. & Orth. Int.* **3**, 99–102.