ICC Annual Meeting 2018: Chronic Edema and Compression

Monitoring of Leg-Edema-Treatment by Electronic Devices

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June 7th 2018

Agenda

Monitoring of Edema–Treatment using Electronic Devices

01 Introduction Bodytronic 600

02 Comparison BT600 – water displacement

03 Validation of BT600 for volume measurement

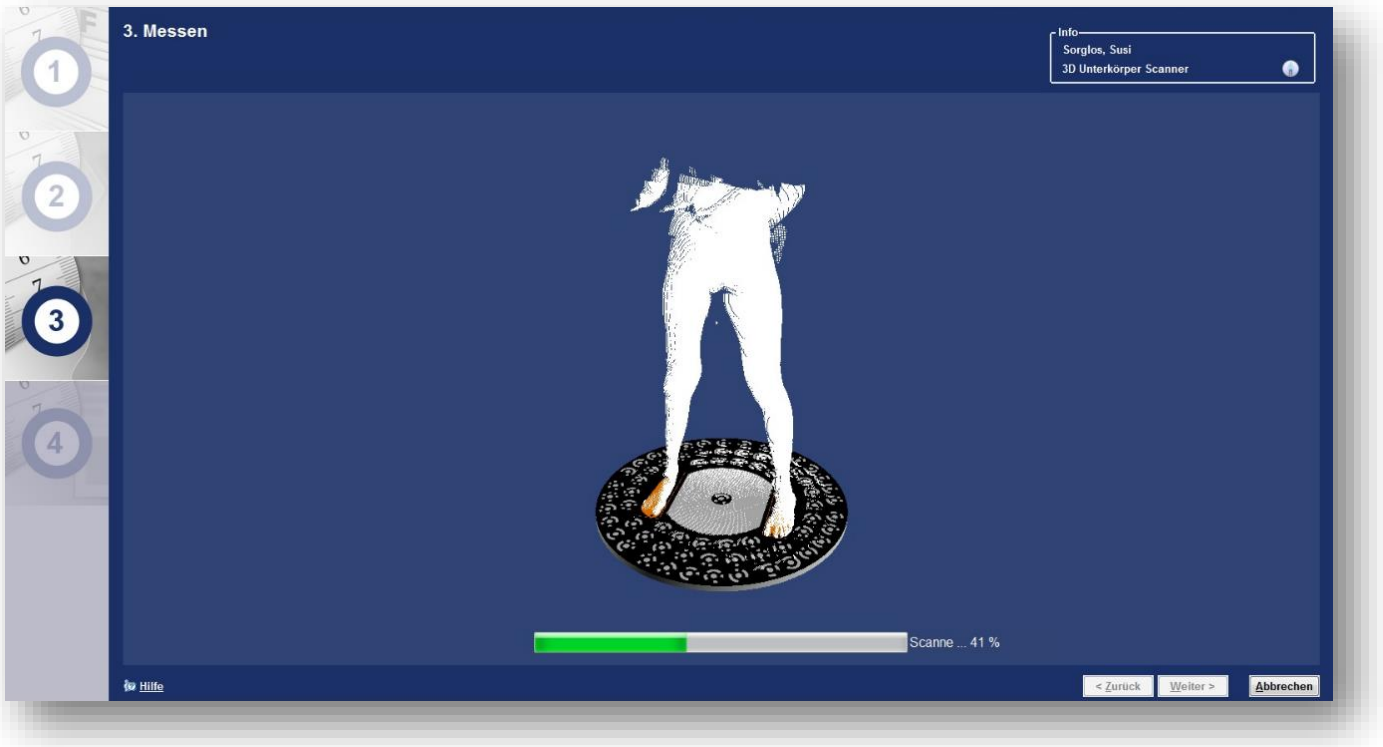
04 Summary

01 Introduction of Bodytronic 600.

Bodytronic® 600
system overview

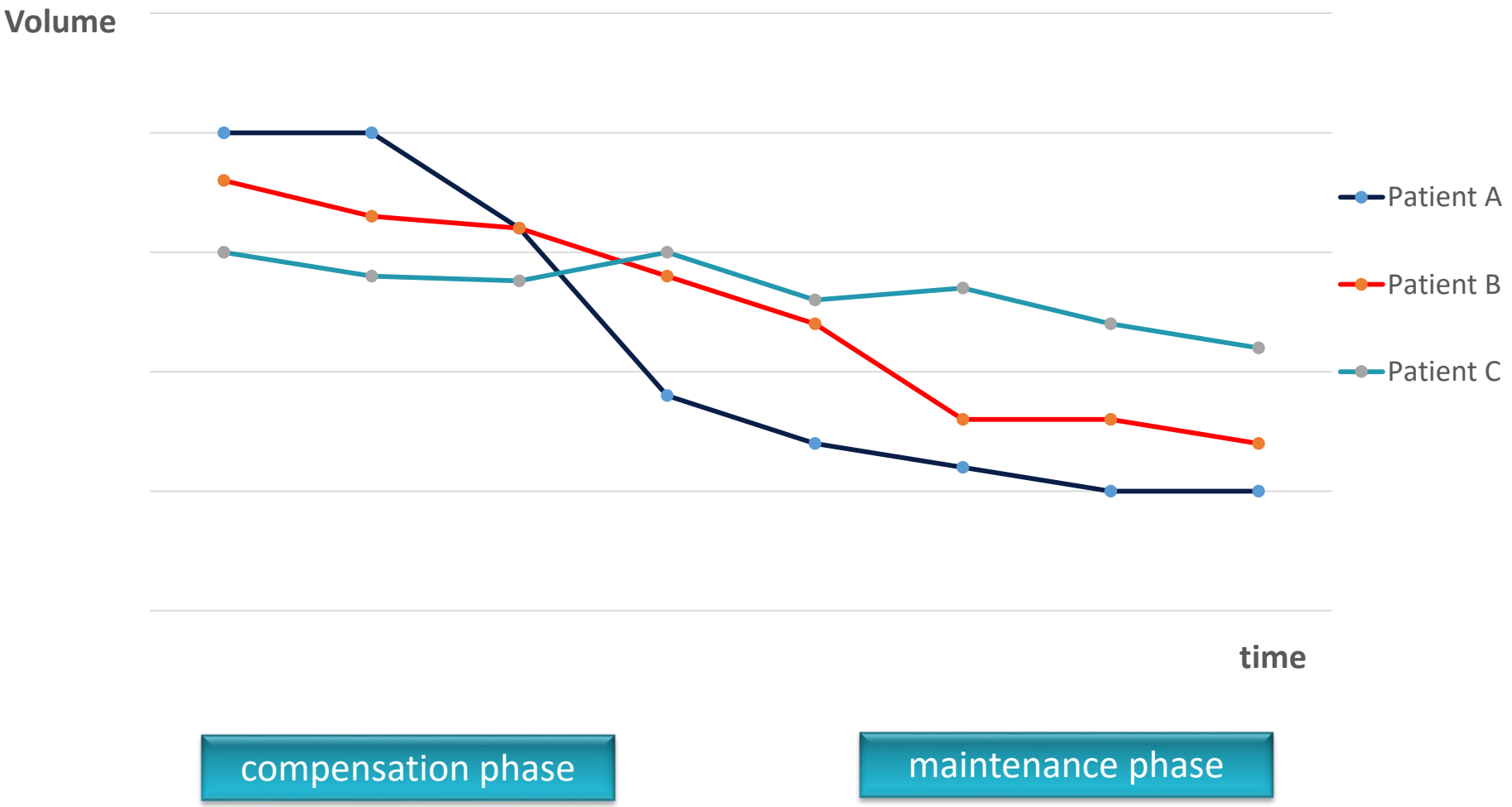
width:	1.24m
length:	2.30m
height:	2.30m
base area:	2.85m²
weight:	ca. 250kg

Measuring process



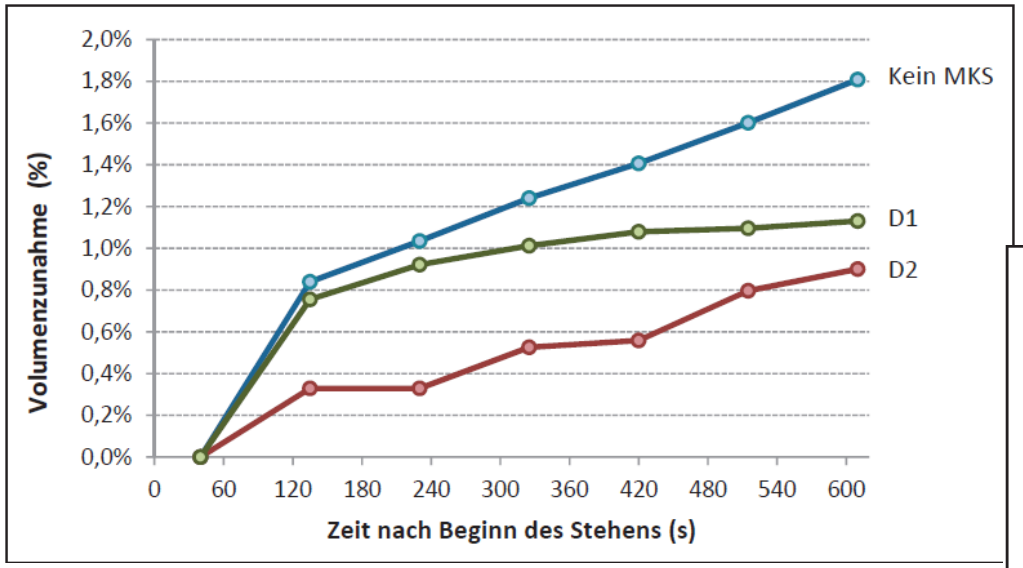
- During measuring phase platform is automatically rotating a full circle (360°).
- Simultaneously to rotating process the 3-D-model will be calculated and displayed on the PC-screen.
- As post process volume will be calculated in segments:
  calf volume ankle up to knee (A-D), thigh volume knee to thigh (D-G) and panty volume (G-waist).

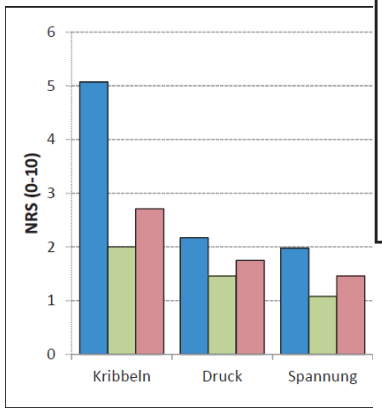
Example of volume documentation by BT600

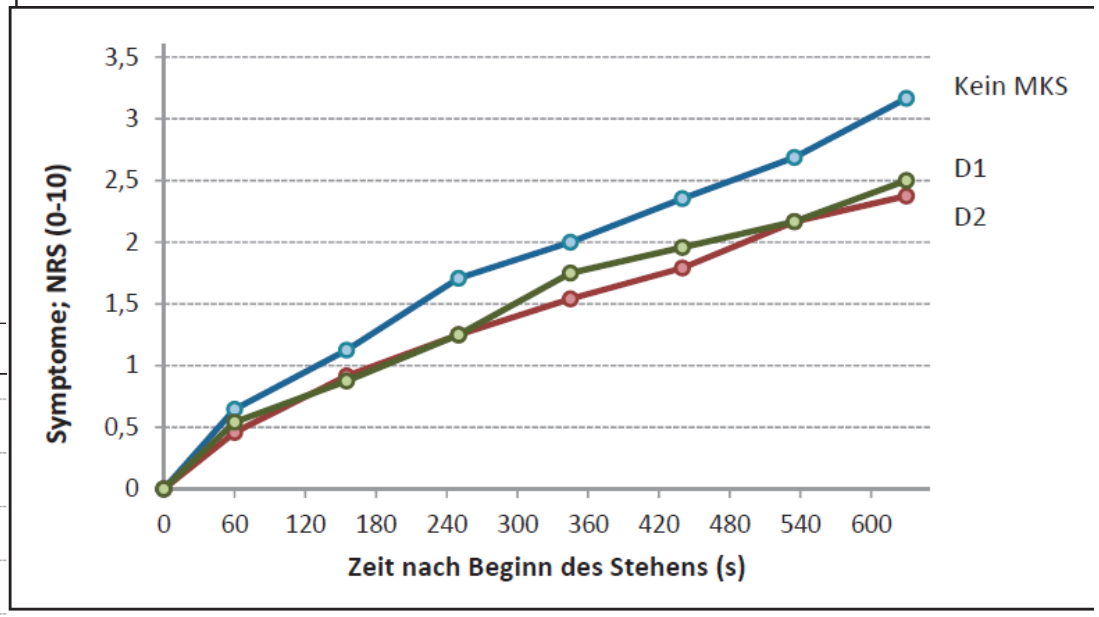


First: Technique was already successfully used for clinical trials!

Expl #1: „CVS-study“ by Blättler, Thomä, Winkler, Amsler







First: Technique was already successfully used for clinical trials!

Expl. #2: „ulcertec-AG-study“ by Konschake, Jünger

- the influence of calf & thigh compression on leg-edema was examined
- Result #1:
  - by calf-length compression the edema was compensated in calf area but
  - in thigh area the compensated edema arose as a similar volume increase.
- Result #2:
  - light thigh compression was sufficient to compensate the edema along the whole leg (< 10 mmHg)

Clinical Hemorheology and Microcirculation 64 (2016) 425–434
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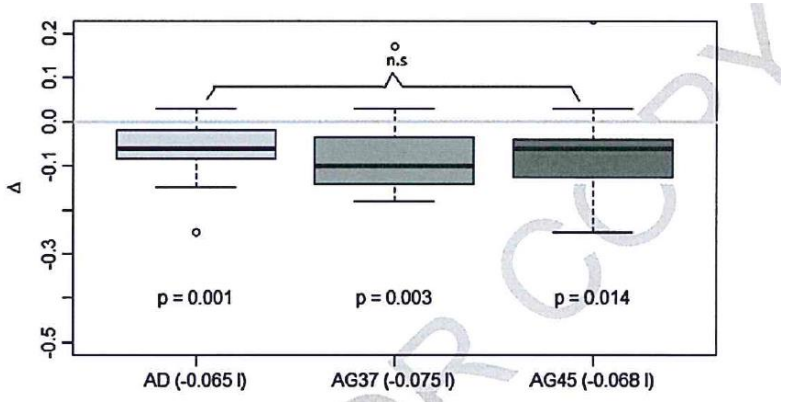
IOS Press

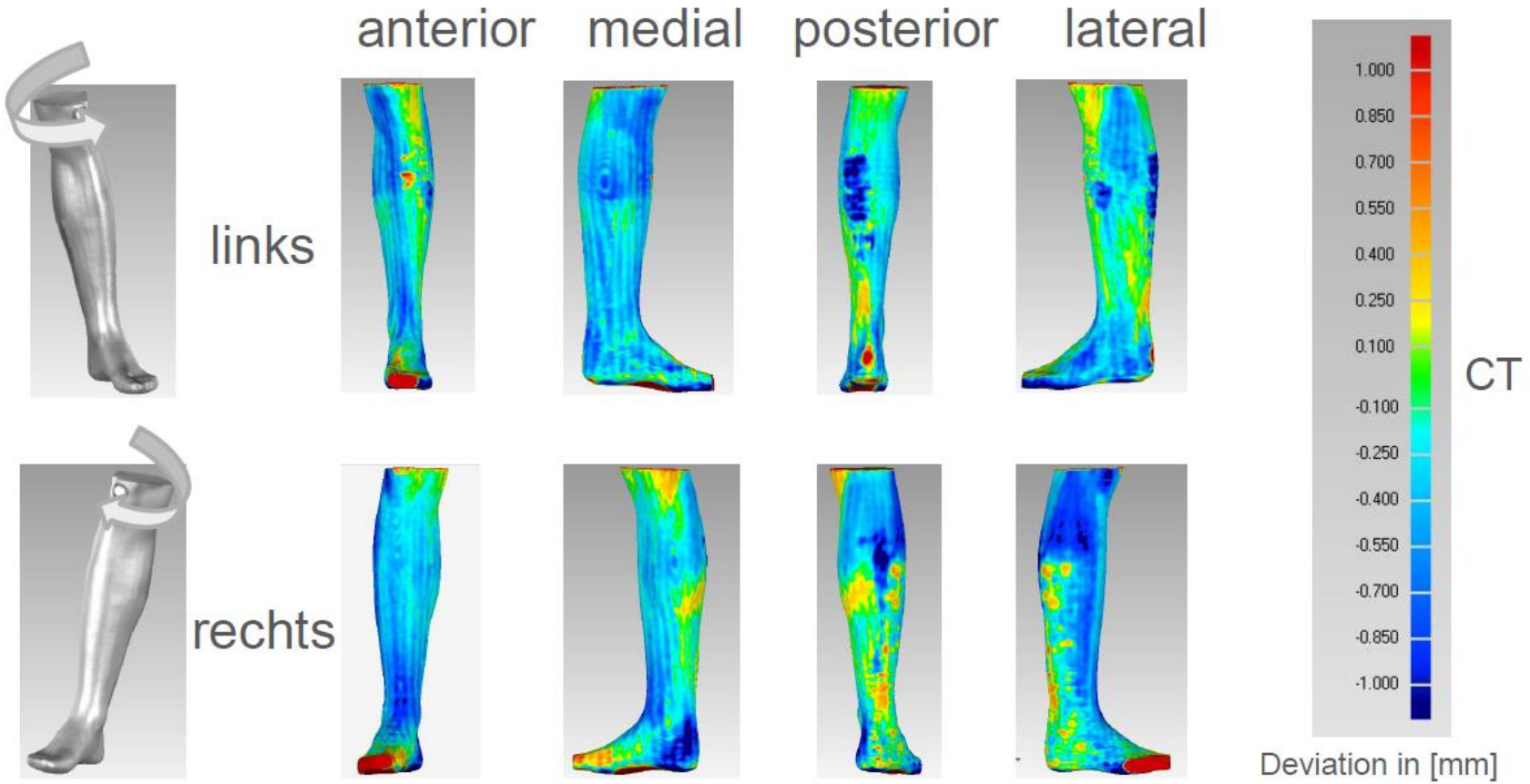
Compression in the treatment of chronic venous insufficiency: Efficacy depending on the length of the stocking

Wolfgang Konschake*, Helene Riebe, P. Pediaditi, Hermann Haase, Michael Jünger and Stine Lutze
Department of Dermatology, Universitätsmedizin Greifswald, Germany



Investigation of Universitätsmedizin Rostock (Tischer 2015)

Ergebnisse: 3D Oberflächen Analyse CT vs Bodytronic



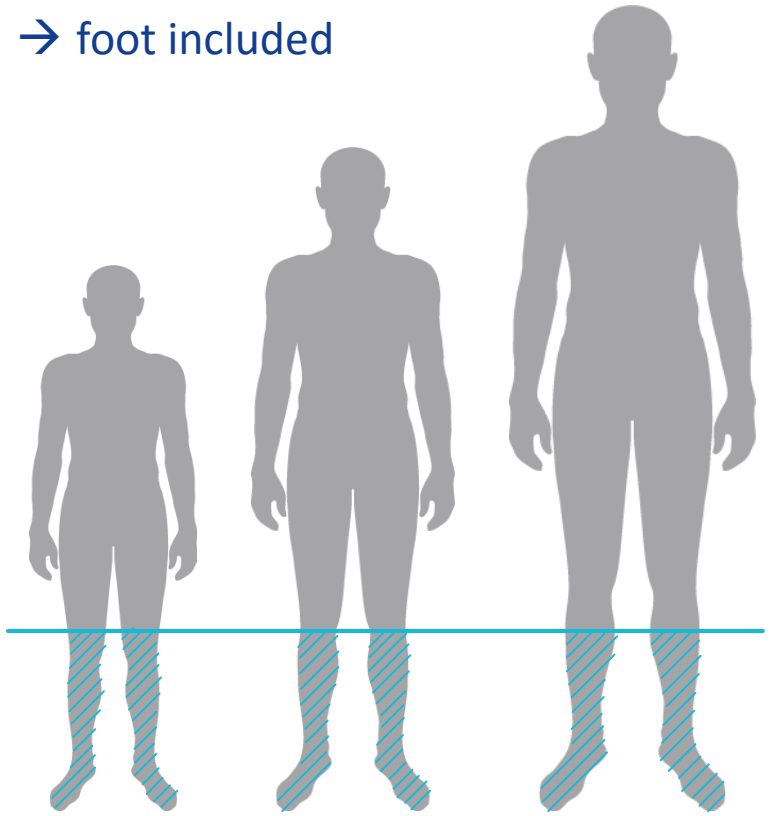
Hohe Übereinstimmung -> sehr genaue Messung

02 Comparison BT600 – water displacement

Comparison

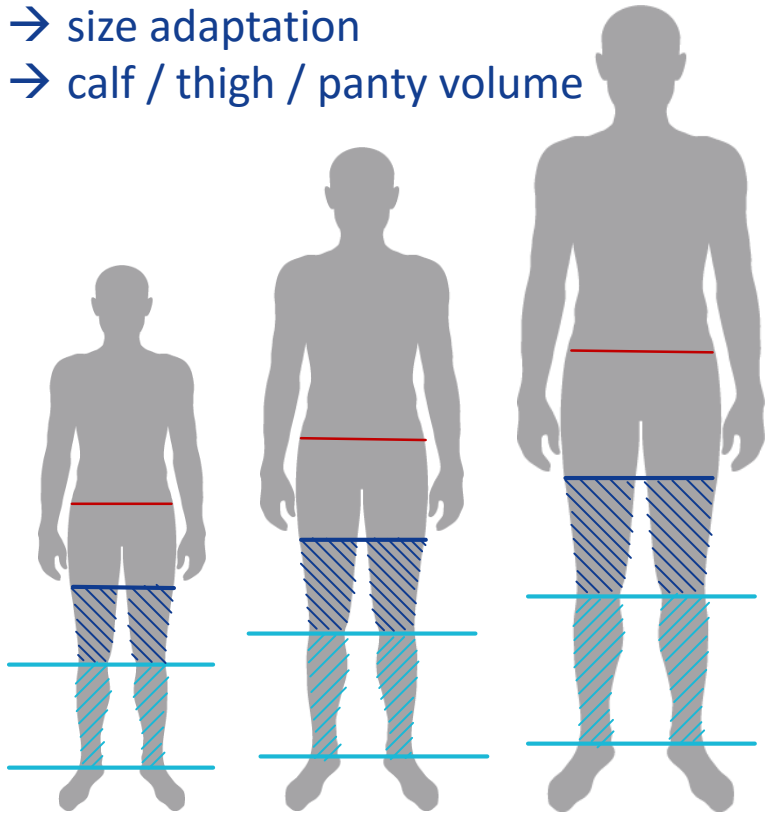
Major differences between water displacement (WD) & BT 600

→ foot included



WD

→ size adaptation
→ calf / thigh / panty volume



BT600

Comparison of handling / performance features

	water displacement	BodyTronic 600
duration of measurement	several minutes	55 seconds
simplicity of handling	✗	✓
calf / thigh / panty volume	✓ / ✗ / ✗	✓ / ✓ / ✓
size adaptation	✗	✓
foot included	✓	✗
repeatability	✓	✓
precision	✓	✓
independency of temperature & repercussion	✗	✓
online documentation	✗	✓

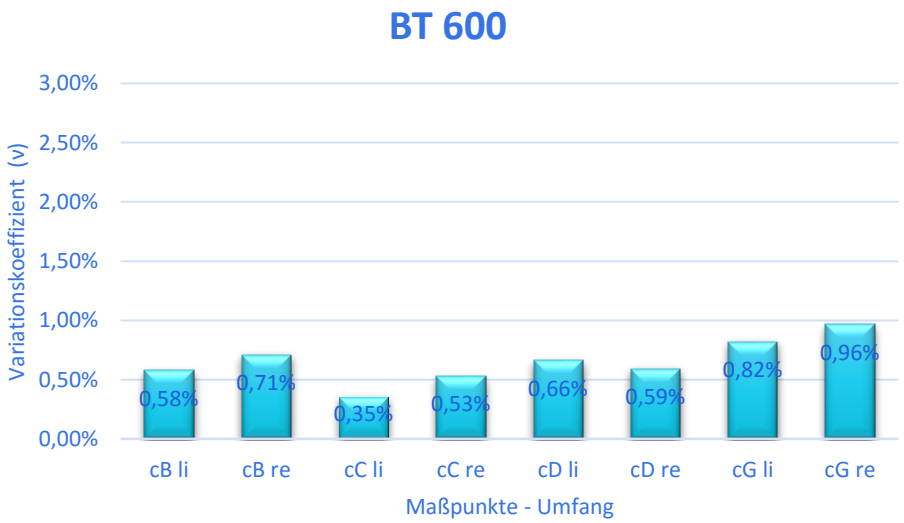
water column 1 m: 73.6 mmHg!

03 Validation of BT600 for volume measurement

(in comparison to “gold standard” water displacement)

Pre-investigation:

Comparison electronic measurement vs. manual method

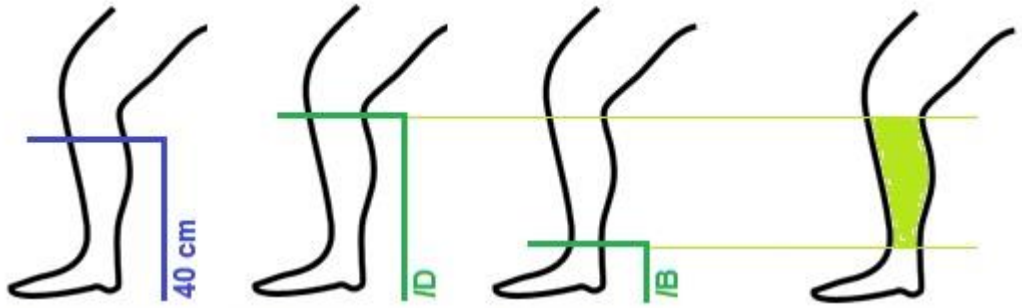


Reproducibility of BT600 circumference measurements was was 2…3 times better than manual method (measuring tape)

Real comparison is only able and acceptable after having compensated general differences:
foot included / not included & size adaption

Investigation was therefore performed by a modified water displacement device:

- foot was measured separately and subtracted
- „size adaptation“ was simulated by using a device with variable overflow

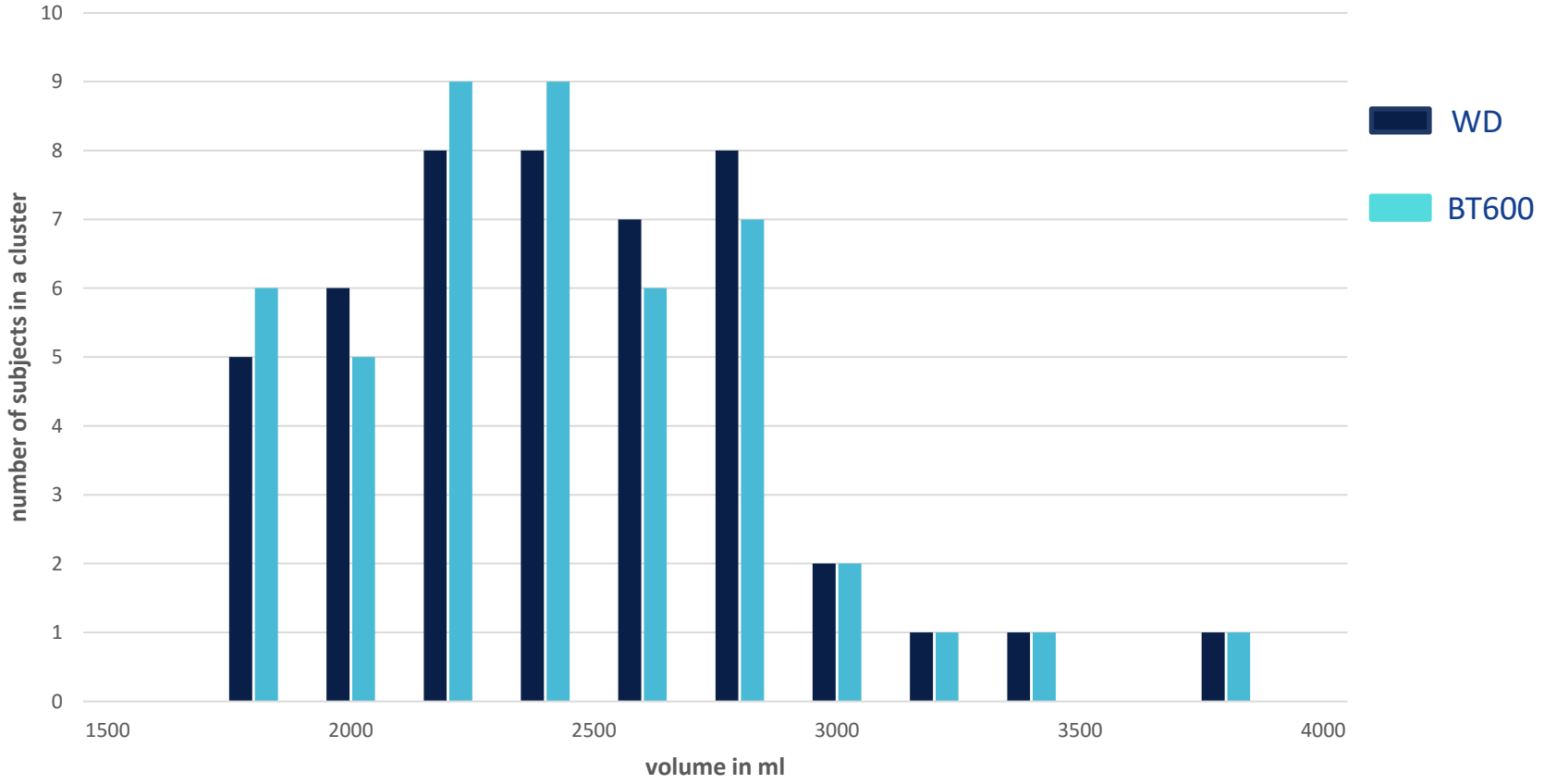


1st measurement | 2nd measurement | 3rd measurement | finally measured calf volume

1st investigation with 50 healthy volunteers (Bachelor degree of Rebecca Hoffmann / TU Ilmenau)

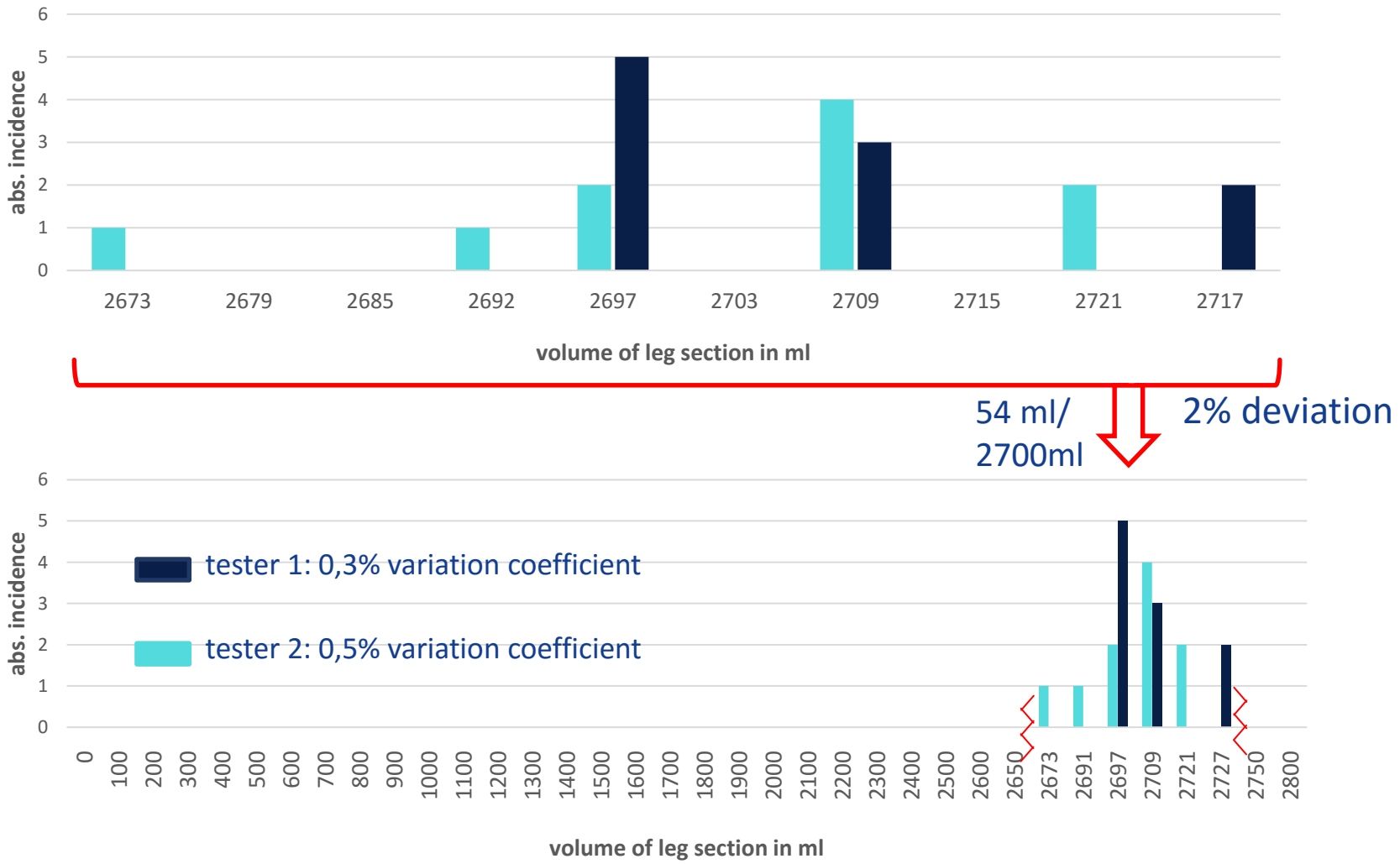
- 50 volunteers were included
- all 50 were healthy subjects (no edema)
- all subjects were measured by WD as well as BT600
- 4 drop outs -> 46 subjects could be included in evaluation

Results:
Distribution of calf volume of the 46 subjects measured with both methods (cluster of 100 ml / ~ 3%)



2nd investigation: Reproducibility - BT600 in-vitro:

10 measurements per (calf length) plastic leg and tester



Comparison repeatability – both systems

10 measurements per (calf length) plastic leg and tester

	repeatability BT600
cycles	10
arithmetic mean [ml]	2719
median [ml]	2720
standard deviation [ml]	5,6765
variance [ml]	32,2222
coefficient of variation	0,0021

	repeatability WD
cycles	10
arithmetic mean [ml]	2977,8
median [ml]	2969
standard deviation [ml]	30,1470
variance [ml]	908,8444
coefficient of variation	0,0101

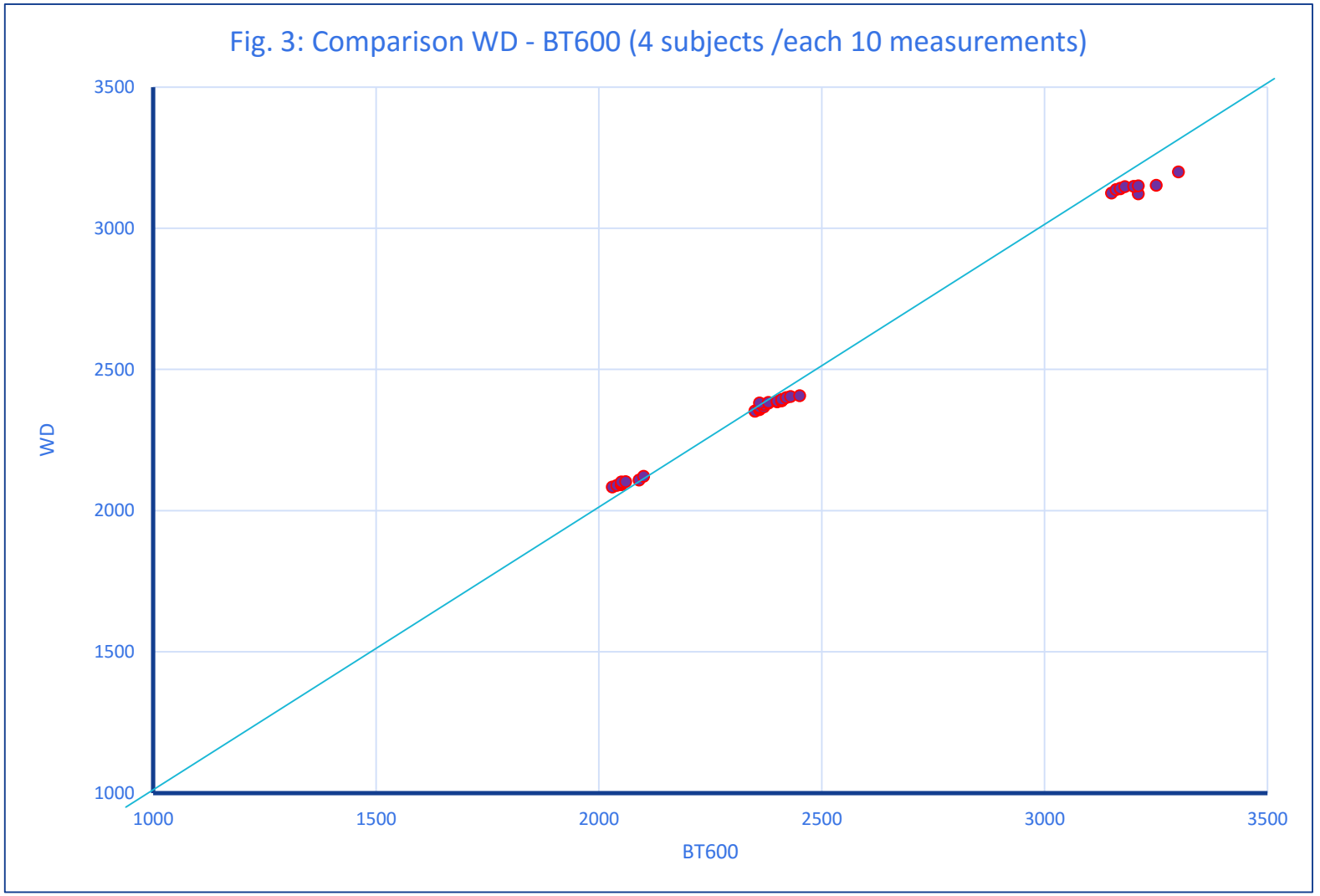
1 : 5,3

Cave!

BT600‘s standard deviation is 5 times than WD‘s (in-vitro test).

3rd investigation: Comparison WD – BT600 with healthy subjects

(performed by Nguyen Thi, QuynhTrang / trainee TU Ilmenau)



Comparison WD – BT600 with healthy subjects: 10 measurements per subject

Cave:
WD measurements were performed with idealized conditions: room with air condition, water with regulated temperature, no edema…)

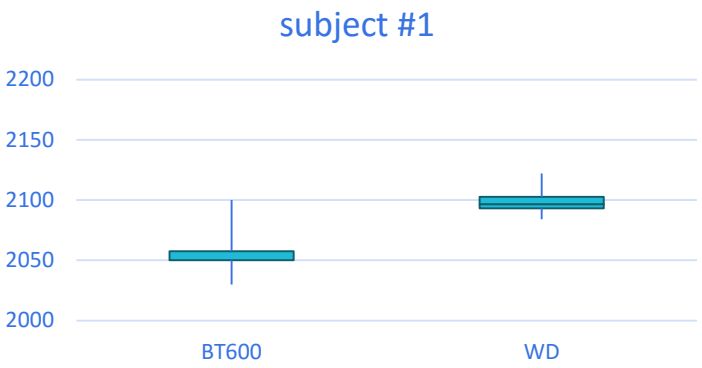
	BT	WD
min. dev. within 1 subject	30 ml	25 ml
max. dev. within 1 subject	90 ml	78 ml

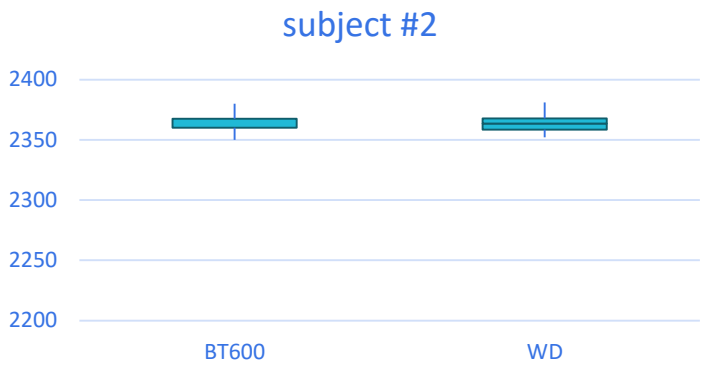
diff. between both methods (measurement by measurement)	min	max
	0 ml	99 ml
	0%	3,0%

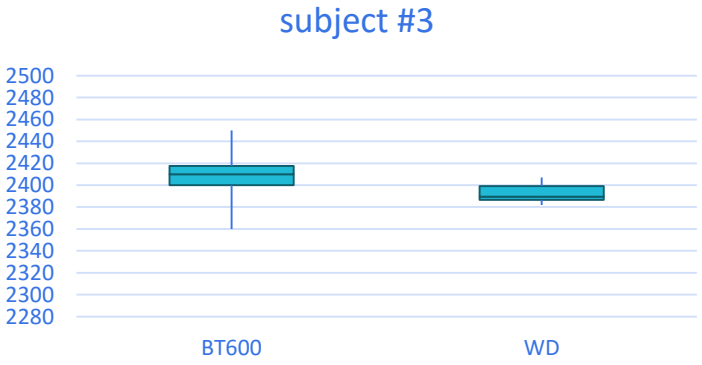
	Var.coefficient	
	BT	WD
sub 1	1,00%	0,49%
sub 2	0,37%	0,37%
sub 3	0,98%	0,35%
sub 4	1,36%	0,34%
average	0,93%	0,39%

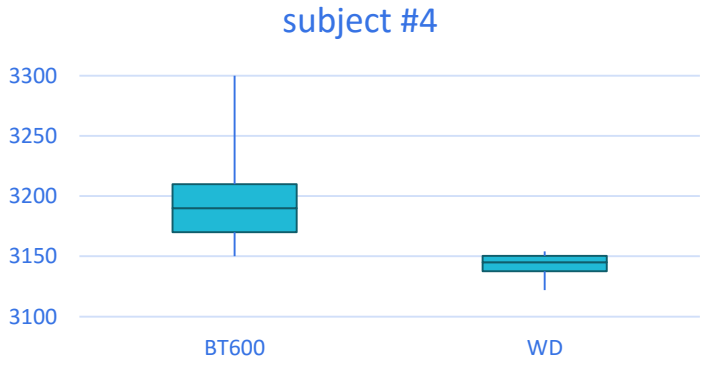
Comparison WD – BT600 with healthy subjects:

(box plot display)









04 Summary

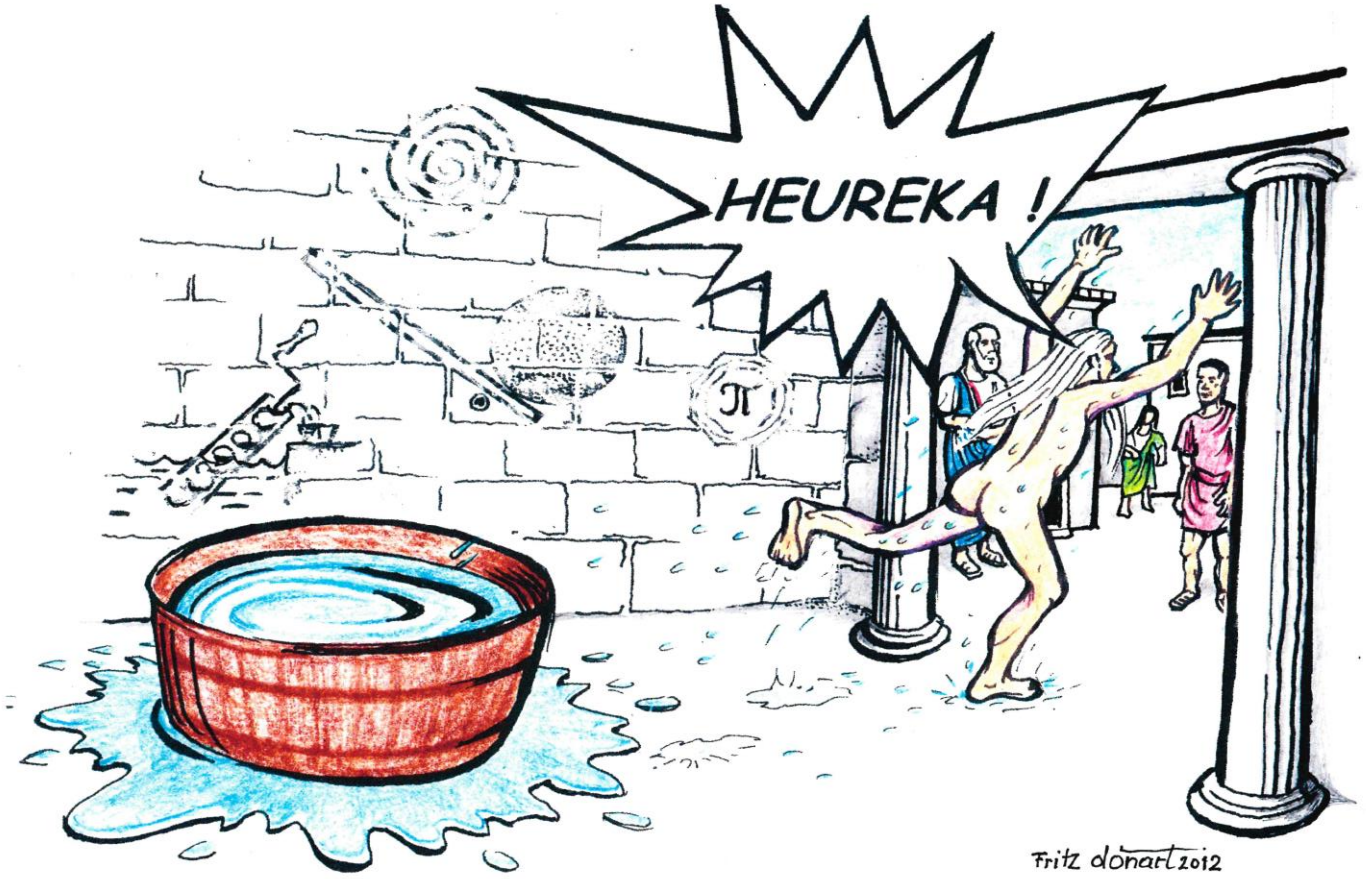
Summary

1. Both methods deliver comparable results (+/- 40 ml)
2. Reproducibility investigations delivered different results depending on the method:

   - in-vivo: WD was slightly better than BT600

   - in-vitro: BT600 achieved better results than WD
3. WD is limited to calf-area and influenced by several parameters (temperature, experience of personal etc.). It is difficult to handle and lengthy.
4. BT600 is automatically adapting the segmentation to individual anatomy (esp. body height) of each person

Archimedes (about 2300 years ago):



©Alfred Obermayer: Die Schwerelosigkeit im Menschen

Conclusion for volume measurements:

It‘s time to switch from WD to electronic solutions like BT600.

Thank you very much for your attention!

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