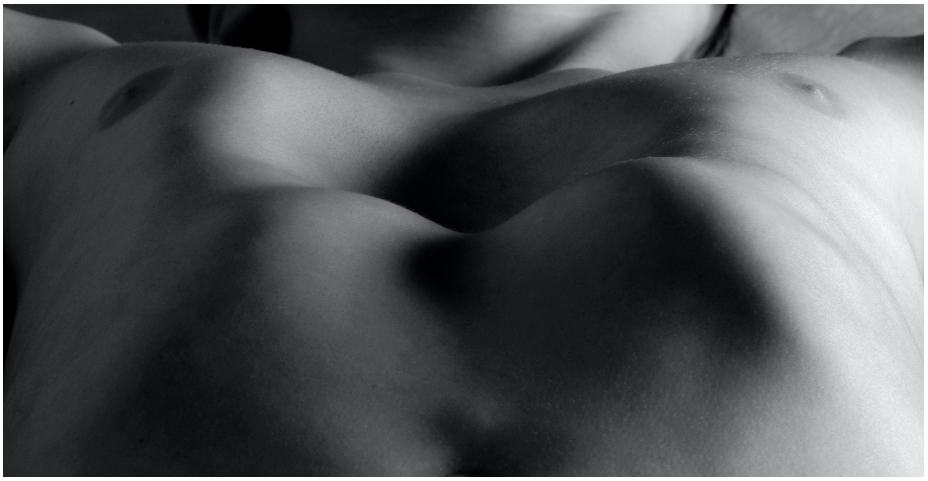
THE PAEDIATRIC & ADOLESCENT ANTERIOR CHEST WALL DEFORMITY SERVICE ANNUAL REPORT

1st April 2017 – 31st March 2018



Royal Hospital for Children, Glasgow

"The right option for the right patient"

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The completed Annual Report should be sent electronically by 31 May to:

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Section A Service

A1 Aim / Purpose / Mission Statement / Date of Designation

- The **Aim** of the service is to provide a comprehensive multidisciplinary service to all children and adolescents in Scotland with anterior chest wall deformities.
- The **Mission Statement** is *"The right option for the right patient"*
- The service received National Service designation on **1st October 2016**

A2 Patient Group and Pathway

As a result of the withdrawal of the Paediatric Cardiothoracic Service from this work some years ago, referrals to the Lead Clinician increased and necessitated the development of a dedicated clinic for patients with anterior chest wall deformities. From mid-2010, the Orthotic service assisted with the development of a bespoke dynamic brace for Pectus Carinatum. As a result, the number of such referrals continued to rise and the need for a multidisciplinary clinic became apparent. Such a clinic was impossible without national service designation and the support of a number of individuals and services.

The national service receives referrals from General Practitioners and Specialists, the latter usually from Paediatric Medicine, Cardiothoracic Surgery, Orthopaedics and Paediatric Surgeons from other Scottish Units. All referrals are vetted and patients are reviewed in clinic, though there are few treatment options available for those under 6 years. Many patients develop their chest wall deformity later, typically as they transition from Primary to Secondary education.

There are two main treatment pathways in the service. The first is for Pectus Excavatum patients and is a wait and see until in their teens at which time surgery can be offered for suitable patients. The Nuss operation (thoracoscopically assisted) is our operation of choice for such patients. In selected younger patients a Vacuum Bell may be considered though this is not in the Service Level Agreement.

The second pathway is for Pectus Carinatum patients and is focused on Dynamic Bracing for those suitable (>6 years old, sufficiently compliant chest wall and suitably motivated patient). The brace is worn for 18-20 hours each day in the treatment phase and this is reduced once correction is achieved (the maintenance phase). Those who fail, who are not suitable for bracing, or who opt for surgery by choice are considered for surgical correction of their Pectus Carinatum with a modified Ravitch Operation.

A3 Service Components

The service is made up of a number of staff groups. The core group consist of:

- 2 Consultant Paediatric Surgeons
- 2 Paediatric Orthotists
- 1 Paediatric Physiotherapist

Other services essential to the success include:

- Paediatric Anaesthetic & Theatre nursing team
- Inpatient Paediatric Nursing
- Paediatric Pain Team
- Medical Illustration
- Paediatric Radiology
- Paediatric Cardiology

- Paediatric Respiratory Physiology Laboratory
- Paediatric Clinical Psychology

Section B Quality Domains (HEAT)

B1 Health Improvement

As anterior chest wall deformities rarely have clinical indications for surgical correction, it is essential that we continue to ensure all surgical interventions are safe and that surgery for cosmetic and body image improves quality of life for those undergoing it.

a) Measures of health improvement in patients

Our dedicated Physiotherapist is assessing the impact of treatment (surgical and bracing) by utilising the PedsQL™ Paediatric Quality of Life Inventory. Appendix 1 & 2 show the ones we use one for the teenagers and one for the parents.

B2 Efficiency

a) Workforce and Service Interdependencies

All the components of the service are outlined in a mind map format in Appendix 3.

b) Workload

Most patients attending the multidisciplinary chest wall clinic have either Pectus Carinatum or Pectus Excavatum. A minority have other or complex chest wall deformities. This is demonstrated graphically for the database of patients extending back to 1999 in Figure 1. The service workload has been increasing rapidly since Dynamic Bracing was first offered at the Royal Hospital for Sick Children in mid 2010. This historical outpatient and surgical workload pre-national service designation is represented in Figures 2 & 3. The workload for the 4 main components of the service (Surgery, Outpatients, Orthotics, and Physiotherapy) from 01/04/17 – 31/03/18 is shown in Tables 1 & 2.

Figure 1 Overall prevalence of chest wall deformity subgroups

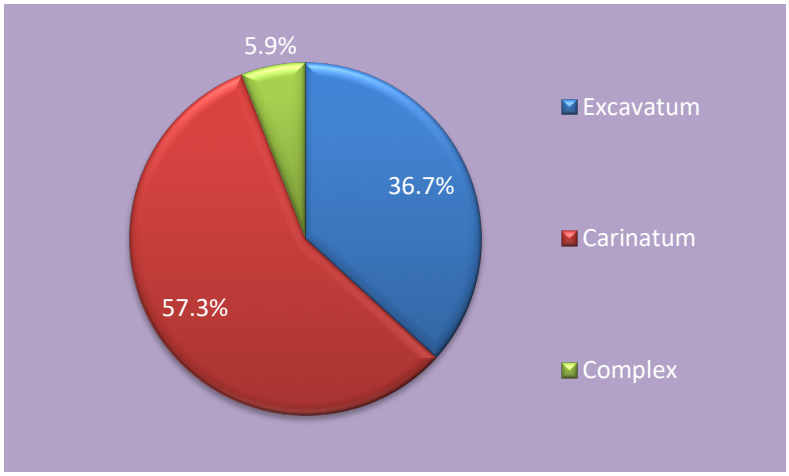


Figure 2 Chest Wall Service Outpatient activity 2010 to end March 2018

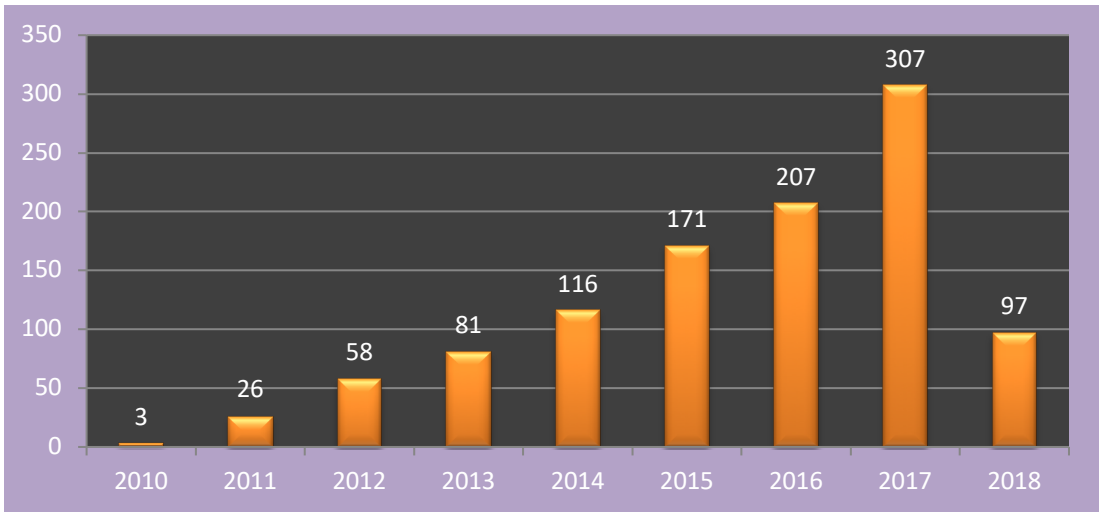


Figure 3 Chest Wall Service Surgical activity 2010 to end March 2018

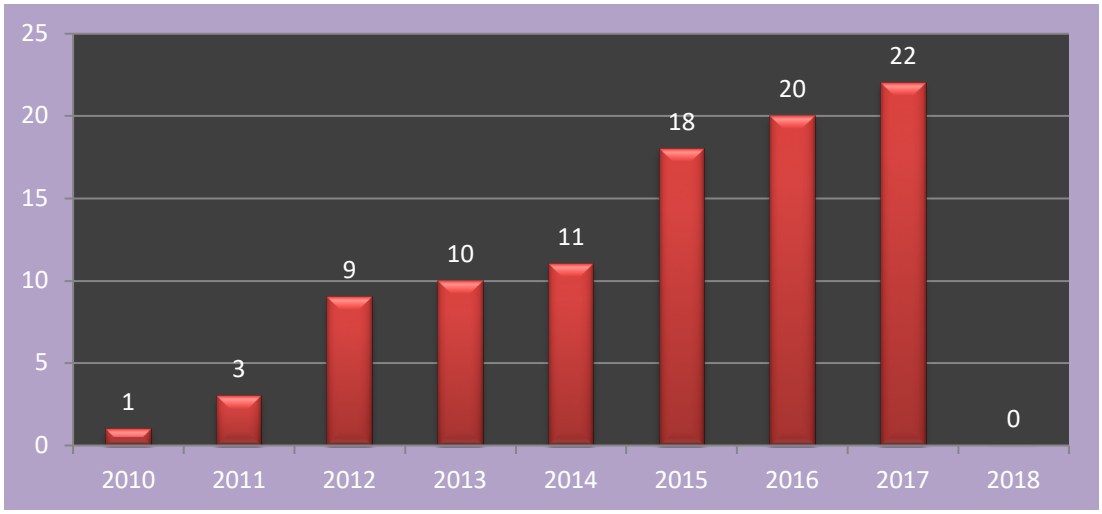


Table 1 Surgical workload 01/04/17 to 31/03/18

Total Operations	Thoracoscopically assisted Nuss operation	Modified Ravitch operation	Removal metal	Surgery for complications
23	14	2	6	1

Table 2 Outpatient workload 01/04/17 to 31/03/18

Total Number	Non- GG&C Health Board	Physio review at clinic	Orthotics review at clinic	Other Orthotics Appointments	Clinical Photographs	Psychology review
357	172	126	108	237	184	0

c) Finances

NHS Greater Glasgow & Clyde
Women & Children's Directorate
Chest Wall
Twelve Month Report: 2017/18

Actual Activity	14
Projected Activity	14
Contract Activity	10
Contract Type	Block

	Full Year Funded Value Of Agreement £	Twelve Month Funded Value Of Agreement £	Actual Outturn As At 31st March 2018 £	Variance £	Projected Full Year Outturn £
FIXED					
Medical	39,474	39,474	39,474	0	39,474
Nursing	37,631	37,631	37,631	0	37,631
AHP's	162,920	162,920	162,920	0	162,920
Facilities	77	77	77	0	77
A&C	5,867	5,867	5,867	0	5,867
Total Fixed	245,970	245,970	245,970	0	245,970
VARIABLE					
Drugs	4,625	4,625	6,476	-1,850	6,476
CSSD / Diagnostics	605	605	847	-242	847
Surgical Sundries	31,636	31,636	44,290	-12,654	44,290
Other	16,268	16,268	22,776	-6,507	22,776
Total Variable	53,135	53,135	74,389	-21,254	74,389
Indirect					
Imaging	4,250	4,250	4,250	0	4,250
Labs	278	278	278	0	278
Total Indirect	4,528	4,528	4,528	0	4,528
Overheads					
	45,546	45,546	45,546	0	45,546
Total Overheads	45,546	45,546	45,546	0	45,546
TOTAL	**349,178**	**349,178**	**370,432**	**-21,254**	**370,432**

B3 Access to Treatment

a) Measures of ease of access to service

The service is relatively new. Word of mouth and personal communications with colleagues in the field have been the main promotions. Medical Appointments are channelling all anterior chest wall referrals to the service. We have also undertaken a multidisciplinary presentation at the Scottish Paediatric Orthopaedic Conference for service promotion. Further enquires have been made to present at the British Association of Prosthetists and Orthotists. Some members of the team attended and presented at the annual Chest Wall International Group (CWIG) International Conference in Florence.

b) Review of Health Board patient distribution

Referrals by Health Board are show in Figures 4 for the period of the report. Health Board of origin for those undergoing surgery is shown in Table 3. Service level agreement figures are in Table 4.

Figure 4 Number of clinic appointments by Health Board (01/04/17 - 31/03/18)

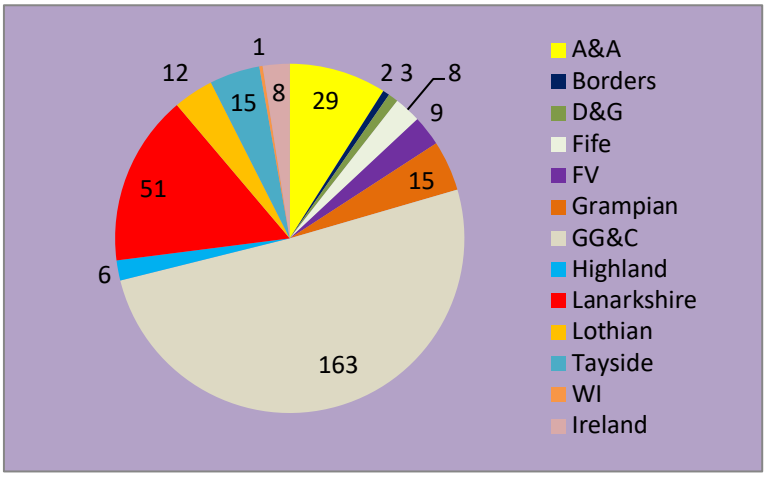


Table 3 Health Board representation for those undergoing surgery (01/04/17 - 31/03/18)

Health Board	Number
GG&C	7
Lanarkshire	5
FV	3
A&A	1
Tayside	1

Table 4 Agreed Service Level Agreement numbers

Service Level Agreement		**Agreed**	**Number achieved**
New OP appointments	All pectus referrals	100-150	108
Operations	Pectus Excavatum (Nuss procedure)	8	14
	Pectus Carinatum (Modified Ravitch)	3	1
	Metal Removal	8	5
Non operative procedures	Brace patients	25	46

B4 Treatment, effectiveness and safety

a) KPIs

Agreed 6 measures of quality performance from 01/04/17-31/03/18 are listed in Table 3. All complications are listed in Table 4.

Table 3 Recordable outcomes for chest wall service

Domains of Quality Performance Measures:	**Agreed Indicators**	Results
Equitable: Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location or socio-economic status	All cases by NHS Board	Figure 4
	Surgery by NHS Board	Table 3
Efficient: Avoiding waste, including waste of equipment, supplies, ideas, and energy	Referrals by Condition:	
	- Excavatum	39
	- Carinatum	69
	- Other	21
	Number of patients reviewed in clinic	322
	- Carinatum to Excavatum new patient ratio	1.8:1
	- Return:New patient ratio	1.8:1
	- Number converted to bracing	46
	Number converted to surgery	15
	- Nuss - insertion	14
	- Nuss - removal	4
	- Modified Ravitch	1
Timely: Reducing waits and sometimes harmful delays for both those who receive care and those who give care	Occupied bed days (Nuss & Ravitch)	6 days
	Occupied bed days (Bar removal)	<1 day
	Waiting times from referral to first appointment	74 days
	Mean New Ways Wait	64 days
	Time from assessment to bracing	38.5 days
Clinical Outcomes		
Effectiveness: Providing services based on scientific knowledge	Mortality of less than 1%	0%
	Number of complications:	6
	- Bleeding following removal of Nuss bars	0
	- Infected prosthesis	1
	- Pneumothorax requiring treatment	0
Safe: Avoiding injuries to patients from care that is intended to help them	- Number of significant adverse events	0
	- HAI outbreaks and notification of surveillance concerns	0
Patient focused Outcomes		
Person-Centred: Providing care that is responsive to individual personal preferences, needs and values and assuring that patient values guide all clinical decisions	Engage patients and carers in all aspects of care and provide detail of:	
	- Complaints less that 1%	0
	- Pre and post intervention quality of life measures such as EuroQOL	In progress
	- Positive feedback	Twitter feeds

b) Scottish Patient Safety Programme (SPSP)

The Royal Hospital for Children (RHC) is at the forefront of patient safety, the chest wall surgical team aim is to ensure delivery of safe high quality peri-operative care for all patients with pectus deformities. In line with SPSP recommendations, RHC theatres use a standardised approach to patient safety ensuring surgical team briefing and surgical safety checklists are carried out prior to commencing and following any surgical procedure. These processes ensure key equipment, personnel and resources are available prior to commencement of surgery (e.g. Sternal saw in theatre and support is available from the Scottish Paediatric Cardiac Surgery Service). As part of the surgical team debrief, each case is reviewed and any perceived improvements or risks are addressed. Improvements in ward staffing and training have allowed us to manage these patients in a ward setting e immediately post-operatively.

c) Successes and Risk Register

The core team attended the Chest Wall International Group International Congress in Florence in June. Donna McHugh presented a paper outlining our success to date with dynamic bracing and showed the attendance the "Glasgow Brace". (Appendix 4) We also presented a poster at the joint BAPS/IPEG Congress in London in July 2017 outlining our service and results to date. (Appendix 5)

Laura Baxter was awarded a Gold Medal by the Institute of Medical Illustrators for the photo on the cover of this document.

The main risk going forward is the difficulty coping with the outpatient workload.

f) Adverse events & Complaints

To date there have been no complaints. There was a question raised by an MSP on behalf of a patient about funding for a Vacuum Bell. This is a specialised kit that is used to treat milder Pectus Excavatum, particularly in younger patients. At present, this is not part of the National Service Level Agreement and must be purchased privately from the sole supplier in Germany (circa €500).

There have been no serious adverse events.

C) All Complications

Table 4 Surgical Complications

ID	Type Defect	Surgery	Complication	Date Complication	Outcome
1	Pectus excavatum	Thoracoscopically assisted Nuss Op.	Right lower lobe collapse on CXR at 1st clinic review	03/07/2017	Resolved with physiotherapy
2	Pectus excavatum	Thoracoscopically assisted Nuss Op.	Right lower lobe collapse at 1st clinic review	26/06/2017	Resolved with physiotherapy
3	Pectus excavatum	Thoracoscopically assisted Nuss Op.	Superficial wound dehiscence (from scratching)	10/07/2017	Resolved with antibiotics
4	Complex defect	Thoracoscopically assisted Nuss Op.	Erythema & scarring onto bar with left nipple retraction	14/08/2017	Resolved with antibiotics
5	Pectus excavatum	Thoracoscopically assisted Nuss Op.	Superficial wound infection (bilateral)	28/08/2017	Resolved with antibiotics
6	Pectus excavatum	Thoracoscopically assisted Nuss Op.	Deep wound infection	14/08/2017	Required premature removal lower bar

Section C Developments

C1 Service Developments

a) 3D scanning and milling proposal

This is a very exciting development both for the Chest Wall Service and also for the Orthotics Department as a whole, as it has the potential to revolutionise orthosis production, patient satisfaction and departmental productivity, as well as providing a much-enhanced environment by removing plaster of Paris from the environment.

3D scanning will allow us to monitor treatment in a non-invasive way and will hopefully provide positive feedback to patients as to progress, particularly for those undergoing Dynamic Bracing. It will also allow non-invasive objective assessment of Nuss surgery results without the need for irradiation. The Scanning equipment is now in use and we have started scanning patients who are attending for dynamic bracing assessment.

b) Introduction of thermal sensor into brace

We have just started to insert thermal sensors into braces that continuously record temperature and whose data can be downloaded by Bluetooth technology. This gives us objective evidence of "wear time" for braces. This will has begun to assist us to better interpret results of bracing.

c) Physiotherapy

Physiotherapy input has been extremely beneficial since a dedicated Senior Physiotherapist joined the team on 1/5/17. Her presence in clinic means all new referrals have a physiotherapy assessment and a treatment plan instituted where appropriate. Peri-operatively, respiratory and post-surgery protocols have been developed to enhance recovery.Appendix 6 is the Physiotherapy In-Patient Pathway for Pectus Surgery and Appendix 7 shows the Pectus Surgery Recovery Protocol.

Ashley Johnstone has had 2 posters accepted for the CWIG meeting in Seoul, South Korea. More on this in next year's report.

d) Clinical Psychology

As the service beds in, we will formalise the role for Clinical Psychology in supporting the service. The aim is to refer all future patients, due to be listed for surgery, for formal psychological assessment before being listed for surgery.

e) Anaesthesia & Surgery

A number of minor modifications are planned for those undergoing surgery this upcoming summer (2018). The impact of these will be assessed. It is planned to have Pain Team Nurses on site over the weekend following surgery to assist Physiotherapy with mobilisation and pain control.

C2 Research Developments

a) Joint collaboration with Strathclyde University Engineering

We are working with Professor Terry Gourlay from the Engineering Department at Strathclyde University. There are many mutually positive areas we are exploring, including 3D modelling with a view to 3D printing Nuss bar template (or even bars) to optimally correct deformities, especially complex and asymmetrical ones. We are also exploring the biomechanics of the tissues to understand the stresses on the bars and how to minimise these. We have also discussed the provision of a pressure measurement device to categorise pressure required for correction in pectus

carinatum patients. They are also looking at providing in brace pressure monitoring to ensure pressure exerted by bracing can be optimised, in real time, by the patient.

C3 Information developments

a) Website and patient information leaflet developments

We need to develop a suitable library of information for patients and families to aid in decision-making re treatment options and potential benefits and risks. We have information leaflets in progress, our website is now up and running and we are continuing to look at social electronic media options.

Section D Issues going forward

D1 Monitor appropriate KPIs for the service

D2 Define the role of Clinical Psychology

D3 Deal with increasing pressure to achieve waiting times for new patients

D4 We need to agree a position on the use of the Vacuum Bell

D5 Further Develop website and appropriate information literature and social media platforms

D6 Foster working relationship with Strathclyde University for developments and research

D7 The 3-D scanning has not yet been introduced during the period of this report. It will be in use for the next report.

Appendix 1

ID#_____

Date:_____

PedsQL™

Paediatric Quality of Life Inventory

Version 4.0 - English (United Kingdom)

TEENAGER REPORT (ages **13-18**)

INSTRUCTIONS

On the following page is a list of things that might be a problem for you. Please tell us **how much of a problem** each one has been for you over the **PAST MONTH** by circling:

0 if it is **never** a problem
1 if it is **almost never** a problem
2 if it is **sometimes** a problem
3 if it is **often** a problem
4 if it is **almost always** a problem

There are no right or wrong answers.
If you do not understand a question, please ask for help.

*Over the **PAST MONTH**, how much of a **problem** has this been for you...*

ABOUT MY HEALTH AND ACTIVITIES *(problems with...)*	Never	Almost Never	Some-times	Often	Almost Always
1. It is hard for me to walk more than a couple of streets (about 100 metres)	0	1	2	3	4
2. It is hard for me to run	0	1	2	3	4
3. It is hard for me to do sports activities or exercise	0	1	2	3	4
4. It is hard for me to lift heavy things	0	1	2	3	4
5. It is hard for me to have a bath or shower by myself	0	1	2	3	4
6. It is hard for me to do chores around the house	0	1	2	3	4
7. I have aches and pains	0	1	2	3	4
8. I feel tired	0	1	2	3	4

ABOUT MY FEELINGS *(problems with...)*	Never	Almost Never	Some-times	Often	Almost Always
1. I feel afraid or scared	0	1	2	3	4
2. I feel sad	0	1	2	3	4
3. I feel angry	0	1	2	3	4
4. I have trouble sleeping	0	1	2	3	4
5. I worry about what will happen to me	0	1	2	3	4

HOW I GET ON WITH OTHERS *(problems with...)*	Never	Almost Never	Some-times	Often	Almost Always
1. I have trouble getting on with other teenagers	0	1	2	3	4
2. Other teenagers do not want to be my friend	0	1	2	3	4
3. Other teenagers tease me	0	1	2	3	4
4. I cannot do things that other teenagers my age can do	0	1	2	3	4
5. It is hard to keep up with other teenagers my age	0	1	2	3	4

ABOUT SCHOOL / COLLEGE *(problems with...)*	Never	Almost Never	Some-times	Often	Almost Always
1. It is hard to pay attention in class	0	1	2	3	4
2. I forget things	0	1	2	3	4
3. I have trouble keeping up with my school / college work	0	1	2	3	4
4. I miss school / college because of not feeling well	0	1	2	3	4
5. I miss school / college to go to the doctor or hospital	0	1	2	3	4

Appendix 2

ID#_____

Date:_____

PedsQL™

Paediatric Quality of Life Inventory

Version 4.0 – English (United Kingdom)

PARENT REPORT for **TEENAGERS** (ages **13-18**)

DIRECTIONS

On the following page is a list of things that might be a problem for **your teenager**.
Please tell us **how much of a problem** each one has been for **your teenager** during the **past ONE month** by circling:

0 if it is **never** a problem
1 if it is **almost never** a problem
2 if it is **sometimes** a problem
3 if it is **often** a problem
4 if it is **almost always** a problem

There are no right or wrong answers.
If you do not understand a question, please ask for help.

*In the past **ONE month**, how much of a **problem** has your teenager had with …*

PHYSICAL FUNCTIONING ***(problems with…)***	Never	Almost Never	Some-times	Often	Almost Always
1. Walking 100 metres	0	1	2	3	4
2. Running	0	1	2	3	4
3. Participating in sports activities or exercise	0	1	2	3	4
4. Lifting something heavy	0	1	2	3	4
5. Taking a bath or shower by him or herself	0	1	2	3	4
6. Doing chores around the house	0	1	2	3	4
7. Having aches or pains	0	1	2	3	4
8. Feeling tired	0	1	2	3	4

EMOTIONAL FUNCTIONING ***(problems with…)***	Never	Almost Never	Some-times	Often	Almost Always
1. Feeling afraid or scared	0	1	2	3	4
2. Feeling sad	0	1	2	3	4
3. Feeling angry	0	1	2	3	4
4. Trouble sleeping	0	1	2	3	4
5. Worrying about what will happen to him or her	0	1	2	3	4

SOCIAL FUNCTIONING ***(problems with…)***	Never	Almost Never	Some-times	Often	Almost Always
1. Getting on with other teenagers	0	1	2	3	4
2. Other teenagers not wanting to be his or her friend	0	1	2	3	4
3. Getting teased by other teenagers	0	1	2	3	4
4. Not being able to do things that other teenagers his or her age can do	0	1	2	3	4
5. Keeping up with other teenagers	0	1	2	3	4

SCHOOL FUNCTIONING ***(problems with…)***	Never	Almost Never	Some-times	Often	Almost Always
1. Paying attention in class	0	1	2	3	4
2. Forgetting things	0	1	2	3	4
3. Keeping up with schoolwork	0	1	2	3	4
4. Missing school because of not feeling well	0	1	2	3	4
5. Missing school to go to the doctor or hospital	0	1	2	3	4

Appendix 3

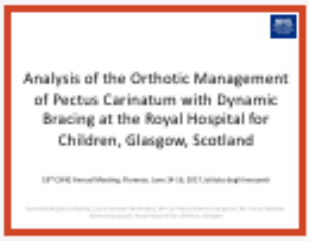

CHEST WALL SERVICE
Blue
Started 2015
Stopped 2015
Stratos system
Ravitch for carinatum
Nuss bars
Nuss kit
Nuss for excavatum
Thoracoscopy
Surgery
Epidural
Anaesthesia
Specialist bed
THEATRE
Immediate
Late
PAIN TEAM
Online community
Virginia 2016
Annual Congress
Florence 2017
CWIG
Workshops
Cardiff 2014
Patient Proforma?
Plastics
Clinic template
Other specialists PRN
Spinal / Orthopaedics
Bracing for carinatum
ORTHOTIST
PHYSIOTHERAPIST
Pre-op
Post-op
Postural
Pain team for early reviews
SURGEONS
MDT CLINIC
Referrals
Medical Photography
Final result
Progress
Contrasty images
Pre-treatment
PSYCHOLOGIST
Web based
Leaflets
Pectus carinatum
Pectus excavatum
INFORMATION
Immediate post-op
NSD
Business case
NSD Reports
Finance
CLASSIFICATION
Pectus carinatum
Pectus excavatum
Complex defects
Pectus arcuatum
DATABASE
Photographic evidence
Research
Psychology assessments
Immediate post-op
CXR
RADIOLOGY
At 1st post-op clinic
CT for pre-op workup
Anatomy
Haller Index
Spinal x-ray for scoliosis
Cardiology
ECHO
Lung Function
Post-op
Pre-op

Appendix 4

Analysis of the Orthotic Management of Pectus Carinatum with Dynamic Bracing at the Royal Hospital for Children, Glasgow, Scotland

18th CWIG Annual Meeting, Florence, June 14-16, 2017, Istituto degli Innocenti

Donna McHugh (Orthotist), Laura Andrews (Orthotist), Mr Carl Davis (General Surgeon), Mr James Andrews (General Surgeon), Royal Hospital for Children, Glasgow



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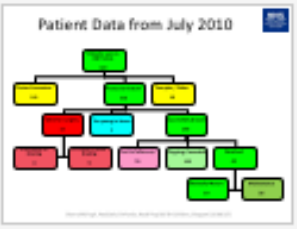

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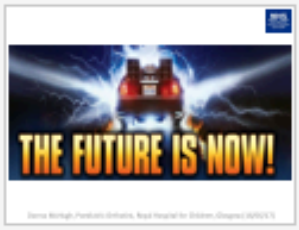

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Appendix 5

A REVIEW OF CHEST WALL ANOMALIES IN SCOTLAND
The Glasgow Experience
S DAVIS, J ANDREWS, D McHUGH, C DAVIS.

Aim

A move from cardiothoracic to general surgeons performing surgery to correct chest wall anomalies in our institution has resulted in increased referrals. As the service has recently received national service designation (October 2016), this offered the opportunity to review experience to date.

Method

The authors interrogated a prospective local database of chest wall referrals to general paediatric surgery over an 18 year period between 1999-2016.

Results

344 persons were referred for assessment in the study period (81% male). 133 (39%) had pectus excavatum, 184 (53%) had pectus carinatum and 27 (8%) had a variety of complex defects (Figure 1). Numbers and severity of the defects for each condition is outlined in Figure 2. 74% excavatum but only 29% carinatum defects were symmetrical. Where defects were asymmetrical, there was a bias towards the right side for both conditions. Significant scoliosis was noted in 10% of excavatum and 7% of carinatum cases. Marfan's syndrome was confirmed in 2%.

Dynamic bracing using a Glasgow designed and manufactured carbon fibre brace (Figure 3) was offered as first-line therapy for Pectus Carinatum from May 2010. Of those braced (n=132), 30% had a full correction, 48% are still undergoing bracing treatment, 4% discontinued treatment, 12% were lost to follow-up and the remaining 9 patients opted for surgery.

49 patients with chest wall deformities have undergone surgery. All those who underwent surgery had moderate or severe defects. 37 patients had a Nuss procedure for Pectus Excavatum (32 were thoracoscopically assisted). 12 patients underwent surgical management for Pectus Carinatum either by choice, failure of dynamic bracing or unsuitability for bracing. All had a modified Ravitch procedure; 5 using the Stratos system and 7 using the Sternalock system.

There were 22 complications across all surgeries. 4 late Stratos system failures were identified. One deep Nuss bar infection was successfully managed with long-term antibiotics. 7 superficial wound infections and 3 hypertrophic scars occurred following Nuss operations. One patient developed opioid dependency.

Conclusion

This series demonstrates that Pectus Carinatum is more common than Pectus Excavatum within the setting of a multidisciplinary service that offers operative and non-operative management strategies for young persons with chest wall deformities. Surgery should be reserved for moderate or severe defects. The Nuss operation is the procedure of choice for Pectus Excavatum. Dynamic bracing is the first-line treatment for Pectus Carinatum with surgery being reserved for those who fail or are unsuitable for bracing.

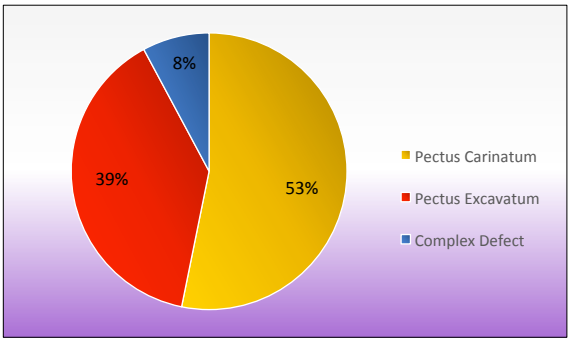

Figure 1 Chest wall defects by category

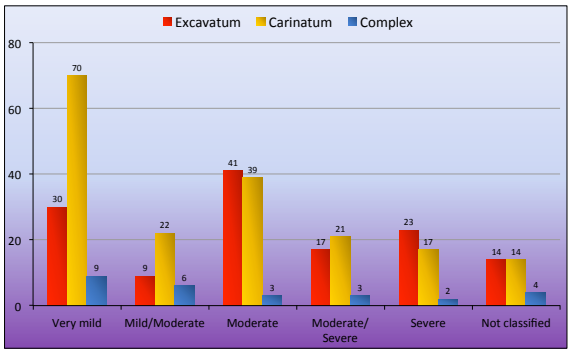

Figure 2 Severity of chest wall defects by category

Figure 3 Glasgow carbon fibre brace for Pectus Carinatum

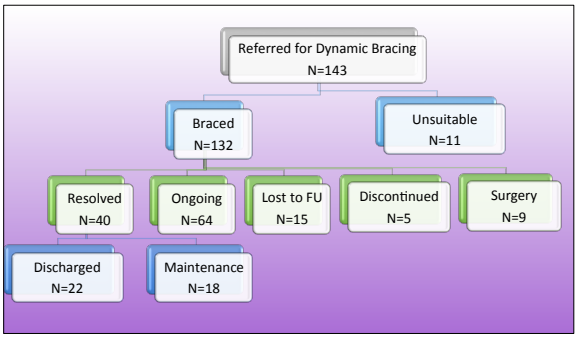

Figure 4 Dynamic Bracing

Appendix 4

Appendix 6

Physiotherapy In-Patient Pathway for Pectus Surgery

Pre-Op

Issue Pectus Recovery Pathway
Respiratory Assessment
Provision of Incentive spirometer (Coach 2 Device)
Calculation of predicted Inspiratory Capacity (IC) and record IC achieved pre-op
Advice to commence Incentive Spirometry (IS) once able post-surgery: x10 breaths hourly
Advice regarding post-op precautions :No twisting, rolling, side lying, lifting
Completion of PedsQL&Nijmegan Questionnaires

Post-Op

Patient completion of Pectus Recovery Pathway - daily
Respiratory Assessment - daily
Encourage hourly IS setting daily goal for IC - starting day 0
Ensure good IS technique
Bed transfer practice in accordance with precautions from day 1
Up to sit from day 1 and encourage mobility from day 2
Commence UL ROM exercises, scapula setting / posture advice from day 1
Daily review of precautions: no twisting, rolling, side lying, lifting
Stair practice in preparation for discharge (day 4-5)

Discharge

IS to continue at home 2 hourly when awake, ensure good technique
Record IC achieved on discharge
Review of post-op precautions and discussion regarding completion of ADLs
Advice regarding sitting posture on discharge
Home Exercise Programme for posture and upper limb range of movement
Daily walking encouraged at home with steady increase in distance and speed
Follow up Physiotherapy Review appointment or phone call arranged for within

Appendix 7

Name:	CHI:
Date:	

NHS Greater Glasgow and Clyde

PECTUS SURGERY RECOVERY

Please use this tool to track your recovery!
Check off each box as you complete the activity.

Predicted Incentive Capacity (IC) :_____ ml

Day 0 Date_____	**Breathe Deeply**	Use Incentive Spirometry every hour once awake (10 breaths each set) Aim for 25 % of IC: _____ml Value achieved: _____ml ☐1 ☐2 ☐3 ☐4 ☐5 ☐6☐7 ☐8 ☐9 ☐10
	Be Active	☐ Ensure awareness of precautions following surgery. To remain lying flat on back or with back of bed up - no side lying, rolling or twisting of spine. ☐ Circulatory exercises of legs whilst remaining in bed – moving toes / ankles / bending knees.

Day 1 Date_____	**Breathe Deeply**	Use Incentive Spirometry every hour once awake (10 breaths each set) Aim for 25 % of IC: _____ml Value achieved: _____ml ☐1 ☐2 ☐3 ☐4 ☐5 ☐6☐7 ☐8 ☐9 ☐10
	Be Active	☐ Ensure awareness of precautions following surgery. To remain lying flat on back or with back of bed up - no side lying, rolling or twisting of spine. Get out of bed and up to chair with Physiotherapist / Nurse on 2 occasions. Try to stay up for about 1 hour. ☐1 ☐2 Start gentle arm and posture exercises with Physiotherapist on 2 occasions. ☐1 ☐2

Day 2 Date_____	**Breathe Deeply**	Use Incentive Spirometry every hour once awake (10 breaths each set) Aim for 50 % of IC: _____ml Value achieved: _____ml ☐1 ☐2 ☐3 ☐4 ☐5 ☐6☐7 ☐8 ☐9 ☐10
	Be Active	☐ Practice getting up and back into bed with minimal help ☐ Aim to remain up out of bed Walk to the toilet or around your room on 3 occasions ☐1 ☐2 ☐3 Continue gentle arm and posture exercises on 3 occasions. ☐1 ☐2 ☐3

Name:	CHI:
Date:	

Day 3 Date_____	Breathe Deeply	Use Incentive Spirometry every hour once awake (10 breaths each set) Aim for 50 % of IC: _____ml Value achieved: _____ml ☐1 ☐2 ☐3 ☐4 ☐5 ☐6☐7 ☐8 ☐9 ☐10
	Be Active	☐ Aim to remain up out of bed ☐ Practice getting up and back into bed with minimal help Walk a short distance along the corridor with supervision on 3 occasions ☐1 ☐2 ☐3 Continue gentle arm and posture exercises on 3 occasions.☐1 ☐2 ☐3

Day 4 Date_____	Breathe Deeply	Use Incentive Spirometry every hour once awake (10 breaths each set) Aim for 50 % of IC: _____ml Value achieved: _____ml ☐1 ☐2 ☐3 ☐4 ☐5 ☐6☐7 ☐8 ☐9 ☐10
	Be Active	☐ Aim to remain up out of bed ☐ Practice getting up and back into bed independently Walk the length of the ward on 3 occasions with supervision ☐1 ☐2 ☐3 Continue gentle arm and posture exercises on 3 occasions.☐1 ☐2 ☐3
	Plan	☐ Start to think about going home and note down any queries.

Day 5 Date_____	Breathe Deeply	Use Incentive Spirometry every hour once awake (10 breaths each set) Aim for 75 % of IC: _____ml Value achieved: _____ml ☐1 ☐2 ☐3 ☐4 ☐5 ☐6☐7 ☐8 ☐9 ☐10
	Be Active	☐ Aim to remain up out of bed Regular walks around the ward with supervision if still required ☐1 ☐2 ☐3 ☐4 ☐5 ☐6☐7 ☐8 ☐9 ☐10 Continue arm and posture exercises on 3 occasions. ☐1 ☐2 ☐3 ☐ Stair Practice with Physiotherapist
	Plan	Youshouldbereadytogohomesoon! ☐ Askstaffanyquestionsyouhavebeforedischarge. ☐ Ensure you are confident with your home exercise program. Ensure you are confident regarding post-op precautions for going home.

*****DO NOT DISCARD*****

Please give to Physiotherapy Staff on discharge to file.