OBJECTIVE

(1) To examine the evidence for the effectiveness of differences in timing and type of speech and language therapy for children with cleft palate with or without a cleft lip and (2) to identify types of interventions assessed.

DESIGN: Nine databases, including MEDLINE and EMBASE, were searched between inception and March 2011 to identify published articles relating to speech and language therapy for children with cleft palate with or without cleft lip. Studies that included at least 10 participants and reported outcome measures for speech and/or language measures were included. Studies where the experimental group had less than 90% of children with cleft palate with or without cleft lip were excluded. Two reviewers independently completed inclusion assessment, data extraction, and risk of bias assessment for all studies identified.

RESULTS: A total of 17 papers were evaluated: six randomized control trials and 11 observational studies. Studies varied widely on risk of bias, intervention used, and outcome measures reported. None of the studies had a low risk of bias. In terms of intervention approaches, seven studies evaluated linguistic approaches and 10 evaluated motor approaches. Outcomes measures did not support either approach over the other, and based on data reported it was difficult to ascertain which approach is more effective for children with cleft palate with or without cleft lip.

CONCLUSIONS: The review found little evidence to support any specific intervention. Key uncertainties need to be identified and adequately powered, methodologically rigorous studies conducted to provide a secure evidence base for speech-language therapy practice in children with cleft palate with or without cleft lip.

KEY WORDS: cleft palate, speech, speech therapy, systematic review

It is estimated that cleft palate with or without lip (CP±L) occurs in approximately 1 in 700 live births, making CP±L one of the most common congenital malformations (Vieira, 2008). A cleft lip is usually repaired at 3 months of age and a cleft palate from 6 to 12 months (Vieira, 2008); although, in the past repairs were carried out later (sometimes up to 3 years of age). Cleft palate surgery is more controversial with considerable variation internationally in timing, various stages and sequence of the repair process, and the surgical technique used (Lohmander, 2011).

Speech is considered one of the primary outcome measures of palate repair. Although cleft palate repair is now usually carried out within the first year of life, children continue to present with speech difficulties. An audit of cleft services conducted in 1998 (Clinical Standards Advisory Group, 1998) found that around 29% of children with unilateral cleft lip and palate (UCLP) needed further surgery to improve elements of
speech, such as hypernasality (Sell et al., 2001). Hardin-Jones and Jones (2005), in their analysis of the speech of 212 preschool children with repaired cleft palates, found that 68% had received speech therapy and that despite advances in the overall management of these children, the majority still required speech therapy.

Within the field, outcome measures for “speech” have been highly controversial, with a wide range of approaches used including both objective and subjective measures. For example, objective measures have included acoustics and electropalatography (EPG). Perceptual measures, associated with judging the speaker’s intelligibility, are part of an overall evaluation of speech. They usually include judging resonance, especially hypernasality and hyponasality, and judging nasal emission, which is a measure of consonant production.

Fortunately, as detailed below, there has been some progress in international consensus regarding perceptual outcome measures, with greater recognition of the complex process for ensuring reliable and valid perceptual outcomes (Sell, 2005; John et al., 2006; Lohmander et al., 2009). Language outcome measures have also been reported, usually based on formal standardized assessments and/or a judgment of language performance in terms of morphology, phonology, syntax, semantics, and pragmatics.

Within the field of speech and language intervention for children with CP±L, traditional articulation approaches that focus on modifying atypical production of speech sounds (Van Riper, 1978) have been widely used. With the development of the discipline of clinical linguistics, phonetic and phonological approaches started to be applied to the assessment and intervention of speech sound disorders in the 1970s (Grunwell, 1993). More recently psycholinguistic approaches have also been used with this population (Stackhouse and Wells, 1997). The psycholinguistic approach investigates the underlying speech processing skills, including both speech input and output, compared with existing stored lexical representations. Its relevance for speech and language therapy is that irrespective of the speech or medical diagnosis, the level of breakdown in the speech processing profile is identified and targeted in therapy (Stackhouse, 2011). This approach is usually used in combination with other approaches, especially phonetic and phonological. Some speech and language therapists have offered early intervention in the form of babble workshops for parents and their infants, which aim to modify deviant and restricted early sound development (Russell and Grunwell, 1993); whereas, the majority of other approaches take place from the age of 3 extending into the school years. Two other approaches are input modeling, which aims to stimulate speech output by increasing awareness of speech sounds (Harding and Bryan, 2002) and oral motor activities. Approaches vary greatly from therapist to therapist, and no uniform approach has been taken.

There have been no systematic reviews to summarize the current state of the evidence base for speech intervention in children with CP±L. The most comprehensive literature review was produced by Enderby and Emerson (1995), who concluded that research to investigate the effectiveness of interventions for speech impairment “was somewhat sparse” (p. 103) and was of dubious quality. In particular, they noted the lack of reliable and sensitive speech and language outcome measures, as well as problems with the heterogeneity of the populations under study. This current review aimed to identify the types of intervention that have been assessed. The review also aimed to assess the evidence for the effectiveness of current theoretical models of speech-language therapy (SLT) interventions, the most appropriate age of delivery, and the optimum intensity, duration, and delivery method for improving the speech of children with CP±L.

Methods

Identification of Studies

MEDLINE, EMBASE, ISI Web of Knowledge, CI-NAHL, PsycINFO, Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE), and the Health Technology Assessment Database were searched from inception to March 2011. The search terms included indexing and text words associated with cleft lip and/or palate and speech and language therapy (see Appendix A for the MEDLINE strategy). No language restrictions were applied. In addition, Web sites including National Institute of Clinical Excellence (NICE) and the meta-Register of Controlled Trials (mRCT) were searched, and the references of identified studies were screened.

Inclusion Criteria

Studies had to fulfill the following criteria to be included in the review.

Study Design

Studies included both randomized and non-randomized controlled trials (trials are studies that attempt to control for key elements of bias within the design). Observational comparative studies, either within or between groups, were also included to identify types of interventions assessed.

Patients

Children with CP±L were included in the review. Studies had to include at least 90% children with nonsyndromic CP±L or include syndromes with no known developmental delay (e.g., Stickler, hemifacial
microsomia). Children with isolated cleft lip only were excluded.

**Intervention**

Any SLT intervention was included within the review.

**Comparison**

No intervention control group or a different SLT intervention were used as comparators.

**Outcome**

Any speech and/or language outcome was included within the review. Studies reporting only psychosocial outcomes were excluded.

The results of the searches were screened independently by two reviewers (A.B. and P.W.). Articles considered potentially relevant were obtained and assessed for inclusion independently by two reviewers (A.B. and M.P.). All three reviewers were experienced researchers. Disagreements were resolved through consensus or referral to a fourth reviewer (D.S., an experienced clinician) when necessary and possible.

**Data Extraction and Analysis**

**Descriptive Information**

Two reviewers (A.B. and A.V. [an experienced clinician]) independently extracted the following descriptive data from the included studies: author, publication year, country of study, study design, population characteristics, setting, inclusion/exclusion criteria, intervention details, outcome measures, and results data.

**Types of Intervention Assessed**

Observational studies were also included for analysis of the interventions. The authors used a qualitative approach to synthesize data across studies (Dixon-Woods et al., 2005) and focused on three main areas: theoretical or therapeutic perspective, method of delivery (setting, person delivering the intervention), and timing of the intervention (age of intervention, intensity, and frequency of the intervention).

**Meta-Analysis of Trials Only**

**Outcome Measures**

Primary outcome measures of speech and language were extracted, followed by secondary outcomes of psychosocial outcomes (e.g., confidence, quality of life, social integration).

**Effect Sizes**

Standard mean differences (SMDs) and/or effect sizes together with 95% confidence intervals (CIs) were extracted for continuous outcomes, and odds ratios (ORs) together with 95% CIs were extracted for dichotomous outcomes. These figures were taken directly from the papers or calculated based upon raw data provided within the papers where necessary. Effect sizes and CIs were plotted using forest plots. This approach was used because the studies were too heterogeneous, both clinically and statistically, to permit statistical pooling and so a narrative synthesis was conducted.

Disagreement was resolved through discussion and consultation with the fourth reviewer (D.S.). Study authors were contacted for additional information where necessary and possible.

**Assessment of Risk of Bias**

Two reviewers (A.B. and A.V.) independently assessed studies using the Cochrane Risk of Bias tool (Higgins and Green, 2011) to rate each of the following five components as high, low, or unclear risk of bias: (1) method of sequence generation (how the randomization sequence was generated, e.g., random number table), (2) method of allocation concealment (how the randomization was concealed from researchers/clinicians), (3) method of blinding of the outcome assessor (how the study ensured the outcome assessor did not know the condition to which the participant had been allocated), (4) selective reporting of outcome data (not reporting all outcomes in the results that are mentioned in the method or failing to use standard outcome measures within a particular field of research), and (5) completeness of outcome data (whether all attritions were accounted for and whether an intention to treat analysis was performed). In the case of SLT, it is not possible for the treating clinicians or participants to be blind to their treatment allocation; therefore, adequate blinding was considered to have taken place if both data analysis and outcome assessment were blinded. Selective reporting of outcome data was considered to have taken place when papers reported only outcomes that had a favorable result or if the outcome measures assessed did not include standard measures that experts in the area would expect to have been reported.

**RESULTS**

**Types of Intervention Assessed**

The searches identified 1305 references, of which 17 were included in the review (Fig. 1). The total number of
participants across the 17 studies meeting inclusion criteria was 654, with a range of 10 to 90 participants per study. Six randomized controlled trials (RCTs) (n = 150 participants) and 1 controlled trial (n = 20 participants) were included in the meta-analysis. Another 10 observational studies were included for the evaluation of interventions: six cohort studies, three before-and-after studies, and one with an unclear design. Studies were conducted in Mexico (seven studies all from the same research center [n = 278 unique participants]), United States (four studies), China (four studies), U.K. (one study) and Denmark (one study). Four studies were conducted prior to 1990, six were conducted between 1990 and 2000, and the remaining seven studies took place after 2000. Table 1 provides an overview of the included studies with more detailed descriptions available in Appendix B.

Meta-Analysis

Assessment of Risk of Bias

The assessment of risk of bias was based upon the combined judgments of the five separate components (see Table 2). All six of the RCTs were judged as having unclear risk of bias due to unexplained sequence generation, unclear allocation concealment, inadequate blinding of outcome assessment, and the presence of missing outcome data (see Table 2). Only one study reported adequate sequence generation (Pamplona and Ysunza, 2000), none reported adequate allocation concealment, and four studies had adequate blinding of outcome assessment. All of the studies reported complete outcome data, and there was no evidence of selective outcome reporting (Table 2).

Outcome Measures (Effects on Speech)

All seven trials (six RCTs and one controlled trial) that are included in the meta-analysis reported data on speech. The exact outcome measures varied across studies with three dichotomizing the outcome into the proportion of children with adequate or inadequate speech, persistent or modified compensatory articulation disorder (CAD), and positive change or no change in speech (Fig. 2). Two further studies used ordinal data scales to report levels of speech ability and levels of CAD. Both these scales had four levels that were reorganized into two categories for analysis as binary data. Speech ability was grouped as low or high and levels of CAD as low (none or mild) and high (moderate or severe). All other outcomes were continuous and included scales to assess intelligibility, acceptability of speech, and correction of CAD, as well as validated scales for linguistic level, all based on free speech samples (Fig. 3).

Two studies (Ysunza et al., 1997; Gibbon et al., 2001) suggested a beneficial effect of computer-generated speech assessment (EPG or nasoendoscopy) combined with visual feedback versus no feedback.

One suggested that EPG compared with conventional therapy not involving visual feedback increased the proportion of children showing an improvement in s (OR, 10.7, 95% CI, 0.40 to 287.8) and t sounds (OR, 3.3, 95% CI, 0.2 to 54.5). However, the study was very small (n = 12) and CIs were wide (Gibbon et al., 2001). The other study provided evidence for a reduction in the severity of CAD (OR, 96.3, 95% CI, 3.4 to 2715.3) for nasoendoscopy combined with feedback compared with nasoendoscopy alone (Ysunza et al., 1997) (see Fig. 2 for a summary of these studies). Two studies by Pamplona and Ysunza (2000) and Pamplona et al. (1996) suggested a greater improvement in linguistic level with parental interaction compared with no parental interaction (SMD, 1.5, 95% CI, 0.84 to 2.24; SMD, 0.89, 95% CI, 0.00 to 1.79). Two other studies showed an improvement in time to correct CAD for whole language (SMD, −0.36, 95% CI, −1.08 to 0.36) and motor approach (SMD, −1.96, 95% CI, −2.85 to −1.08) compared with a purely phonological approach (Pamplona et al., 1999; Pamplona et al., 2004). The controlled study (Scherer et al., 2008) showed no effect of focused stimulation compared to intervention on receptive language (see Fig. 3 for a summary of these studies).

Outcome Measures (Psychosocial Outcomes)

Although none of the other studies assessed psychosocial outcomes, two studies reported on level of play (Pamplona et al., 1996; Pamplona and Ysunza, 2000). One study (Pamplona and Ysunza, 2000) suggested that

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**FIGURE 1.** Flowchart of review search results and numbers of included papers.
parental interaction improved play compared with no interaction (SMD, 0.44, 95% CI, −0.43 to 1.31); whereas, the second study by the same author (Pamplona et al., 1996) suggested that interaction reduced play (SMD, −0.43, 95% CI, −1.05 to 0.19). Therefore, the findings are inconclusive regarding the effects of speech and language therapy interventions on play. The results are shown in Figure 4.

**Evaluation of Interventions**

**Descriptive Information: Therapeutic Approach**

The therapeutic approaches used in the studies fall broadly into two groups: motor and articulation versus linguistic approaches (see Fig. 5). Figure 5 shows the differences among these approaches and the kinds of techniques incorporated within them. This section summarizes the different approaches taken to highlight the types of interventions currently in use with children with CP±L. One study compared more than one approach (Pamplona et al., 1999): the traditional motor approach compared with the phonological approach (see “Multiple Approaches” section).

**Motor Approaches**

Seven studies focused on motor movements specifically in the context of speech, often referred to as the traditional articulation approach or phonetic approach (Van Demark, 1974; Van Demark and Hardin, 1986; Ma et al., 1990; Chen et al., 1996; Pamplona et al., 1999; Yang et al., 2003; Hardin-Jones and Chapman, 2008). In this approach a single phoneme at a time is worked upon in therapy. Once elicited, often a challenge in this type of etiology, it is practiced within consonant-vowel–type nonsense syllables, before moving onto establishing the sounds in words and sentences, and finally working on carryover in connected speech. Throughout the intervention process, auditory awareness is emphasized to the participant. These techniques follow an articulatory approach (see Fig. 5).

Two studies focused on the more general motor movements that are used when sucking and maintaining oral pressure but not in the context of speech (see Fig. 5). The approach focuses on sucking and blowing and on general lip and tongue movements not associated with speech motor movements (Regan and Versaci, 1977; Ma et al., 2003).

Two other studies that took a primarily motor approach included those that focus on the use of visual feedback through the use of EPG (Gibbon et al., 2001) or nasopharyngoscopy (Ysunza et al., 1997) (see Fig. 5). These had their roots in traditional articulatory approaches yet not only provided the usual auditory feedback but also additional visual feedback.

**Linguistic Approaches**

Seven studies (Van Demark and Hardin, 1986; Pamplona et al., 1996; Pamplona and Ysunza, 2000; Pamplona et al., 2004; Pamplona et al., 2005; Scherer et al., 2008; Pamplona et al., 2009) used linguistic approaches that included phonological approaches (where children are introduced to multiple sounds or sets of sounds working toward the child’s understanding and production of the rule-based phonological sound system), focused stimulation (where the child is presented with vocabulary targeted at particular sounds), or whole-language approaches (where the emphasis is on creating successful communication experiences for the children) (see Fig. 5 and Table 1).

**Multiple Approaches**

Only one study contrasted the different approaches (Pamplona et al., 1999). This study compared the traditional articulation approach with the phonological linguistic approach. This study, although an RCT, had a small sample size (n = 29) and was rated as having unclear risk of bias due to unexplained sequence generation and allocation concealment (Table 2). The remaining studies compared different types of linguistic approaches with one another, compared one type of intervention with no intervention, or compared parental interaction with no interaction.

One study tested the phonological approach against the whole-language approach (Pamplona et al., 2004). Again, this study was a small (n = 30) RCT but was found to have a low risk of bias. All the other studies were case series. Additionally, none of these studies could be compared because each used different outcome measures.

Finally, two additional studies looked at the inclusion of the additional effect of visual feedback (EPG and nasopharyngoscopy) when used alongside a motor or phonetic approach (Ysunza et al., 1997; Gibbon et al., 2001). These two RCTs were small and had an unclear risk of bias (n = 29).

**Descriptive Information: Delivery of Intervention (Setting and Facilitator)**

The settings of the interventions varied. Whereas most were conducted in the clinic setting, four studies were carried out in the home and three studies assessed the effectiveness of a therapy provided at a summer camp (see Table 1). The three studies looking at summer camps (Van Demark and Hardin, 1986; Pamplona et al., 2005; Pamplona et al., 2009) did not find a difference between this setting and a clinic setting. However, Pamplona et al. (2005) reported that the costs of running an intensive summer camp course were
<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Location</th>
<th>Cleft Type</th>
<th>Age</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Comparator Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pamplona et al., 1999</td>
<td>29</td>
<td>Mexico</td>
<td>UCLP*</td>
<td>3–7 y</td>
<td>RCT</td>
<td>Motor: Trad</td>
<td>Linguistic: phono</td>
</tr>
<tr>
<td>Gibbon et al., 2001</td>
<td>12 (8 male*)</td>
<td>U.K.</td>
<td>UCLP (7), BCLP* (2), SCP (3)</td>
<td>5–18 y</td>
<td>RCT</td>
<td>Motor: EPG</td>
<td>Conventional therapy with no visual feedback</td>
</tr>
<tr>
<td>Ysunza et al., 1997</td>
<td>17</td>
<td>Mexico</td>
<td>UCLP</td>
<td>11–13 y</td>
<td>RCT</td>
<td>Motor: nasoendoscopy + feedback</td>
<td>Motor: nasoendoscopy, no feedback</td>
</tr>
<tr>
<td>Pamplona et al., 2004</td>
<td>30</td>
<td>Mexico</td>
<td>UCLP</td>
<td>3–7 y</td>
<td>RCT</td>
<td>Linguistic: WL*</td>
<td>Linguistic: phono</td>
</tr>
<tr>
<td>Pamplona et al., 1996</td>
<td>21</td>
<td>Mexico</td>
<td>UCLP</td>
<td>3–5 y</td>
<td>RCT</td>
<td>Linguistic: WL with parental interaction</td>
<td>Linguistic: WL without parental interaction</td>
</tr>
<tr>
<td>Pamplona and Ysunza, 2000</td>
<td>41</td>
<td>Mexico</td>
<td>UCLP</td>
<td>3–4 y</td>
<td>RCT</td>
<td>Linguistic: FS parental interaction</td>
<td>Linguistic: FS no parental interaction</td>
</tr>
<tr>
<td>Scherer et al., 2008</td>
<td>10 (plus 10 children without CLP as control; 9 male)</td>
<td>USA</td>
<td>CLP, non CLP</td>
<td>1–3 y</td>
<td>CT</td>
<td>Linguistic: FS*</td>
<td>Linguistic: Phono WL at summer camp</td>
</tr>
<tr>
<td>Hardin-Jones and Chapman, 2008</td>
<td>30 (plus 10 children without clefts, 33 male)</td>
<td>USA</td>
<td>BCLP (6), UCLP (20), hard and soft palate (3), SCP (1)</td>
<td>2–3 y</td>
<td>Cohort</td>
<td>Motor: Trad</td>
<td>No intervention</td>
</tr>
<tr>
<td>Yang et al., 2003</td>
<td>16 (8 male)</td>
<td>China</td>
<td>CP with obturator plate</td>
<td>5–29 y</td>
<td>Cohort</td>
<td>Motor: Trad</td>
<td>No intervention</td>
</tr>
<tr>
<td>Ma et al., 1990</td>
<td>30 (12 male)</td>
<td>China</td>
<td>CP</td>
<td>4–6 y</td>
<td>Cohort</td>
<td>Motor: Trad</td>
<td>No intervention</td>
</tr>
<tr>
<td>Van Demark, 1974</td>
<td>67</td>
<td>Denmark</td>
<td>CP</td>
<td>5–7 y</td>
<td>Cohort</td>
<td>Motor: Trad</td>
<td>No intervention</td>
</tr>
<tr>
<td>Pamplona et al., 2009</td>
<td>50</td>
<td>Mexico</td>
<td>CP</td>
<td>Mean 42 ± 11 mo</td>
<td>Cohort</td>
<td>Linguistic: WL at summer camp</td>
<td>Linguistic: WL in clinic</td>
</tr>
<tr>
<td>Pamplona et al., 2005</td>
<td>90</td>
<td>Mexico</td>
<td>UCLP (45), CP (45 control)</td>
<td>3–10 y</td>
<td>Cohort</td>
<td>Linguistic: Phono WL at summer camp</td>
<td>Linguistic: Phono WL in clinic</td>
</tr>
<tr>
<td>Chen et al., 1996</td>
<td>33 (15 male)</td>
<td>China</td>
<td>CP</td>
<td>4–16 y</td>
<td>Before and after</td>
<td>Motor: Trad</td>
<td>N/A</td>
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<tr>
<td>Regan and Versaci, 1977</td>
<td>45</td>
<td>USA</td>
<td>CP±L</td>
<td>18 mo–7 y</td>
<td>Before and after</td>
<td>Motor: nonspeech</td>
<td>N/A</td>
</tr>
<tr>
<td>Van Demark and Hardin, 1986</td>
<td>13 (9 male)</td>
<td>USA</td>
<td>CP±L</td>
<td>6–12 y</td>
<td>Before and after</td>
<td>Linguistic: Phono*</td>
<td>N/A</td>
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<tr>
<td>Ma et al., 2003</td>
<td>67 (42 male)</td>
<td>China</td>
<td>CP</td>
<td>4–11 y</td>
<td>Unclear (abstract only)</td>
<td>Motor: nonspeech focus</td>
<td>No intervention</td>
</tr>
</tbody>
</table>

* Not all studies reported gender. Figures are provided where reported. UCLP = unilateral cleft lip and palate, BCLP = bilateral cleft lip and palate, WL = whole language, FS = focused stimulation, phono = phonological.
<table>
<thead>
<tr>
<th>Setting</th>
<th>Facilitator</th>
<th>Intensity</th>
<th>Duration</th>
<th>Results</th>
<th>Follow-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Standard mean difference $= 1.936$</td>
<td>Until compensatory articulation had been corrected (6–22 mo)</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>“s” sound: odds ratio $= 10.714$</td>
<td>None</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>“t” sound: odds ratio $= 3.333$</td>
<td>None</td>
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<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>104 h, hourly</td>
<td>Not stated</td>
<td>Standard mean difference $= 0.361$</td>
<td>4–27 mo</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>104 h, hourly</td>
<td>3 times a wk for 8 mo</td>
<td>Levels of play (secondary outcome): standard mean difference $= -0.433$</td>
<td>8 mo</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>3 h</td>
<td>4-monthly in small groups</td>
<td>Standard mean difference $= 1.539$</td>
<td>12 mo</td>
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<tr>
<td>Home</td>
<td>Parents</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Expressive language: standard mean difference $= 0.441$</td>
<td>None</td>
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<tr>
<td>Home</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Auditory compreception: intervention mean $= 105.4$, comparator mean $= 107.22$</td>
<td>27 mo of age</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Formant frequency of $A$: intervention mean $= 2391$, comparator mean $= 2391$</td>
<td>6 mo</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Formant frequency of $E$: intervention mean $= 2146$, comparator mean $= 2466$</td>
<td>6 mo</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Formant frequency of $E$: intervention mean $= 3277$, comparator mean $= 2970$</td>
<td>6 mo</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Formant frequency of $U$: intervention mean $= 2873$, comparator mean $= 2890$</td>
<td>6 mo</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>8–13 h</td>
<td>Once a wk for 6 mo</td>
<td>Correct lip/tongue movements: intervention mean $= 12$, comparator mean $= 12$</td>
<td>6 mo</td>
</tr>
<tr>
<td>Clinic</td>
<td>Therapist</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Intervention mean $= 35.11$, comparator mean $= 49.62$</td>
<td>Intervention mean $= 49.62$, Up to 12 mo</td>
</tr>
<tr>
<td>Summer camp/clinic</td>
<td>Therapist</td>
<td>Standard therapy: 58.5 h, 2 x 45 min/wk</td>
<td>Standard therapy: 9 mo</td>
<td>Situational speech: odds ratio $= 0.603$</td>
<td>9 mo</td>
</tr>
<tr>
<td>Summer camp/clinic</td>
<td>Therapist</td>
<td>Standard therapy: 69 h, 2 h/ wk</td>
<td>Summer camp: 5 d/wk for 3 wk</td>
<td>Discourse (contextual) speech: odds ratio $= 1.446$, Semantic speech: odds ratio $= 1.556$</td>
<td>9 mo</td>
</tr>
<tr>
<td>Summer camp/clinic</td>
<td>Therapist</td>
<td>Standard therapy: 69 h, 2 h/ wk</td>
<td>Summer camp: 5 d/wk for 3 wk</td>
<td>Odds ratio $= 3.143$</td>
<td>9 mo</td>
</tr>
<tr>
<td>Home</td>
<td>Parents</td>
<td>26 h, 1 h/d</td>
<td>26 d</td>
<td>Articulation defectiveness: mean before therapy $= 3.88$, mean after therapy $= 2.54$</td>
<td>9 mo</td>
</tr>
<tr>
<td>Home</td>
<td>Parents</td>
<td>5–10 h</td>
<td>20–40 d</td>
<td>Nasality: mean before therapy $= 1.94$, mean after therapy $= 1.31$</td>
<td>None</td>
</tr>
</tbody>
</table>
### TABLE 2  Risk of Bias in RCTs*

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Design</th>
<th>Sequence Generation</th>
<th>Allocation Concealment</th>
<th>Method of Blinding of Outcome Assessor</th>
<th>Completeness of Outcome Data</th>
<th>Reporting of Outcome Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pamplona et al., 2004</td>
<td>RCT</td>
<td>Low</td>
<td>Unclear</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Gibbon et al., 2001</td>
<td>RCT</td>
<td>Unclear</td>
<td>Unclear</td>
<td>Unclear</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Pamplona and Yzunsa, 2000</td>
<td>RCT</td>
<td>Unclear</td>
<td>Unclear</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Pamplona et al., 1999</td>
<td>RCT</td>
<td>Unclear</td>
<td>Unclear</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Ysunza et al., 1997</td>
<td>RCT</td>
<td>Unclear</td>
<td>Unclear</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Pamplona et al., 1996</td>
<td>RCT</td>
<td>Unclear</td>
<td>Unclear</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Scherer et al., 2008</td>
<td>CT</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

* Low = low risk of bias; High = high risk of bias; Unclear = information in the paper not sufficient to assess risk of bias; CT = controlled trials.

**FIGURE 2.** Odds ratios for binary primary outcomes.

**FIGURE 3.** Standard mean differences for continuous primary outcomes.

**FIGURE 4.** Standard mean differences for continuous secondary outcomes.
considerably cheaper than the same therapy administered in the standard way within clinics (US $100 and US $412 US, respectively; see paper for details).

Interventions were delivered by parents or speech and language professionals. Those interventions using parents produced general advice for them with interventions designed to be used regularly at home, particularly focusing on language. These contrasted sharply with therapy targeted at consonant errors that require speech and language professionals, trained parents, speech and language assistants, or teaching assistants (see Table 1).

Descriptive Information: Timing of Intervention (Duration, Intensity, and Age of Delivery)

Only eight studies reported the duration of the intervention. Of these, five studies were delivered over 20 to 60 days. One intervention ran for 6 months, one for 8 months, one for 9 months, and a remaining intervention was conducted for 1 year (see Table 1 for details).

The intensity of the interventions also varied from three times a year, weekly, twice weekly, three times a week, or five times a week to daily (Table 1).

The age of the therapeutic intervention varied across the studies. Overall, interventions took place between 12 months and 29 years, often with large age ranges included within the same study. For example, the study by Yang et al. (2003) included 49 participants aged 5 to 29 years (see Table 1).

DISCUSSION

Summary

This review identified 17 studies of various SLT interventions in children with CP±L. Of these studies only seven were trials (six RCTs and one controlled trial) and contributed to the meta-analysis of effectiveness.

Effectiveness of Interventions

Most studies suggested beneficial effects of the interventions on speech and language outcomes, but effect sizes varied and confidence intervals were wide, making it difficult to draw overall conclusions based on the current published evidence in studies of children with CP±L. Only two studies assessed psychosocial outcomes, and these reported conflicting results despite comparing the same interventions and being conducted by the same authors. Differences between studies meant there was no consistent evidence to support specific settings for interventions. The review could not determine the optimal duration (number of sessions) or intensity (regularity of sessions) of therapy or who was best placed to facilitate such interventions (e.g., parents, teaching assistants, or speech therapists or pathologists).

Assessment of Risk of Bias

All had small sample sizes and had an unclear risk of bias. It was noted that five of the seven trials included in the analysis were published by a single author and completed at the same site. This raises concern about generalizability of the data.

Evaluation of Intervention Types

To evaluate the types of interventions used, an additional 10 small observational studies were included, all of which had methodological weaknesses. A variety of SLT techniques were reported in the studies. In most cases, the descriptions of the therapeutic approaches were limited. The studies did not provide sufficient evidence to support any particular theoretical approach or provide enough information about the optimum length, setting, or age of intervention.

Intervention Effectiveness: Current Thinking and Practice

There is some literature that provides further evidence from relevant non-cleft populations. McCauley et al. (2009) undertook a systematic review in non–cleft-related speech impairment on the effect of nonspeech oral motor exercises on speech physiology, speech production, and intelligibility. They concluded that there is insufficient evidence to support or refute their use to produce effects on speech. A Cochrane review of EPG also concluded that there was no evidence on which to recommend the technique for children with clefts (Lee et al., 2009).
Many of the recent phonological therapy approaches that have been published within the speech impairment literature have not been tested with this group (Bowen, 2009). Cleft speech is conceptualized as an articulation disorder with phonological consequences (Grundy and Harding, 1995). Therefore, future studies should aim to evaluate the evidence to support the use of speech-related motor techniques, such as the traditional articulation approaches in comparison with or in addition to linguistic techniques such as phonetic and phonological approaches. In addition, focused stimulation or whole-language approaches should be evaluated further in preschool children. Other specific intervention models that require further testing include multisensory input modeling (Harding and Bryan, 2002), which provides children with multiple exemplars of target behavior to raise conscious awareness of how sounds are made. As yet there is only clinical-level evidence for the success of this intervention strategy.

**Speech Outcomes**

Within cleft SLT interventions there is wide variation in the nature of the outcome measures used (see Appendix B), in part because the aims of the studies are also hugely variable, from those aiming to change speech sound production, improve velopharyngeal closure, or improve language skills. It is noteworthy that those measuring speech do not always meet the current standards for reporting outcomes. For example, Sell and Grunwell (2001) discuss the problem of simplistic and inadequate speech reporting systems where speech is reported using 4-point gross classification scales, as found in several studies in this review. Sell (2005) and Lohmander and Olson (2004) have each described current standards for reporting outcomes in speech studies, and most of the studies reviewed fall below these. When measuring speech outcome, current thinking is that perceptual speech assessment (human listener) rather than instrumental assessment has the greatest face validity (Kuehn and Moller, 2000). It is also important to evaluate different speech parameters (Lohmander and Olson, 2004; John et al., 2006; Henningsson et al., 2008), such as that of hypernasality/hyponasality, nasal airflow errors, and consonant production, as separate entities. There is, however, considerable controversy on the use of intelligibility as an outcome measure (Witzel, 1991; Whitehill, 2002; Henningsson et al., 2008) due to it being affected by speaker variables, listener variables, external factors such as context, the message content, and background noise, and the complexity of its measurement.

In early intervention studies measures of language as well as speech are appropriate because there is some evidence that language-based interventions improve speech production (Scherer et al., 2008). Furthermore, it is important to interpret speech outcomes within the framework of development and particularly language skills in the early years, given the known risk for delayed expressive language development in children born with CP±L and the impact this may have on phonetic and phonological development.

**Additional Outcomes**

Historically SLT has focused on outcome studies almost exclusively at the level of the impairment, for example, the disorder as a result of pathology. The World Health Organization (1980, 2001) has advocated broader outcomes describing the impact of the impairment on an individual’s functional performance (activity) and his or her social consequences (participation). Therefore, there is a need to measure the impact of the speech impairment on a person’s social functioning (McCormack et al., 2009). In this review studies that measured only psychosocial factors were excluded because speech is generally viewed as the primary outcome for SLT intervention, but secondary outcome assessment of psychosocial functioning is important.

Alongside the clinical assessment of effectiveness, it is also important for clinicians to consider the costs of interventions and the effect on social functioning (McCormack et al., 2009). For example, summer camps or intensive residential courses may be a more cost-effective method of delivery that may prove beneficial from a psychosocial perspective and help increase motivation to improve.

**Study Design**

Systematic reviews base the evidence for intervention models on a hierarchy of methodological designs (Centre for Reviews and Dissemination, 2001). The criterion standard for evidence of effectiveness is taken from high-quality RCTs with large sample sizes. Although RCTs are the criterion standard, they are not always possible. In these instances observational studies can provide useful evidence, but they should be conducted to the highest methodological standard with sample sizes based on calculations that allow the detection of realistic and clinically important effects.

Some have argued that systematic reviews of SLT interventions are problematic due to the limited research base within the field (Pring, 2004). Although it is true that there are few well-designed, adequately powered RCTs, there are observational studies that may provide evidence to guide current practice and future research (Pring, 2004). In these cases it is still possible for these observational studies to be reviewed in a systematic way; though meta-analyses may not be possible,
narrative synthesises of intervention models within systematic reviews provide both researchers and clinicians with a firmer basis on which to design future interventions. It is still important, however, for future studies to adopt the RCT methodology in order to reduce the risk of bias in study designs.

Limitations of the Review

The review examined SLT interventions of varying types. This makes it difficult to compare effect sizes or to pool them for the purposes of meta-analysis. Studies had small sample sizes, and no study findings were replicated either in the same or in other centers.

For the purposes of this review all studies with a sample size of fewer than 10 were excluded. This was due to the high risk of bias present in these studies and the absence of a control group. Pring (2004) stated that case studies are useful to assess whether a potential treatment has an effect that justifies further investigation in an RCT. Case studies can also give an indication as to why a treatment effect has been found (Pring, 2004). These case studies need closer inspection by researchers to highlight key approaches that could be assessed in future studies. But it is important that such studies are replicated with larger participant numbers in order to lend some support to the techniques.

It is unclear whether it is possible to generalize results across different languages, countries, and cultures. The possible difficulties associated with generalizing the findings from different countries must be considered in relation to this review. Seven of the studies were conducted in Mexico and another four were conducted in China where time of surgery and resources may be very different from those of countries such as the U.K. and the United States. In the developing world context, Sell et al. (2011) summarized the challenges of speech outcome studies, described different models of speech therapy delivery, and highlighted attitude, cultural, and language issues for both service providers and users. The differences in resources between developing and developed countries may make comparisons difficult. Most obvious is the lack of timely surgery and speech and language therapy professionals in many parts of the developing world. Sell et al. (2001) described many examples of in intervention models within the literature and addressing these using adequately designed studies that are well reported. In order for reviews to be most useful in the future it is important that papers of SLT interventions include detailed information about the intervention and its underlying therapeutic approach. It is also necessary to describe the intervention setting, who provided it, and the frequency and intensity of the intervention in sufficient details to allow replication (Marshall et al., 2010). Where possible, future studies should take the form of RCTs and use core outcome measures as standard.

The review has highlighted the need to compare motor-based phonetic approaches with linguistic approaches in future studies.

CONCLUSION

We found a lack of evidence to support any one existing intervention. The review was unable to identify the optimum setting, duration, intensity, age, or facilitation method of SLT interventions. The studies included in this review provide some suggestions for future models of intervention. However, further research is required to identify the elements of SLT interventions that may be effective, including their impact on other aspects of children’s communication and psychosocial well-being.

REFERENCES


Implications for Practice

This review was unable to provide any evidence to support any specific model of SLT intervention in relation to theoretical perspective, duration, age, setting, intensity, and delivery.

Implications for Research

Future researchers within the field of SLT intervention need to consider addressing the key uncertainties within the literature and addressing these using adequately designed studies that are well reported. In order for reviews to be most useful in the future it is important that papers of SLT interventions include detailed information about the intervention and its underlying therapeutic approach. It is also necessary to describe the intervention setting, who provided it, and the frequency and intensity of the intervention in sufficient details to allow replication (Marshall et al., 2010). Where possible, future studies should take the form of RCTs and use core outcome measures as standard.

The review has highlighted the need to compare motor-based phonetic approaches with linguistic approaches in future studies.


Appendix A  Search Strategy for MEDLINE (on OVID)

1  Cleft Palate/ (14,334)
2  Cleft Lip/ (9934)
3    hare lip$.tw. (90)
4    harelip$.tw. (327)
5  Palatoschisis.tw. (81)
6  cleft lip$.tw. (7164)
7  cleft palate$.tw. (7454)
8  orofacial$. cleft$.tw. (443)
9  facial cleft$.tw. (742)
10 oral cleft$.tw. (387)
11 craniofacial cleft$.tw. (79)
12 Velopharyngeal Insufficiency/ (1156)
13 Velopharyngeal Insufficiency.tw. (448)
14 or/1–13 (1986)
15 Speech Therapy/ (4380)
16 (speech adj3 therap$).tw. (2416)
17 (speech adj3 clinic$).tw. (468)
18 (speech adj3 intervention$).tw. (154)
19 (speech adj3 train$).tw. (373)
20 (speech adj3 rehabilitat$).tw. (468)
21 "Early Intervention (Education)"/ (1046)
22 (early adj3 educat$).tw. (1287)
23 (early adj3 interven$).tw. (11,627)
24 or/15–23 (20,059)
25 exp Speech Production Measurement/ (4196)
26 (speech adj3 assess$).tw. (847)
27 (speech adj3 screen$).tw. (84)
28 (speech adj3 measur$).tw. (1188)
29 (speech adj3 outcome$).tw. (403)
30 (speech adj3 evaluat$).tw. (881)
31 (articulation adj3 test$).tw. (167)
32 or/25–31 (6812)
33 24 or 32 (26,029)
34 14 and 33 (1080)
35 limit 34 to ("all child (0 to 18 years)” or “young adult (19 to 24 years)” (816)
36 (Child$ or infant$ or baby or babies or boy$1 or girl$1 or pre-school$ or preschool$ or toddler$ or young people or young adult$).tw. (1,048,686)
37 34 and 36 (386)
38 35 or 37 (832)
Appendix B  Detailed Study Characteristics

<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Participants</th>
<th>Intervention</th>
<th>Outcome</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pamplona et al., 2004</td>
<td>Mexico. Single-center RCT.</td>
<td>30 children with UCLP post-primary surgical correction with compensatory articulation disorder (CAD) associated with velopharyngeal incompetence. Exclusions: hearing loss, neurological deficits, language disabilities, post-surgical fistula.</td>
<td>Intervention A: Phonological approach. Modification of groups of sounds, treatment goals based on child’s active phonological rules, establishment and maintenance of phonological contrasts. Small group including speech pathologist, 2-3 children and mothers. 1-h sessions, twice weekly until CAD eliminated.</td>
<td>Total time taken to correct CAD in sessions assessed by 2 independent examiners based on a free speech sample.</td>
<td>Standard mean difference = 0.361</td>
</tr>
<tr>
<td>Gibson et al., 2001</td>
<td>Conducted in U.K. Single-center RCT.</td>
<td>12 participants: 7 children with UCLP, 2 with bilateral cleft lip and palate (BCLP) and 3 with clefts of the soft palate (SCP) following surgical correction, with compensatory articulation disorder, and a history of speech therapy pre-EPG, aged 5-15 y, 8 male.</td>
<td>Intervention A: Electropalatography (EPG) (4 sessions, followed by non-EPG therapy (another 4 sessions). Individual sessions lasting 30-45 min. Targeted anterior placement for /t/ and /s/ and groove formation for /s/. Administered by specialist cleft center speech and language therapists with training in EPG. Same therapist for EPG and non-EPG for each participant.</td>
<td>EPG and acoustic data taken during read-aloud word list using natural conversational rate. 3 time points: pretherapy, post-fourth session, and posttherapy. 10 words analyzed: 5 containing /t/ and 5 containing /s/. COG score and qualitative observations by EPG experts.</td>
<td></td>
</tr>
<tr>
<td>Pamplona et al., 1999</td>
<td>Conducted in Mexico. Single-center RCT.</td>
<td>29 children with repaired UCLP aged 3–7 y. Exclusions: hearing difficulties, language impairment, or neurological disorders.</td>
<td>Comparison of two therapies to correct compensatory articulation. Therapy A: Therapy according to traditional standard errors in articulation treated on a phoneme-by-phoneme basis. 1-h sessions twice a week. Administered by speech pathologist. Group sessions of 2-3 children. Therapy B: Therapy according to phonological approach—treatment goals set depending on phonological rules that are active in child’s system, focused on modification of groups of sounds and emphasis on establishment of previously neutralized contrasts. 1-h sessions twice a week. Administered by same speech pathologist as Therapy A. Group sessions of 2–3 children.</td>
<td>Total time of speech therapy from onset of therapy until the complete normalization of articulation as assessed in a phonological analysis from a free speech sample (videotape). Assessed by two examiners with 8 y of experience in the procedure, both involved in the study.</td>
<td>Standard mean difference = 1.936</td>
</tr>
<tr>
<td>Ysunza et al., 1997</td>
<td>Conducted in Mexico. Single-center RCT.</td>
<td>17 children with UCLP following surgical closure with compensatory articulation disorder associated with velopharyngeal incompetence and negative lateral pharyngeal wall displacement during speech. Exclusions: syndromes known to cause developmental delay, hearing difficulties, postoperative fistula.</td>
<td>Intervention A: Speech therapy 3 times a week for 60 min delivered by a speech pathologist aimed at correcting compensatory articulation. No visual feedback. Therapy involved modifying negative movements of the lateral pharyngeal walls using phoneme samples.</td>
<td>Modification or persistence of negative movements of the lateral pharyngeal walls at 12 wk as rated by an examiner inspecting the image from videonasopharyngoscopy.</td>
<td>Odds ratio = 96.333</td>
</tr>
</tbody>
</table>

Appendix B: Detailed Study Characteristics

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<td>Odds ratio = 96.333</td>
</tr>
<tr>
<td>Study</td>
<td>Methods</td>
<td>Participants</td>
<td>Intervention A: Nonparental involvement. Whole-language therapy. Recreation of everyday significant events. Groups of 2 children and 1 speech pathologist. Mean age 3 y 9 mo. 1 h 3 times weekly for 8 mo.</td>
<td>Intervention B: Parental involvement. Whole-language therapy. Recreation of everyday significant events. Groups of 2 children, mothers, and 1 speech pathologist, mean age, 3 y 7 mo. 1 h 3 times weekly for 8 mo.</td>
<td>Outcome</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Pamplona et al., 2009</td>
<td>Conducted in Mexico. Cohort study.</td>
<td>50 patients with cleft palate. Mean age, 42 mo.</td>
<td>Intervention A: Whole-language therapy delivered at summer camp for 3 wk Monday–Friday for 4 h a day.</td>
<td>Intervention B: Whole-language therapy delivered using standard speech therapy in a clinic setting for 9 mo twice a week for 45 min.</td>
<td></td>
</tr>
<tr>
<td>Hardin-Jones and Chapman, 2008</td>
<td>Conducted in USA. Cohort study.</td>
<td>Comparison of a total of 30 children with cleft lip and/or palate not referred for therapy, those referred for therapy and received it, those not receiving therapy, and an additional 10 children without clefts aged 27 mo. 6 had BCLP, 20 UCLP, 3 hard and soft palate cleft, 1 SCP. Exclusions: cleft lip only, syndromes known to cause developmental delay.</td>
<td>Intervention A: Therapy received between 9 and 21 mo (mean, 16 mo). Delivered weekly for 60–75 min at home, or twice weekly for 30 min at home. Administered by speech and language pathologists with 1–19 y of experience (mean, 10 y). Stimulation of consonant sounds using modeling and tactile placement cues and encouraging vocabulary development through play with additional oral movements. Comparator A: Patients who had not been referred for treatment. Comparator B: No therapy but were referred. Comparator C: Children without cleft (normal speech development).</td>
<td>Comparison of initial and final levels of development using situational, discourse, semantic levels.</td>
<td></td>
</tr>
<tr>
<td>Scherer et al., 2008</td>
<td>Conducted in USA. Controlled study.</td>
<td>10 children with CLP and 10 children without CLP, aged 14-35 mo. 11 girls, 9 boys. Exclusions: genetic syndromes, neurological impairment, hearing difficulties, preterm birth earlier than 36 wk of gestation.</td>
<td>Therapy delivered only to children with CLP. Children without clefts were used as a comparison group demonstrating normal speech and language development. Mothers trained to use focused stimulation approach, consisting of description of technique, role play of scripted procedure examples, demonstration by clinician and parent-child practice with clinician coaching. Modeling of target words at least 3 times during play session and then use of expansions if child did not respond correctly. 2-4 training sessions of 45 min until 80% accuracy with technique achieved.</td>
<td>Sequenced Inventory of Communicative Development Inventories–Revised (expressive &amp; receptive language). Transcripts—assessment of language sample by blinded raters. Systematic analysis of language transcripts: Number of total words, number of different words, mean length of utterance, percentage of responses. Speech: Percentage of glottal stops, number of true consonants, Percent Consonants Correct-Revised.</td>
<td></td>
</tr>
</tbody>
</table>

**Linguistic level (levels 1-5):** Prelinguistic, 1-word utterances, semantic combination, simple sentences and complex. Assessed by 2 independent listeners watching free play videotape for 40 min at preintervention and postintervention. Level of play (1-3): Relational, symbolic, or imaginative assessed by independent assessors by videotape for 40 min. Parental interaction: Modified in Intervention B at postintervention versus no modification.

**Standard mean difference = 0.895**

Levels of play (secondary outcome): standard mean difference = −0.433

**Expressive language:**

- Standard mean difference = 0.117
- Receptive language: standard mean difference = 0.392
<table>
<thead>
<tr>
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<td>Pamplona et al., 2005</td>
<td>Conducted in Mexico. Cohort study.</td>
<td>45 children with UCLP following primary surgical closure, with CAD in association with velopharyngeal incompetence aged 3–10 y.</td>
<td>Intervention A: Summer camp for 3 wk, 4 h a day Monday–Friday. Mothers present. Maximizing articulation in naturalistic setting and within a linguistic context. Using phonological principles and whole-language model. Intervention B: Speech therapy to correct CAD 2 times weekly for 1 h for 12 mo using phonological principles and whole-language model. Small groups with mothers, 2–3 children and speech pathologist. Control: 45 children with cleft palate following primary surgical closure with CAD in association with velopharyngeal incompetence following secondary speech surgery aged 3–10 y.</td>
<td>Level of CAD—No (Normal), Mild, Moderate or severe at pre and post as rated by examiners using videotaped 1-h play and storytell-ing sample.</td>
<td>Odds ratio = 3.143</td>
</tr>
<tr>
<td>Ma et al., 2003</td>
<td>Conducted in China. Abstract only. Unclear study design.</td>
<td>67 children with cleft palate aged 4–11 y, 42 boys, 25 girls. No specific exclusion criteria stated.</td>
<td>Voice training program. Reinforcement for velopharyngeal closure ability (1 mo postoperation), instruction to say “oh” loudly 30 times twice daily for 1 mo. Reinforcement of competence (2 mo postoperation). Instruction to blow balloon 40–60 times once or twice daily and play harmonica 1–2 times a day. Lip posture and movements: grin, pout, blow, say /p/, nibble underlip with upper, huff, and say silent /l/ for 10–15 min 2–3 times daily.</td>
<td>Song Ruyao evaluation of vocalization and speaking condition (4 grades): Excellent = no different to normal speech, fine = some differences in speaking but understandable, mistake = abnormalities to a great extent, bad = cannot be understood.</td>
<td></td>
</tr>
<tr>
<td>Yang et al., 2003</td>
<td>Conducted in China. Cohort study.</td>
<td>Post-speech therapy group: 16 patients with cleft palate with pharyngeal obturator, aged 5–28 years (mean, 17.2 y), 8 males, 8 females who received speech therapy after this surgery. Pre-speech therapy group: 33 individuals with cleft palate (18 males and 15 females) aged 5–29 (mean, 15.8 y), with pharyngeal obturator, had participated in speech training classes from August 1999 to August 2000 who did not receive speech therapy after surgery. Control: healthy students aged 5–15 y. Exclusions: Received speech therapy post–cleft palate closure, oral or nasal fistulas, hearing difficulties or learning difficulties, severe bite deformity, local accent.</td>
<td>Intervention A: standard speech therapy care, described as speech training, wearing a velopharyngeal obturator to assist pronunciation and homework practice. Comparator B: Healthy control group who received no intervention.</td>
<td>First three formant frequencies (F1, F2, and F3) assessed on vowel sounds a, e, i, and u, using computer-based recording instrument, preintervention and postintervention up to 6 mo following speech therapy.</td>
<td>Formant frequency of A: intervention mean = 2391, comparator mean = 2391 Formant frequency of E: intervention mean = 2146, comparator mean = 2466 Formant frequency of I: intervention mean = 3277, comparator mean = 2970 Formant frequency of U: intervention mean = 2873, comparator mean = 2890</td>
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<td>Chen et al., 1996</td>
<td>Conducted in China. Before-and-after study.</td>
<td>33 children with CP between 1 mo and 5 y post–cleft palate repair and functional speech disorder aged 4–16 y (mean, 6.9 y), 15 males. No specific exclusion criteria.</td>
<td>Intensive speech therapy (1–2 times per d, 0.5–1 h a session for 1–2 mo). Lip movement training, tongue movement training, elicitation of correct consonants, and training of syllable combination production using Pinyin method, induction method, classification method, and games.</td>
<td>Speech intelligibility score at preintervention and postintervention and speech intelligibility for consonants before and after therapy. Classifications: category I: abnormal articulatory place, category II: abnormal manner of articulation, category III: both abnormal articulatory place and manner.</td>
<td>Mean before therapy = 38.43, mean after therapy = 89.54</td>
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<tr>
<td>Study</td>
<td>Methods</td>
<td>Participants</td>
<td>Intervention</td>
<td>Outcome</td>
<td>Results</td>
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<td>Ma et al.,</td>
<td>Conducted in China. Co-</td>
<td>30 patients with cleft palate from 4-6 y with submucous cleft palate, in-</td>
<td>Intervention A: postoperative speech training for 6 months, once a</td>
<td>Intelligibility on experimental syllable diagram and on alphabet at pretherapy, 3 months, and post-therapy, and lateral head X-ray (stationary position, pronouncing &quot;ee&quot;).</td>
<td>Correct lip/tongue movements: intervention mean = 12, comparator mean = 12</td>
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<td>1990</td>
<td>hort study.</td>
<td>complete and complete UCLP and BCLP, all having received von Langenbeck repair; 12 male, 18 female.</td>
<td>week for 20–30 min. Involving lip and tongue movements and blowing exercises, practicing pronouncing single vowels and double vowels, correct mandibular movement exercises and phonetic alphabet exercises.</td>
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<td>Correct blowing: intervention mean = 16, comparator mean = 16</td>
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<td></td>
<td></td>
<td>No specific exclusion criteria.</td>
<td>Comparator B: No therapy.</td>
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<td>Correct mandibular movements: intervention mean = 18, comparator mean = 18</td>
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<td>Van Demark</td>
<td>Conducted in USA. Before-</td>
<td>13 children with cleft palate with or without cleft lip aged 6.8–12 y (mean, 8.7 y), 9 boys, 4 girls. All had velopharyngeal competence or marginal competence, with articulation errors judged by the first author to have potential to improve.</td>
<td>Summer camp delivery of systematic multiple sound approach to articulation. 1-h sessions per day for 26 d. Total of 104 h. Half individual sessions, half with another child. Administered by speech pathologists with experience in cleft, except for 3 children who received it from a graduate speech pathologist.</td>
<td>Rated on scales: articulation definiteness scale of 1–7, severity of velopharyngeal competence scale 1–3. Used speech sample of conversational speech, Iowa Cleft Palate Articulation Test, responses on phonetically balanced sentences.</td>
<td>Articulation definiteness: mean before therapy = 3.88 mean after therapy = 2.54 Nasality: mean before therapy = 1.94, mean after therapy = 1.31</td>
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<td>and Hardin,</td>
<td>and-after study.</td>
<td>No specific exclusion criteria.</td>
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<td>23 out of 27 had adequate speech</td>
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<td>1986</td>
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<td>Regan and</td>
<td>Conducted in USA. Co-</td>
<td>45 consecutive children with CL±P post surgical correction. Mean age 19.8 mo at start of intervention. Mean age 6.9 y at completion of study.</td>
<td>Parents seen for half hour to explain and instruct on straw sucking. Advised to provide all liquids through a straw (a cup called “sip-it” was used). Parents responsible for enforcement of the procedure. Evaluation twice yearly for approximately 4 y.</td>
<td>4-point rating scale used by a professional listener to estimate voice and speech acceptability based on a substantiated speech sample. Listening by 2 skilled speech clinicians and 1 layperson all not involved in study. Parental judgments also gathered.</td>
<td>Percentage correct on both the 44 and 70-item Iowa/Danish Pressure Articulation test as rated by a Danish speaking speech pathologist and the investigator (95% agreement). Type of errors made: oral distortion, substitution including glottal and pharyngeal and omissions.</td>
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<td>Versaci, 1977</td>
<td>hort study.</td>
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<td>Van Demark,</td>
<td>Conducted in Denmark. Co-</td>
<td>67 children with cleft palate who had not received speech therapy.</td>
<td>Intervention A: Received intervention between two speech assessment points.</td>
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<tr>
<td>1974</td>
<td>hort study.</td>
<td>No specific exclusion criteria.</td>
<td>Comparison A: Had not received intervention between two speech assessment points.</td>
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