Predicting Midline Fascial Re-approximation with Component Separation in Complex Ventral Hernias: Maximizing the Utility of Pre-operative Computed Tomography

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BACKGROUND:
Component separation techniques have allowed for midline fascial reapproximation in large midline ventral hernias. In certain cases, however, fascial apposition is still not feasible resulting in a suboptimal bridged repair. Previous estimates on myofascial advancement is based on hernia location and does not take into account variability between patients. Examination of pre-operative computed tomography (CT) may provide insight into these variabilities and may allow for prediction of abdominal closure with component separation.

METHODS:
A retrospective review was conducted of patients who underwent abdominal wall reconstruction from 2007-2010 with component separation techniques by the senior author (PB). Pre-operative CT imaging was obtained for all patients and specific parameters were analyzed using image analysis software (Terarecon, Inc.). Student's t-test and Fisher's exact test were used for continuous and categorical variables, respectively. Logistic regression was utilized to predict ideal operative closure. Multivariate analyses were adjusted for age and gender.

RESULTS:
54 patients met the study criteria and had pre-operative CT imaging for analysis. 48 patients had fascial reapproximation, while 6 patients had a bridged repair. Age, gender, weight, and BMI were similar between groups ($p>0.05$). Significant differences were seen between groups in 3 variables; transverse defect size, defect area, and percent abdominal wall defect. Average transverse hernia defect and hernia area resulting in a bridged repair was 19.8cm and 420cm^2 v. 10.4cm and 184.2cm^2 in defects able to achieve closure ($p<0.05$). On analyzing the percent abdominal wall defect, bridged defects were found to be statistically higher than defects achieving closure (18.9% v. 10.6%; $p<0.05$).

CONCLUSIONS:
Predicting midline approximation following component separation is critical as outcomes following bridging repair result in high recurrence rates. Preoperative determination of abdominal wall defect ratios and hernia defect areas may represent a more accurate method to predict abdominal wall closure following component separation techniques.

	Bridged (n = 6)	Reapproximation (n =48)	p-value*
Age (years)	58.5 (11.0) †	58.6 (12.2)	0.984
Gender (% (n) male)	33.3 (2)	41.7 (20)	1.000
Weight (kg)	109.1 (22.2)	101.3 (32.3)	0.605
BMI (kg/m^2)	37.0 (4.2)	35.7 (11.2)	0.800
Defect size (Medial-lateral) (cm)	**19.8 (5.9)**	**10.4 (5.3)**	**0.0002**
Defect size (Superior-inferior) **(cm)**	21.5 (6.3)	14.4 (8.2)	0.050
Defect area (cm^2)	**420.0 (184.8)**	**184.2 (192.3)**	**0.006**
Defect percent‡	**18.9% (6.7%)**	**10.6% (5.2%)**	**0.0007**
Rectus width – Left	6.9 (3.1)	6.4 (2.2)	0.619
Rectus width – Right	5.5 (2.1)	6.1 (2.2)	0.538
Abdominal wall circumference	107.7 (19.3)	98.2 (12.9)	0.115
Pannus circumference	128.2 (13.9)	117.3 (16.1)	0.118
Pannus thickness	3.9 (1.4)	3.7 (1.7)	0.737
Intraabdominal area	288.3 (160.4)	233.5 (80.3)	0.171
Abdominal wall thickness	2.7 (0.8)	4.9 (8.4)	0.536
Abdominal wall/Pannus circumference	0.84 (0.10)	0.84 (0.08)	0.886
Abdominal wall volume/Defect area	81.90 (54.44)	393.50 (605.17)	0.217
Intraabdominal/Pannus volume	0.77 (0.69)	0.81 (0.65)	0.898
Abdominal wall/Pannus circumference	0.84 (0.10)	0.84 (0.08)	0.886

* p-values calculated using Student's T-test assuming unequal variance for continuous variables, and Fisher's exact test for categorical variables
† Values reported as mean(SD) for continuous variables, %(n) for categorical variables
‡ Defect % calculated using the following formula: (Medial-lateral defect size)/(abdominal circumference) x 100

	Univariate		Multivariate*	
	OR (95% CI)	**p-value**	**OR (95% CI)**	**p-value**
Age (years)	1.00 (0.93, 1.07)	0.984	1.00 (0.93, 1.07)	0.982
Gender (% (n) male)	1.43 (0.24, 8.57)	0.696	1.43 (0.24, 8.57)	0.696
Weight (kg)	0.99 (0.97, 1.02)	0.599	0.99 (0.97, 1.02)	0.626
BMI (kg/m^2)	0.99 (0.91, 1.07)	0.795	0.99 (0.91, 1.08)	0.858
Defect size (Medial-lateral)	**0.78 (0.65, 0.93)**	**0.005**	**0.77 (0.64, 0.92)**	**0.003**
Defect size (Superior-inferior)	0.90 (0.81, 1.01)	0.066	0.89 (0.80, 1.00)	0.053
Defect area (cm^2)	1.00 (0.99, 1.00)	0.029	**0.995 (0.991, 0.999)**	**0.016**
Defect percent**	**1.84e(-11) (1.15e(-19), 0.003)**	**0.010**	**5.51e(-12) (8.45e(-21), 0.004)**	**0.012**
Rectus width – Left	0.91 (0.64, 1.30)	0.613	0.88 (0.60, 1.28)	0.510
Rectus width – Right	1.14 (0.75, 1.75)	0.531	1.13 (0.72, 1.76)	0.592
Abdominal wall circumference	0.95 (0.89, 1.01)	0.125	0.94 (0.87, 1.01)	0.082
Pannus circumference	0.95 (0.89, 1.01)	0.129	0.95 (0.89, 1.02)	0.134
Pannus thickness	0.91 (0.55, 1.53)	0.731	0.93 (0.53, 1.65)	0.812
Pannus area	1.00 (0.99, 1.00)	0.316	1.00 (0.99, 1.00)	0.331
Intraabdominal area	0.99 (0.98, 1.00)	0.179	0.99 (0.98, 1.00)	0.114
Abdominal wall thickness	1.31 (0.63, 2.73)	0.475	1.31 (0.62, 2.78)	0.477