

Ergonomic evaluation of a new type of rollator

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A prototype of a novel rollator, named “Walker” on the Swedish market, was evaluated with respect to obstacle climbing, steering and general usability. The prototype has a novel design with a triangular base and a double front wheel on a lever arm arrangement to simplify passing across obstacles. Both technical tests and user tests were carried out.

The main conclusion is that “Walker” is in several respects ergonomically advantageous compared to the traditional out-door rollators, especially in rough terrain and when passing obstacles. Suggestions for improvements of certain functions of “Walker” are made, such as handling in narrow environments and the ability to fold the rollator.

Key-words: Mobility aid, rollator, ergonomic, usability

1 Introduction

Mobility aids are anticipated to be increasingly demanded in the future. Apart from an ageing population in Europe the elderly of the next decades are not expected to be content with a passive everyday living. To meet this demand a conceptually new outdoor rollator named “Walker” has been developed. The main focus has been to improve the accessibility to outdoor environments and to give the rollator an appealing design.

As traditional rollators often halt suddenly at certain obstacles, such as pavement curbs, the new rollator is equipped with a double front wheel arranged on a lever arm system so that the rollator can “climb” across obstacles, see Figures 1 and 5. This allows a smooth passing across obstacles and in rough terrain. In addition, the new rollator is planned to be produced in different coloured layouts to allow the user to choose an individual style. In the present paper, a study carried out by ERAK, as commissioned by Trionic AB, is reported.

2 Objectives

The goal of the study was to perform an independent ergonomic evaluation of *Walker*, in particular with respect to its capacity to overcome obstacles, steering and general user-friendliness. Furthermore, the goal has been to benchmark the technical performance of *Walker* when overcoming obstacles to that of the two most used outdoor rollators on the Swedish market.

3 Method

The evaluation consisted of a technical part in which the forces needed for passing of four different obstacles (curb stones and door-sills) were measured for “Walker” and two common out-door rollators in Sweden, see Figure 1. In addition, a user survey was carried out in which ten rollator-users evaluated “Walker” in comparison to their standard rollator. In addition, a literature review has been made with respect to rollator usage and user satisfaction with traditional rollators.



Figure 1: A conventional rollator tested, Dolomite Soprano (left), and the Walker prototype (right).

3.1 Technical tests

Technical handling tests were performed with *Walker* and two outdoor rollators common on the Swedish market, *Carl-Oskar* from Ahlberg-Leber and *Soprano* from Dolomite. The force needed to overcome typical obstacles was evaluated as well as general maneuverability and weight. The obstacles investigated were standard thresholds (42 mm and 29 mm) as well as curb-stones: 70 mm and 32 mm with a 45 degree slant.

For these tests, the rollator was driven across the obstacle while the maximum force was registered with a digital force indicator as shown in Figure 2. For all rollators tested the handle was fixed at 90 cm above ground. Each test was repeated ten times, and a mean force value was calculated for each obstacle, see Hallén et al (2006).



Figure 2: Cross-section of a standard threshold [left]. Traversing a threshold [center] and a curb [right] with the Walker prototype. The force is registered.

3.2 User tests

In the user-based tests ten rollator users participated, six women and four men. Seven out of the ten participants made contact to Trionic or ERAK, replying to advertisements at the internet, rollator agents, service flats, in stores or through personal contacts. The remaining three were contacted by ERAK. Four persons who initially showed interest in the study later declined to participate. Two of them mentioned that Walker was too bulky, and two replied it did not have an appealing design. The participants were between 20 and 95 years old with an average of 60 years. Three of them were younger than 39 years and six were older than 60 years.

The participants were lent a Walker prototype for daily life evaluation during a two week period. After this period, semi-structured interviews were carried out as well as a monitored walk over a course representing lightly forested terrain with Walker and with the user's standard rollator. Hereby Borg's RPE scale (Borg et al., 1987) and body maps (Kuorinka et al., 1987) were used, as well as electromyographical methods with surface electrodes placed on the left and right trapezius muscles, see Figure 4. Photo- and video-documentation was also made.



Figure 4: EMG recording when using the Carl-Oskar rollator in the terrain.

4 Results

4.1 Literature survey

The literature search resulted in a relatively small number of relevant publications. A selection of those found to relate to rollator usage and the user needs is found in the reference list of the present paper, see further Hallén et al (2006).

The most comprehensive survey is reported by Brant (2000), in which 64 new rollator users were interviewed after one and four months of use. In the study, the most quoted problems were to handle and operate the rollators, especially outdoors. They felt heavy and hard to control on sloping surfaces. Also traversing curbs and transporting the rollator was reported as problematic. It was also stated that rollators may make the user feel old.

The women in the study were up to three times more dissatisfied than the men. The hard part for them was to control the rollator, which could be attributed to that women generally are physically weaker than men, and that more women live alone thus having a harder time getting help with their rollators than men do. The younger users, under 70 years, were less satisfied with the rollators' area of use and the transportation of the rollator. The reason was assumed to be that younger users have a more active life and have greater demands for different activities. The older users, over 70 years, were less satisfied with the weight of the rollator.

When it comes to product development, there were wishes to access lighter and more direction stable rollators that can climb a curb more easily. Moreover, the users asked for rollators that are easy to handle, both to maneuver and to lift and transport.

4.2 *Weight and handling*

Some of the participants in the user tests (see below) reported the Walker prototype to be heavy. However, all rollators tested had a nominal weight in the same range (9-11 kg). The reason is rather that the Walker prototype has its center of gravity further away from the bar handles than traditional rollators. This leads to more strenuous maneuvering in sloping terrain and difficulties when lifting the rollator up stairs etc, particularly when the basket is loaded.

Another issue with the Walker design is that turning with the rollator is much restrained when operating on a gripping ground, like painted concrete. The reason is a gripping effect of the double front wheel arrangement. For this reason it is possible to lift the front wheel 3 mm, and fix it in this position using a spring-loaded pin. This arrangement fully eliminates the problem, see Figure 5. However, to change the wheel position the user has to bend down to floor level, or lift up the front of the rollator, which was reported to be cumbersome by some participants in the user tests.



Figure 5: The front wheel of Walker in upper (left) and lower (right) position.

4.3 *Passing obstacles*

The forces needed to pass obstacles were considerably reduced using “Walker”. The traditional rollators required 6-13 times greater force for the curbs and thresholds tested, see further Hallén et al (2006). One of the standard rollators had to be lifted across the higher curb-stone. With the front wheel fixed in its upper position the force needed for Walker was slightly higher than with the wheel in its lower position.

4.4 *User tests*

The EMG results from the monitored walk, as in Figure 4, show that the highest stress measured for ten participants was on average 15 % lower when the participants used Walker compared to their standard rollator, see Hallén et al (2006). This is interpreted as a lowered trapezius muscle tension when using Walker for the walk. Note that the ground of the terrain chosen for the monitored walk was fairly smooth. With both rollators most strain was perceived in the shoulders, justifying the choice of sensor placement.

In the user evaluations after the two week test period Walker was ranked higher than the traditional rollators in all out-door environments, see Figure 6 and Figure 7. A complete listing of the questionnaire is given in Hallén et al (2006). Also other functions were appreciated, such as the overall design and the brake. However, in shops and other in-door environments Walker was judged to be less practical than traditional

rollators, mainly due to its wider body frame restricting accessibility in narrow spaces. Also, the prototype was perceived as heavy when lifting it up stairs etc.

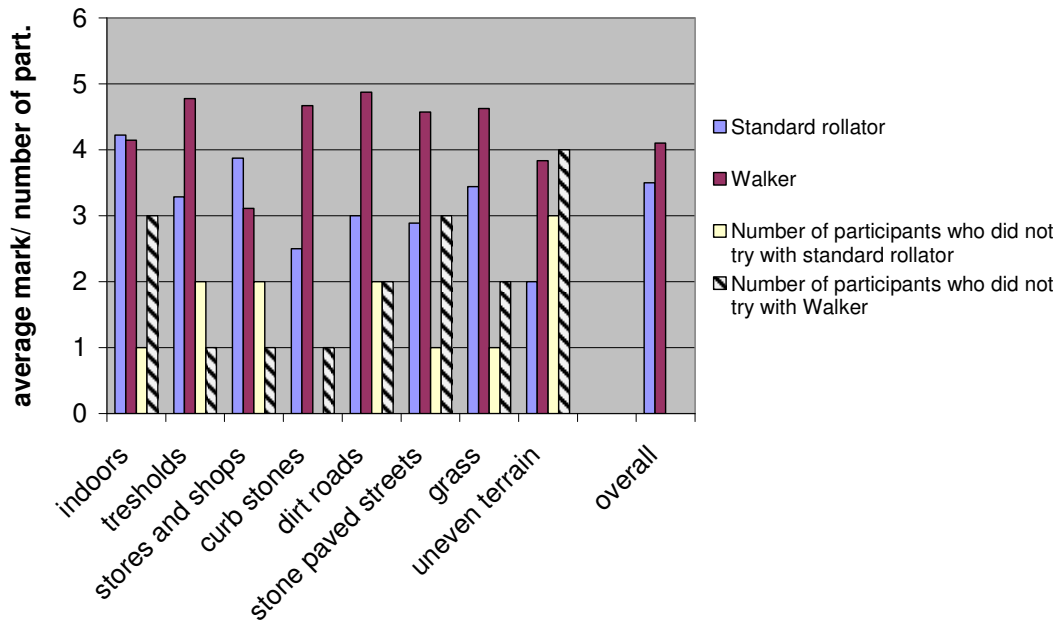


Figure 6. Average marks for Walker and the participants' standard rollator on different grounds.

Areas for which Walker would benefit from improved design and functionality were identified, such as the folding function and the physical width, and suggestions for improvements are given in Hallén et al (2006). Especially elderly participants stated that the Walker prototype needs further development whereas the younger participants had fewer remarks. However, seven out of nine users in the test group stated that they would rather keep Walker than their standard rollator.

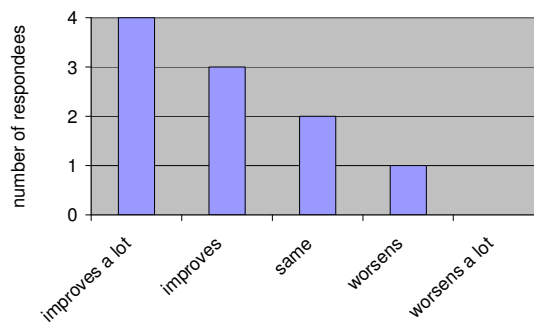


Figure 7: Answers to the question "How does Walker change the possibility to overcome obstacles compared to your standard rollator?"

5 Discussion

Only ten participants were taking part in the user based study and the results from the user tests must therefore be viewed as preliminary. Moreover, the participants may not be representative to typical rollator users as some were joining the group after having shown interest in the Walker product after exposure at fairs and alike. Also, note that the average age in the group (60 years) is lower than that of a typical rollator user. This was deliberate as Walker has been developed to attract younger rollator users.

The measured decrease in EMG level on the trapezius muscles when using Walker as compared to standard rollators was fairly small. A greater difference is expected if the tests were repeated in a more rough terrain with more pronounced obstacles (stones, tree-roots etc). In the RPE subjective rating the walk was in average rated as 'fairly easy' with Walker and 'somewhat strenuous' with the participants standard rollator.

Still, the results from the semi-structured interviews and the evaluation of the monitored walk are that the Walker prototype is perceived as ergonomically advantageous in out-door environments. In addition the technical tests showed that the force needed for passing typical obstacles is substantially lower with the Walker prototype.

6 Conclusion

The main conclusion of the study is that Walker in several respects is ergonomically advantageous compared to conventional rollators when used in terrain and when passing obstacles. The forces measured when passing typical obstacles were 6-13 times lower than those measured using standard rollators.

The semi-structured interviews at the end of the two week test period showed that the participants of the user group judged Walker to be advantageous in all tested out-door environments. The younger participants in the evaluation study were more positive towards Walker than the older participants.

Certain functions of the Walker prototype were found to have technical shortcomings, especially accessibility to narrow indoor environments and the procedure applied when folding the rollator, e.g. for transport in a car. To meet the needs of particularly elderly users, the mechanism for rollator disassembly should be improved, especially folding and detachment of wheels.

7 References

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