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MASTER TURNER

Wash and friction test rapport

1.0 Purpose:

Padded turning systems aim to reduce friction when transferring users with physical and/or cognitive impairments to reduce the risk of shear injuries to the user and the risk of work-related injuries to caregivers during everyday repositioning. Washing and drying the system wears out the products, which increases friction during transfers, which increases the risk of injures to the user and caregiver[1].

The purpose of this study is to investigate how friction changes for a Master Turner turning system during washing and drying 0-50 times, and whether changing procedures can contribute to a longer lifespan for the turning system.

2.0 Test setup, procedure and test material:

Wash and friction test were performed by RISE- Research Institutes of Sweden AB – Swerea, reference no: O100560-1255375-2 for master care A/S, Sofienlystvej 3, 8340 Malling, Denmark.

2.1 Test material

The test was performed on a Master Turner, in this case Master Turner Royal Combi (A) and a mattress cover Vario Cover ST (B)[2].

2.2 Wash and drying procedure:

Wash and drying were performed in accordance with a modified EN ISO 6330:2021 (see below). The washing test was based on the latest requirements from a Danish tender in 2023/2024, where demands for higher washing temperature and demands for drying in a tumble dryer were required.

The Danish Technological Institute has tested and found that washing the materials at 70°C for a minimum of 20 minutes complies with the limit values for washing according to NIR[3].

It has not been possible for RISE to dry the products at a maximum of 40°C, which is why it is estimated that drying the materials at 50°C with a residual moisture of 12% (±3) will have a similar effect of the products as drying at 40°C.

2.2.1 Test procedure – wash and drying:

Washing procedure:

- Modification: 7 N (70°C), 20 min, cool down to 55°C.
- Washing machine: Type A (Electrolux Wascator FOM 71 CLS)
- Detergent: 3 (ECE A without bleach)
- Dosage: 20g/wash cycle.
- Number of washes: 50 (samples taken out for friction test every 10 washes)

Drying procedure:

- Procedure: F, tumble dry
- Tumble dryer: Type A1, Electrolux 5130 (B and C) Electrolux T5190 (A)
- Temperature: Max 50°C

2.3 Procedure friction test:

The coefficient of friction between the materials was determined according to EN ISO 14882:2005. The test was performed at wash/drying cycles: 0, 10, 20, 30, 40 and 50. Test climate: According to EN ISO 139:2005 20 ±2 °C and 65 ±4 % RH.

Friction test is carried out to simulate a transfer of a user in bed on a turning system going:

- Up and down in bed
- Turning (from side to side)

2.3.1 Test modifications – friction:

The friction test is modified to correspond to the pressure of an 80 kg person on a mattress. This is chosen so that the test reflects an average user of a turning system.

3.0 Test results:

The friction tests are performed 2 times in each direction and show results for:

Static friction – the maximum friction before movement is initiated – how much force must be applied before an object can be set in motion.

Dynamic friction – maximum friction during movement- the maximum force needed to keep the object in motion.

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[1] User – person lying on the turning system. Caregiver – person who handles the turning system during transfers in bed.

[2] Test materials have been received (at RISE) from the client (master care A/S) on the 27.3.2024.

[3] National Infection Hygiene Guidelines (DK: *"Nationale Infektionshygiejniske Retningslinjer"*)

3.1 Test material:

A – Master Turner Royal Combi (Padded blue turning sheet).
B – Vario Cover (Gray mattress cover with nylon in the middle).

3.2 Test combinations:

Combination A1 + B1 – shows the friction when both Master Turner and Vario Cover is washed.
Combination A1 + B2 – shows the friction if only the Master Turner is washed (Vario Cover remains unwashed).

3.3 Static friction results:

Amount of cycles/material	0 ↑↓	0 ←→	10 ↑↓	10 ←→	20 ↑↓	20 ←→	30 ↑↓	30 ←→	40 ↑↓	40 ←→	50 ↑↓	50 ←→
A1 + B1	0,17	0,17	0,23	0,27	0,25	0,24	0,25	0,27	0,24	0,23	0,24	0,23
A1 + B2	0,17	0,17	0,21	0,18	0,21	0,17	0,19	0,17	0,19	0,18	0,19	0,18

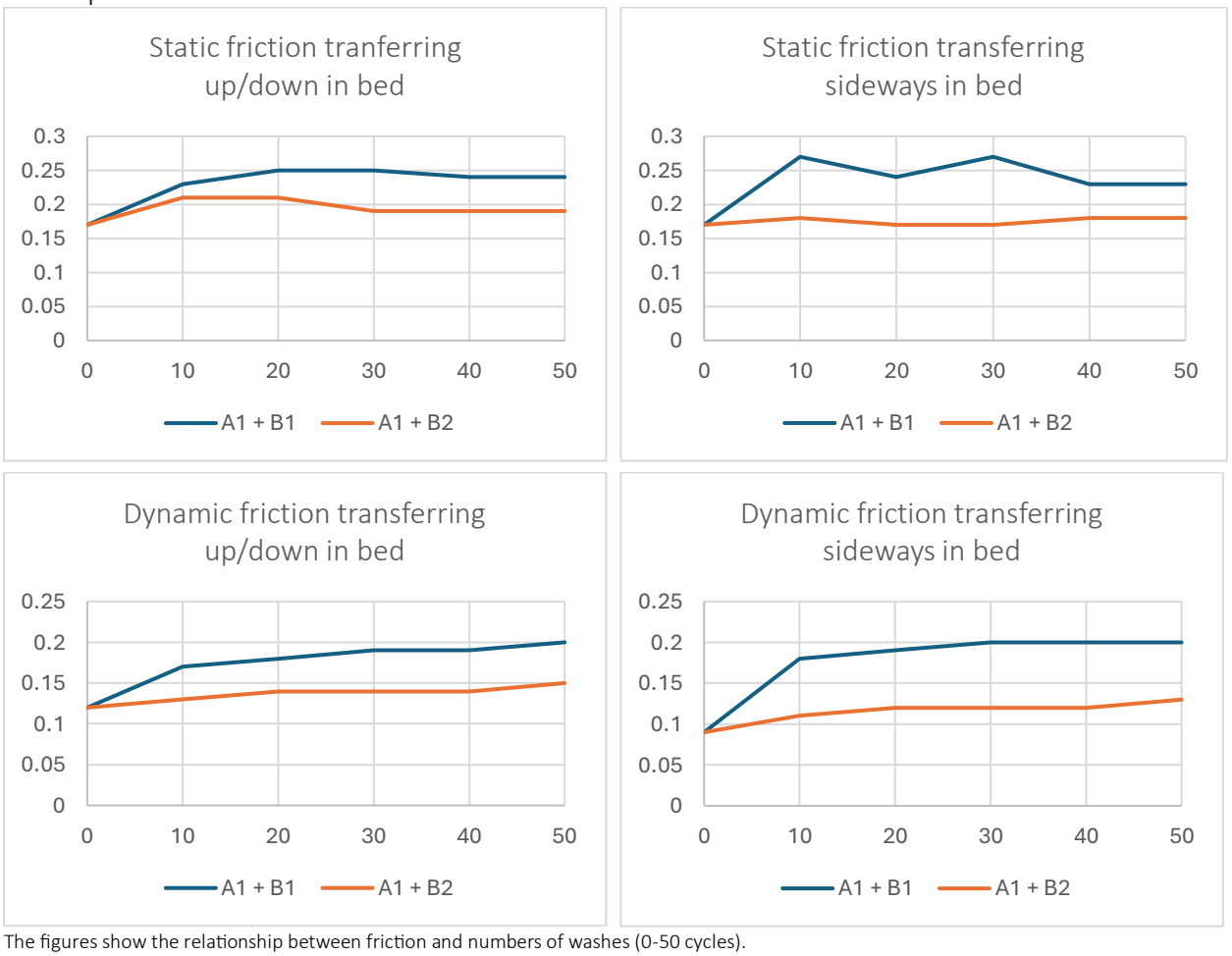
Table 1. Static friction coefficient (average value of two test)
The table shows the friction corresponding to movements up/down in bed (↑↓) and movements sideways in bed (←→).

3.4 Dynamic friction results:

Amount of cycles/material	0 ↑↓	0 ←→	10 ↑↓	10 ←→	20 ↑↓	20 ←→	30 ↑↓	30 ←→	40 ↑↓	40 ←→	50 ↑↓	50 ←→
A1 + B1	0,12	0,09	0,17	0,18	0,18	0,19	0,19	0,20	0,19	0,20	0,20	0,20
A1 + B2	0,12	0,09	0,13	0,11	0,14	0,12	0,14	0,12	0,14	0,12	0,15	0,13

Table 2. Dynamic friction coefficient (average value of two tests)
The table shows the friction corresponding to movements up/down in bed (↑↓) and movements sideways in bed (←→).

3.5 Graphical results:



The figures show the relationship between friction and numbers of washes (0-50 cycles).

4.0 Test result and discussion:

RISE – Research Institutes of Sweden AB has tested the Master Turner turning system's friction before and after 0, 10, 20, 30, 40 and 50 washing/drying cycles (hereafter referred to as the wash cycles) to determine the impact of washing/drying on the system's ability to reduce friction when transferring an 80 kg person in bed. In addition, friction is tested using a washed Master Turner in combination with an unwashed mattress cover.

The largest increase in friction is seen between wash cycle 0-10, where the entire turning system is washed (A1 + B1). During the rest of the test period (10-50 cycles) only small fluctuations in friction are seen. It can be concluded that friction does not increase significantly whether the system is washed 10 times or 50 times.

Static friction is generally higher than dynamic friction. This is due to the fact that it takes more effort to set an object in motion than to keep it moving[4]. Since both static and dynamic friction must be overcome before the caregiver can turn or pull the user into bed or reposition the user, it is important that both friction results are as low as possible. The washing test shows that neither static nor dynamic friction increases significantly during the test cycle (10-50).

If the sliding material on the cover wrinkles after washing, the anti-slip edge will pull towards the middle of the mattress and the user will be stopped by the anti-slip part faster during transferring (decreased range of movement). The helper will experience an increase in friction and/or the transfers will be more difficult to carry out. In addition, the material's ability not to wrinkling is important for minimizing the risk of pressure ulcers. It is therefore important that the cover maintains its width and functionality in its life span even after being cleaned.
Looking at the pictures of the washed material, the Vario Cover only has a minimal tendency to crease/wrinkle even after many wash cycles (see Appendix 1). This means that the cover does not wrinkle under the user, which can be crucial for stabilizing the friction after 10 wash cycles and more. Furthermore, the wings on the side of the cover can, when mounted under the mattress, also minimize the risk of wrinkles when the cover is mounted on the mattress.

The test results show that if a larger increase in friction is needed under the user, it can be recommended to avoid washing the mattress cover and instead only wash the Master Turner (A1 + B2) if this is safe in terms of hygiene. This may be relevant for users with high BMI/ bariatric users, users with high tonus or users who "sink into the mattress" and therefore are extra heavy to move. In addition to minimizing friction, not washing the mattress cover will prolong the life span of the Vario Cover and will reduce the need to replace/buy new products and thereby have an economically positive effect.

There are small fluctuations in the measurements, where the friction seems to decrease the more the products are washed. This must be due to the low amount of test volume and not a statement of friction decreasing during increased washing cycle.

Over the last 20 years hygiene requirements for cleaning helping aids have become stricter. This has had a negative impact on the longevity of some helping aids including padded turning systems, as they are all constructed using the sliding properties of different types of nylon.
Therefore, it is crucial to test the friction value after washing the Master Turner to determine how we best accommodate the increase in hygiene demands and keep a high quality and functionality standard for the product. However, other factors can have an influence on the sliding properties such as the quality of the material, the use of the product, the quality of the mattress, and the weight of the user. The nylon on the Master Turner has been double-coated since 2022 and this, together with the materials dense weave and rip-stop function (670 N/5 cm), increases the durability of the Master Turner[5].
At the moment there are no alternative raw materials with as high anti-friction properties as nylon. This especially poses an issue for upholding a good ergonomic situation handling users over 90 kg. There is still a need to investigate other, more durable solutions for the turning systems in the future.

This pilot study shows that the biggest change in sliding properties for Master Turners is seen in the first 10 wash cycles. After this point, the curve is stabilized and there are only minimal changes in the sliding properties (10-50 cycles). This may indicate that it is the coating that deteriorates to some extent in the beginning. This is supported by the fact that the friction is much less affected when it is only the Master Turner that has been washed and not the mattress cover. Users who can avoid washing the Vario Cover can therefore expect longer durability and less friction when using the turning system.
We know that using fabric softeners has a detrimental effect on the coating. It is therefore important that the end user refrains from using softener and if possible, uses a gentle detergent.

[4] https://da. Wikapedia.org/wiki/Friction
[5] According to similar washing test done in 2014 on single coated nylon (static 0.27 vs 0.24) / (dynamic 0.22 vs 0.18)

5.0 Conclusion:

The clinical significance of the study is, as expected, that washing and drying does reduce the sliding properties for a Master Turner system. The study also shows that the product has a long life span of at least 50 wash/dry cycles with the same sliding properties (friction values) as after 10 cycles. If possible, by only washing and drying the Master Turner and not the Vario Cover, the initial reduction in sliding properties is minimized, the durability/life span of the turning system is extended, and the environmental impact of the turning system is minimized.

6.0 Perspective:

Future manufacturing of turning systems should focus on both the occupational aspect of minimizing strain for both users and caregivers when transferring the user in bed as well as how we minimize the environmental aspects of using turning systems and the durability of the system.
It is therefore important that when choosing the raw material for the product we focus on functionality, minimizing the need for washing or choose a material where the impact of the washing is low regarding the sliding properties. A more durable raw material should also lead to a decrease in new purchases and less textile waste. This has a high environmental impact. Optimally, the finished product should be included in a recycling process so that the raw materials have as small a climate footprint as possible.

Based on our knowledge in the field there are still no raw materials that meet the requirements listed above. Therefore, we should take a closer look at what can be done to extend the life span of the products. Empirical feedback shows us that if it is possible to hang-dry the products, do gentle washing and use e.g. incontinence sheets for users with incontinence challenges, the life span of the Master Turner system is extended. The climate footprint of using incontinence sheets has not been accounted for, but it is assumed that using a reusable incontinence product has a smaller climate footprint than washing an entire turning system.

Appendix 1:

Material before wash/drying – 0 x wash/drying:

Material after 10 x wash/drying:

Material after 20 x wash/drying:

Material after 30 x wash/drying:

Material after 40 x wash/drying:

Material after 50 x wash/drying:

master care A/S, Sofienlystvej 3, 8340 Malling, Denmark
Phone no. +45 86938585- mail: info@master-care.dk – www.master-care.dk