

**Comparison of the Dart Target™ and
Traditional Landmark Method for the
Placement of Chest Decompression
Needles in the Treatment of Tension
Pneumothorax**

MAJ USA (Ret) Michael Morrison, DSc, MPAS, PA-C
MAJ John Knight, MD
MAJ USA (Ret) Paul Allen DSc, MPAS, PA-C, FAAPA

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Disclaimer

- San Antonio Military Medical Center (SAMMC) Institutional Review Board approved.
- The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.
- None of the authors have any financial disclosures or conflicts of interest.
- This study did not involve the use of medications requiring FDA approval.

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Introduction

- Tension pneumothorax is a potentially life threatening condition, fatal if not treated appropriately.
- Causes of preventable death on the battlefield
 - ❖ Hemorrhage
 - ❖ Tension pneumothorax
 - ❖ Airway compromise
 - ❖ Hypothermia

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Study Purpose

- Compare placement, penetration, time and complications of the Dart Target™ to Traditional Landmark Method (TLM) on a cadaver specimen

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Relevance

- Harcke et al. (Winter 2013) Feedback to the field (FB2F) Needle Thoracentesis Decompression: Observation From Postmortem Computed Tomography and Autopsy
 - ❖ 16 Cases 23 attempts
 - ❖ 6 attempts still under investigation
 - ❖ 17 attempts
 - 13 anterior approach – 6 successful
 - 4 lateral approach at anterior axillar line – all 4 successful

TLM Devices

- Catheter/Needle
- Case



- Catheter/Needle
- Cover



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MCDS™



- Mojo Dart needle (14-gauge, 3.25" needle/catheter unit)



- Dart Target™



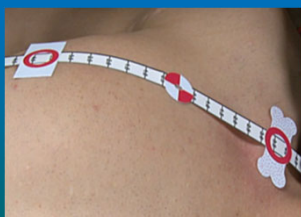
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Dart Target™ Placement



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Dart Target™ Placement



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Dart Target™



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Significance

- Alternative to traditional landmark method
- Mitigate combat stress during this critical life saving skill
- Limited clinical data available for the Dart Target™

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Hypothesis

- Research Hypothesis: The Dart Target™ will increase first time successful placement, penetration, take less time, and reduce potential complications in the treatment of a tension pneumothorax

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Methods

- This was a mixed methods study
- Prospective randomized crossover quasi-experimental design comparing the Dart Target™ and TLM.
- Qualitative survey of study participants
- Since cadavers were used, there were minimal medical risks to participants entered into this study; informed consent was waived

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Methods

- INCLUSION CRITERIA:
 - ❖ Volunteers
 - ❖ Previously trained in needle decompression
 - ❖ Medical providers at Brooke Army Medical Center, U.S. Army Medical and Dental Department Center (AMEDD C&S) and School, and Centre of Emergency Health Science (CEHS) Bulverde TX
 - ❖ Level of experience ranged from combat medic to emergency medicine physician.
- EXCLUSION CRITERIA: Personnel not trained in needle decompression

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Methods

■ Demographics

Medical Profession		Mean Age (years)	33.54 (SD 6.58)
Physician Emer Med	3.77%	Mean OET Deployment (months)	4.31 (SD 7.53)
Resident Emer Med W 3	16.98%	Mean OET Deployment (months)	5.42 (SD 8.55)
Resident Emer Med W 2	2.81%	Mean Other Deployment (months)	2.03 (SD 2.55)
Resident Emer Med W 1	8.49%	Medical Experience (years)	5.64 (SD 6.63)
Physician Assistant	23.94%	Service Branch	
Physician Assistant Student	3.65%	USA	59.43%
Nurse	6.67%	USAF	24.33%
EMT / P	7.81%	USMC	0.96%
Flight Medic	20.25%	ARMY	3.77%
Medic	6.60%	NAVY	11.35%
Flight Nurse	0.94%	Rank	
Other	0.94%	CV	11.32%
Previous Needle Decompression		FS	16.98%
Training Sessions		EG	0.43%
< 5	23.54%	EP	2.81%
6-10	14.31%	OT	0.94%
11-20	17.81%	O2	9.43%
> 20	44.34%	O3	22.96%
Previous Needle Decompression on Patients		O4	14.31%
0	40.57%	O5	0.94%
< 5	35.80%	OS	0.94%
6-10	16.98%	Combat Experience (Y/N)	
11-20	2.81%	Yes	53.77%
> 20	3.77%	No	46.23%

Methods

- Outcome measures
 - ❖ Primary – Proper placement – 2nd ICS/MCL
 - ❖ Secondary – Penetration, Time, Neurovascular Bundle, placement in unsafe area (medial placement over anatomical structures)
 - ❖ Survey data concerning preference
- Randomization
 - ❖ Rast random number generator by Alejohandro Vargas 2.2.2, May 01, 2013
 - ❖ Cadaver, Side, and Method
- Setting:
 - ❖ Facility support : The (CEHS) in Bulverde, TX and (AMEDD C&S)
 - ❖ Six sessions were conducted
 - ❖ Six non-embalmed, non-frozen cadavers were used

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Methods

- Placement: 2nd ICS/MCL equal or less than 15mm from designated point
- Time: procedure completed in less than 30 seconds from determination of tension physiology
- Penetration: Through the chest wall into the pleural space
- Neurovascular complications: Needle catheter unit penetration through the artery/vein/nerve running under the rib
- Placement in unsafe area (medial placement over anatomical structures)

Methods

■ Cadaver Preparation

- ❖ Second intercostal space mid-clavicular line identified/marked by expert
- ❖ Chest – athletic tape between clavicles and nipples
- ❖ Axilla – incision placed to provide window for verification



Methods

■ Performance

- ❖ Training conducted prior on both methods with practice period
- ❖ Randomized Cadaver
- ❖ Needle Decompression Landmark Method
- ❖ Dart Target™ Decompression Method
- ❖ Distance from correct point, Penetration, Time, Neurovascular and medial placement were recorded

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Methods

■ Qualitative Survey

- ❖ Five questions
- ❖ Likert Scale
- ❖ Ease of use and preference explored

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Statistical Analysis

- SPSS Sample Power, Version 2.0 was used to estimate required sample size needed for a power of 0.8, with an alpha of 0.05
- We assumed 100% success for placement, less than 30 seconds for time, adequate chest cavity penetration, and needle catheter avoidance of neurovascular bundle and medial placement for potential complications
- To detect a difference of 10% in any of these parameters, a sample size of 100 subjects per method acting as their own controls was determined.

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Statistical Analysis

- Independent sample t-test for precision/placement
- 2X2 contingency test for time, penetration and complication

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Results

- One hundred and six volunteer medical providers performed two procedures on each cadaver
- Statistically significant and a potentially clinically significant difference between the Dart Target™ group 1% and TLM group 10.5% ($p = 0.019$) for needle placement in the Medial/Medial Superior danger area
- No statistically significant difference in correct placement in the Dart Target™ group 19.8% when compared to the TLM 45.3%

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Results

- Statistically significant difference in time to placement in < 30 seconds, Dart Target™ 2.8% compared to TLM 79.2% ($p < 0.001$)
- No statistically significant difference in:
 - ❖ Penetration ($p > 0.611$)
 - ❖ Neurovascular complication ($p > 0.460$)

Results

	Number Successful		Percentage Successful		P Value
	Dart	TLM	Dart	TLM	
Time (<30 seconds)	3	84	2.80%	79.20%	p < 0.001
Correct placement rate	21	48	19.80%	45.30%	p > 0.05
Adequate penetration rate <small>*N = 105</small>	99	97	93.45	92.50%	p > 0.05
NV bundle compromise rate	17	11	16%	10.40%	P > 0.05
Great then 15mm Medially (Dangerous miss rate)	1	11	1%	10.50%	p = 0.019

Time to Completion

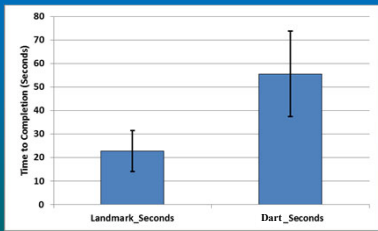


Figure 1. Time to completion in seconds by method

Results

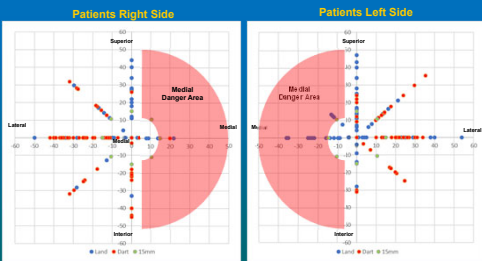


Figure 4. Greater than 15 millimeters from point (Medial Danger Area)

A12 Better, but you are mixing yes/no 30 seconds rates with mean time; pick one. I put a sort of sample table in the results section of the manuscript

Author, 11/2/2014

Results

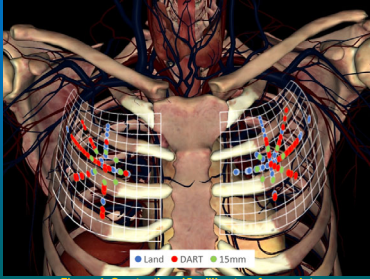


Figure 4. Greater than 15 millimeters from point (Medial Danger Area)

Distribution of distance from Neurovascular bundle

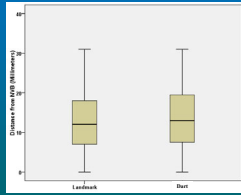


Figure 3. Distribution of distance from the neurovascular bundle by technique. In the box plots, the median is the dark line within the box. The box is defined by the 25th and 75th percentiles so 50% of the cases have values within the box. The error flags represent the largest and smallest observed values that are not outliers. Outliers (o) are values more than 1.5 box-lengths from the quartile. Extremes (*) are values more than 3 box-lengths from the quartiles

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Penetration

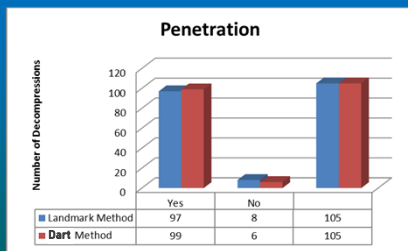
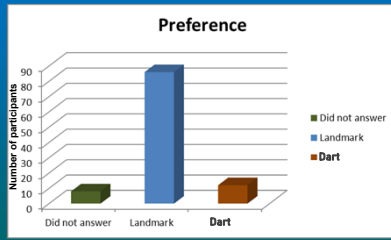


Figure 6. Penetrations by Method

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Landmark Method Preferred



Participants Preference of Method

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Discussion

- Increased penetration rate 92-94%
- Advanced training level - 56% had performed the TLM clinically
- Dart Target™ designed for younger fit military model for 2nd ICS/MCL
- Medial Danger Area
- Potential for untrained provider use to be safe and effective

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Limitations

- Most cadavers were emaciated
- During two data collection days, only one cadaver was available
- No female cadavers specimens
- Inexperience with new product
- Combat stressors not simulated

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Conclusion

- No statistically significant difference in placement, penetration or neurovascular complications
- Statistically significant difference in time favoring the TLM over the Dart Target™
- Statistically significant difference in potentially dangerous placement rates favoring the Dart Target™ over the TLM
- Future Studies
 - ❖ Include Female
 - ❖ Younger cadavers/more types
 - ❖ Stressors

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