

Role of obturators and other feeding interventions in patients with cleft lip and palate: a review

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Abstract

Background Newborns with cleft palate have a distorted maxillary arch at birth. Depending upon the type of cleft, infants suffer from a variety of problems, many of which are related to feeding difficulties. Feeding these babies is an immediate concern because there is evidence of delayed growth of children with cleft lip and palate (CLCP) compared to normal infants. Many methods have been devised to overcome these problems, including the use of special bottles, nipples, and initial obturator therapy.

Review A Pub Med search was conducted using the following search terms: feeding interventions in cleft lip and palate, feeding plate/obturator in cleft palate. All the relevant articles were studied and the reference list of selected articles was also studied. Effects of different feeding interventions in infants with cleft palate with special emphasis on obturators, based on descriptive reports, expert opinions, and available data from clinical trials was reviewed.

Results The combination of search terms generated a list of 74 articles out of which 51 articles were excluded based on analyses of abstracts and full texts. Three additional publications were identified by the manual search. A total of 26 relevant articles were selected which included randomised controlled trials and descriptive studies on feeding interventions and obturators.

Conclusion A single intervention may not fulfil all feeding requirements of infants with CLCP. Combined use of different feeding interventions such as palatal obturator,

Haberman feeder, and breast milk pump and lactation education may successfully meet the feeding needs of both mother and child.

Keywords Feeding · Cleft palate · Obturator

Introduction

Cleft lip and cleft palate (CLCP) is the most common congenital abnormality of the orofacial structure. The worldwide incidence of CLCP has been reported to be 1/600 live births (Mossey and Little 2002). Recent epidemiological data collected from 34 states and 30 countries for the years 2002–2006 showed an average prevalence of cleft lip with or without cleft palate to be 7.94/10,000 live births internationally. Countries with the highest and lowest rates were Japan and South Africa, respectively (Tanaka et al. 2012). It is estimated that of the total number of cleft infants, 50 % are affected with combined CLCP, 30 % with isolated cleft palate, and 20 % with isolated cleft lip (Reilly et al. 2007).

A cleft palate may occur on the soft palate only, or it may extend forward through the hard palate. It also may be unilateral or bilateral and may occur alone or in conjunction with cleft lip, as part of a syndrome, or in association with other abnormalities (Raman et al. 2004).

Although CLCP is a single anomaly, its consequences affect several systems and functions of the child and result in social and psychological problems. Therefore, early repair of cleft palate is imperative. The optimal timing for cleft palate surgery still remains controversial. Every cleft centre throughout the world follows its own surgical treatment protocol based on the multidisciplinary experience. Ideal timing of the lip closure is at the age of 3 months and that of

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palatal closure is at the age of 9 months. Early surgical velopharyngeal reconstruction and palatal closure at the first year of age is very important for achieving the standard of speech quality and articulation (Ziak et al. 2010).

It was earlier suggested that late hard palate repair (at around 12–14 years of age) would be less damaging than early hard palate repair, assuming that the former allows more maxillary growth (Schweckendiek 1978; Bardach et al. 1984; Ross 1987). However, various authors have not found any significant difference in maxillary growth between different age groups ranging from 6 months to 9.4 years. (Blijdorp and Egyedi 1984; Noverraz et al. 1993; Swennen et al. 2002). Berkowitz et al. (2005) have suggested that palatal closure should be performed when the cleft size is 10 % of total palatal surface area which generally occurs between 18 and 24 months but can occur earlier or later.

Before the closure of palatal defects, babies with CLCP are confronted with several obstacles to successful feeding. The infant feeding process depends upon smooth synchronisation of two processes, namely sucking and swallowing. Because of their abnormal oral anatomy, infants with CLCP have difficulty creating oral pressure gradients (Reid et al. 2007) which impacts the pharyngeal stage muscle movements and delays the triggering of swallowing movements (Masarei et al. 2007a).

Feeding problems typically encountered in these patients have been described by multiple investigators (Goyal et al. 2012) and the degree of feeding difficulty varies with the type and severity of the cleft. The degree of palatal clefting corresponds to the degree of feeding difficulty; more significant feeding problems reflect more extensive palatal clefting (Clarren et al. 1987). Infants with CLCP exhibit shorter sucking bursts, faster sucking rates, higher suck–swallow ratios, and increased positive-pressure generation than normal infants (Masarei et al. 2007b). Britton et al. (2011) have reported that assisted feeding via nasogastric tubes were required in 29 % of cleft infants and that it took a month or longer to establish a regular feeding pattern in 77 % cleft infants, while 20 % never established a feeding pattern. Inefficient oral feeding results in retardation of growth and development (Avedian and Ruberg 1980; Felix-Schollaart et al. 1992; Lee et al. 1996). However, although there may be an early lag period, children with clefts tend to catch up to the norm and achieve growth equality by 3 years of age, thus appearing to conform to the concept of catch-up growth (Ranalli and Mazaheri 1975). The severity of the cleft type also affects the growth of the patient (Jacobs 1983; Jones 1988).

Materials and methods

A systematic review according to the PRISMA 2009 Checklist (<http://www.prisma-statement.org/2.1.2%20-%20PRISMA%202009%20Checklist.pdf>) was performed.

A MEDLINE search (PUBMED) of articles published prior to 2013 was conducted to summarise the use of obturators and other feeding interventions in infants with clefts using the keywords “feeding interventions in CLCP” and “feeding plate/obturator in cleft patients.” Any relevant work published in the English language and containing information about the described issue was considered for inclusion in the review. Abstracts were screened for compliance with the inclusion criteria. Subsequently, full text analyses were performed.

Results

The search strategy is presented in Fig. 1.

The combination of search terms resulted in a list of 74 articles. A total of 51 articles were excluded based on analyses of abstracts and full texts. The reasons for exclusion were as follows: case reports ($n = 9$), reviews ($n = 3$), no relevant information regarding obturators as a feeding plate in cleft palate patients ($n = 39$). A total of 23 articles from the electronic search of the PUBMED database were included. Three additional publications were identified by the manual search.

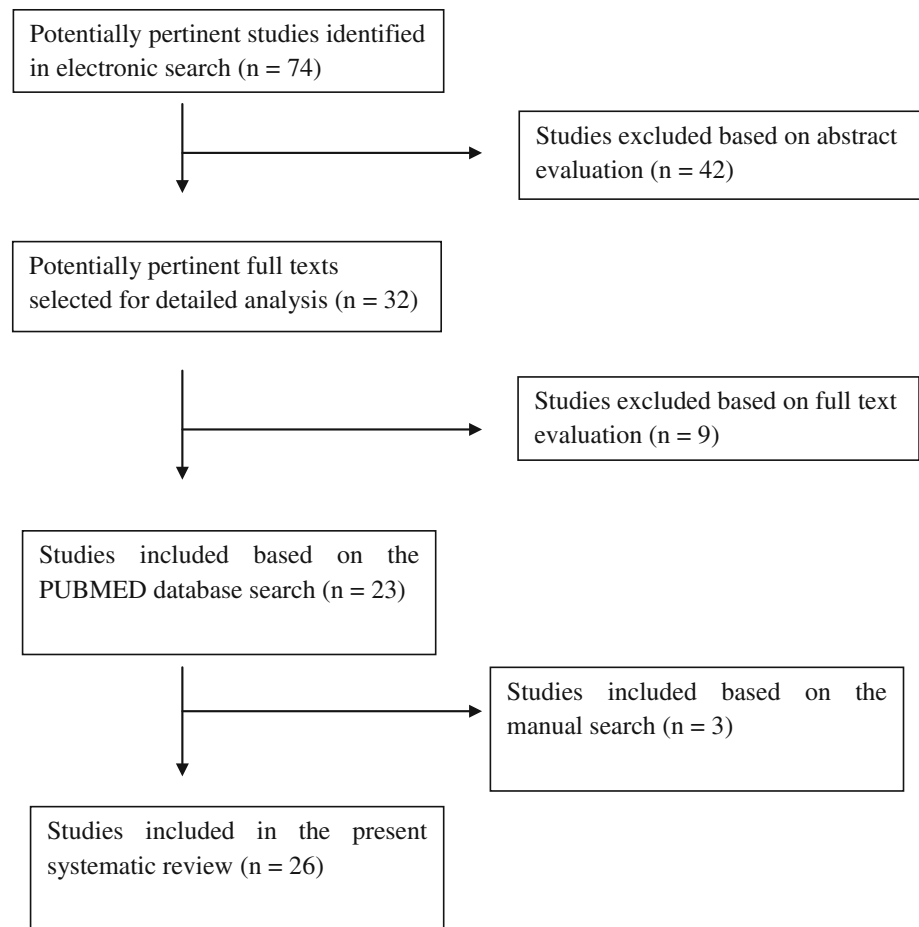
Ultimately, the feeding interventions and obturators were analysed from the identified randomised controlled trials ($n = 4$) (Brine et al. 1994; Shaw et al. 1999; Prah et al. 2005; Masarei et al. 2007a) and descriptive studies ($n = 22$) (Tisza and Gumpertz 1962; Williams et al. 1968; Paradise et al. 1969; Paradise and McWilliams 1974; Campbell and Tremouth 1987; Clarren et al. 1987; Saunders et al. 1989; Choi et al. 1991; Richard 1991; Lang et al. 1994; Trenouth and Campbell 1996; Kogo et al. 1997; Oliver and Jones 1997; Turner et al. 2001; Mizuno et al. 2002; Da Silva Dalben et al. 2003; Garcez and Giugliani 2005; Masarei et al. 2007b; Sabarinath et al. 2008, 2009; Britton et al. 2011; Ize-Iyamu and Saheeb 2011) and are discussed in detail below regarding their role in patients with clefts.

Squeezable/compressible bottle with various teats and nipples

A wide variety of specialised teats and nipples are available for use in infants who present with CLCP or other feeding difficulties. Likewise, a wide variety of independent descriptive studies regarding teats and nipples have reported varying degrees of effectiveness with feeding (Table 1).

Cup/spoon and disposable syringe feeding

The quest for excellence has led to further developments of new feeding techniques for babies with clefts. Lang et al.

Fig. 1 Search strategy

(1994) advocated cup feeding as a useful technique for infants who are difficult to breastfeed. However, the safety of this technique has been questioned.

Spoon feeding is the most popular and common method of feeding infants with CLCP in India according to a national survey conducted in India from May 2006 to September 2007. Spoon feeding is also preferred by the majority of surgeons (Gopalakrishna and Agrawal 2010).

When babies were fed a combination of breast milk and formula using a syringe without a needle, significant increases in weight gain, faster feeding times, and greater volumes of feeding were recorded. Thus, feeding with a syringe is easier and more practical (Ize-Iyamu and Saheeb 2011).

Breastfeeding

Whether or not breastfeeding is feasible in infants with CLCP is often an immediate question, and opinions have varied historically. There are descriptive studies indicating that infants with CLCP are able to successfully breastfeed at least to some degree, although supplemental bottle

feeding may be necessary to meet nutritional needs. Various studies (Clarren et al. 1987; Garcez and Giugliani 2005) support breastfeeding in babies with clefts. However, other reports (Oliver and Jones 1997) cite less success with breastfeeding for infants with cleft palate than for infants with cleft lip or no cleft. In a recent study on 90 Scottish parents of cleft infants, 47 mothers (52 %) decided to change their method of feeding from breastfeeding because of their child's cleft with 81 % of these mothers changing to using formula milk and a bottle. Only 13 % of all subjects were breastfed for 6 months or more (Britton et al. 2011).

In general, the success of breastfeeding, like bottle feeding, will depend upon the degree of clefting and the status of the airway. Infants with a small cleft in the soft palate may be able to breastfeed; in contrast, infants with more significant palatal clefting will likely have considerable difficulty. This is consistent with some previous studies (Clarren et al. 1987; Da Silva Dalben et al. 2003). However, others (Jones 1988) have reported that the shape or size of the palatal cleft does not affect breastfeeding.

Clinical protocols developed by the American Academy of Breastfeeding Medicine in 2007 serve as a guideline that

Table 1 Various feeding interventions in infants with cleft lip and/or cleft palate (CLCP)

Intervention	Features of various teat/nipple	Comments
Randomised controlled trial comparing a squeezable or rigid bottle with an NUK orthodontic nipple (Shaw et al. 1999)	NUK orthodontic nipple is soft and pliable with a high flow rate. It has a broad base with a hole on the tip (Shaw et al. 1999)	Modified equipment (compressible bottle and NUK orthodontic nipple) combined with parental counselling led to significantly greater weight gain and head circumference in infants with CLCP compared to a control group (who used standard rigid bottles with an NUK orthodontic nipple) at 12 months of age (Mizuno et al. 2002; Shaw et al. 1999)
Randomised controlled trial comparing a squeezable plastic container with a Mead Johnson cleft palate nurser and a standard nipple with a cross-cut (Brine et al. 1994)	Mead Johnson cleft palate nurser is a soft, compressible bottle that can be easily squeezed. It is fitted with a cross-cut nipple Cross-cut nipple can be used with either rigid or compressible bottles. Has a thick and a thin side with a one-way valve that prevents excessive air intake and allows milk to flow only when the nipple is compressed by the infant. Depending on the degree of clefting, one, two, or three additional holes can be provided in the teat (Shaw et al. 1999)	Both feeding devices, when used with a nutrition intervention protocol, were equally effective for supporting normal growth in infants with clefts (Brine et al. 1994)
Uncontrolled experiment (one small series of cases) using Haberman Feeder (Campbell and Tremouth 1987)	Haberman feeder is soft and pliable with a one-way valve that prevents rapid fluid flow and opens only when the infant sucks Nipple has three different flow rates, indicated by raised markings on the nipple itself; this controls the flow of milk into the infant's mouth (Campbell and Tremouth 1987)	Faster feeding times, less vomiting, satisfactory weight gain, and parental acceptance for infants who were fed with a Haberman Feeder (Campbell and Tremouth 1987) The Haberman Feeder was also found to be the most popular method used by 18 of 25 mothers in a questionnaire-based study conducted among the mothers of 25 neonates with CLCP (Trenouth and Campbell 1996) The Haberman Feeder has gained popularity in the USA in recent years (Mizuno et al. 2002)
Prospective experimental study using Type-P teat which is widely used in Japan (Mizuno et al. 2002)	Type-P teat has one side with a thick wall for placement against the roof of the mouth and one side with a thin wall for the infant to suck The bottle is soft and compressible, allowing for assisted feeding. It has a longer, wider shaft, which leads to a higher expression pressure. It can also be modified so that the teat has a single hole instead of a Y-cut (Mizuno et al. 2002)	Feeding efficiency, expansion pressure, and feeding frequency improved using a type-P teat. It is widely used in Japan (Mizuno et al. 2002)
Based on clinical experience using Benifex cleft lip/palate nurser (Paradise and McWilliams 1974)	Benifex cleft lip/palate nurser has a rigid, plastic, slotted shell into which a disposable milk-containing plastic bag is placed and onto which a conventional nipple-carrying cap is screwed (Paradise and McWilliams 1974)	An adequate amount of milk can be fed in 15–20 min with prompt upturns of weight towards normal, but does not prevent aspiration or nasal escape of food (Paradise and McWilliams 1974)
Prospective experimental study comparing Cleft NUK with regular NUK (Choi et al. 1991)		Usually not recommended for infants with clefts; an experiment conducted to measure intra-oral negative pressure during bottle feeding with a regular NUK (MAM) teat and an NUK orthodontic nipple in 23 infants with clefts showed no improvement in feeding after using the cleft NUK (Choi et al. 1991)

may impact breastfeeding success. Various feeding positions are recommended for infants with clefts, such as the football hold/twin position, face-on straddle position, semi-upright infant position, positioning the breast towards the “greater segment”, the side of the palate which has the most intact bone and supporting the breast while feeding.

Role of specialist cleft nurses

A critically important member of the multidisciplinary cleft team with regard to establishing and maintaining an effective feeding regime is the specialist cleft nurse. These specialist nurses offer detailed feeding instructions and support for new parents of babies with cleft lip/palate. The timing of arrival of these nurses should be as early as possible preferably 24–48 h after birth. The help and support given by the specialist nurse was found to be positive by over 95 % of parents in a questionnaire-based study conducted in Scotland. The parents found it difficult to find the right feeding method for their baby until they received input from the specialist cleft nurses (Britton et al. 2011).

Palatal obturators

A feeding obturator is a device that creates a seal between the oral and nasal cavities and controls the flow of milk. It comprises an acrylic plate inserted into the mouth over the hard palate, essentially closing the palatal defect. Separation between the nasal cavity and the oral cavity can thus be obtained.

Different authors have discussed the advantages and disadvantages of obturators which are presented below.

Advantages of obturators

1. An obturator creates a rigid platform on which a baby can press the nipple and extract milk (Saunders et al. 1989).
2. It reduces potentially painful ulceration of the nasal septum by the teats because of the plasticity of the tissue conditioner on the fitting surface of the tissue conditioner (Saunders et al. 1989).
3. It helps create sufficient negative pressure that allows for adequate sucking of milk (Ravichandra et al. 2010).
4. It facilitates feeding, reduces nasal regurgitation and the incidence of choking, shortens the time required for feeding, and prevents the tongue from entering the defect and interfering with the spontaneous growth of palatal shelves towards the midline (Saunders et al. 1989).

5. It helps to correctly position the tongue to perform its functional role in the development of the jaws and thus contributes to speech development.
6. It reduces the passage of food into the nasopharynx, thus reducing the incidence of otitis media and nasopharyngeal infections (Paradise et al. 1969).

Thus, a feeding plate restores the basic functions of mastication, deglutition, and speech production until the cleft lip and/or palate can be surgically corrected.

Problems associated with use of obturators

1. Frequent visits for examination of the oral mucosa, which is very delicate and easily damaged by the obturator; ongoing adjustments and replacements are needed to accommodate growth (Williams et al. 1968; Sabarinth et al. 2008, 2009).
2. Repeated construction of new obturators because of baby’s growth (Williams et al. 1968).
3. Often associated with poor oral hygiene, which can lead to fungal growth on the palate if the proper cleaning procedure for the prosthesis is not followed (Saunders et al. 1989).
4. May be costly.
5. Associated with hazards encountered while taking impressions for construction of the obturator, such as difficulty in removing the impression due to engagement of undercuts and fragmentation of the impression upon withdrawal from the mouth with subsequent respiratory obstruction and cyanotic episodes (Sabarinth 2008, 2009).
6. Intra-oral placement of the obturator is challenging and can add to the burden of maintenance (Masarei et al. 2007a).

There are two schools of thought regarding the use of obturators. One suggests that the feeding plate eliminates slow and frustrating feeding, reduces choking episodes, and improves growth and the parent’s psychosocial well-being. Others dispute this, reporting that the use of obturators does not improve feeding or that there is insufficient evidence to support the use of obturators (Masarei et al. 2007a).

Role of the obturator as a feeding intervention can be considered in following ways:

Nutritional gain: Favourable outcomes have been reported for infants with seemingly intractable feeding outcomes. In such studies, the principal measures were height and weight, and the combined effects of the obturator, lactation education, and breastfeeding resulted in better weight gain within normal limits (Kogo et al. 1997; Turner et al. 2001). However, in other studies (Prahl et al. 2005; Masarei et al. 2007a), these measures did not differ

significantly between groups who used an obturator and those who did not. Masarei et al. (2007a) conducted a randomised controlled trial on 50 patients with clefts to assess the effects of obturators on infant feeding at 3 and 12 months of age following palate repair at 6 months of age. They observed no significant differences in growth, height, head circumference, or body mass index. In addition, no significant differences between cleft types were found in physiological measures of bottle feeding, including the length of sucking bursts, rate of sucking, peak-to-peak intervals, percentage of positive-pressure generation, and the suck–swallow ratio between the groups of infants managed with or without an obturator.

Effectiveness of palatal obturators for improving feeding efficiency: As presented in Fig. 2, Turner et al. (2001) demonstrated that the combined use of a palatal obturator and lactation education resulted in reduced feeding times, an increased volume consumed, and a higher flow rate. In a trial carried out by Kogo et al. (1997), breast milk was easily expressed by mothers using a modified Hotz-type plate; however, the feeding time was about 25 min, which was too lengthy and tiring for mothers. Prahl et al. (2005) studied the quantitative effects of obturators on feeding, and found that feeding was better in the obturator group than in the non-obturator group, but there were no differences in feeding variables between the groups. These results show that although obturators do not ameliorate the need for supplemental feeding, a higher volume ingested is definitely an indication of improved sucking performance and a promising step towards independent breastfeeding.

Restoration of infant's ability to generate intra-oral pressure: The feeding plate or obturator is a passive

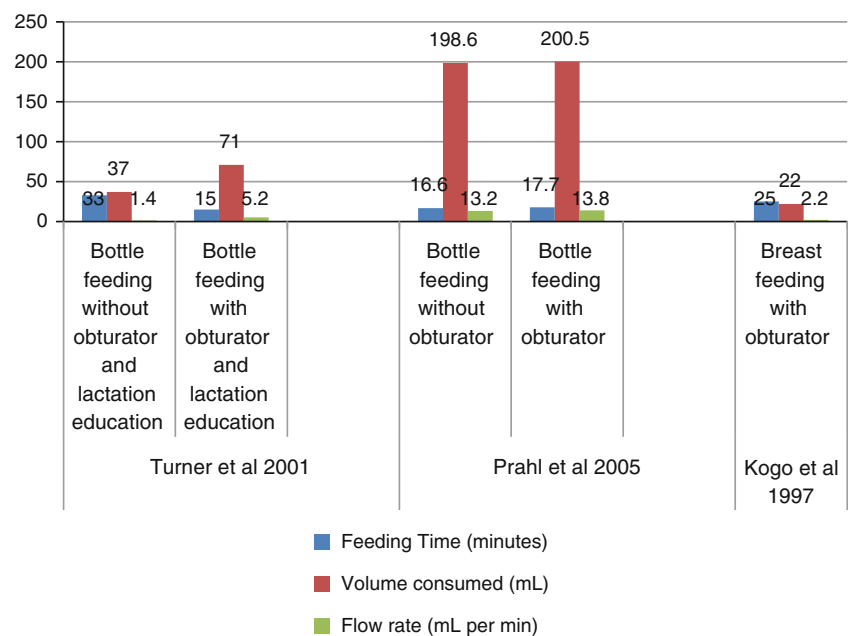
prosthetic appliance that helps create sufficient negative pressure, thus allowing for adequate sucking of milk. Pressures of about -0.5 to -0.6 cmH₂O have been measured in babies with CLCP wearing a Hotz-type feeding plate. Such infants can suck and intake about 22 g of breast milk per attempt, and breastfeed until naturally weaned (Kogo et al. 1997).

However, in another study, the presence or absence of an intra-oral orthopaedic plate did not make any difference in the ability of infants with clefts to generate negative intraoral pressure (Choi et al. 1991).

The site of posterior (tongue/palate) closure and extent of the soft palate cleft are also crucial factors in a baby's ability to generate suction. The oral cavity can be viewed as a closed box that extends anteriorly to the soft palate (Kogo et al. 1997). Thus, during sucking, tongue–palate contact might occur anterior to small soft palate clefts, which need not necessarily be closed.

Correction of abnormal tongue position: The feeding plate corrects the abnormal tongue positioning used by infants with CLCP and thus improves the airway. It also prevents the tongue from exploring and widening the cleft. Osuji (1995) hypothesised that if an opposing surface in the form of an obturator was provided, cleft infants would produce more normal tongue movements, including compression of the teat. However, Masarei et al. (2007a) suggested that regardless of cleft type or obturator status, all infants show poor formation and posterior transfer of the bolus in the oral cavity. Alternatively, infants with cleft lip and/or palate might recognise early that there is no opposing surface for the tongue to contact during sucking and therefore do not establish this movement pattern.

Fig. 2 Comparison of feeding efficiency in infants with cleft lip and/or cleft palate



Evaluation of pharyngeal stage difficulty: If an obturator facilitates more efficient or normal feeding patterns at the oral stage, there would be a subsequent improvement at the pharyngeal stage. However, in a previous study, this was not found to be the case for either cleft type (Masarei et al. 2007a).

Lactation education: Parents of infants with cleft palate can be educated about feeding techniques, positioning of the infant, volume fed, feeding duration, and so forth (Table 2). The combined use of a palatal obturator and lactation education may reduce feeding time and may be associated with good growth; infants with CLCP can achieve normal growth when parents are instructed about feeding through videos (Turner et al. 2001).

Feeding technique: Feeding techniques have been described by a number of researchers. The enlargement, stimulate, swallow, rest (ESSR) technique described by Richard (1991) is the most notable:

E = Enlarge the nipple hole to allow formula to reach the back of the infant's throat without having to rely on ineffective suction.

S = Stimulate the suck reflex by rubbing the teat against the lower lip, which prepares the infant for feeding through an enlarged teat. Then invert and insert the bottle to prevent spilling and waste.

S = Swallow fluid normally to receive an adequate amount of formula without using excess energy to meet nutritional requirements for proper weight gain.

R = Rest after signal. Monitor infant cues during feeding and resting. Infant will exhibit a facial expression that indicates a short break is necessary. Allow infant to finish swallowing formula already in the back of the throat to avoid gagging or nasal regurgitation.

Repeat this process until the infant has eaten a normal amount of formula in a normal amount of time.

Richard compared traditional bottle-feeding techniques to ESSR among 69 infants with CLCP. All infants wore a palatal obturator; the results provided limited but promising evidence that using the ESSR technique with a palatal obturator could allow for adequate feeding (Richard 1991).

Table 2 Lactation education

Position/posture	Hold infant in an upright or semi-sitting position for feeding (Tisza and Gumpertz 1962)
Flow of liquid	Avoid continuous flow of liquid Flow should be slow enough to prevent choking (Shaw et al. 1999)
Timing	Frequent burping during feeding Burp after 15–30 mL formula has been given (Tisza and Gumpertz 1962)
Liquid viscosity	Thickened liquids create a slightly more cohesive bolus that moves more slowly through the hypopharynx, allowing more time for airway closure (Tisza and Gumpertz 1962)

Parental satisfaction: Few reports have concluded that feeding obturators reduce parents' frustration over feeding problems and help relieve anxiety related to the birth of a child with this pathology (Turner et al. 2001).

In one study (Masarei et al. 2007a), parental compliance was reasonably good immediately after plate implantation and at 3 months of age. However, by 6 months of age, compliance was poor, with only 14 of 23 infants wearing their plates consistently throughout the day. Britton et al. (2011) found that 70 % of the parents who used the pre-surgical appliance rated the appliance highly in terms of feeding and were happy with the 'improved feeding and cosmetic results'.

Conclusion

The goals of feeding an infant with a cleft lip or palate are similar to the goals of feeding any infant: maintaining optimum nutrition is the first priority, and finding a technique as close to normal as possible is the second. Feeding interventions should reduce stress experienced by the infant and family, promote growth and development, and facilitate a normal feeding pattern. Various randomised controlled trials, clinical trials, and systemic reviews have suggested different feeding interventions.

A squeezable bottle with an NUK orthodontic nipple, a squeezable Mead Johnson cleft palate nurser, and a cross-cut nipple have been found to effectively support normal growth in infants with clefts. The Haberman Feeder and type-P teat, disposable syringe (without needle), Benifex cleft lip/palate nurser, cup feeding, and spoon feeding can also be used as feeding interventions in patients with clefts.

There is contradictory evidence regarding the use of obturators. Some evidence suggests that they do not facilitate feeding or weight gain in babies with CLCP. However, other promising sources suggest that they may indeed improve feeding efficiency in such infants. A mother's natural instinct to breastfeed her child should not be completely dismissed and the use of obturators and obtaining help through lactation counselling could prove advantageous.

A single intervention may not fulfil all feeding requirements of infants with CLCP; thus, a combination of various interventions should be used. The combined use of a palatal obturator, Haberman bottle, breast milk pump, and lactation education may successfully meet the needs of both mother and child. More research on the efficacy of palatal obturators with various other bottles and nipples in combination with education as a feeding intervention is needed for the development of best clinical practices. A pragmatic approach, fuelled by a better understanding of the issue along with simultaneous attempts to overcome the challenges in feeding, would lead to significant benefits in the near future.

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