Clinical Summary

Accurate feedback of chest compression depth on a manikin on a soft surface with correction for total body displacement

Beesems SG, Koster RW. *Resuscitation.* 2014; 85:1439-1443

Purpose:

The primary purpose of this paper was to determine accuracy of the TrueCPR™ coaching device with a manikin on a test bench and on various surface types.

Methods:

- A test bench was set up with a Laerdal® manikin (Resusci Anne SkillReporter®) and a precisely calibrated drill press. The manikin records depth measurements using SkillReporter software, recorded directly to a laptop. This software was used to collect all chest compression data during both the bench testing and manual CPR experiments.
- The manikin measured compression depth with error <1 mm. Calibration was repeated several times throughout the experiment.
- Tested feedback devices included the TrueCPR device using Triaxial Field Induction (TFI) technology and QCPR® (Laerdal Medical) using accelerometer technology.
- Manual CPR experiments were performed, with compression depth simultaneously measured by the TrueCPR device or by QCPR and the manikin in all experiments.
- Chest compressions were given on various surfaces: floor, foam mattress, or air mattress with feedback from the TrueCPR device or QCPR to a depth of 50 mm. (See graphs below.)
- Compression depths as measured by the devices were then compared to the depths measured by the manikin.

Results:

- CPR guided by QCPR on the floor showed an underestimation of 1.9 mm.
- When the manikin was placed on soft surfaces, chest compression depth measured by the TrueCPR device was more accurate independent of the surface, while the accelerometer of QCPR overestimated the depth compared to the manikin.
- In the drill press, the TrueCPR device showed a systematic underestimation of 2 to 3 mm on a hard surface compared to the depth measured by the manikin.
- The TrueCPR device measures depth precisely, independent of the stiffness of the surface upon which CPR is being performed, with a constant inaccuracy of <4.5 mm.
- The addition of a backboard did not alter the findings with the TrueCPR device. Compression depth was decreased by half using QCPR.

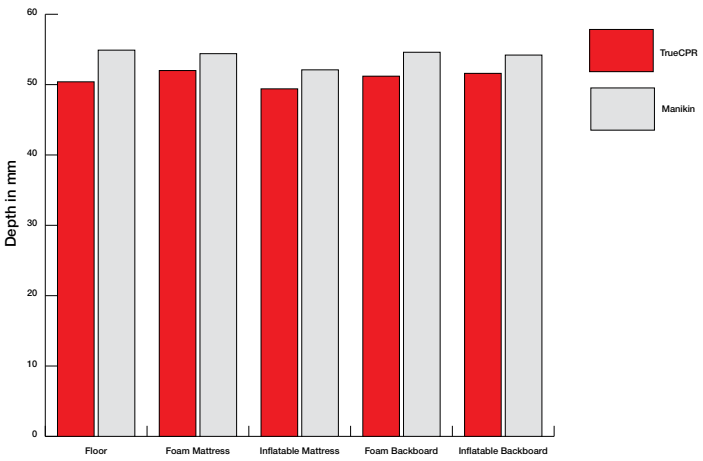
Conclusions:

- Accelerometer technology was found to have a significant and clinically relevant inaccuracy when performing CPR on a soft surface.
- This study confirmed the overestimation of compression depth and therefore shallow compressions using accelerometer-based feedback devices on soft surfaces.
- The TrueCPR device eliminated the inaccuracy and overestimation of compression depth shown to occur with accelerometer devices on soft surfaces.
- Correction for body size and displacement on a soft surface is needed for accurate delivery of chest compressions.
- Data is needed from cardiac arrests that are performed with accurately measured chest compressions. This could result in different recommendations on compression depth in future guidelines.

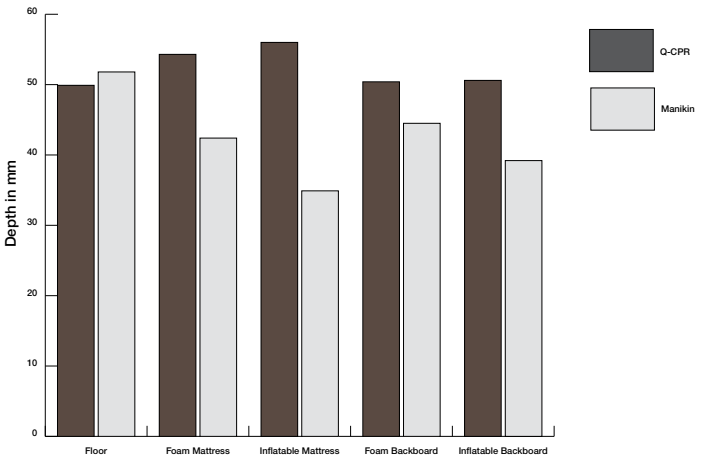
Depth as measured by feedback device compared to simultaneous measurement from manikin			
	TrueCPR Coaching Device	**Manikin**	**p-value**
Floor	50.4 (±1.6) mm	54.9 (±1.8) mm	
Foam Mattress	52.0 (±1.9) mm	54.4 (±1.8) mm	
Inflatable Mattress	49.4 (±2.6) mm	52.1 (±2.8) mm	p <0.001
Foam Backboard	51.2 (1.6) mm	54.6 (1.5) mm	
Inflatable Backboard	51.6 (1.8) mm	54.2 (1.4) mm	
	QCPR	**Manikin**	
Floor	49.9 (±2.8) mm	51.8 (±2.6) mm	
Foam Mattress	54.3 (±3.6) mm	42.4 (±2.3) mm	
Inflatable Mattress	56.0 (±3.8) mm	34.9 (±3.6) mm	p <0.001
Foam Backboard	50.4 (3.6) mm	44.5 (2.4) mm	
Inflatable Backboard	50.6 (4.9) mm	39.2 (2.4) mm	

Note: Additional data in tables provided by authors

TrueCPR device vs. Manikin



QCPR vs. Manikin



Physio-Control Discussion Points:

- Under ideal circumstances all chest compressions should occur on the floor. This is typically not the case in the hospital setting, therefore accurate CPR feedback on soft surfaces is needed.
- The TrueCPR device, utilizing Triaxial Field Induction (TFI), is intended to overcome the limitations of accelerometer-based CPR feedback devices and was shown to measure depth precisely across all surfaces tested in a manikin study.
- TFI uses three-dimensional magnetic fields to precisely pinpoint the distance between the chest pad and back pad independent of body or surface movement. By utilizing TFI and the back pad as a reference point, the TrueCPR device provides true depth measurement and corrects for body displacement on a soft surface thus overcoming the major limitations of accelerometer technology.
- Accelerometers measure the depth and rate of chest wall movement during each compression and convert the acceleration information into distance traveled. Therefore, the compression of the soft surface is not accounted for in the depth measurement.
- This study adds to the body of evidence citing accelerometer inaccuracy. There are over 20 published references related to the inaccuracy of single-sensor accelerometers on soft surfaces.

Note: These results are based on using a manikin with an “ideal” chest and may vary on humans.

For further information, please contact Physio-Control at 800.442.1142 (U.S.), 800.895.5896 (Canada) or visit our website at www.physio-control.com.

Physio-Control Headquarters
11811 Willows Road NE
Redmond, WA 98052
www.physio-control.com

Customer Support
P. O. Box 97006
Redmond, WA 98073
Toll free 800 442 1142
Fax 800 426 8049

Physio-Control Canada
Physio-Control Canada Sales, Ltd.
7111 Syntex Drive, 3rd Floor
Mississauga, ON
L5N 8C3
Canada
Info.canada@physio-control.com
Toll free 800 895 5896
Fax 866 430 6115

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