

Role of Speech-Language Pathologist in Pediatric Corrosive Ingestion in Zagazig University Children Hospital

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ABSTRACT

Background: Pediatric corrosive ingestion injuries represent a significant proportion of total ingestion injury annually. Medical and surgical advancements over the past five decades led to significant reductions in mortality. Optimal treatment of children with ingestion injuries requires a multi-skilled team approach.

Objective: The aim of the work was to assess the effects of corrosive ingestion in children and to determine the role of speech-language pathologist. **Patients and methods:** This cross section study was conducted on 52 patients with corrosive ingestion. The patients were admitted at Zagazig University Children Hospitals from February 2018 to February 2019. **Results:** Our results showed that there was high significant relation between impaired oral intake and period of admission, PICU admission, days to initiate oral feeding and grade of mucosal injury. Also, there was high significant relation between fluid, semisolid and solid dysphagia and oropharyngeal mucosal injury. Also, there was a high significant relation between oesophageal mucosa grading of injury and oropharyngeal mucosal injury. **Conclusion:** Children admitted to hospital with severe ingestion injury to the oral cavity, oropharynx and esophagus had significant and sustained delay in the recovery of effective PO intake milestones, with many requiring ongoing gavage feeding at hospital discharge.

Keywords: Speech-Language Pathologist, Pediatric Corrosive Ingestion.

INTRODUCTION

Children who ingest liquid chemical substances sustain diffuse injuries to multiple sites across the oral cavity, pharynx, larynx and esophagus⁽¹⁾. The pediatric population is the most affected. The highest risk age groups are infants and pre-schoolers⁽²⁾. Although, it is not a public health problem, caustic ingestion is a significant issue worldwide, particularly in developing countries in which an unsafe environment is a substantial risk factor for child injury⁽³⁾.

Dysphagia and difficulty with oral intake are common initial symptoms following ingestion injury in children. More than one third of children have difficulty with oral intake within 48 hours following injury, so swallowing assessment is needed to detect which stage of swallowing is affected⁽⁴⁾. Endoscopic grading of mucosal injury: 0 = normal examination, I = edema and hyperemia of the mucosa, IIa = superficial ulceration, erosions, friability, blisters, exudates, hemorrhages, and whitish membranes, IIb = grade IIa plus deep discrete or circumferential ulcerations, IIIa = small scattered areas of multiple ulceration and areas of necrosis with brown-black or grayish discoloration, and IIIb = extensive necrosis⁽⁵⁾. Severe injuries and associated complications that often involve children or health professionals are initiated by cessation of oral intake, as well as long-term nonoral feeding, with gavage feeding often used to avoid further damage to tissues in the short term⁽⁶⁾.

There is no standard treatment of caustic ingestion during the acute phase. Several treatment strategies are described in pediatric surgery books⁽⁷⁾.

All patients who suffered a caustic ingestion should be hospitalized and evaluated comprehensively.

The clinical history must emphasize the type and amount of caustic and if possible get the product package. Hemodynamic stabilization and adequacy of the patient's airway are priorities. The induction of vomiting or gastric lavage is contraindicated following caustic ingestion because a re-exposure of the oesophageal mucosa to the caustic agent with further injury may occur⁽⁸⁾.

AIM OF THE WORK

The aim of the work was to assess the effects of corrosive ingestion in children and to determine the role of speech-language pathologist.

PATIENTS AND METHODS

Study design and setting:

This cross section study was conducted on 52 patients with corrosive ingestion. The patients were admitted at Zagazig University Children Hospitals from February 2018 to February 2019.

Ethical approval and written informed consent: An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the treatment.

Patients were subjected to the following:

A) Full history taking including: Name, age, sex, length of admission, need for and duration of pediatric intensive care unit (PICU) admission, need for intubation/ventilation, substance ingested (nature,

amount, Ph), location of ingestion event (home, other) and symptoms on presentation to hospital.

B) General and local examination:

- ❖ Examination of the oral cavity which may reveal hyperemia, edema or ulcerations.
- ❖ General examination including searching for concomitant skin burn to other body parts.
- ❖ Consultation of toxicologist and cardiothoracic pediatric surgeon.

C) Fibro-optic endoscopic evaluation of swallowing (FEES):

The patients underwent FEES by the speech-language pathologist during the period of acute admission 1-7 days from ingestion injury.

Both naris were examined visually and the scope passed through the most patent naris without administration of a topical anesthetic or vasoconstrictor to the nasal mucosa, thereby eliminating any potential adverse anesthetic reaction.

All foods/liquids were dyed green with food coloring:

- ❖ **Liquid consistency:** 3, 5, 10, 20 ml water colored with food dye
- ❖ **Semi-solid consistency:** teaspoon of yoghurt colored with food dye
- ❖ **Solid consistency:** Dry bread or biscuits, which were dipped in colored liquid.

Findings of FEES examination included:

- ❖ Pharyngeal mucosa, which may reveal hyperemia, edema or ulceration
- ❖ Pharyngeal phase of swallowing of fluid, semi-solid and solid substances, which may reveal normal or residual and choking (Figure 1, 2 and 3).

According to these findings: The speech-language pathologist organize the feeding therapy including period of admission, days-post injury to initiate oral feeding and feeding status during period of admission, after discharge and days post-injury to the resumption of normal oral intake.

The speech-language pathologist also follow up the patients before and after eosophagoscopy



Figure (1): Residual during fluid swallowing.



Figure (2): Residual during semi-solid swallowing.



Figure (3): Residual during solid swallowing.

D) Esophagoscopy:

The patients were under general anesthesia, always administered by a certified pediatric anesthesiologist anesthesia. We use flexible endoscope (Figure 4).



Figure (4): Pentax 8.7 flexible endoscope.

Findings of Esophagoscopy included:

1) Grading of esophageal mucosal injury:

- ❖ **0:** normal examination.
- ❖ **I:** edema and hyperemia of the mucosa.
- ❖ **IIa:** superficial ulceration erosions, friability, blisters, exudates, hemorrhages, and whitish membranes.
- ❖ **IIb:** grade IIa plus deep discrete or circumferential ulcerations.
- ❖ **IIIa:** small scattered areas of multiple ulceration and areas of multiple necrosis with brown-black or grayish discoloration.
- ❖ **IIIb:** extensive necrosis ⁽⁵⁾.

2) **Esophageal stricture**

Esophagoscopy was used to detect level, site, size, number of esophageal strictures for further dilatation.

Esophageal dilatation:

We used Savary-Gilliard dilator (flexible and directed plastic dilators), first passing a flexible metallic guidewire through the stricture until reaching the stricture and then passing a different caliber Savary dilators (7, 9, 11 and 12.8 mm) (21FR,27FR,33FR,38FR) depending on the diameter of the stricture segment. Most subsequent dilation procedures were scheduled in 2 weeks until achievement of intraluminal dilatation of the esophagus (12.8 mm), improvement in patient's symptoms or earlier if patients returned with further dysphagia. After each dilation patients were observed for 4 hours with specific attention to the occurrence of chest pain, abdominal pain and difficulty in breathing and hemodynamic status. Patients were discharged home the same day with instructions to immediately report the development of fever, chest pain or shortness of breath. All patients received antireflux therapy for 1week (10 mg of omeprazole after endoscopic examination).

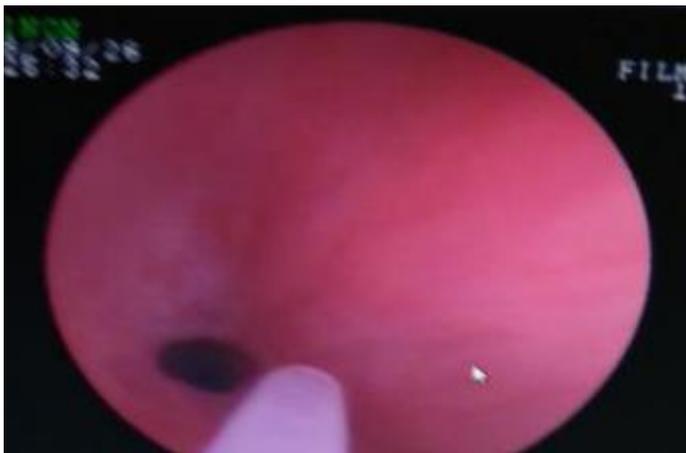


Figure (5): The stricture part

During the follow up for next 6 months, number of dilations needed by the patient, size of 1st dilator, clinical symptom (vomiting and dysphagia) and weight were registered for each patient.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done:

- Independent-samples t-test of significance was used when comparing between two means.
- Chi-square (x²) test of significance was used in order to compare proportions between two qualitative parameters.

- The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following:
- Probability (P-value)
 - P-value < 0.05 was considered significant.
 - P-value < 0.001 was considered as highly significant.
 - P-value > 0.05 was considered insignificant.

RESULTS

Table (1): Demographic data of the studied cases:

Variable		
Age (months)		
Mean ± SD	36.2 ± 7.4	
Range	18-50	
	No.	%
Sex		
Female	25	48.1
Male	27	51.9

This table showed that the mean age of cases was 36.2 ± 7.4 with range of (18-50) months and percent of females was 48.1% and males was 51.9% .

Table (2): Swallowing pattern of the studied cases

Variable	N	%
Swallowing Semisolid		
Normal	37	71.2
Shocking	15	28.8
Swallowing Solid		
Normal	45	86.5
Shocking	7	13.5
Swallowing Fluid		
Normal	33	63.5
Shocking	19	36.5

This table showed that normal swallowing of semisolid fluid in 71.2% of cases, solid in 86.5% of cases and fluid in 57.7% of cases.

Table (3): Characters of stricture of the studied cases

Variable	N=52	%
Stricture location:		
-Lower 1/3	6	11.5
-Middle 1/3	8	15.4
-Upper 1/3	27	51.9
-Whole esophagus	5	9.6
-No stricture	6	11.5
Stricture segment:		
Short	36	69.2
Long	10	19.2
No stricture	6	11.5

This table showed that stricture location was in upper segment by a percent of 58.7%, lower segment by a percent of 13%, middle segment by a percent of 17.4% and whole esophagus by a percent of 10.9%. stricture segment was short in 69.2%, long in 19.2% and no stricture in 11.5 %.

Table (4): Dysphagia Improvement after dilatation

Dysphagia Improvement after dilatation:		
-Improved	41	78.8
-still complaining	5	9.6
- No stricture	6	11.6

This table showed that 78.8% of cases showed dysphagia improvement after dilatation in comparison to 9.6 % that showed no improvement.

Table (5): Stricture improvement after dilatation

Stricture Improvement after dilatation:		
-Improved	30	57.8
-still need dilatation	16	30.6
- No stricture	6	11.6

This table showed that 57.8% of cases showed stricture improvement after dilatation in comparison to 30.6% of cases who still need for dilatation.

Table (6): Relation between dysphagial improvement after endoscopy of the studied cases and nature of ingested substance

Variable	Improved cases N=41		Not improved cases N=5		χ^2	P value
	N	%	N	%		
Substance ingested :						
Cloride	9	22.0	0	0.0	2.75	0.252
Flash	6	14.6	2	40.0		
Potash	26	63.4	3	60.0		
Liquid nature :						
Acid	15	36.6	2	40.0	Fisher test	0.618
Alkali	26	63.4	3	60.0		

χ^2 is for chi square test

p value is significant if <0.05

This table showed that there was no significant relation between outcome after endoscopy of the studied cases and nature of ingested substance.

Table (7): Relation between impaired oral intake and Period of admission, PICU admission, days to initiate oral feeding and grade of mucosal injury

Variable	Impaired oral intake N=19		Normal oral intake N=33		MW	P value
Period of hospital admission (days) :						
Mean \pm SD	8.4 \pm 8		22 \pm 10.9		23.0	<0.05 (S)
Median	5		30			
Range	1-25		10-30			
Days to initiate oral feeding :						
Mean \pm SD	2.88 \pm 1.8		3.6 \pm 0.54		18.0	<0.001 (HS)
Median	1.5		3.5			
Range	1-3		2-7			
	N	%	N	%	χ^2	P value
PICU admission:						
Yes	1	5.3	11	33.4	Fisher test	<0.05 (S)
No	18	94.7	22	66.6		
Grade of eosophageal mucosal injury:						
0	0		7			<0.001 (HS)
I	4		19			
IIa	3		6			
IIb	4		1			
IIIa	3		0			
IIIb	5		0			

MW is for Mann whitney test.

This table showed that there was high significant relation between impaired oral intake and period of admission and PICU admission. Also, there was significant relation between impaired oral intake and days to

initiate oral feeding . Also, there was significant relation between impaired oral intake and grade of mucosal injury.

Table (8): Relation between oropharyngeal mucosa and swallowing

Variable	Edema N=10		Hyperemia N=27		Sloughing N=15		χ^2	P value
	N	%	N	%				
Solid								
Chocking	4	40.0	0	0.0	3	20.0	10.79	0.005 (S)
Normal	6	60.0	27	100.0	12	80.0		
Semisolid								
Chocking	4	40.0	0	0.0	11	73.3	26.01	<0.001 (HS)
Normal	6	60.0	27	100.0	4	26.7		
Fluid								
Chocking	3	30.0	1	3.7	11	73.3	23.28	<0.001 (HS)
Normal	7	70.0	26	96.3	4	26.7		

χ^2 is for chi square test

This table showed that there was high significant relation between semisolid, fluid and solid dysphagia and oropharyngeal mucosal injury.

Table (9): Relation between oropharyngeal mucosa and oesophageal mucosa grading

Variable	Edema N=10		Hyperemia N=27		Sloughing N=15		χ^2	P value
	N	%	N	%				
Oesophageal mucosa grading of injury :								
0	0	0.0	4	14.8	0	0.0	45.05	<0.001 (HS)
I	5	50.0	15	55.6	2	13.3		
IIa	5	50.0	2	7.4	3	20.0		
IIb	0	0.0	0	0.0	3	20.0		
IIIa	0	0.0	0	0.0	2	13.3		
IIIb	0	0.0	0	0.0	5	33.4		

χ^2 is for chi square test

This table showed that there was high significant relation between oesophageal mucosa grading of injury and oropharyngeal mucosal injury.

Table (10): Relation between oropharyngeal mucosa and hospital admission, days to initiate oral feeding and PICU admission

Variable	Edema N=10		Hyperemia N=27		Sloughing N=15		F	P value
Days of hospital admission :								
Mean ± SD	9.60 ± 7.35		5.77 ± 7.21		15.60 ± 10.40		16.93	<0.001 (HS)
Days to initiate oral feeding:								
Mean ± SD	3.30 v± 1.41		1.78 ± 0.97		4.60 ± 1.80		23.26	<0.001 (HS)
	N	%	N	%	N	%	χ^2	P value
PICU admission :								
Yes	2	20.0	5	18.5	5	33.3	1.25	0.533
No	8	80.0	2	81.5	10	66.7		

F is for Kruskal Wallis test

This table showed that there was high significant relation between oropharyngeal mucosa and hospital admission and days to initiate oral feeding, while there was no significant relation between oropharyngeal mucosa and PICU admission.

DISCUSSION

The present study included 52 child with mean age of cases is 36.2 ± 7.4 months with range of (18-50) months and percent of females was 48.1% and males was 51.9%.

Tarek et al.⁽⁹⁾ whose study was observational study that included 100 children with an established diagnosis of post-corrosive oesophageal stricture who were engaged in repeated endoscopic dilatation sessions and conducted at the Paediatric Endoscopy Unit, Cairo University Paediatric Hospital from March 2015 to September 2016. They found that males represented 63% of the patients. The mean age of the patients was 5.9 ± 2.6 years. Similarly **Yalçın and Aygün**⁽¹⁰⁾ in their study reported that of 45 cases, 24 (53.3%) were males, while 21 (46.7%) were females. The youngest case was 9 months old, the oldest case was 168 months and average age of the cases was 24.7 months. **Follent et al.**⁽¹¹⁾ who conducted their study in a quaternary hospital in Brisbane, Australia, for the acute care management of a chemical or button battery ingestion injury during a 6-year period (January 2008-December 2013). They found that mean age was 31.5 ± 35.4 months and percent of females was 49% and males was 51%. **Temiz et al.**⁽¹²⁾ found that the male/female ratio was 129/77 and mean age was 38.1 ± 28.8 months.

Children, especially boys, have well-developed skills and are curious to examine substances and drink them. However, they lack the knowledge of the portability of substances. This implies that boys in preschool stage (3–4 years) need more attention and caring by parents to avoid such ingestion incidents. Moreover, parents' behaviors are affected further by culture⁽¹³⁾.

In this study percents of ingested substances were 19.2%, 15.4% and 65.4% for chloride, flash and potash respectively. Also 34.6% of liquids were acidic and 65.4% were alkaline. Moreover, 92.3% of cases ingested the substance at home and 7.7% of cases in other places. This was quiet similar to what stated by **Tarek et al.**⁽⁹⁾ who demonstrated that the majority of their patients ingested an alkaline substance (potash). 6% of them ingested a neutral substance (chlorine) and only 4% of them ingested an acidic substance (H_2SO_4). **Nondela et al.**⁽¹⁴⁾ reported that the majority of ingested caustic substance (27.5%) was the oxidizing/reducing agent in the form of household bleach and all these had low-grade oesophageal injury. None of them subsequently developed oesophageal strictures. The second most common caustic substances ingested was strong alkaline in either liquid, crystal or powder form, with pH varying from 9 to 13. Liquid alkaline ingestions caused the most severe injury with three developing oesophageal strictures. Acid ingestion was infrequently seen in three children (7.5%) and none of

these developed long-term oesophageal injury. **Yalçın and Aygün**⁽¹⁰⁾ reported that their cases were exposed to bleacher in 20 patients (44.4%), dishwasher detergent in 11 patients (24.4%), rinse aid in 5 patients (11.1%), drain cleaner in 4 patients (8.9%), washing machine detergent in 3 patients (6.7%), decalcifier in 1 patient (2.2%) and surface cleaner (sodium hypochlorite) in 1 patient (2.2%). This comes in consistency with what stated by **Follent et al.**⁽¹¹⁾ who demonstrated that percents of ingested substances were 65%, 29% and 3% for alkali, button battery and unknown respectively. 78% of cases ingested the substance at home. In a study by **Huang et al.**⁽¹⁵⁾ conducted in Australia, they reported that 76% of the accidents occurred at home, where 74% were caused by alkaline, 6% by acidic agents, and 20% were caused by contamination with other agents.

Follent et al.⁽¹¹⁾ stated that at discharge, 10/31 children (32%) in the impaired PO intake cohort were NPO (9 with gavage, and 1 receiving TPN), 1 child was receiving gavage with some PO intake (thin fluids, soft diet), 15/31 (48%) were managing full modified PO intake (2 on clear fluids only, 8 on soft diet and 5 on puree diet) and 5 (16%) had returned to regular pre-morbid PO diet.

We also observed that there was edema in oropharyngeal mucosa in 19.2%, hyperemia in 51.9% and sloughing in 28.8%. Grading of oesophageal mucosa was grade 0 in 7.7%, grade I in 42.3%, grade IIa in 19.2%, grade IIb in 5.8%, grade IIIa in 3.8% and IIIb in 9.7% and no endoscopy in 11.5%. **Nondela et al.**⁽¹⁴⁾ verified that 67.5% of children were found to have grade 0, I and IIa on endoscopic oesophageal injury grading. **Follent et al.**⁽¹¹⁾ observed that grading of injury was grade 0 in 4%, grade I in 16%, grade IIa in 43%, grade IIb in 22%, grade III in 10% and no endoscopy in 6%. A study by **Tohda et al.**⁽¹⁶⁾ from the United States, over 28-year period, reported 95 patients with caustic ingestion. Approximately 60% of the patients had a mild degree (grade 1) or no esophageal injury (grade 0) and only 15% had grade 3 injury. **Temiz et al.**⁽¹²⁾ observed that grading of injury was grade 0 in 41.7%, grade I in 23.8%, grade IIa in 20.4%, grade IIb in 13.6%, grade IIIa in 0.5% and no endoscopy in 6%.

In this study, stricture location was in upper segment by a percent of 58.7%, lower segment by a percent of 13%, middle segment by a percent of 17.4% and whole esophagus by a percent of 10.9%. Stricture segment was short in 69.2%, long in 19.2% and no stricture in 11.5%. **Tarek et al.**⁽⁹⁾ in their study verified that stricture location was in upper segment by a percent of 87.1%, lower segment by a percent of 3.5%, middle segment by a percent of 62.4%. Stricture segment was short in 30.6%, long in 69.4% and no stricture in 11.5%.

Our study verified that 1st dilator size was 7 mm in 32.7% of cases and 9 mm in 55.8% of cases. While, 3rd dilator size was 11 mm in 19.2% of cases and 13 mm in 28.8% of cases. Number of dilatations was 5 times in 17.3% of cases, 6 times in 36.5% of cases, 7 times in 7.7% of cases and 8 or more in 26.9% of cases. On contrary, **Tarek *et al.***⁽⁹⁾ illustrated that number of dilatations was 35.21 ± 12.79 . **Tharavej**⁽¹⁷⁾ performed stepwise dilatation from a 5-mm to a 7-, 9-, 11-, 12.8-, 14-, and 15-mm diameter. The “rule of three” was applied in each session.

Kochman *et al.*⁽²⁾ defined refractory benign esophageal stricture (RBSE) and recurrent stricture as an inability to successfully dilate to a 14-mm diameter over five sessions at 2-week intervals and the inability to maintain luminal patency for more than 4 weeks after successful 14-mm dilatation, respectively.

We also observed that 78.8% of cases showed dysphagia improvement after dilatation in comparison with 9.6 % that showed no improvement. Also In the current study 57.8% of cases showed stricture improvement after dilatation in comparison with 30.6% of cases who still need for dilatation. **Tharavej**⁽¹⁷⁾ observed that two patients with recurrent stricture after adequate dilatation who refused surgery underwent long-term periodic repeated dilatation at 12-week intervals (four sessions/year). They were satisfactory with the treatment and had good swallow function and nutritional status without the need of enteral feeding. **Contini *et al.***⁽³⁾ agree with us where they reported a good nutritional status is strongly related to a successful dilatation of esophageal stricture.

Singhal and Kar⁽⁶⁾ recommended endoscopic esophageal dilatation as a standard primary treatment of corrosive esophageal stricture. The treatment efficacy is comparable between the balloon and bougie techniques.

A study from India by **Broor *et al.***⁽¹⁷⁾ that included patients with accidental ingestion and stricture length < 2 cm, reported a success rate for dilatation of > 80%

In this study we found that there was no significant relation between outcome after endoscopy of the studied cases and nature of ingested substance.

There was high significant relation between impaired oral intake and period of admission and PICU admission. Also, there was significant relation between impaired oral intake and days to initiate oral feeding . Besides, there was significant relation between impaired oral intake and grade of mucosal injury. There was high significant relation between semisolid, fluid and solid dysphagia and oropharyngeal mucosal injury. There was high significant relation between oesophageal mucosa grading of injury and oropharyngeal mucosal injury.

There was high significant relation between oropharyngeal mucosa and hospital admission and days to initiate oral feeding while there was no significant relation between oropharyngeal mucosa and PICU admission. This is in agreement with what stated by **Follent *et al.***⁽¹¹⁾ who stated that children who had more oropharyngeal mucosal injury with impaired PO intake, had significantly more severe endoscopic-graded esophageal injuries grade II and III injuries, which were more likely to have a PICU admission and had longer hospital stays than children with non-impaired PO intake.

Yet long term follow up was needed to assess late onset complications and the role of endoscopy on long term evaluation, another limitation to our study was need for evaluating factors affecting success of dilatation. In conclusion, children admitted to hospital with severe ingestion injury to the oral cavity, oropharynx, and esophagus had significant and sustained delay in the recovery of effective PO intake milestones, with many requiring ongoing gavage feeding at hospital discharge. Feeding therapy provided by the speech-language pathologist may provide the opportunity to improve patient safety, support return to a developmentally appropriate PO diet, and improve quality of life for children with ingestion injury, and their families.

CONCLUSIONS

Children admitted to hospital with severe ingestion injury to the oral cavity, oropharynx, and esophagus had significant and sustained delay in the recovery of effective PO intake milestones with many requiring ongoing gavage feeding at hospital discharge. Feeding therapy provided by the speech-language pathologist may provide the opportunity to improve patient safety, support return to a developmentally appropriate PO diet and improve quality of life for children with ingestion injury and their families.

RECOMMENDATION

Speech-language pathology should be considered in children corrosive ingestion as an adjuvant treatment plan to dilatation therapy. Further studies involving larger sample size and longer follow up period are essential to confirm or refuse our findings.

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