Effects of Surgery on Brain Structure and Language Skills Among Children with Isolated Cleft of the Lip and/or Palate

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INTRODUCTION

1 in every 1,563 babies born in the U.S. has cleft lip and cleft palate
(Mai et al., 2019)

Reading Skills

- Isolated cleft of the lip and/or palate (iCL/P) significantly elevates risk of reading impairment -- dependent on type (Conrad, 2018)

Brain Structure

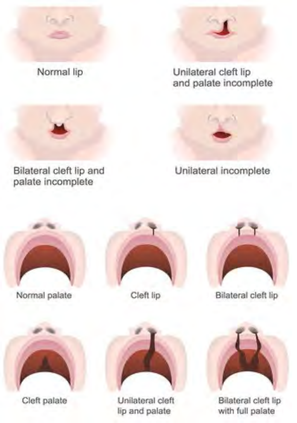
- Differences for oral clefts:
  - Increased frontal gray matter volume -- associated with better reading skills
  - Increased posterior occipital volume -- associated with worse reading skills (Conrad et al., 2021)
- Differences in interhemispheric and cerebellar white matter integrity

Speech/Language

- Quality of speech in males with cleft is associated to structural differences in the cerebellum (Conrad et al., 2010)
- Presence of oral cleft causes differences in speech input skills (Southby et al., 2021)

QUESTION

How does **surgery exposure** impact the **brain structure** and **language skills** of children with oral clefts?



PURPOSE

- Investigate the **neurological impacts** of **surgery** on patients with isolated cleft of the lip and/or palate
- Examine the role of **cleft type** (lip only, lip *and* palate, palate only) on pediatric neuropsychology

(Ameri Surgical Instruments, 2023)

VARIABLES

Independent: Type of oral cleft, number of surgeries

Dependent: Language skills, brain structure

DATA ANALYSIS

1. Divided data into 3 groups based on cleft type
2. Univariate Analysis of Variance (ANOVA)
3. Group difference statistics for those with significant F-values
4. Pearson Correlations (r)
5. Z-score transformation to evaluate significant differences in correlation strengths

RESULTS

Table 1. Univariate Analysis of Variance and Group Difference Statistics		iCLO N = 6 Mean (SD)	iCLP N = 11 Mean (SD)	iCPO N = 10 Mean (SD)	F	Sig.
Age		10.21 (1.06)	10.06 (1.23)	11.01 (.85)	.785	.465
Surgeries	Total Number	3.00 (1.67)#	6.08 (3.53)	2.70 (1.77)^#	**5.146**	**.013**
Language Skills	Expressive	107.33 (9.16)	101.17 (15.37)	101.46 (13.47)	.470	.630
	Receptive	111.00 (8.83)	107.08 (14.70)	98.57 (13.28)	1.574	.230
Brain Data: Global	Intracranial Volume (cc^3)	1533511.50 (178891.86)	1523356.75 (120815.30)	1474080.71 (129848.02)	0.598	.557
	Whole Brain (cc^3)	1279909.71 (110351.16)	1380139.46 (92985.82)	1350161.84 (102787.26)	1.991	.155
Brain Data: Regional	Cerebrum†	0.88 (0.04)	0.89 (0.02)	0.87 (0.03)	1.476	.245
	Cerebellum †	0.11 (0.01)	0.10 (0.01)	0.11 (0.01)	2.406	.108
	Frontal †	0.38 (0.03)	0.37 (0.03)	0.37 (0.03)	0.205	.816
	Parietal †	0.20 (0.01)	0.20 (0.01)	0.19 (0.02)	0.990	.384
	Temporal †	0.17 (0.01)	0.17 (0.02)	0.17 (0.02)	0.234	.793
	Occipital †	0.10 (0.01)	0.10 (0.01)	0.10 (0.01)	1.251	.301
Brain Data: Language-Specific ROIs	Broca's Area †	0.02 (0.00)	0.02 (0.00)	0.02 (0.00)	0.194	.824
	Wernicke's Area †	0.01 (0.00)	0.01 (0.00)	0.02 (0.00)	0.013	.987
	Angular Gyrus †	0.04 (0.01)	0.03 (0.00)	0.03 (0.00)	0.478	.625

†Ratio to whole brain volume; #< iCLP; ^< iCLO

Table 2. Pearson Correlations (r) and Differences between Groups		iCLO			iCLP			iCPO			Sig. Group Differences			
		Surgeries	Exp.	Rec.	Surgeries	Exp.	Rec.	Surgeries	Exp.	Rec.	Var.	Groups	Z	*p*
Language Skills	Expressive	.091	-	-	.542	-	-	-.511	-	-	#S	iCLP > iCPO	2.26	.024
	Receptive	.000	-	-	.494	-	-	-.217	-	-	-	-	-	-
Brain Data: Global	ICV (cc^3)	-.639	-.142	.117	-.026	**.781****	**.725***	.207	.081	-.374	-	-	-	-
	Whole Brain (cc^3)	.474	.500	.360	-.065	**.875*****	**.819****	-.137	.121	-.498	Exp.	iCLP > iCPO	2.38	.017
											Rec.	iCLP > iCPO	2.51	.012
Brain Data: Regional	Cerebrum	-.167	.042	.421	-.043	.487	.450	.641	.034	.355	-	-	-	-
	Cerebellum	-.290	-.502	-.626	-.020	**-.831****	**-.787****	-.483	-.300	-.540	-	-	-	-
	Frontal	.193	-.121	.180	.261	.425	.457	.322	.159	-.246	-	-	-	-
	Parietal	-.737	-.118	-.009	-.149	-.513	-.595	.149	-.343	.717	Rec.	iCPO > iCLP	2.34	.019
	Temporal	-.074	-.513	-.255	-.101	**-.738****	**-.714***	.138	.054	.560	Rec.	iCLP > iCPO	2.26	.024
	Occipital	-.654	-.213	-.035	-.178	-.248	-.170	**.694***	.024	.143	#S	iCPO > iCLO	2.32	.021
Brain Data: Language-Specific ROIs	Broca's	-.212	-.288	.102	.388	-.386	-.384	.280	.114	-.213	-	-	-	-
	Wernicke's	-.365	**-.859***	-.705	-.007	-.561	-.442	.277	.124	.485	Exp.	iCLO > iCPO	2.05	.040
	Ang. Gyrus	-.569	-.259	-.156	.250	.165	.114	.000	-.139	-.120	-	-	-	-

*p < .05; **p < .01; ***p < .001

DISCUSSION

Conclusions

- Number of surgeries did **not** have a strong impact on language skills or brain structure
- There was **not** a strong relationship between language skills and brain structure in participants with iCLO and iCPO
- Significant relationships between language skills and global/regional brain data among iCLP participants

Limitations

- Small sample size
- Did not use Bonferroni correction
- Only one variable for surgery – might have been overshadowed by other surgery variables or not the most accurate predictor

FUTURE RESEARCH

- Larger sample size
- Different method for classifying the cleft type (unilateral vs bilateral cleft)
- Impact of sex on neurological effects
- Prevention methods

ACKNOWLEDGEMENTS

Special thanks to Dr. Amy Conrad for her mentorship and support, the Conrad Neurodevelopment Lab for making this research possible, and the Secondary Student Training Program and Belin-Blank Center at the University of Iowa for providing this research opportunity.

This study was supported by K23DE024511 (NIH/NIDCR).

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