

# Nonnutritive sucking and upper airway instability

*Suzione nonnutritiva ed instabilità delle prime vie aeree*

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KEY WORDS. — Obstructive Apnoea - Obligatory Nasal Breathing - Thumb Sucking - SIDS - Glossoptosis - Glossopexy  
PAROLE CHIAVE. — *Apnea Ostruttiva - Obbligatorietà della Respirazione per Via Nasale - Suzione del Pollice - Morte Improvvisa in Culla - Glossoptosi - Glossopessia*

## Introduction

In infants with an upper airway instability, the obstruction of the pharynx due to aspiration of the tongue (called «vacuum-glossoptosis apnoea») may play a role into the pathogenesis of sudden infant death syndrome (SIDS) <sup>1-3</sup>. As non-nutritive sucking can stabilize the upper airway <sup>4</sup>, in 1979 Cozzi et al. speculated that the use of a dummy may protect from glossoptosis-related SIDS <sup>2</sup>. A recent study has been designed to test this hypothesis. Actually, Mitchell et al. have found that in a group of 485 SIDS victims the use of a dummy during the last sleep before death was very much less frequent than in a large control group of infants <sup>5</sup>. They have calculated that by encouraging dummy use the number of SIDS victims in New Zealand could drop by about 50 percent <sup>5</sup>. This epidemiological study supports the concept that SIDS may be related to glossoptosis-apnoea and repropose the question: how can the use of a dummy stabilize the upper airway?

To study the possible mechanisms involved in this action, we review the mechanisms of various methods that have been found valid in clinical practice for the prevention of glossoptosis-apnoea associated with congenital micrognathia, hypertrophic adenoids, upper respiratory tract infection (URTI), or choanal atresia. These clinical observations are relevant because the pathogenesis of glossoptosis-apnoea associated with these conditions is similar to that postulated for glossoptosis-related SIDS <sup>1-3</sup>.

## Methods which may prevent glossoptosis-apnoea in infants and children with congenital micrognathia and hypertrophic adenoids

*Open-mouth breathing.* In 1923, Pierre Robin coined the

terms «glossoptosis», meaning obstruction of the pharynx due to a relapse of the tongue, and «glossoptosism», meaning upper airway instability <sup>6</sup>. He differentiated between a «congenital» and an «acquired» glossoptosis, the latter being more often associated with hypertrophic adenoids. In his original view, glossoptosis was a mechanical consequence of a congenital micrognathia <sup>6</sup>. Pierre Robin noticed that the micrognathic infant breathes with his or her mouth open as closing his or her mouth causes a glossoptotic pharyngeal obstruction <sup>6,7</sup>. Oral breathing, however, predisposes to URTI which in turn causes hypertrophy of adenoids and obstruction of the rhinopharynx <sup>7</sup>. Actually the removal of the nasal obstruction by adenoidectomy does not cure «glossoptosism». This status is responsible for recurrent functional obstruction of the pharynx and persistent mouth-breathing that often continue after surgery («adenoidism without adenoids») <sup>6,7</sup>. Open-mouth-breathing, therefore, does not appear to be the result of either a nasal obstruction or of a bad habit, but a manoeuvre adopted by the glossoptotic patient to bring the tongue forward, thus preventing glossoptotic pharyngeal obstruction <sup>6,7</sup>. Our clinical experience supports the validity of this Robin's old and rather neglected concept.

Pierre Robin considered thumb sucking with an open mouth a pathognomonic sign of an upper airway instability <sup>7</sup>. A similar sign known as «the two fingers sign» has been more recently described in a group of young children with hypertrophic adenoids and sleep-apnoea <sup>8</sup>. The child may learn to prevent or to reverse severe glossoptosis-apnoea associated with hypertrophic adenoids by depressing his or her tongue with two fingers <sup>8</sup>. We, too, have noticed that the micrognathic infant may use the thumb to depress his or her tongue, thereby relieving respiratory distress and/or oropharyngeal dysphagia. Depressing the tongue is an action that involves passive opening of the mouth.

*The pharyngeal vacuum.* In infants with congenital micrognathia, measurements of pharyngeal pressure (Fig. 1) have shown high negative values during inspir-



terized by alternate apnoea and crying in an infant with bilateral choanal atresia<sup>14</sup>. He believed that the inability of the infant to open his or her mouth was the cause of apnoea. The ensuing cyanosis stimulated crying, which he considered as a method to induce mouth-breathing, thus relieving the obstructive apnoea. The manoeuvre of «depressing the lower jaw and maintaining an opening between the lips» established satisfactory mouth-breathing and relieved the cyclic dyspnoea<sup>14</sup>. A different «method of keeping the baby's mouth open» consists of a simple nipple with a large hole on its apex through which the infant with bilateral choanal atresia is able to breathe without respiratory distress (Fig. 2)<sup>15</sup>. The inability to open the mouth and the consequent inspiratory efforts may cause the tongue to be sealed to the palate<sup>16</sup>. A feeding tube which is passed through the mouth into the stomach may reduce the dyspnoea in infants with bilateral choanal atresia by breaking this obstructive glosso-palatal «seal»<sup>16</sup>.

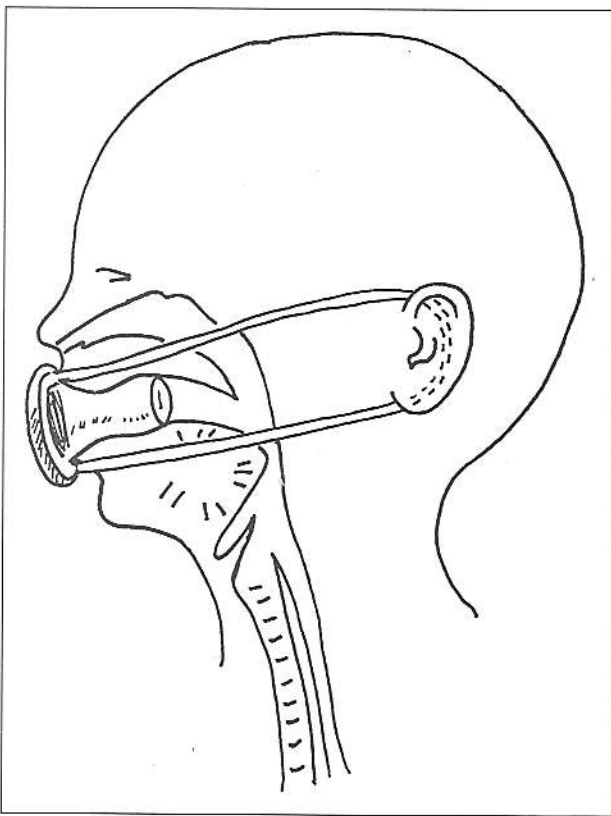
In 1977, Cozzi suggested that the infant's inability to mouth-breathing was mainly caused by an obstruction of the pharynx due to glossoptosis<sup>1</sup>. In this view, the infant with symptomatic choanal atresia is able to switch to oral ventilation, but he or she experiences increased airway resistance which requires greater inspiratory efforts<sup>1-3 10 17 18</sup>. The ensuing increase of the intrathoracic depression is transmitted to the pharyngeal cavity and results in a force which tends to aspirate the tongue backwards (Fig. 1). As this force is not counterbalanced by an appropriate increase of the genioglossus activity, the tongue will be progressively sucked backwards until it seals off the oro-pharyngeal airway<sup>1-3 10 17 18</sup>. Depressing the tongue with a finger or the handle of a spoon can be a useful technique to break or to prevent «the pharyngeal vacuum», thus reversing or avoiding glossoptosis-apnoea in infants with choanal atresia/stenosis<sup>1 2 10</sup>. Furthermore, thumb sucking with open lips may also have a protective action against glossoptosis-apnoea. During sleep, some infants with bilateral choanal stenosis are able to breathe through the mouth around the thumb without awakening. As soon as the thumb is removed, the obstructive apnoea recurs<sup>10</sup>. Similarly in infants with choanal atresia, naso- and oro-pharyngeal tubes are effective in preventing glossoptosis-apnoea as they minimize the «negative pharyngeal pressure»<sup>2 10</sup>.

#### Possible mechanisms whereby nonnutritive sucking may stabilize the upper airway

In 1973, Swift and Emery noticed that five normal infants who were sucking dummies responded to digital nasal occlusion by breathing through the mouth around the dummies, but when the dummies were removed the infants showed signs of obstructive apnoea<sup>4</sup>. In 1979, these clinical observations induced Cozzi et al. to suggest that dummy use may protect from SIDS by keeping

the oral airway open, thus preventing a pharyngeal vacuum and the consequent sealing off the airway<sup>2</sup>. In 1984, Paludetto et al found that nonnutritive sucking was associated with an increase of transcutaneous oxygen tension in premature infants; they speculated that non-nutritive sucking may activate upper airway muscles and enhance alveolar ventilation<sup>19</sup>. In 1993, Mitchell et al. doubted that a dummy serves as an oral airway but suggested that dummy sucking may stimulate some sensorial receptors which increase the genioglossus muscle tone and help to maintain upper airway patency<sup>5</sup>. We are not aware of other studies concerning the possible mechanisms whereby the use of dummies may prevent episodes of partial or complete functional obstruction of the upper airway.

Clinical observations indicate that the methods that may prevent glossoptosis-apnoea are quite similar in infants with upper airway instability associated with different conditions including congenital micrognathia, hypertrophied adenoids, choanal atresia/stenosis, and URTI. These methods include opening the mouth, depressing



**Fig. 2.** Illustration of the Mc Govern's nipple. This simple device (invented by the parents of a child born with bilateral choanal atresia) serves as an oral airway to relieve glossoptosis. *Illustrazione della tettarella di Mc Govern. Questa invenzione dei genitori di un bambino nato con atresia bilaterale delle coane è utile come cannula orale per evitare la glossoptosi.*

the tongue, thumb-sucking and the use of naso- or oro-pharyngeal tubes. The main physiological mechanism of these methods appears to be the establishment of an adequate oral or nasal airway, which avoids the pharyngeal vacuum and prevents vacuumglossoptosis apnoea. These clinical data, therefore, suggest that a dummy, like a thumb or a solid oro-pharyngeal tube, may serve as an oral airway which minimizes the build-up of negative pharyngeal pressure, thus reducing the aspirating force of the tongue.

Furthermore opening the mouth, depressing the tongue, thumb-sucking and the use of oro-pharyngeal tubes induce an opening of the mandible. According to Pierre

Robin, opening of the mandible is a manoeuvre that serves to displace the tongue forwards<sup>6,7</sup>. This manoeuvre may not appear protective because it implies a posterior displacement of the mandible angle, endangering the pharyngeal airway. Genioglossus muscle activity, however, increases when the jaw is either voluntary or involuntary opened<sup>20</sup>. Opening the mouth, therefore, stimulates a protective reflex to ensure a patent pharyngeal airway (Fig. 3). Opening the jaw more widely is associated with further enhancement of genioglossus activity<sup>20</sup>. These latter clinical and physiological data suggest that dummy sucking may protect from glossoptosis also by causing the mandible to open and thus

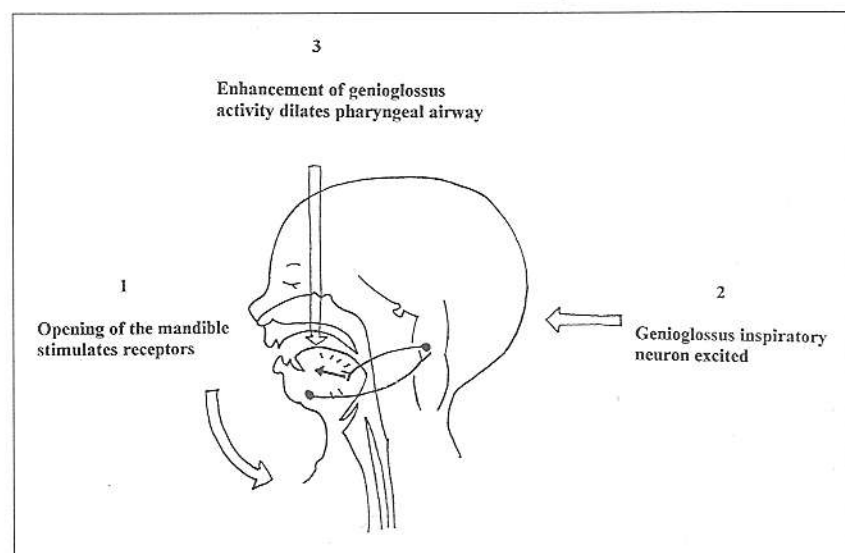


Fig. 3.

Schematic illustration showing one of the ways in which nonnutritive sucking may relieve glossoptosis.

Rappresentazione schematica di una delle vie attraverso cui la suzione non nutritiva può evitare la glossoptosi.

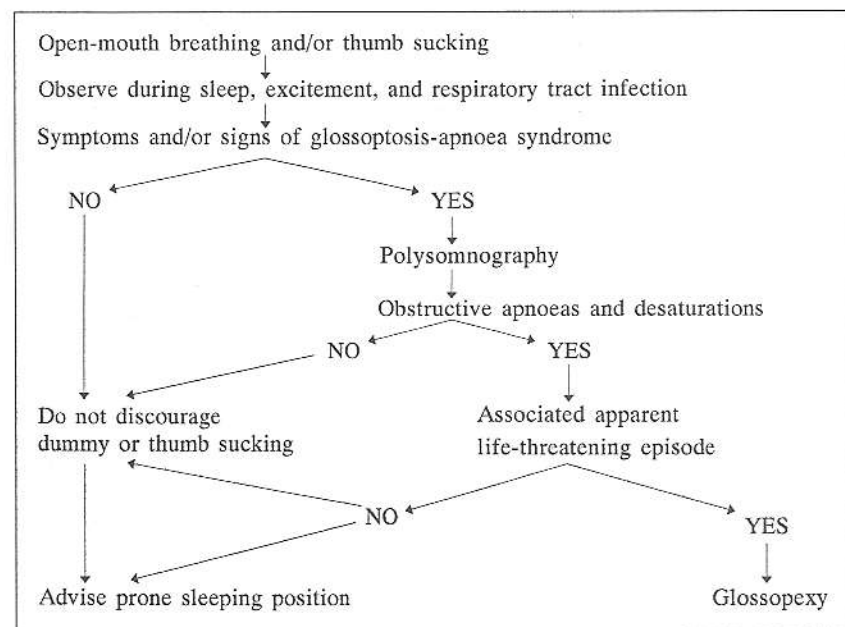


Fig. 4.

Algorithm for evaluation and management of infants and children who are thumb suckers and/or open-mouth breathers.

Algoritmo di procedure nei bambini che respirano con la bocca aperta e/o succhiano il pollice.

stimulating the airway dilating. Tongue «media» serves as an oral part of the partition which the normal upper airway. We conclude, the clinical observation of action of dummy involve both the Dummy or thumb the mandible stimulates the genioglossus which pharyngeal airway lips helps to establish way.

Open-mouth breathing help to identify airway instability glossoptosis apnoea sleeping, or excite infants is important SIDS<sup>10</sup>. As open may reduce but believe that infant apparent life-threatening glossopexy<sup>1</sup>.

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<sup>2</sup> Cozzi F, Albani R. A common pathophysiology of the vacuum-glossoptosis. Med Hypotheses 1979;7:1-10.

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stimulating the activity of genioglossus and other upper airway dilating muscles.

Tongue «median grooving» that forms a channel which serves as an oral airway and opening of the mouth are part of the particular manoeuvres of gasp, cough, and cry which the normal infant may adopt after birth to stabilize the upper airway and achieve respiratory autonomy<sup>21</sup>. We conclude, therefore, that the above mentioned clinical observations support the concept that the protective action of dummy use against glossoptosis-apnoea may involve both the mechanisms previously postulated<sup>2,5,19</sup>. Dummy or thumb sucking with closed lips by opening the mandible stimulates a reflex enhancement of genioglossus which helps to maintain the patency of nasopharyngeal airway. Dummy or thumb sucking with open lips helps to establish an adequate oro-pharyngeal airway.

### Implications

Open-mouth breathing and thumb sucking may also help to identify those infants with a subclinical upper airway instability who present clinical manifestations of glossoptosis apnoeas/hypopnoeas only during URTI, sleeping, or excitement (Fig. 4). Identification of these infants is important because they are at increased risk of SIDS<sup>10</sup>. As open-mouth breathing and thumb sucking may reduce but not eliminate the risk of SIDS, we believe that infants with an upper airway instability and apparent life-threatening episodes require a prophylactic glossopexy<sup>10</sup>.

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