Exercise Tolerance in Growing Rod "Graduates" – New Respiratory Functional Outcome Measure

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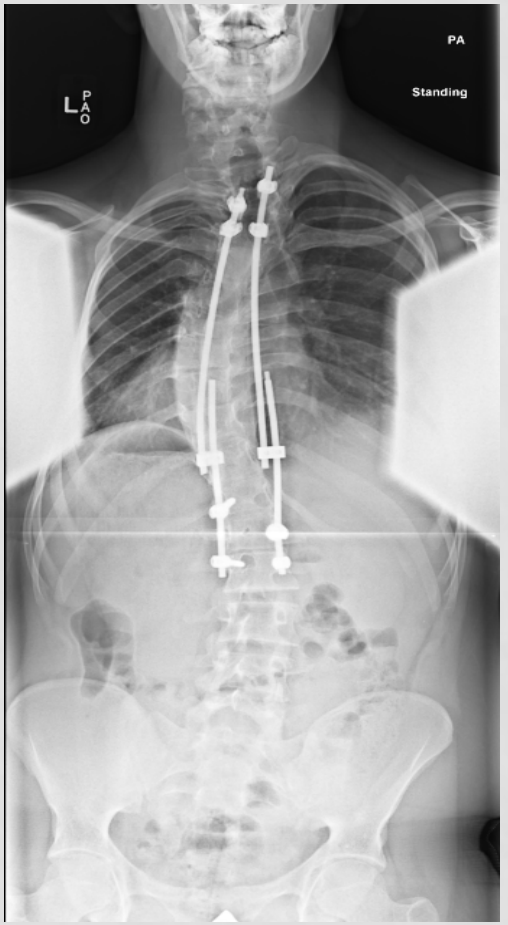

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BACKGROUND

- **Pulmonary function test (PFT) used as a primary outcome measure of respiratory capacity are highly dependent on patient effort and technical variations – making test of ?value**

- **EOS patients perceived to have physical limitations in spite of treatment , supported by generally underwhelming PFT results**

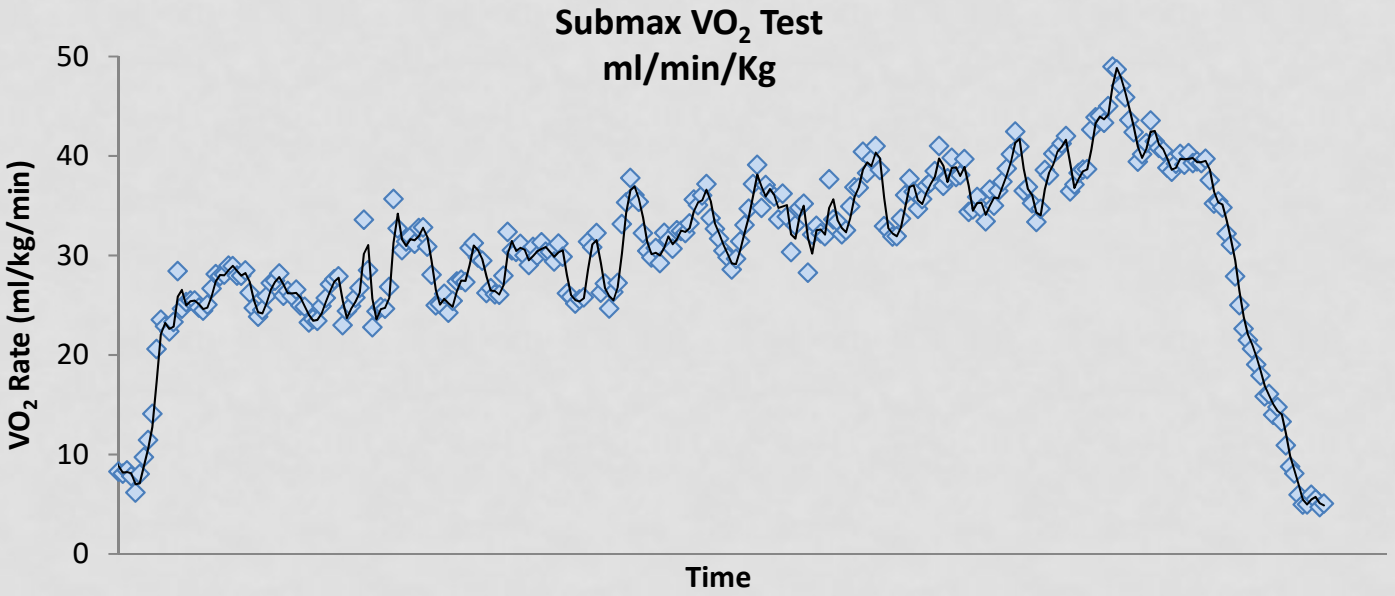
TSRH GR grads
SRS 2015 eposter 220

FEV1pred **52% (36-62)**

FVC pred **57.5% (39-76)**

EXERCISE EVALUATION

- To evaluate exercise O_2 consumption during a graded exercise test
- Characterize respiratory capacity in EOS patients who are ≥1 year since last GR/definitive fusion surgery



METHODS: VO_2 CONSUMPTION TEST

- **VO_2 collected breath by breath by gas exchange portable system**
- **Heart Rate monitor**
- **Variables**
  - **Ventilation**:
    - Breaths/min (f)
    - Tidal volume (VT)
    - Ventilation (VE)
  - **Cardiovascular**:
    - HR, HR% - percent of age predicted HR max
  - **Metabolic** :
    - VO_2 Rate (ml/kg/min)
    - VO_2 Cost (ml/kg/m)
    - respiratory exchange ratio (R) VCO_2/VO_2
    - VO_2 max predicted
  - **Velocity** (mph)

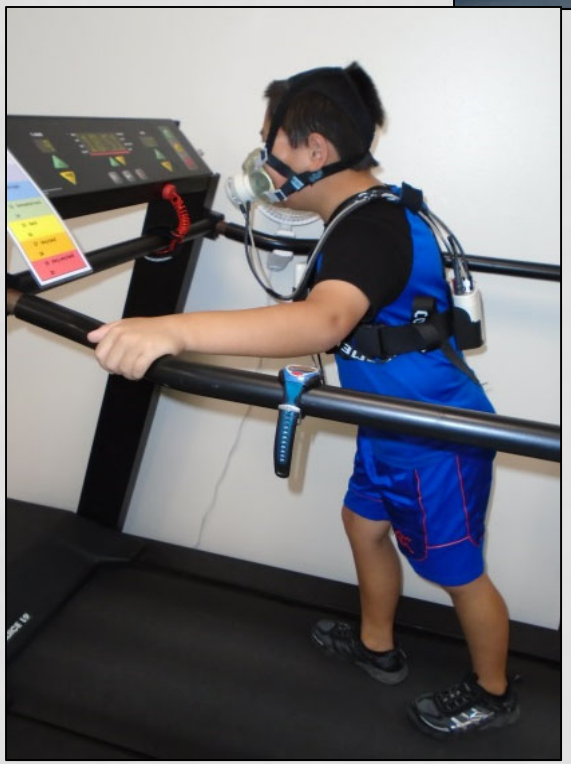
METHODS: PROTOCOL

A. Oxygen consumption

- Over-ground walking – self-selected velocity

- Submaximal graded exercise test
  - Progressive treadmill protocol

  - VO_2 max predicted
    - reaching 85± 5% age-predicted heart rate (HR) max



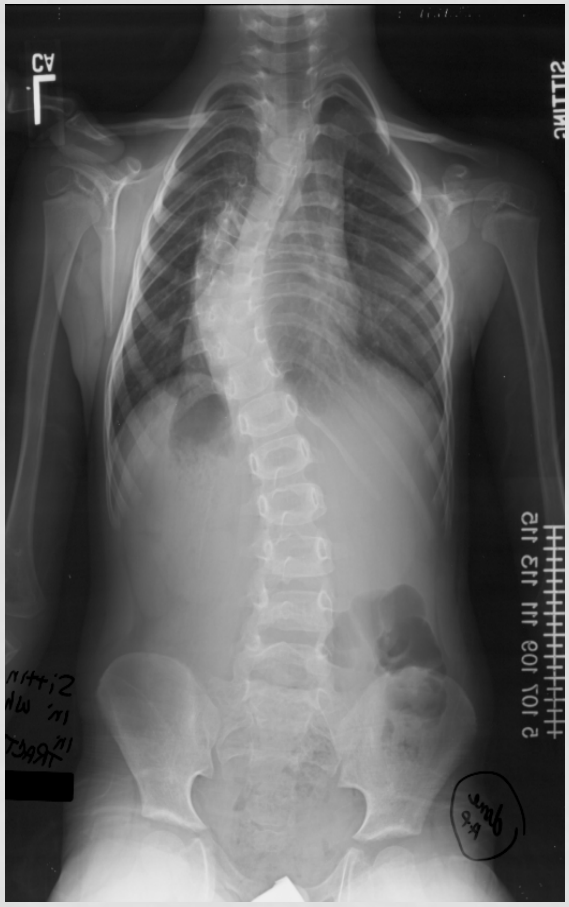
B. Student t-test compared EOS patients to control group

RESULTS GR GRADUATES

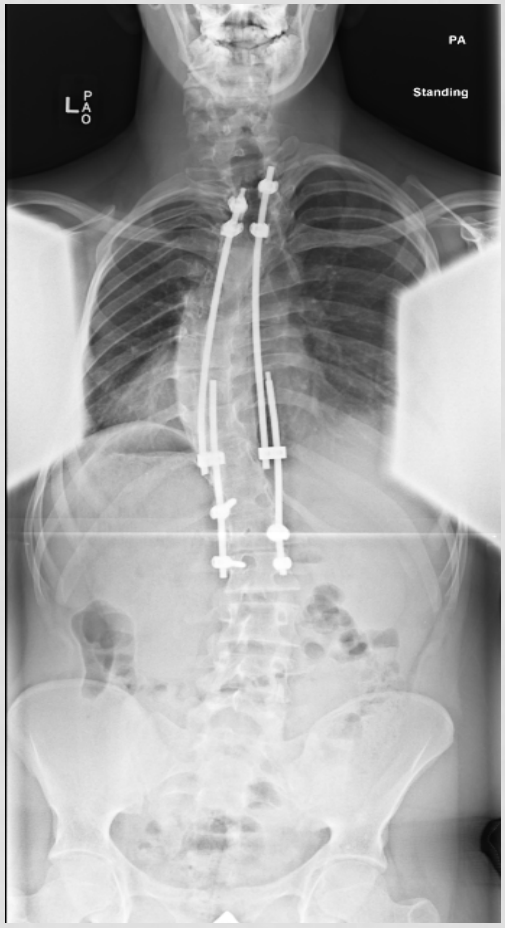
EOS group diagnoses:

- 4 congenital
- 3 idiopathic
- 2 syndromic
- 2 neuromuscular

- Age at most-recent visit: 13.6 (9.8 – 17)
- Months since last surgery: 42.2 (23.9-66.6)
- Definitive fusions: 6
- Still lengthening: 1
- No lengthenings, observation only: 4



Preop, 5 years old



Most-recent 16.2 yo
8 lengthenings
0 complications
62.1 months since last surgery

PATIENTS: EOS VS. CONTROL

	EOS	Control	p value
N	**11**	**20**	--
Age at test	12.6	13.1	0.592
Height	150	157	0.215
Weight	38.8	52.2	0.090

	PFT			
	FVC_{abs}	FVC %	$FEV_{1\ abs}$	FEV_1 %
EOS	1.2 (.48-2.04)	48.4 (23-80)	1.2 (.40-2.59)	50.5 (15-77)

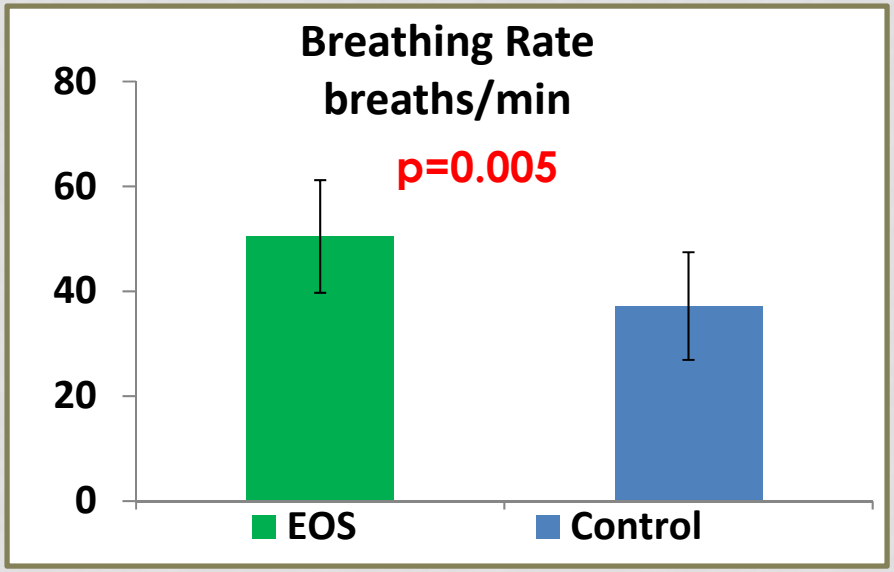
OVER-GROUND WALKING

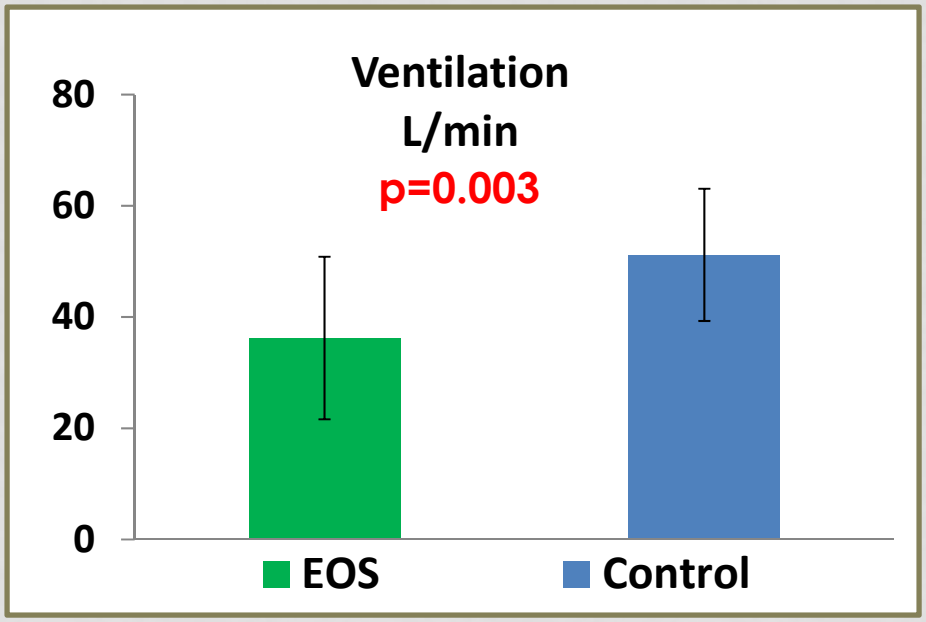
	VO_2 Rate ml/kg/min	HR bpm	VO_2 Cost ml/kg/m	Velocity mph
EOS	21.0	131	0.28	2.8
Control	17.5	117	0.22	3.0
p value	0.107	**0.021**	**<0.000**	0.083

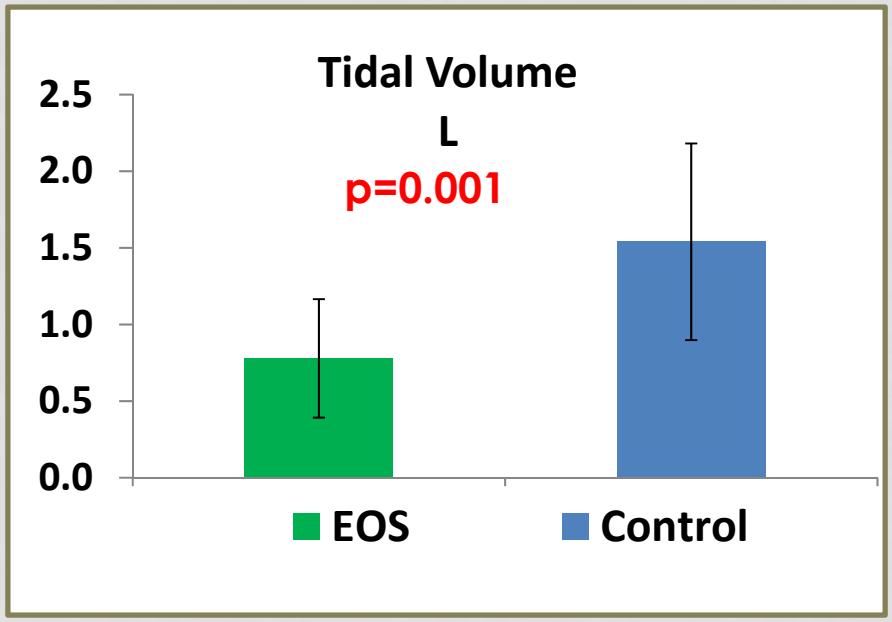
- At self-selected walking velocity
  - EOS group had a higher HR and increased VO_2 Cost
  - Velocity was not significantly different **p>ns**
    - ***Able to keep up with peers***

END OF TEST (eg 85% HR_{Max})

- Compared to controls, the EOS group takes:
  - 36% higher resp rate
  - Achieving 50% the Volume at
  - 70% Ventilation rate





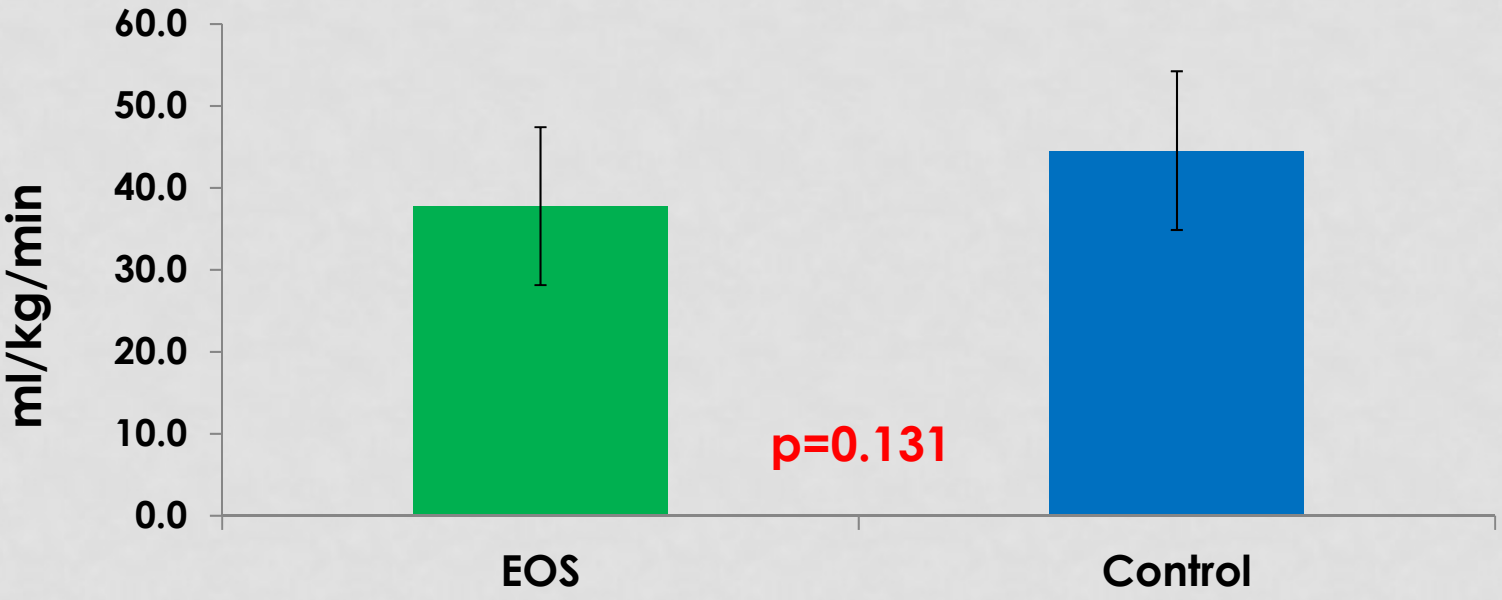


END OF TEST (eg 85% HR_{Max})

	VO_2 Rate ml/kg/min	HR bpm	% HR max	Velocity mph	R* VCO_2/VO_2
EOS	28.2	164	79%	2.8	1.02
Control	34.2	174	84%	3.6	0.90
p value	**0.035**	0.231	0.433	**0.000**	**0.004**

- Heart rate is similar, but EOS group consumes less VO_2 while walking at a **slower** velocity
- EOS group is working harder than controls(R = 1.02)
  ***R ≥ 1.1 anerobic metabolism (nearly at VO_2 max)**

CAVEAT: VO_2 MAX $_{PRED}$



- VO_2 max was predicted in 9/11 EOS patients
- EOS group showed a lower predicted VO_2 max than controls, but this was not significant

+VE CONCLUSION

- PFT suggests poor function ~50% pred
- VO_2 test demonstrates that GR graduates are able to keep up with their peers with typical everyday walking velocity
- They have the capacity to exercise but at a lower work load (slower speed) due to respiratory limitations

NEXT STEP – EXERCISE TESTING FOR PATIENTS WITH "BETTER" PFT'S (>65%$_{PRED}$)

Thank You

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