



Australian children with cleft palate achieve age-appropriate speech by 5 years of age



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ABSTRACT

Introduction: Children with cleft palate demonstrate atypical speech sound development, which can influence their intelligibility, literacy and learning. There is limited documentation regarding how speech sound errors change over time in cleft palate speech and the effect that these errors have upon mono- versus polysyllabic word production. The objective of this study was to examine the phonetic and phonological speech skills of children with cleft palate at ages 3 and 5.

Methods: A cross-sectional observational design was used. Eligible participants were aged 3 or 5 years with a repaired cleft palate. The Diagnostic Evaluation of Articulation and Phonology (DEAP) Articulation subtest and a non-standardised list of mono- and polysyllabic words were administered once for each child. The Profile of Phonology (PROPH) was used to analyse each child's speech.

Results: N = 51 children with cleft palate participated in the study. Three-year-old children with cleft palate produced significantly more speech errors than their typically-developing peers, but no difference was apparent at 5 years. The 5-year-olds demonstrated greater phonetic and phonological accuracy than the 3-year-old children. Polysyllabic words were more affected by errors than monosyllables in the 3-year-old group only.

Conclusions: Children with cleft palate are prone to phonetic and phonological speech errors in their preschool years. Most of these speech errors approximate typically-developing children by 5 years. At 3 years, word shape has an influence upon phonological speech accuracy. Speech pathology intervention is indicated to support the intelligibility of these children from their earliest stages of development.

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1. Introduction

Cleft palate (CP) is a congenital anomaly characterised by the presence of an open cleft between the oral and nasal cavities. There are different variations of CP, including unilateral cleft lip and palate (UCLP), bilateral cleft lip and palate (BCLP) and clefts of the palate only (CPO) [1]. Although procedures for palatal surgery can differ depending on cleft type and surgeon preference, children with CP typically undergo primary palatal repair within the first 12–18 months of life. Children with CP are known to have speech difficulties and experience delays in their speech sound development. This spans from the period of their first vocalisations [2,3]

through to their school years and beyond [4,5]. These speech sound difficulties place children with CP at a higher risk of encountering literacy issues once they reach school-age, which can have long-term residual effects upon their academic achievement [6]. Research regarding the long-term speech outcomes of children with CP suggests that the earlier surgery is conducted, the better the child's speech outcomes in terms of their intelligibility, resonance and size of consonant inventory [7,8]. Early speech pathology assessment and intervention is vital to ensure children with CP achieve the best possible outcomes for their speech development [5,9,10].

1.1. Speech sound errors in CP speech

The speech errors produced by children with CP can be phonetic or phonological in nature. Phonetic errors result from inaccurate manner or placement of the child's articulators. Broadly, there are two types of phonetic errors produced by children with CP;

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obligatory and compensatory errors. Obligatory [11] or passive [12,13] errors are produced due to the presence of a structural deficit. The child with CP is unable to produce the target sound accurately as their oral anatomy differs from that of typically-developing (TD) children. Examples of obligatory errors include nasal air emission (NAE) on pressure consonants, nasalised consonants, and weak consonant productions resulting from reduced intraoral pressure. In contrast, compensatory [11] or active [12,13] errors result when a child with CP attempts to articulate a sound in a way that compensates for the presence of velo-pharyngeal insufficiency (VPI). This is generally achieved by involving structures which are present lower in their vocal tract, such as their larynx and pharynx, to articulate sounds. These errors include glottal and pharyngeal stops and pharyngeal fricatives. Other compensatory errors include nasal fricatives, mid-dorsum palatal stops and nasal substitutions. These final three error types are also known as 'maladaptive articulations' as they are articulated in the oral cavity and not posterior to the velopharyngeal valve [8].

Phonological or phonemic [14,15] errors are deviations from the target speech sound which children produce to simplify adult speech. These result from the child's inability to organise and represent speech sounds appropriately [16]. All children with and without CP exhibit developmental phonological errors as they develop mastery of adult speech sounds. Examples of developmental phonological errors include gliding, context-sensitive voicing and cluster reduction. Normative data is available to guide clinical decisions about the appropriate age for a child to have 'outgrown' the different types of developmental phonological errors; after which time speech pathology intervention may be recommended. Children with CP are understood to be at high risk of using phonological errors beyond the appropriate age due to decreased hearing levels resulting from middle-ear infections, structural deficits which may affect the development of their phonological systems, and delayed language development [16].

1.2. Phonetic speech development of children with CP

Departures from typical speech development for children with CP are evident from early infancy, with these children demonstrating a delayed onset of canonical babbling and reduced consonant inventories when compared to their non-cleft peers [2,3]. There is strong evidence that by 3 years of age, several phonetic errors distinguish children with and without CP; including weak articulation of pressure consonants, nasal realisation of voiced plosives and NAE [11–13,17]. Yet surprisingly, by age 5 years, the research evidence for phonetic development is contradictory. Several studies identify no significant [16], or one single error which distinguishes cleft and non-cleft speech at 5 years of age; that being inadequate /s/ productions resulting from fronting or palatalisation [5]. Conversely, other studies contest this finding; reporting that phonetic speech disorders remain prevalent amongst the 5-year-old CP population. For example, research exploring speech outcomes for 38 Thai children with CP demonstrated that 94% still presented with articulation deficits at 5 years [9]; while a 2014 UK audit of 1110 children with CP revealed that only 48% demonstrated phonetic speech development within the normal range by school-age [18].

These differing outcomes may be explained by the different methodologies employed in the individual studies. Firstly, of the eight studies referenced above, only three used normally-developing controls [11,12,16]. Comparison with TD peers is important as it provides a clearer indication of which speech errors are and are not age-appropriate.

Secondly, each of these research groups utilised different tools to measure speech development. Indeed, the Thai study used only a

perceptual rating scale scored by a single Speech-Language Pathologist (SLP) assessor. The use of a perceptual scale as a stand-alone assessment tool is not recognised as best practice when measuring speech outcomes [19]. Additionally, Prathane and colleagues failed to provide reliability measures to verify these ratings.

Finally, the speech outcomes for the UK audit may diverge from other studies due to its large sample size. The audit examined the phonetic outcomes of 1110 children; which presents a far greater sample size than any other piece of CP research examining phonetic development. It is possible that the size of this sample provided sufficient power to identify trends in phonological development that may not have been apparent in previous investigations. These contradictions in the research findings highlight the importance of undertaking further research into phonetic speech development in children with CP, especially at 5 years of age.

1.3. Phonological speech development of children with CP

The phonological speech development of children with CP is also ambiguous due to conflicting research findings. The evidence for young children with CP consistently shows a higher use of phonological processes than their age-matched peers. In the 3-year-old population, Hutters et al. claimed that developmental phonological processes (i.e. speech processes occurring in TD children) were more common in children with CP than those without [12]. The children with CP also produced additional phonological speech errors; primarily final consonant deletion and cluster reduction [5,17]. By age 5 years, the phonological development of these children is less clear. According to Chapman, by 5 years, children with CP do not demonstrate any phonological speech errors that differ from their TD peers [16]. In contrast, Harding and Grunwell reported that phonological errors may be *more* prevalent than phonetic errors as these children approach school-age [13].

As was the case for phonetic dimensions of CP speech, the research exploring phonological speech development has involved different research methodologies and outcome measures. Moreover, there is far less research examining phonological development, as compared to phonetic development in children with CP; particularly for children aged 5 years. This may reflect the long-standing viewpoint that speech sound errors in CP arise primarily from structural deficits; which overlooks the important role of phonology in a child's speech development [17]. Given the conflicting findings of Chapman, and Harding and Grunwell, it seems that a deeper exploration into phonological errors at 5 years, and how these compare to the occurrence of phonetic errors in children with CP, is clearly justified.

1.4. Word shape development in the CP population

In exploring the phonetic and phonological speech development of children with CP, it is also important to develop an understanding of word shape development, and the influence that word shape may have upon speech error production. Unfortunately, the majority of CP research studies use a limited range of words to assess a child's speech; with the speech development of most participants only being examined using a norm-referenced picture-naming task. According to James, Ferguson and Butcher, such tasks are often not sufficient to gain a holistic representation of a child's speech development, as these assessments tend to contain a large proportion of monosyllabic words (MSWs) [20]. It is easier for children to accurately produce MSWs as opposed to polysyllabic words (PSWs), which contain multiple elements that must be stored in a child's phonological representations, then

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